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Pack-size legislation reduces severity of paracetamol overdoses
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The pattern of plasma sodium abnormalities
Acute haemodynamic effects of cigarette smoking
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Abdominal Aortic Aneurysm neck morphology: Proposed classification system

ABSTRACT

Background While aneurysm neck length, angulation and width have all been previously assessed in endovascular abdominal aortic aneurysm repair (EVAR), aneurysm neck shape has not been considered.

Aims To analyse the influence of aneurysm neck morphology on outcome following EVAR.

Methods Aneurysm neck morphology in 70 patients undergoing EVAR from April 2001 to May 2004 was determined using pre-operative CT scans and graft plans. Necks were classified as flared, parallel, irregular, conical, barrel or hourglass. End-points were death, Type I endoleak and graft migration.

Results Forty-six per cent of necks were flared, 34% parallel, 9% irregular, 6% conical, 3% barrel and 3% hourglass. Mean follow-up was 20.2 months (range 4-35). There was one Type I endoleak and one graft migration. There were no aneurysm related deaths.

Conclusions Assessment of aneurysm neck morphology should be part of the routine preoperative workup for EVAR. A classification system of AAA necks is suggested to facilitate this.

INTRODUCTION

Endovascular aortic aneurysm repair (EVAR) is now an accepted treatment option in the management of abdominal aortic aneurysm (AAA). The reduction in surgical insult occurs at the expense of long-term durability and these patients require long-term follow-up indefinitely. Continuing perfusion and pressurisation of the aneurysm sac (Endoleak) is a unique complication associated with EVAR and remains the Achilles heel of the procedure. Of particular importance is the achievement of an adequate seal at the proximal and distal attachment zones in the aorta and iliac vessels. Failure to achieve a seal here results in a Type I endoleak which, if left uncorrected, may eventually result in aneurysm rupture. The anatomy of the aneurysm neck (the portion of normal aorta between renal arteries and aneurysm, which is used as a proximal sealing zone between stent-graft and aortic wall) is therefore a keystone of EVAR. The importance of neck length, neck diameter, and angulation has been well documented by others. The actual shape of the proximal sealing zone, and its influence on the planning process, degree of oversizing, and outcome has not previously been examined. Criado and colleagues, when reporting the results of the Talent LPS pivotal clinical trial comment on the fact that the Type I endoleak rate was higher than expected, and speculate that this may reflect difficulties related to unfavourable proximal neck anatomy. Factors that they examined include neck length, width, angulation, and the presence of mural thrombus. As with other studies, however, overall neck morphology was not taken into consideration.

Oversizing the endograft relative to the aneurysm neck ensures adequate apposition between graft and aneurysm wall and is critically important in achieving a proximal seal. Oversizing serves two purposes: (a) Ensuring good graft-aortic wall contact, thus preventing a Type I endoleak, and (b) Adding to the radial compression force of the graft which helps prevent graft migration. Various graft manufacturers differ in their methods of determining how the aneurysm neck is measured and what degree of graft oversizing should be applied. What all have in common, however, is that little attention has been paid to the morphology of the aneurysm neck, and its planning implications. Excessive oversizing may produce a “guttering” effect at the graft-aortic sealing zone, increasing the risk of Type I endoleak, distal migration, and aortic neck dilatation.

Herein we propose a classification system for the shape of the proximal aneurysm neck and examine its relevance to endoluminal graft planning.
PATIENTS & METHODS
The CT scans and manufacturers’ endoluminal graft plans were reviewed in a consecutive series of 81 patients who underwent endovascular repair of abdominal aortic aneurysm at Sir Charles Gairdner Hospital from April 2001 to May 2004. Insufficient aneurysm neck length in 11 patients required the use of a fenestrated stent-graft and these patients were therefore excluded. The remaining 70 patients form the basis of this study.

Wall-to-wall aneurysm neck measurements including thrombus, atheroma and/or calcium were taken at 3mm intervals, commencing at the level of the renal arteries and continuing inferiorly until a neck length of 21mm had been assessed. In an angulated neck the minimum diameter seen in an axial image was taken as the real diameter. A difference in diameter of 3mm or greater between consecutive measurements was taken as representing a significant contour change.9

Aneurysm necks fell into one of six categories based on neck morphology: flared, parallel, conical, barrel, hourglass and irregular (Figure 1).

Aneurysms were repaired using the Zenith stent-graft (W.A. Cook, Brisbane, Australia) in 67 cases and the Talent LPS device (Medtronic AVE, Santa Rosa, U.S.A.) in three cases. Mean aneurysm diameter was 57mm (Range 48-85).

Graft oversizing during planning was performed in accordance with the manufacturers’ recommendations. With the Zenith device, graft oversizing of 15% to 25% based on the largest aortic neck diameter was performed. With the Talent device, an average neck diameter was calculated using all the available neck measurements, as described elsewhere10 and the graft was subsequently oversized by 10-20% (Figure 2).

All patients undergoing EVAR at Sir Charles Gairdner Hospital have been entered onto a prospectively maintained database with follow-up clinical and CT data entered at six weeks, six months and twelve months postoperatively and annually thereafter. Mean postoperative follow-up was 20.2 months (range 4-35). Primary end-points were the presence of Type I endoleak, graft migration and death and secondary end-points were the existence of any other type of endoleak and need for secondary intervention.

RESULTS
Flared necks were the commonest (n=32, 46%), then parallel (n=24, 34%), six (9%) were classified as irregular, four (6%) were conical, two (3%) were barrel and two (3%) were hourglass (Figure 3). Mean maximum neck diameter was 27.1mm (Range 20-34mm), while mean endograft diameter implanted was 29.5mm (Range 22-36mm).

There were nine endoleaks in total (13%), one Type I, seven Type II and one Type III. The Type I endoleak occurred in an aneurysm with a flared neck treated with a Zenith® graft and required the deployment of a proximal extension piece which was successful in excluding the leak. The secondary intervention rate was 11.4% (eight patients). None of the other seven interventions were related to the proximal sealing zone or aneurysm neck. Thirty day mortality was zero and there were six late deaths, none of which were aneurysm related.

Only one incidence of graft migration was recorded. This occurred in an aneurysm with a flared neck treated with a Talent LPS device. While the entire suprarenal portion of the graft now lies below the renal arteries, the patient has not yet developed an endoleak. No instances of graft migration has been identified in the patients treated with the Zenith device.

DISCUSSION
While others have made reference to the shape or contour of the aneurysm neck when planning an endovascular repair,4-7, 11 to our knowledge no formal classification system has ever been proposed. We suggest a classification system based on our experience which is an essential aspect of endograft planning in our institution. Rose and colleagues, in their series of 46 patients, describe 37% of necks as “conical”, 28% as “straight”, 13% as “reverse conical” and 9% as “barrel”. These figures differ somewhat from our series and this may be a reflection of differing definitions of shape, strengthening the case for a common classification system, such as we propose.

Reviewing the planning instructions of two of the principal endograft manufacturers in Australia, we failed to find specific guidelines pertaining to oversizing and neck morphology. As shown, significant diameter differences can exist between different stent grafts for a specific aortic neck configuration (Figure 2). Our planning strategy with the Zenith graft is based on the manufacturers’ recommendations and mid term follow-up of this
**FIGURE 1 — ANEURYSM NECK SHAPES**
A. FLARED NECK
B. PARALLEL
C. BARREL
D. CONE
E. IRREGULAR
F. HOURGLASS

**FIGURE 2 — INFLUENCE OF ANEURYSM NECK MORPHOLOGY ON DIFFERENT OVERSIZING TECHNIQUES IN GRAFT PLANNING**
A. BARREL
B. FLARED NECK

**OPTION A (Zenith)**
15%-25% oversizing of Max diameter
Maximal Diameter - 24mm
Graft Diameter: 28-30 mm

**OPTION B (Talent)**
10%-20% oversizing of
Average Diameter - (20+24+18): 3 = 21.7mm
Graft Diameter: 23-26 mm

**OPTION A (Zenith)**
15%-25% oversizing of Max diameter
Maximal Diameter - 26mm
Graft Diameter: 30-33 mm

**OPTION B (Talent)**
10%-20% oversizing
Average Diameter - (21+26): 2 = 23.5mm
Graft Diameter: 26-28 mm
series using the neck morphology classification system, and the oversizing strategies during planning revealed no late graft migration or late Type I endoleaks. Our experience with the Talent device is too limited to reach any firm conclusions with regards to the incidence of distal migration. Criado and colleagues make the association between “higher than expected” incidence of Type I endoleaks, and “unfavourable proximal neck anatomy” in their series of Talent grafts but make no specific reference to neck shape.7

Sternbergh and colleagues found that endograft oversizing of >30% was associated with a greater incidence of increased aortic neck diameters at six months, device migration at one year and AAA expansion at two years. On the basis of this study they recommended avoidance of excessive oversizing but, as with others, make no reference to the influence of neck shape on either graft planning or outcome.8

The total endoleak rate of 13%, while in keeping with other reports, is almost twice that reported in the U.S. pivotal trial of the Zenith® stent-graft.12 The vast majority of endoleaks in this series were Type II, detected immediately post-operatively and subsequently resolved spontaneously. In our experience almost all aneurysms will demonstrate a Type II endoleak in the immediate postoperative period provided enough intravenous contrast is administered and the x-ray exposure time is long enough. Not surprisingly, there was no association between aneurysm neck classification and endoleak type with respect to the Type II or Type III endoleaks which were observed, reinforcing the view that these phenomena are unrelated to the proximal seal (Table 1). The secondary intervention rate of 11.4% is well within accepted international limits.13-14

The low Type I endoleak rate observed in this series despite the variety of neck shapes is encouraging but makes meaningful interpretation of the data difficult. One possibility is that alterations in stent-graft design since the first reported case in 1991 have resulted in continually improving results.15 The latest modification in the Zenith stent-graft design, the Zenith Flex™ graft, has 5mm gaps between the 1st and 2nd and 2nd and 3rd stents, allowing for greater conformity of the graft to neck angulation and theoretically an improved proximal seal. This may mean that the shape of the aneurysm neck is less relevant today than it would have been in the past, rendering the present study largely irrelevant.

An alternative interpretation of our results is that the numbers included are simply inadequate to provide sufficient data to reach any firm conclusions. A larger series of patients followed-up for a longer period of time will be helpful in resolving this issue and we continue to recruit patients to this study with this in mind. Until then, we feel that assessment of aneurysm neck morphology should form part of the routine pre-operative workup for AAA patients undergoing endovascular aneurysm repair and hope that others will find the proposed classification system in this paper useful.

We believe that taking the aneurysm neck shape into account when planning the graft and oversizing to the largest neck diameter is an important aspect of graft planning as evidenced by the low Type I endoleak observed in this series. The suggested classification system provides straightforward nomenclature of the aortic neck morphology. Its use, along with clear guidelines on oversizing will permit comparison and standardization of the differing views on this contentious issue.

<table>
<thead>
<tr>
<th>ENDOLEAK TYPE</th>
<th>NO.</th>
<th>ANEURYSM NECK TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1</td>
<td>Flare</td>
</tr>
<tr>
<td>II</td>
<td>4</td>
<td>Parallel</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Flare</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Hourglass</td>
</tr>
<tr>
<td>III</td>
<td>1</td>
<td>Parallel</td>
</tr>
</tbody>
</table>

Table 1
ANEURYSM NECK TYPES IN PATIENTS WITH ENDOLEAKS

FIGURE 3 — DISTRIBUTION OF NECK SHAPES

CONNECTION

BARREL

FLARE

HOURGLASS

IRREGULAR

PARALLEL

CONE

CO McDONNELL ET AL
REFERENCES


Correspondence to: Mr Ciaran McDonnell, Dept of Vascular Surgery, St. James’s Hospital, James’s Street, Dublin 8. Tel. +353-1-416 2790; Fax. +353-1-410 3599 E-mail: comcdonnell@eircom.net
The impact of the establishment of a surgical high dependency unit on management of Abdominal Aortic Aneurysm

ABSTRACT

Background Our ability to maintain satisfactory levels of outcome after elective abdominal aortic aneurysm (AAA) surgery is increasingly strained by rising levels of co-morbidity in the presenting population. In this study we present a comparative outcome analysis of patients undergoing elective AAA surgery 18 months before and after the establishment of a surgical high dependency unit (HDU).

Methods The preoperative status (ASA & POSSUM scores), operative factors and postoperative outcomes as well as duration of stay were calculated for 104 patients undergoing elective AAA repair (57 prior to the HDU opening and 47 patients afterwards).

Results Patients undergoing surgery in the latter period had significantly higher ASA (2.5±0.06 versus 2.7±0.7; p=0.007), overall POSSUM (33.2±0.5 versus 35.5±0.8; p=0.02) and physiological POSSUM (16.3±0.3 versus 15.5±0.2; p=0.048) scores than those operated on prior to establishment of the HDU (data are mean±SEM; 2-tailed p-score). The two groups had similar total lengths of hospital stay (518 versus 534 days). However, following establishment of the HDU patients occupied fewer ICU bed days (110 versus 181). This resulted in a saving of €50,750.

Conclusion The efficiency and quality of care following elective AAA surgery can be improved by provision of HDU step-down facilities without significantly increased expenditure.

INTRODUCTION

There is a progressively increasing demand on intensive care beds. As the surgical workload increases, more centres perform complex procedures requiring high levels of post-operative care. As a result of the increasing demand, ICU beds may not be available for post-operative monitoring for patients undergoing elective aortic aneurysm surgery. A further problem in this group of patients is the high number of co-morbid conditions present. It is now accepted that patients presenting for elective AAA surgery are increasingly physiologically compromised. This results in frequent case cancellations and postponement of surgery, which is distressing for both patient and family. Significant waste of hospital expenditure on repeated fruitless elective admissions results.

We recently upgraded a regular six-bedded ward to a four-bedded surgical high dependency unit (HDU). Three years after its establishment we have performed a comparative outcome analysis on elective aortic aneurysm operations carried out eighteen months before and after establishment of the unit.

AIMS

The aims of this study were to determine whether provision of a high dependency step-down unit improves management of elective abdominal aortic aneurysm patients and whether the cost associated with elective AAA repair could be reduced.

METHODS

Two time periods were analysed. From January 1998 to June 1999, 57 patients underwent elective AAA repair. Forty-seven patients had surgery in the second time period, January 2002 to July 2003. Only patients having surgery for aortic aneurysmal disease were included in this analysis. Demographic data, intra-operative and post-operative data were recorded. ASA grade (American Society of Anaesthesia) and POSSUM Scores (Physiological and Operative Severity Score for the enumeration of Mortality and
Morbidity) were calculated on the basis of data collected from anaesthetic notes, admission notes and operative notes.

The conventional POSSUM score has two components, a physiological score which comprises 12 preoperative physiological variables and an operative score which contains six operative variables. Each variable is scored and then combined to produce a physiological score and an operative score that increase with increasing physiological dysfunction or severity of operation. Total POSSUM Scores were calculated as the sum of operative and physiological scores.

**STATISTICAL ANALYSIS**

Differences in distribution of demographics, diagnostic categories and outcomes were examined using Chi-squared proportional analysis. A p-value of less than 0.05 was considered significant.

**RESULTS**

Patients undergoing surgery in the period 2002-2003 had significantly higher physiological POSSUM scores (pPOSSUM) (19.2±0.7 v 17.5±0.5 p=0.048) (Figure 1) and total POSSUM scores (tPOSSUM) (35.5±0.8 v 33.2±0.5 p=0.02) (Figure 3) compared to those operated on prior to establishment of the HDU. No difference was seen in operative POSSUM scores (oPOSSUM) between the two groups. A higher proportion of the patients presenting in the period 2003-2003 had ASA Grades of >3 compared to the earlier period (p<0.007) (Figure 4).

Mean age, operative POSSUM score, anaesthetic time, operative time, intraoperative blood loss, aortic cross-clamp time and maximum aneurysmal diameter were not significantly different between the two groups (Table 1).

Four patients died post-operatively in the HDU compared to two deaths in the ICU during the preceding 18 months. However, the number of major cardiac, respiratory and renal complications was similar between the groups (Table 2). Although the two groups had similar total lengths of hospital stay (518 versus 534 days), the latter group occupied fewer ICU bed days (110 versus 181) requiring a total stay of 224 days in HDU instead.

When costs of stay were compared, the earlier group’s ICU expenditure averaged €287,100 compared to €236,350 for those who were discharged to HDU, a saving of €50,750. This however needs to be offset against a cost of HDU provision of €100,800 in total.

In order to explain the differences in pPOSSUM scores between the groups, we examined the proportion of elective and ruptured aortic aneurysms operated upon over both time periods. Elective repairs formed a higher proportion of the total group in the later period but this was not statistically significant.

**DISCUSSION**

High dependency units (HDUs) are becoming increasingly important in bridging the gap between the level of care provided in an intensive care unit and the level of care provided on a general surgical ward. They have a vital role in reducing elective case cancellations and, although difficult to quantify, are likely to improve ICU bed turnover. HDUs have been shown to reduce ICU readmission rates and allow earlier discharge of patients. While there has been support for high dependency units in recent years, only a minority of hospitals in Ireland and the UK have dedicated surgical high dependency units. One possible reason for this is a lack of evidence supporting their benefit.

Although several studies have suggested that the introduction of HDU facilities alone does not lead to a reduction in hospital mortality, postoperative management on an HDU has been associated with fewer cardiorespiratory complications, compared to post operative patients treated on a general surgical ward. Postoperative stays in HDU allow patients to be stabilised before returning to the general surgical ward. The facility to provide invasive monitoring should reduce the incidence of unexpected postoperative cardiorespiratory complications. Studies by Gamil et al and Leeson-Payne et al suggested that many patients on the general wards would benefit from closer observation and monitoring.

The impact of high dependency units on the workload and occupancy of the intensive care unit is particularly relevant to vascular surgeons. Frequent case cancellation due to ICU unavailability is an ever-increasing problem. This strain on ICU facilities, coupled with the rising levels of co-morbidity in our elective aortic aneurysm population, challenges our ability to provide satisfactory delivery of service and postoperative care to our patients.
Table 1
DEMOGRAPHIC AND INTRA-OPERATIVE DATA

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Age</td>
<td>71.5 ± 0.95</td>
<td>71.2 ± 1.4</td>
</tr>
<tr>
<td>Male : Female</td>
<td>49M : 8F</td>
<td>36M : 11F</td>
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<tr>
<td>AAA Size</td>
<td>5.8 ± 0.16</td>
<td>6.2 ± 0.17</td>
</tr>
<tr>
<td>Anaesthetic Time (Mins)</td>
<td>220 ± 9</td>
<td>219 ± 7</td>
</tr>
<tr>
<td>Duration of Surgery (Mins)</td>
<td>204 ± 9</td>
<td>200 ± 8</td>
</tr>
<tr>
<td>Cross Clamp Time (Mins)</td>
<td>71.88 ± 2</td>
<td>78 ± 3</td>
</tr>
<tr>
<td>Blood Loss (mls)</td>
<td>2355 ± 158</td>
<td>2062 ± 175</td>
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</table>

Table 2
POST-OPERATIVE COMPLICATIONS

<table>
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<tbody>
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<td>Respiratory Failure</td>
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<td>Lower Respiratory Tract Infection</td>
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<td>11</td>
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<tr>
<td>Arrhythmia</td>
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<td>Myocardial Infarct</td>
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<tr>
<td>Pulmonary Oedema</td>
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<td>Urinary Tract Infection</td>
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<td>1</td>
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<tr>
<td>Bleeding</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Inflammatory Syndrome</td>
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<td>1</td>
</tr>
<tr>
<td>Wound Infection</td>
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<td>1</td>
</tr>
<tr>
<td>Colonic Ischaemia</td>
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<tr>
<td>Deep Vein Thrombosis/ Pulmonary Embolus</td>
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<td>1</td>
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<tr>
<td>Acute Renal Failure</td>
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<td>4</td>
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<tr>
<td>Lower Limb Ischaemia</td>
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<td>2</td>
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<tr>
<td>Mortality</td>
<td>2</td>
<td>4</td>
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</table>
Although care provided in a HDU is cheaper than in ICU, there has been no observed reduction in demand for ICU care with the introduction of high dependency units. There are several controversies surrounding the organisation of a HDU, one of which is nurse to patient ratio. Boots et al suggest that a defined high dependency service becomes cost-effective when patient care requires more than one nurse for three patients. HDUs vary in terms of their proximity to the ICU, with the majority being geographically distinct from the ICU. They have a variable number of designated consultants, who may be surgeons, anaesthetists or physicians. These units are highly variable in size, ranging from 3 – 13 beds.

In the current study, reduced bed occupancy was compensated for by more prolonged HDU stays. This eliminated any cost saving on ICU expenditure. HDU costs are higher than those of a general surgical ward because of the level of sophisticated care provided. Significantly higher nurse/patient ratios are required. Added to that are the higher costs of consumables, pharmacy costs and capital assets. However, the cost is at most only 50% of that of ICU. The cost can be difficult to quantify as illustrated by other observational studies. Any cost implications are likely to be offset by improvements in the quality of care as inferred by our findings and those of others. Once a HDU is established, only observational studies are really possible because of clinical pressure to admit patients if capacity permits. Other well recognised confounding factors, such as fluctuating rates of referral when HDU and ICU are full, and admission criteria vary as the critical care services become busier, making measurement of supply and demand difficult.

Dhond et al reported that mid-week was the busiest period for HDU activity as the unit accommodated elective surgical procedures. This would suggest that, although the occupancy in ICU remains the same, the HDU allows a greater elective workload to be undertaken.

CONCLUSION

As outcome after AAA rupture remains poor, it is essential that high-risk patients continue to be treated electively. In our own experience there appears to be a trend towards a greater proportion of elective aortic aneurysm repairs, which may be a result of earlier intervention in high-risk groups. Despite the fact that our patient population is becoming increasingly physiologically compromised, we have maintained acceptable levels of postoperative morbidity. In addition their post-operative stay in ICU was reduced with little increased cost. Although difficult to quantify, as demand for ICU beds is a constant strain, it is likely that vacating ICU beds earlier has a beneficial effect on ICU bed turnover. The quality, and therefore value, of inpatient care can be improved by provision of high dependency step-down facilities.

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Correspondence to: Ms MC Barry, Dept of Vascular Surgery, St. Vincent’s University Hospital, Elm Park, Dublin 4 Tel: 01.2773709; Fax: 01.2773678 E-mail: mary.barry@st-vincents.ie
Haemodynamic determinants of elevated pulse wave velocity during acute isometric handgrip exercise

ABSTRACT

Background Measurement of pulse wave velocity (PWV) provides a reliable index of vascular stiffness. Despite its widespread application, the physiological inter-relationships between PWV, blood pressure (BP) and in particular, heart rate (HR), have yet to be fully elucidated. Furthermore, little is known about altered arterial compliance during acute exercise.

Aim To examine the effects of 3-min supine non-dominant isometric handgrip exercise (ISOMEX), performed at 30% of maximum voluntary contraction, on carotid-radial PWV, BP and HR in the dominant arm of 51 healthy subjects.

Results During exercise, PWV correlated strongly with diastolic BP (r = 0.55, p < 0.01) and mean arterial pressure (r = 0.51, p < 0.01). PWV and HR failed to correlate at rest or during exercise.

Conclusion ISOMEX invoked an elevated PWV, which is predominantly related to BP or factors determining it, and not HR. The carotid-radial PWV stress test is a simple measurement that may have prognostic potential for use in large-scale population studies.

INTRODUCTION

Pulse wave velocity (PWV), the speed of pulsatile wave transit along an arterial segment, is a sensitive and reliable surrogate of vascular stiffness.5,6 Resting PWV increases with advancing age, reflecting elevated arterial stiffness, or its inverse, reduced compliance. The progression of arterial stiffness is also accelerated by a number of cardiovascular disorders.3-6

Studies designed to examine the physiological relationships between PWV and standard resting haemodynamics report conflicting results. Whilst strong, but variable, correlations between PWV and blood pressure (BP) are frequently documented,3,9,10 its association with other measured and derived parameters (e.g. heart rate (HR), rate pressure (double) product and pulse pressure) is less clear.3,9-16 Furthermore, the potential influence of HR on the PWV continues to evoke much controversy despite the use of cardiac pacing to induce tachycardia.3,12,14,15,17

The effects of elevated HR and BP on the PWV of normal subjects during acute exercise are also unclear. Movement artefact tends to restrict reliable measurement of PWV during dynamic exercise. Hence, recent isotonic studies only report acute alterations of compliance during the post-exercise recovery phase.16,18 Stable recording of PWV can be acquired using isometric exercise and although some studies are reported,19-21 the detailed inter-relationships between the various haemodynamic parameters and PWV during isometric exercise remain unclear. Most reports on PWV relate to the elastic, carotid-femoral circulation. Less attention has been addressed to the more muscular carotid-radial arterial segment even though it is easily accessed, allows precise measurement using synchronous, dual transducer techniques and is a part of the vasculature that is relatively spared from the effects of both ageing and occlusive atheromatous disease.2,5

The current study describes, in control subjects, aspects of the direct physiological inter-relationships between dominant arm carotid-radial PWV and standard non-invasively measured haemodynamics during acute non-dominant arm isometric handgrip exercise (ISOMEX). This particular mode of exercise was chosen for study not only because of the stability of the recordings, but also due to the acute nature of its sympathetically mediated vasoconstrictive effect.22-24

Isometric exercise invokes a notable elevation of diastolic BP, in addition to modest increases of systolic
BP and HR. By measuring PWV during ISOMEX, the effect of a concurrent rise of HR, on a background of amplified vascular tone, can be examined. The hypothesis underlying the current study is that BP, or factors causing the BP response, rather than HR, determine the speed of pulse wave transit during ISOMEX. We also propose that measurement of PWV in the upper limb during the standard isometric exercise protocol is practicable for use as a vascular stress test in human population studies.

METHODS

SUBJECTS

The study took place at the exercise laboratory of the Cardiovascular and Coronary Care Unit, St. Luke’s Hospital, Kilkenny, Ireland. Institutional ethics approval was obtained and all volunteers provided informed consent. Full data sets were recorded from 51 controls (22 males and 29 females, Table 1), recruited from a local population with a mean total cholesterol of 5.5 ± 1 mmol/l. Participants with a history of diabetes mellitus, a resting BP greater than 140/90 mmHg, Marfan’s syndrome or those taking any form of pharmaceutical or alternative medication were excluded from the study. All subjects were free of symptoms or signs of disease with active lifestyles and no previous history of valvular, atheromatous or hypertensive cardiovascular disease. Six subjects were excluded from the final analysis because of failure to obtain a complete compliment of resting and exercise PWV measurements.

PROCEDURES

Following a demonstration of the experimental protocol, each subject rested supine for approximately 10 minutes. After this period, three individual recordings of brachial BP (systolic and diastolic BP) and HR were taken from the dominant arm with an automated digital oscillometric sphygmomanometer (Omron, model 705 – CP, Omron Matsuaka Corp., Japan). Upper limb PWV was determined directly afterwards using an automatic device, Complior II® (Colson, Paris). This allows online pulse wave recording and automatic calculation of PWV, as previously described and validated. Synchronous measurements were obtained by simultaneously positioning two pressure sensitive transducers, one at the base of the neck for the common carotid artery and the other directly over the radial artery of the dominant arm. The PWV was derived using the time delay between the foot of the proximal (carotid) and distal (radial) waves and the superficially calculated distance separating the respective transducers, according to the following equation: 

\[ PWV \text{ (m/sec)} = \frac{\text{distance (cm)}}{\text{transit time (secs)}}. \]

The procedures used for calculation of the baseline PWV were identical for exercise and recovery. Since comparison of the PWV was performed at the same sitting for each individual, the length between the transducers was not adjusted to allow for the short distance that the pulse wave travels from the origin of the common carotid into the neck. The pre-exercise values for each subject were based on three individual sets of resting steady state data.

The rate pressure product and the mean arterial pressure were estimated according to standard formulae (rate pressure product = HR x systolic BP and mean arterial pressure = \( \frac{1}{3} \) (systolic BP – diastolic BP) + diastolic BP).

PROTOCOL

ISOMEX was performed uninterrupted for three minutes at 30% of maximal voluntary contraction using a Baseline® hydraulic hand dynamometer.
Table 2
HAEMODYNAMIC RESPONSES TO ISOMEX

<table>
<thead>
<tr>
<th></th>
<th>REST</th>
<th>EXERCISE</th>
<th>RECOVERY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SBP, mmHg</strong></td>
<td><strong>females n = 22</strong></td>
<td><strong>males n = 22</strong></td>
<td><strong>females n = 22</strong></td>
</tr>
<tr>
<td>(mmHg)</td>
<td>120 ± 3</td>
<td>133 ± 4*‡</td>
<td>120 ± 3</td>
</tr>
<tr>
<td></td>
<td>115 ± 3</td>
<td>123 ± 3</td>
<td>115 ± 3</td>
</tr>
<tr>
<td><strong>DBP, mmHg</strong></td>
<td>69 ± 1</td>
<td>80 ± 2*‡</td>
<td>69 ± 1</td>
</tr>
<tr>
<td></td>
<td>66 ± 1</td>
<td>74 ± 2*</td>
<td>66 ± 1</td>
</tr>
<tr>
<td><strong>MAP, mmHg</strong></td>
<td>86 ± 2</td>
<td>98 ± 3*‡</td>
<td>86 ± 2</td>
</tr>
<tr>
<td></td>
<td>82 ± 2</td>
<td>91 ± 2*</td>
<td>82 ± 2</td>
</tr>
<tr>
<td><strong>PP, mmHg</strong></td>
<td>51 ± 2</td>
<td>52 ± 2</td>
<td>51 ± 2</td>
</tr>
<tr>
<td></td>
<td>50 ± 2</td>
<td>49 ± 2</td>
<td>50 ± 2</td>
</tr>
<tr>
<td><strong>HR, beats/min</strong></td>
<td>66 ± 2*</td>
<td>72 ± 2*‡</td>
<td>66 ± 2*</td>
</tr>
<tr>
<td></td>
<td>62 ± 2*</td>
<td>66 ± 2*</td>
<td>62 ± 2*</td>
</tr>
<tr>
<td><strong>RPP</strong></td>
<td>7933 ± 288*‡</td>
<td>9646 ± 479*§</td>
<td>7881 ± 312*‡</td>
</tr>
<tr>
<td></td>
<td>7087 ± 246</td>
<td>8143 ± 266*</td>
<td>7087 ± 246</td>
</tr>
<tr>
<td><strong>PWV, m/sec</strong></td>
<td>8.16 ± 0.18*‡</td>
<td>9.18 ± 0.25*§</td>
<td>8.16 ± 0.18*‡</td>
</tr>
<tr>
<td></td>
<td>7.69 ± 0.15</td>
<td>8.38 ± 0.16*</td>
<td>7.69 ± 0.15</td>
</tr>
</tbody>
</table>

Values are mean ± S.E. DBP, diastolic blood pressure; HR, heart rate; MAP, mean arterial pressure; PP, pulse pressure; PWV, pulse wave velocity; RPP, rate pressure product; SBP, systolic blood pressure.

\* = Significant difference compared to baseline, P ≤ 0.05
\† = p ≤ 0.009
\‡ = Significant difference compared to females, P ≤ 0.05
\§ = p ≤ 0.005

**Figure 1** —
CORRELATION BETWEEN PWV AND DBP DURING ISOMEX

**Figure 2** —
CORRELATION BETWEEN PWV AND MAP DURING ISOMEX

**Figure 3** —
CORRELATION BETWEEN PWV AND SBP DURING ISOMEX

**Figure 4** —
CORRELATION BETWEEN PWV AND HR DURING ISOMEX
Subjects were encouraged to maintain constant tension on the dynamometer and to breathe normally throughout (avoiding the Valsalva manoeuvre). Recording of all haemodynamic parameters took place during the third minute of ISOMEX in order to determine the BP, HR and PWV during steady state contraction. On completion of exercise, subjects relaxed for one minute before recording of the recovery BP, HR and PWV commenced.

**STATISTICAL ANALYSIS**
Statistical analyses were applied comparing baseline data to values obtained during exercise and recovery using paired Student t-tests for dependant variables, where appropriate. The Pearson product moment correlation was computed to assess the degree of association amongst variables and all results were analysed with GB-STAT (version 8.0, Dynamic Microsystems, U.S.A.). Statistical significance was accepted at a p value ≤ 0.05. Data are presented as mean ± SE.

**RESULTS**
Haemodynamic changes were recorded successfully from the 51 subjects at the first sitting. Each participant tolerated the protocol comfortably and elicited the expected, although individually variable haemodynamic changes. Resting PWV correlated significantly with age (r = 0.31, p = 0.02), resting diastolic BP (r = 0.33, p = 0.02) and resting mean arterial pressure (r = 0.29, p = 0.04).

ISOMEX significantly elevated the standard haemodynamics such as systolic BP, diastolic BP and HR compared to rest. The systolic BP increased by an average of 10.1 ± 1 mmHg (9 ± 1%) (p = 0.002). The percentage increase of diastolic BP was greater (15 ± 1%, p < 0.0001), although the absolute change was similar: 10.0 ± 1 mmHg. The HR increased by an average of 9.5 ± 1% (P = 0.003), from a resting rate of 63 ± 1 beats/min to 69 ± 1 beats/min. ISOMEX also significantly elevated the derived parameters, rate pressure product (18 ± 2%; p < 0.0001) and mean arterial pressure (12 ± 1%; p < 0.0001). Hand-grip exercise also significantly increased the PWV by 10.9 ± 1%, from 7.89 ± 0.1 m/sec to 8.73 ± 0.2 m/sec (p < 0.0001). The pulse pressure was the only standard haemodynamic variable that did not change (p = 0.94).

Strong correlations were found between exercise PWV and exercise haemodynamics such as diastolic BP (r = 0.55, p = 0.002, Figure 1) and mean arterial pressure (r = 0.51, p = 0.002, Figure 2). The systolic BP (r = 0.41, p = 0.003, Figure 3) and rate pressure product (r = 0.35, p < 0.01) also correlated with the ISOMEX PWV. Despite the significant rise in HR and the similar % change of the PWV, these parameters did not correlate (Figure 4).

Table 2 displays the resting, exercise and recovery haemodynamic parameters for males (n = 22) and females (n = 29). The former presented with higher resting values for all haemodynamics. However rate pressure product, HR, and PWV were the only indices that were significantly greater (p ≤ 0.05). During exercise, males elicited significantly greater PWV (9.19 ± 0.3 m/sec vs. 8.38 ± 0.2 m/sec, p = 0.007) and the systolic BP, diastolic BP, mean arterial pressure, HR and rate pressure product were also significantly elevated (p ≤ 0.05), compared to females. However, the magnitude of the % changes invoked by ISOMEX were similar for each gender. The PWV, and all of the aforementioned haemodynamic parameters, returned to resting pre-exercise levels during the recovery phase. Gender also had no effect on the recovery values.

**REPRODUCIBILITY**
Reproducibility of the methods was confirmed in eight, randomly chosen members of the study group, in whom the protocol was repeated less than 5 days after the original measurements. The % increase of PWV during ISOMEX in this subset at the second recording was similar to that initially observed (15.5 ± 6 vs. 15.2 ± 4%, p = ns). Similarly, the induced changes in mean arterial pressure (15.7 ± 4 vs. 16.1 ± 3%, p = ns) and HR (14.1 ± 4 vs. 14.3 ± 4%, p = ns) were comparable between the two days.

**DISCUSSION**
This study documents the physiological relationships between synchronous dual point carotid-radial PWV and other non-invasive haemodynamics at rest, during acute isometric exercise and recovery. It also provides novel insight into non-dominant forearm exercise, focusing attention on the readily accessible carotid-radial circulation where applicability is widely practicable. The findings support the hypothesis that elevated PWV during isometric exercise is strongly associated with the hypertensive response to this form of physiological exercise stress rather than the rise in HR.
RESPONSES TO ISOMETRIC EXERCISE
A number of previous studies describe the physiological effects of isometric exercise in humans.12,13,25-27 The present report focuses not only on standard BP and HR changes but also explores the effects of ISOMEX on mean arterial pressure, rate pressure product and pulse pressure. The findings relating to the latter are consistent with those derived from published BP and HR data, even though exercise was performed using the non-dominant arm.12,13,25 Such an exercise protocol avoids forearm movement, but, as with dominant arm isometric exercise, invokes arterial stiffening or vasoconstriction due to enhanced sympathetic activity to the heart and blood vessels.22-24 The elevation of BP (particularly diastolic), is directly related to both the intensity and duration of muscle contraction, and to the size of the muscle mass recruited.25-27 Since the BP changes during ISOMEX are coupled with modest changes in HR, the haemodynamic response that amplifies arterial stiffness operates predominantly through BP related mechanisms.

BLOOD PRESSURE AND PWV
The current findings show that at rest, diastolic BP and mean arterial pressure are significantly related to carotid-radial PWV. This corroborates the findings of Kanda et al.9 in healthy males, and Cameron et al.25 who report that the resting carotid-radial PWV of controls, but not diabetic subjects, is associated with diastolic BP and mean arterial pressure. Yasmin and Brown9 concluded that the diastolic BP was the strongest correlate of resting carotid-radial PWV in the healthy offspring of hypertensive patients. Diastolic BP is also reported as the major determinant of aortic PWV in young males.10 However, in both healthy and diseased subjects, other investigations have found that mean arterial pressure or systolic BP is preferentially related to the PWV in the resting state.22,23

The elevated PWV during ISOMEX in the current study correlates strongest with the exercise diastolic BP. ISOMEX induced elevation of diastolic BP is thought to result from increased peripheral arterial resistance,12 likely as a consequence of amplified sympathetic nervous system activity. The weaker relationship between exercise systolic BP and exercise PWV may relate to the greater magnitude of the diastolic BP response. The latter was raised by ~15 % compared to the ~9% rise in systolic BP. The pulse pressure did not change significantly during ISOMEX as a consequence of the greater percentage increase of diastolic BP, relative to systolic BP. This is consistent with the original observations of Lind et al.15 The mean arterial pressure and to a lesser extent, the rate pressure product, which may provide a non-invasive estimate of the ventricular-vascular shear stress component, were also linked to the PWV response during ISOMEX.

HEART RATE AND PWV
Controversy exists with regard to HR and PWV and some authors suggest that PWV should be standardised for the HR level.15 One postulated mechanism whereby HR may influence PWV is that at faster heart rates, the time available for vessel wall recoil is reduced, thereby decreasing distensibility. A cross-sectional study by Nurnburger et al.15 describes a significant association between resting HR and aortic PWV amongst healthy young men. Also, ambulatory HR appears to influence aortic PWV amongst older subjects.17 The present results demonstrate no effect of HR on the upper-limb PWV either at rest, during ISOMEX or recovery. Despite the elevated HR occurring on the background of more taut or stiffened vessels during ISOMEX, it still had no relationship with the PWV. Also, the derived parameter, rate pressure product, elicited a weaker association with PWV than the systolic BP alone, implying that HR in combination with systolic BP has little effect on the PWV, at least in this population of healthy controls.

Similarly, pacing studies designed to simulate exercise tachycardia report conflicting results. Wilkinson et al.16 detected no PWV alteration during incremental atrial pacing, whilst other investigations found that PWV increased significantly by elevating the HR from 40 beats/min to 130 beats/min.12,15,16 Albaladejo et al.17 suggest that a relationship exists between aortic PWV and HR for males but not for females. We found no relationship between PWV and HR in our gender comparisons.

NEUROGENIC REFLEXES AND ISOMEX PWV
The mechanism underlying the raised BP and PWV during ISOMEX in the current study may relate to amplified efferent sympathetic activity. The rise in diastolic BP is consistent with increased peripheral vascular resistance and stiffening of the vasculature, which alters the inherent arterial cushioning function that underlies normal rates of resting PWV. On cessation of exercise, the BP and HR decrease is mirrored by a corresponding fall in PWV, a response consistent with a neurogenic trigger for
the haemodynamic alterations being switched off. This rapid reversal contrasts with the PWV response to acute dynamic exercise. Compliance is elevated by about 66% 30 minutes following moderate intensity cycling exercise and only returns fully to baseline when measured one hour after exercise. Similarly, both upper limb and lower limb PWV are ~10% lower 60 minutes following maximum treadmill exercise. Such delayed responses to isotonic exercise may better reflect metabolic phenomena resulting from this particular mode of physiological stress.

**THE CAROTID-RADIAL ARTERIAL SEGMENT**
The majority of reports regarding synchronous dual arterial site PWV measurement focus on the carotid-femoral circulation. Few synchronous carotid-radial PWV studies are documented, even though studies employing this component of the circulation have notable advantages. Factors such as ageing and disease, that have a pronounced effect on the aorta, do not overtly affect this part of the arterial tree. Indeed, the first measurements of PWV were recorded in the upper limb vasculature because of its accessibility. Furthermore, the carotid-radial circulation comprises a muscular type vasculature which may also be more dependent on endothelial nitric oxide bioavailability. In addition, because of this large smooth muscle component, for any given increase in sympathetic outflow, greater modification of the intrinsic viscoelastic properties of the arterial wall along this particular segment should occur, compared to elastic type arteries.

**CONCLUSION**
The current study describes the abrupt, but temporary, elevation of PWV resulting from a single bout of ISOMEX in healthy subjects. This increase is significantly related to BP, particularly diastolic BP and mean arterial pressure, but not HR. The pattern of the haemodynamic response to ISOMEX is consistent with a likely neurogenic mechanism. Studies characterising controls and patients with cardiovascular disease and related disorders using the standard isometric exercise protocol described here, in conjunction with longitudinal lifestyle changes including diet, exercise, pharmaceutical and other interventions, are indicated in order to verify the diagnostic and prognostic potential of assessing PWV during ISOMEX.

**ACKNOWLEDGMENTS**
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**REFERENCES**
HAEMODYNAMIC DETERMINANTS OF ELEVATED PULSE WAVE VELOCITY DURING ACUTE ISOMETRIC HANDGRIp EXERCISE


Correspondence to: Kieran Reid
Email: kieran.reid@tufts.edu
Dr.Michael.Conway@maila.hse.ie
Tel: + 353 56 7785253 Fax: + 353 56 7785170
Acute haemodynamic effects of cigarette smoking in healthy young subjects

ABSTRACT

Background Invasive studies in middle-aged patients suggest an acute adverse haemodynamic effect of smoking.

Aims To study acute changes in blood pressure (BP), cardiac output, peripheral resistance and aortic compliance following cigarette smoking in healthy young subjects.

Methods Using a non-invasive photoplethysmographic technique we compared the effects of smoking one cigarette with sham smoking in 12 healthy volunteers (22-25 years). Data was analysed using JMP version 5.0.

Results In contrast to sham smoking there was a prompt increase in blood pressure with a maximum effect at 15 min (123±7/75±5 to 143±6/86±6 mmHg, mean±SEM, p<0.01) which is attributed to a rise in cardiac output (p<0.05) rather than changes in peripheral vascular resistance. There was also a significant (p<0.05) increase in heart rate and a reduction in aortic compliance.

Conclusion These results suggest that health or young age do not protect from the adverse effects of smoking.

INTRODUCTION

Although the cardiovascular consequences, ischaemic and peripheral vascular disease, of cigarette smoking are well recognised the relative contribution of the underlying pathophysiological mechanisms e.g. atherosclerosis, increased intimal medial thickness, inflammation, endothelial dysfunction, hypercoagulatibility, platelet activation are less well described.1 Recently we noted that acute cigarette smoking increased blood pressure and arterial stiffness.2 An increase in blood pressure (BP) per se can increase vascular stiffness. As BP is largely determined by cardiac output and peripheral vascular resistance we wished to determine if changes in one or both was responsible for the change in BP and whether BP changes antedated changes in arterial stiffness/compliance. We also hypothesised that by using a continuous, non-invasive beat-to-beat recording of the haemodynamic changes induced by smoking one could compare data obtained in a young healthy population to that from a patient population using more invasive techniques.

METHODS

A group of 12 healthy subjects (six female), aged 22-25 years of age, of which six were regular smokers and six non-smokers, volunteered for this study. Subjects were studied supine in a quiet room resting for 10-15 minutes until a stable baseline was achieved. None were on any medication and all had refrained from smoking for at least two hours. Subjects smoked a single cigarette (nicotine content 1.2 mg) over five minutes and completion was taken as time 0. Data recorded in the five minutes prior to smoking were taken as baseline. The six control subjects followed the same protocol with the exception that their cigarette was not lit (sham smoking). Haemodynamic measurements were recorded non-invasively from finger infra-red photopletismographic recordings of arterial BP – Finometer (TNO Biomedical Instruments, Amsterdam, Netherlands) which derives blood pressure (following calibration to brachial blood pressure) cardiac output and peripheral vascular resistance and arterial (aortic) compliance from the computed aortic flow waveform. It has been shown to accurately reflect pressures recorded invasively3 and has been validated4 to the standards of the Association for the Advancement of Medical instrumentation (AAMI).

Results, expressed as mean ±SEM, were analysed through JMP (Version 3.2.1. SAS Institute Inc). The difference between the response to smoking and controls was analysed using MANOVA. The study has Institutional Ethics approval.

RESULTS

There were no significant differences in baseline values between the two groups. As there were no
changes in any haemodynamic measurement with sham (control) smoking, only the active smoking data are displayed (Figure).

**SYSTOLIC BP**
There was a rise from baseline (123 ±7 mmHg) in systolic pressure by one minute after smoking and the main changes were observed during the 5 to 15 minute period when the peak (143 ±6 mmHg) effect after smoking was achieved (Figure). However systolic pressure did not return to baseline even some 20 minutes following smoking. The difference between the two groups was significant (p<0.01).

**DIASTOLIC BP**
The diastolic blood pressure showed similar changes to that of systolic pressure from a baseline 75 ±5 reaching a peak 86 ±6 mmHg at 15 minutes but had not returned to baseline 20 minutes after smoking (Figure). Again the difference between the two groups (smoking/control) was significant (p<0.01).

**HEART RATE**
The baseline heart rate (68 ±4/min) with smoking increased significantly (p<0.01) following smoking, reaching a maximum (78 ±5/min) at 10 minutes and declined thereafter. In controls (sham smoking) there was no variation in heart rate.

**CARDIAC OUTPUT**
Cardiac output rose from a baseline of 5.6 ±1.62 l/min to 6.4 ±0.8 l/min after 3 minutes following smoking, achieving a peak 6.8 ±1.0 l/min at 10 minutes. It then remained quite static without much fluctuation until the end of the study. The difference observed due to smoking was significant (p<0.001) as sham smoking did not cause any variation in cardiac output.

**TOTAL PERIPHERAL RESISTANCE (TPR)**
In the Finometer this is computed from mean pressure/cardiac output and expressed as dyn.s/cm² and converted as a unit called MU (medical unit system). There was no change from baseline values in smokers (1.03 ±0.1) following smoking (Figure).

**ARTERIAL COMPLIANCE**
Some five minutes after smoking compliance had declined significantly (p<0.001) from 2.55 ±0.1 at baseline to 2.34 ±0.1 reaching 2.3 ±0.1 by 15 minutes. In controls it showed no change and again the difference between the two groups was significant p<0.01.

**CONCLUSION**
This study reveals additional information on the acute haemodynamic response to smoking. It also suggests the adverse effects seen in older patients with disease states are applicable to healthy young subjects. This indicates that young age and a healthy vascular system does not offer protection from the adverse haemodynamic effects of smoking. The number of subjects studied was relatively small, in part due to implementation during the course of the study of a ban in Ireland precluding any smoking indoors.

The study illustrates how a sensitive non-invasive photophlethysmographic technique may accurately reflect the effects of smoking. The Finometer device is now established in the detection of acute changes in cardiac function providing data that has hitherto only been available using invasive intra-aortic recording devices, which by their nature are not applicable in healthy subjects. Indeed with appropriate calibration it can quantitatively reflect change in blood pressure, cardiac output and total peripheral resistance in cardiac surgery patients.

Using Doppler echocardiography Kool et al reported an increase in cardiac index, largely due to an increased heart rate, and increased BP but no change in systemic vascular resistance following smoking in middle-aged subjects. Using radionuclide ventriculography in 12 habitual smokers with suspected ischaemic heart disease Hoilund-Carlsen et al have shown that two cigarettes acutely increased heart rate by 27%, the rate pressure product by 23% and cardiac output by 14%. The total peripheral resistance remained constant. This was accompanied by a 100% increase in plasma adrenaline (but not plasma noradrenaline). In 40 male smokers (mean age 47 years) undergoing diagnostic cardiac catheterisation studied while smoking a cigarette or sham smoking there was a prompt increase in both systolic and diastolic BP reaching a peak after five minutes which had not returned to baseline by 20 minutes. In that study the heart rate increasing from 68±2 to 78±2/min by five minutes and cardiac index (cardiac output divided by body surface area in m²) by approximately 10% but there was no change in systemic vascular resistance index. There was a significant change in the aortic pressure-diameter relation denoting a deterioration of the elastic properties which was maintained throughout the study with the maximum effect on aortic distensibility at five minutes.
Our primary findings were a prompt increase in blood pressure, heart rate and cardiac output immediately following smoking but peripheral resistance remained unchanged. The decline in aortic compliance, or increase in stiffness appeared to lag temporarily behind the changes in blood pressure. Our study using a new non-invasive technique provides results similar to those seen with echocardiography, radio-nucleotide and intravascular catheterisation with micromanometer recordings in a patient population. Although the number of young subjects studied is small it appears that changes in blood pressure pre-date those of aortic compliance suggesting that some of this effect is blood pressure dependent. Nonetheless invasive flow loop studies also show a direct effect on the vascular wall. Our results confirm that the acute rise in blood pressure following smoking is predominantly due to an increase in cardiac output rather than an increase in peripheral resistance.
ACKNOWLEDGEMENTS

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Correspondence to: Professor John Feely,
Tel: 353-1-6081553; Fax: 353-1-4539033
Email:jfeely@tcd.ie
Assessment and management of transient ischaemic attack - the role of the TIA clinic

ABSTRACT

Background As the risk of early stroke following transient ischaemic attack (TIA) is increasingly recognised, the management of patients presenting with symptoms suggestive of TIA presents a clinical challenge.

Methods Analysis of prospectively collected data on patients referred to a TIA clinic in St. Vincent’s University Hospital, between January 2003 and July 2004.

Results One-hundred-and-seventeen (117) patients (mean age 75.5 years) were assessed. The majority (79%) were referred from Accident and Emergency and 61% were seen within one week of referral. Seventy-two patients (62%) had a final diagnosis of cerebrovascular disease (56 TIA, 16 completed strokes), of whom five (7%) and four (5.5%) had severe (>70%) and moderate (>50%) symptomatic carotid artery stenosis, respectively, whilst seven patients (10%) had newly diagnosed atrial fibrillation, five of whom were anticoagulated. Non-cerebrovascular diagnoses were made in twenty-seven patients (24%).

Conclusion A TIA clinic, in co-ordination with Accident & Emergency Services, provides a safe and efficient alternative to hospital admission for patients with TIA symptoms and a low early stroke risk.

INTRODUCTION

Recent studies have shown that the risk of stroke following transient ischaemic attack (TIA) is 8-12% at seven days and 11-15% at one month. These risks are higher than previously quoted and emphasise the need for rapid assessment with institution of preventive treatment, particularly for carotid stenosis and atrial fibrillation. The Royal College of Physicians National Guidelines on Stroke, recommend that patients with TIA or minor stroke be assessed and investigated in a specialised neurovascular clinic within seven days. An additional role of a neurovascular clinic is the identification of patients with non-cerebrovascular causes for their symptoms, such as syncope, arrhythmias, epilepsy or primary eye disorders, which may require specific treatment. Despite the emphasis on out-patient assessment for stroke and TIA, there is a paucity of information on the efficacy of such a facility. In January 2003 a dedicated once weekly TIA clinic was established in the Medicine for the Elderly Day Hospital at St. Vincent’s University Hospital, with the cooperation of the Department of Radiology, Vascular Surgery, Neurology and Ophthalmology. Here we report on the activity of the first 18 months.

OPERATIONAL POLICY

Patients over 65 years of age, presenting to the Accident and Emergency (A & E) Department, with symptoms suggestive of a TIA, were referred to the clinic using a specific referral form. It was emphasised that the indications for referral were acute onset of focal neurological symptoms, lasting less than 24 hours. Non-focal symptoms such as dizziness or syncope, on their own, were not TIs. Furthermore the patient should be 65 years or over and deemed not to need acute hospital admission. Referrals were co-ordinated by the Stroke Nurse Specialist (SNS) and appointments scheduled for the next available clinic. Investigations (radiological and blood) were performed prior to clinical assessment, to ensure that results would be available at time of consultation, in order to facilitate a single visit where possible. The investigations carried out were CT brain scan, carotid doppler ultrasound, ECG, full blood count (FBC), urea, creatinine and electrolytes (U & E), fasting lipids, glucose and erythrocyte sedimentation rate (ESR). CT brain scans were requested unless carried out in A & E. Patients were contacted by telephone on the day preceding clinic attendance by the SNS and appointments for phlebotomy and radiological procedures outlined in detail. The patients attended the day hospital at 8.30am on the appointed morning.
and were directed to the appropriate venue for investigation. They subsequently returned to the day hospital where clinical assessment was carried out and lunch was provided. The results of all investigations were made available for the consensus multidisciplinary conference at 2pm on the day of assessment, where the diagnosis was reviewed and management plans instituted.

METHODS
The following information was gathered prospectively on all patients on an agreed proforma; demographic details, referring source, summary of symptoms, past medical history with pre-existing risk factors, smoking, alcohol, current medications, social situation, neurological assessment, results of investigations, classification of the event, drug therapy and other risk factor advice given, and referrals to other services. Patients diagnosed with TIA or completed stroke were classified as cerebrovascular disease. Analysis of this prospectively gathered information forms the basis of this study.

RESULTS
There were 117 new patients seen at the clinic. (Table 1) The mean age was 75.5 years, 71 (61%) were female and 71 (61%) were seen within one week of referral to the clinic. The majority (79%) of patients were referred from the Accident & Emergency Department. Of the 117 referrals to the clinic, 72 (62%) had a final diagnosis of cerebrovascular disease (TIA, completed stroke). The remaining 44 patients had a variety of other primary diagnoses (Table 2).

CT brain scan was performed on 115 patients (98%), with one patient having an MRI brain scan. Non-vascular abnormalities (subdural haematoma 1, cerebral metastases 1) were found in two patients. Carotid Doppler ultrasound studies were carried out on 116 patients (99%).

Sixty-two patients (53%) were seen and completely assessed on one visit to the neurovascular clinic. Five patients (4%) were referred to other services, notably ophthalmology, vascular surgery, cardiology, neurology and endocrinology (Table 1).

CVA/TIA GROUP
Of the 117 patients referred to the clinic, 72 (62%) had a final diagnosis of cerebrovascular disease (56 TIA, 16 completed stroke) (Table 2). Pre-existing modifiable risk factors included hypertension (38 patients), diabetes mellitus (11), hypercholesterolaemia (21), cigarette smoking (20) and atrial fibrillation (9), of whom only three had been anticoagulated. There were 60 patients on anti-platelet therapy, which in most cases had been commenced in A & E. Following assessment (Table 3) new diagnoses included hypertension (7), diabetes mellitus (2), hypercholesterolaemia (28). Of seven patients with newly diagnosed atrial fibrillation, five were anticoagulated, one patient refused warfarin, whilst in one case anticoagulation was deferred pending carotid artery surgery. New treatment, consisting of hypotensive therapy (13), aspirin (7), dipyridamole (26), clopidogrel (3), statin therapy (32) and oral hypoglycaemics (2) was commenced. Duplex carotid studies were carried out in 116 patients (Table 4). Of the 72 patients with TIA/stroke, nine (12.5%) had symptomatic carotid artery stenosis (>50%). In five patients (7%) the degree of stenosis was greater than 70%, whilst two patients had a completely occluded carotid artery, corresponding to their symptomatic hemisphere. Of the patients in the non-TIA/CVA group, two had severe carotid stenosis (asymptomatic carotid artery stenosis).

DISCUSSION
Our experience suggests that a TIA service is an effective method of assessing patients with a suspected TIA or minor stroke. Over 55% of our patients were comprehensively investigated and assessed at one visit, whilst over 60% of patients were seen within one week of referral.

In our series, 62% had a final diagnosis of cerebrovascular disease, of whom 7% had symptomatic severe carotid stenosis and 10% were diagnosed with new onset atrial fibrillation, the majority of whom were anticoagulated. In two previous studies3,4 of patients referred to a neurovascular clinic 61.5% and 50% were found to have cerebrovascular disease, respectively. Of these 16% and 12% respectively had severe carotid stenosis. The lower incidence of severe symptomatic carotid artery disease in our study may reflect hospital admission of patients with more severe transient ischaemic attack or minor stroke via Accident & Emergency, who have a higher seven-day risk of stroke10 and may have more severe carotid artery stenosis. A further four and two patients had moderate symptomatic and severe asymptomatic carotid stenosis, respectively, in whom carotid
Table 1
CHARACTERISTICS OF PATIENTS, SOURCE OF REFERRAL TO CLINIC AND TO OTHER SPECIALITIES

<table>
<thead>
<tr>
<th>MEAN AGE (YRS)</th>
<th>75.5 (RANGE 61 – 93)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age profiles</strong></td>
<td>%</td>
</tr>
<tr>
<td>≤ 65</td>
<td>14</td>
</tr>
<tr>
<td>66 – 70</td>
<td>29</td>
</tr>
<tr>
<td>71 – 80</td>
<td>37</td>
</tr>
<tr>
<td>81 – 90</td>
<td>32</td>
</tr>
<tr>
<td>≥ 90</td>
<td>5</td>
</tr>
<tr>
<td><strong>Male: Female</strong></td>
<td>46.7:1</td>
</tr>
<tr>
<td><strong>Source of referral</strong></td>
<td>%</td>
</tr>
<tr>
<td>A/E</td>
<td>92</td>
</tr>
<tr>
<td>GP</td>
<td>17</td>
</tr>
<tr>
<td>Consultant</td>
<td>8</td>
</tr>
<tr>
<td><strong>Delay to clinic visit</strong></td>
<td>%</td>
</tr>
<tr>
<td>&lt; 7 Days</td>
<td>71</td>
</tr>
<tr>
<td>&gt; 7 Days</td>
<td>46</td>
</tr>
<tr>
<td><strong>Referral to specialities</strong></td>
<td>%</td>
</tr>
<tr>
<td>Ophthalmology</td>
<td>12</td>
</tr>
<tr>
<td>Vascular surgery</td>
<td>13</td>
</tr>
<tr>
<td>Cardiology</td>
<td>9</td>
</tr>
<tr>
<td>Neurology</td>
<td>3</td>
</tr>
<tr>
<td>Endocrinology</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 2
FINAL DIAGNOSIS

<table>
<thead>
<tr>
<th>N=117</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIA</td>
<td>56</td>
</tr>
<tr>
<td>Completed stroke</td>
<td>16</td>
</tr>
<tr>
<td>Arrhythmia / Syncope</td>
<td>12</td>
</tr>
<tr>
<td>Headache / Migraine</td>
<td>2</td>
</tr>
<tr>
<td>Seizure</td>
<td>3</td>
</tr>
<tr>
<td>Transient global amnesia</td>
<td>3</td>
</tr>
<tr>
<td>Temporal arteritis</td>
<td>1</td>
</tr>
<tr>
<td>Parkinsonism</td>
<td>1</td>
</tr>
<tr>
<td>Cerebral metastases</td>
<td>1</td>
</tr>
<tr>
<td>Mononeuropathy</td>
<td>1</td>
</tr>
<tr>
<td>Vertigo</td>
<td>1</td>
</tr>
<tr>
<td>Hypoglycaemia</td>
<td>1</td>
</tr>
<tr>
<td>Benzodiazepines</td>
<td>1</td>
</tr>
<tr>
<td>Uncertain</td>
<td>18</td>
</tr>
</tbody>
</table>

Table 3
CEREBROVASCULAR RISK FACTORS AND SECONDARY PREVENTION MEDICATION IN TIA / CVA GROUP (N = 72)

<table>
<thead>
<tr>
<th>Prior</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>38</td>
</tr>
<tr>
<td>Atrial Fibrillation</td>
<td>9</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>11</td>
</tr>
<tr>
<td>Hypercholesterolaemia</td>
<td>21</td>
</tr>
<tr>
<td>Ischaemic heart disease</td>
<td>19</td>
</tr>
<tr>
<td>Cigarette smoking</td>
<td>20</td>
</tr>
<tr>
<td>Family history</td>
<td>31</td>
</tr>
<tr>
<td>Prior CVA / TIA</td>
<td>20</td>
</tr>
<tr>
<td>Antihypertensives</td>
<td>38</td>
</tr>
<tr>
<td>Antiplatelet agents</td>
<td>60</td>
</tr>
<tr>
<td>Anticoagulant</td>
<td>3</td>
</tr>
<tr>
<td>Statin</td>
<td>21</td>
</tr>
<tr>
<td>Oral hypoglycaemic agents</td>
<td>4</td>
</tr>
</tbody>
</table>

*Aspirin / dipyridamole / clopidogrel

artery surgery may reduce the risk of further stroke, particularly in men older than 75 years.6 There is no information about the incidence of new onset atrial fibrillation in either of the above studies, but patients with atrial fibrillation, associated with symptomatic cerebrovascular disease, are a high risk group in whom appropriate anticoagulant therapy reduces the risk of further stroke by 66%.5 The clinic was also valuable in identifying new, potentially treatable, risk factors, including hypertension, hypercholesterolaemia, diabetes mellitus and ensuring all patients were on optimal antiplatelet therapy. An additional feature of our service was the presence of a stroke nurse.
specialist, to discuss the diagnosis, relative benefits of therapeutic interventions and lifestyle changes, including diet, exercise, smoking cessation and driving, with patients and their relatives.

A neurovascular clinic has an important diagnostic role as significant numbers of patients with a label of “TIA” may have alternative conditions, requiring specific treatment. In our experience the most common alternative diagnoses were syncope/arrhythmias, migraine, seizures, transient global amnesia, with single cases of biopsy proven temporal arteritis, Parkinson’s disease, subdural haemorrhage and cerebral metastases being recorded. Many of these patients required referral to other specialities and the development of the TIA service, with the co-operation of ophthalmology, neurology, vascular surgery and cardiology, facilitated prompt access to the relevant specialty.

Recent evidence suggests that patients with TIA symptoms, such as prolonged motor weakness, suggesting a high early stroke risk, require immediate in-patient assessment. For TIA patients with a low early risk of stroke, a rapid access TIA clinic provides a safe and efficient alternative to hospital admission.

REFERENCES

7. PROGRESS: Randomised trial of a perindopril-based blood-pressure-lowering regimen among 6105 individuals with previous stroke of transient ischaemic attack. Lancet 2001;358:1033–41

Correspondence to: Dr. Morgan Crowe, St. Vincent’s University Hospital, Elm Park, Dublin 4
The pattern of plasma sodium abnormalities in an acute elderly care ward: A cross-sectional study

ABSTRACT

**Introduction** The combination of ageing, illness, and medications can lead to hyponatraemia or hypernatraemia.

**Aims** To describe the distribution of plasma sodium levels in older patients admitted to hospital.

**Methods** We carried out a hospital based cross-sectional study examining 1,511 serum sodium concentrations ([Na⁺]) among 336 elderly patients and attempted to elucidate the cause(s) of the abnormal serum [Na⁺].

**Results** The study population had a mean age of 81.4. Ninety-two (27.4%) patients had hyponatraemia and seven patients (2.1%) had hypernatraemia during their hospitalisation. The distribution of [Na⁺] results was towards the lower end of the normal range. The mortality rate of patients with hyponatraemia was 14.1% and that of patients with normal serum [Na⁺] was 8.9%. Six patients with hypernatraemia died in hospital. Lower respiratory tract infection and medication accounted for the majority of cases.

**Conclusions** Deranged [Na⁺] is common among elderly patients admitted to hospital.

INTRODUCTION

Disorders of fluid and electrolyte balance are common in elderly patients, often manifesting as abnormalities in plasma sodium concentrations ([Na⁺]). Hyponatraemia is the most important electrolyte disorder in elderly people and can be a complication of a wide variety of diseases. Abnormal sodium balance is associated with significantly higher mortality, patients with hyponatraemia having twice the risk of death compared to those with normal serum [Na⁺].

Hyponatraemia is common in elderly in-patients with an incidence of over 11% in one series. This incidence rate is significantly higher than that of the general hospital population of 1.5%. The incidence of hyponatraemia is reported to be even higher among long-term care residents. Age-related impairment of renal sodium conservation and common illnesses in old age leading to the syndrome of inappropriate antidiuretic hormone (SIADH) are the principal causative factors of hyponatraemia in old age.

The aim of this paper is to calculate the prevalence of plasma [Na⁺] abnormalities in an unselected series of elderly people presenting with acute illness to an acute elderly care unit. We also sought to identify the associated illnesses and potentially causative medication in those elderly patients admitted with deranged plasma [Na⁺].

METHODS

**STUDY DESIGN**

This was a descriptive cross-sectional study to calculate the period prevalence of sodium abnormalities in an elderly hospitalised population. The study was carried out in a busy urban teaching hospital, focusing on patients ≥65 years admitted with acute illness to the acute elderly care ward during the four months from January to April inclusive.

**STUDY PARTICIPANTS**

All patients were aged 65 years and over. We studied all patients admitted in a four-month period to an acute geriatric unit with a variety of medical conditions. Patients were admitted acutely from the emergency department or by direct referral to the ward by the general practitioner.

**DATA COLLECTION**

Patients included in the study were identified from the hospital’s computerised record of admissions.
Patients’ plasma [Na\(^+\)] results were obtained from the hospital’s biochemistry results database. All the plasma [Na\(^+\)] results for each subject were obtained by searching the database under both the patient’s name and hospital reference number. For the purposes of this study, we used the hospital’s biochemistry laboratory’s reference range of normal values. This defined hyponatraemia as a plasma [Na\(^+\)] less than 132mmol/l and hypernatraemia as a plasma [Na\(^+\)] greater than 145mmol/l.

The conditions associated with abnormal sodium results were investigated retrospectively by examining the in-patient notes of all patients with an abnormal plasma [Na\(^+\)]. The casenotes were obtained in all cases. A standardised review of the casenotes was undertaken. This included the diagnoses made on admission, all medication used prior to admission, the need for fluid resuscitation and a review of the discharge summaries. Where there was more than one possible cause for the plasma [Na\(^+\)] derangement, the investigators came to a consensus on the most significant contributing factor. The in-hospital mortality rate for the entire group and for the hyponatraemic and hypernatraemic subgroups were obtained from routine hospital data records.

**RESULTS**

The study population was typical of an elderly care ward, with a mean age of 81.4 ± 7.1 years. During the four-month period, there were 336 patients admitted to the ward with acute illness. Each patient had at least one measurement of plasma [Na\(^+\)] during their admission. Among the 336 patients, there were a total of 1,511 plasma [Na\(^+\)] measurements. The median number of plasma [Na\(^+\)] measurements per patient was three, but this ranged from one to twenty-six tests.

Of the 336 patients admitted, 77 (22.9%) had a sodium less than 132mmol/l on admission. There was a wide range of sodium values from 115 – 170 mmol/l. A further 15 patients (4.5%) developed hyponatraemia in hospital. This gave a total of 92 patients (27.4%) who manifested hyponatraemia at some stage during their hospital admission. Nineteen patients (5.7%) had a plasma [Na\(^+\)] less than 125mmol/l (ie moderate or severe hyponatraemia). Seven patients (2.1%) had a plasma [Na\(^+\)] of greater than 145mmol/l (ie hypernatraemia), during admission. Of this group, only one developed the abnormality in hospital.

The distribution of plasma [Na\(^+\)] on admission has its central tendency towards the lower end of the normal range of [Na\(^+\)] for the population (Figure 1). The mean value of plasma [Na\(^+\)] for the whole patient population was 134.4mmol/l with the median being 134mmol/l. The distribution has a positive skewness, with an extended right-hand tail in the plasma [Na\(^+\)] distribution curve. Both extremes of the plasma [Na\(^+\)] distribution were associated with increased mortality. All but one of the patients with hypernatraemia died in hospital. The mortality rate for the hyponatraemic group was 14.1% (13 deaths from 92 patients). This compared with a mortality rate of 8.9% among those patients with no abnormality in plasma [Na\(^+\)]. The differences between these groups did not reach statistical significance.

Lower respiratory tract infections (40.2%) and adverse medication (21.7%) accounted for the majority of cases of hyponatraemia in this group of patients (Table 1). Thiazide diuretics, selective serotonin reuptake inhibitor antidepressants (SSRIs) and carbamazepine were the medications most commonly implicated in causing hyponatraemia. Only three patients (3.3%) did not have a recognised cause for hyponatraemia after reviewing the cases. All, but one of the seven patients presenting with hypernatraemia had a known diagnosis of dementia. Two of these patients had diarrhoeal illnesses. Four patients were nursing home residents with significant functional impairment. The other patient had a large middle cerebral artery territory infarct with major dysphagia.

**DISCUSSION**

One third of these consecutive acutely ill patients admitted to hospital had a derangement of plasma [Na\(^+\)] at some stage during their hospitalisation. Hyponatraemia occurred in 27.4% of cases and hypernatraemia in 2.1%. These rates were higher than those reported in previous work, probably reflecting the older mean age of our patient cohort. Most of the abnormalities were present on admission. Overall, the distribution of plasma [Na\(^+\)] for this population is to the left of the distribution in the general population, with a mean value at the hyponatraemic end of the normal range. Both high and low plasma [Na\(^+\)] during the hospital stay was associated with tendency to increased hospital mortality, compared to the mortality rate in those patients with normal plasma [Na\(^+\)].

The normal regulation of water and sodium balance involves the interplay of many homeostatic
mechanisms, including thirst perception, the actions of antidiuretic hormone, atrial natriuretic hormone and aldosterone. The normal ageing process is associated with significant changes in some of these homeostatic mechanisms.6,7 Previous studies have shown that thirst perception is impaired in healthy older compared to healthy younger individuals.8,9 In particular, elderly patients with dementia fail to drink adequately when exposed to water deprivation.10 This is in keeping with the high proportion of dementia sufferers in our hypernatraemic group. Evidence suggests that the ageing kidney is more prone to sodium loss.11 The impaired diluting capacity of the ageing kidney coupled with an enhanced antidiuretic response in old age, make older individuals more prone to hyponatraemia.12,13 This may, in part, explain why our distribution curve for plasma \([\text{Na}^+]\) was centred at the lower end of the normal reference range.

Both hyponatraemia and hypernatraemia are markers of underlying disease and are associated with a poorer prognosis.2,3,4,5 Previous studies also confirm our results which suggest an increased mortality with hypernatraemia and hyponatraemia.2,6 However, our study was not designed to demonstrate increased mortality in these groups, and consequently was not sufficiently powered to do so.

Our cross-sectional study design provides reliable and important information on the distribution of plasma \([\text{Na}^+]\) in this elderly group. Because all patients had their plasma \([\text{Na}^+]\) measured on admission, we provide an accurate reflection of the prevalence of plasma \([\text{Na}^+]\) abnormalities on admission to hospital of elderly sick patients. There is little possibility for information bias in these results, as they come from objective data already in existence. However, there may be under-reporting of new cases occurring in hospital since not all patients will have repeated plasma \([\text{Na}^+]\) measurement. As with any cross-sectional study there are limitations with investigating the aetiology of plasma \([\text{Na}^+]\) abnormalities. The main associations we report with hyponatraemia are related to respiratory tract infections and medication. Pulmonary disease, particularly pneumonia, can lead to a syndrome of inappropriate antidiuretic hormone release, by a mechanism which remains unclear.11 Elderly patients, in particular, are predisposed to this abnormal antidiuretic hormone response to infection.11 Numerous drugs prescribed for elderly patients affect water balance. As one would expect, some of our hyponatraemic subjects (13%) were taking thiazide diuretics. Also, SSRIs were implicated as the cause in 6.5% of hyponatraemic cases. The association between SSRIs and hyponatraemia is well known, especially in older patients.17,18

In conclusion, we report a high prevalence of sodium abnormalities in hospitalised elderly patients with acute illness. Overall, there is a trend towards low plasma \([\text{Na}^+]\) in elderly hospitalised patients, reflecting derangement of regulatory systems involved in sodium and water balance due to acute illness and adverse medications. A smaller but significant proportion of elderly patients present to hospital with hypernatraemia. Awareness of the increased mortality burden of both hyponatraemia and hypernatraemia should alert clinicians to the more serious impact of illness associated with these electrolyte abnormalities.
with plasma [Na\(^+\)] abnormalities in acutely ill elderly patients and to respond to these metabolic derangements with a greater sense of urgency.

REFERENCES


Correspondence to: Dr. Paul E Cotter
Unit 4, Merlin Park Regional Hospital, Galway.
Tel 091 775562. Email pecotter@eircom.net;
Denis O’Mahony, Dept of Geriatric Medicine, Cork University Hospital, Wilton, Cork, Tel: 00 353 21 4922396.
Fax: 00 353 21 4922829. Email: omahonyd@shb.ie
Regional variation in prescribing for chronic conditions among an elderly population using a pharmacy claims database

ABSTRACT

Background Age, gender and geographical regions are recognised factors in inequalities in prescribing for chronic diseases in the elderly.

Aim To compare the health board regional distribution of chronic disease among the elderly and to examine variation in quality prescribing across age, gender and regions.

Methods Population based study of prescribing for chronic disease using a national pharmacy claims database. All individuals aged 70 years and over (n = 271,518) were eligible.

Results Over 60% of the elderly in all regions received cardiovascular related medication. The South Eastern, North Western and Western Health Boards had below average prescribing for many chronic conditions. Logistic regression identified age, gender and regional variations in prescribing of preventative therapies for CVD and diabetes.

Conclusion There is a high prevalence of prescribing for chronic conditions in the elderly in Ireland, and there is evidence of gender, age and residing health board inequalities in prescribing.

INTRODUCTION

Ireland, similar to other Western countries, has an increasing ageing population. Those aged 70 years and older account for 8% of the national population. This trend is set to continue with an increase in life expectancy observed in both men and women. There is an associated increase in the number of years spent with a disability, and it is estimated that women live four and men two extra years with a disability. About 80% of those aged 65 years and over suffer from a chronic condition, and both the prevalence of chronic conditions and co-morbidities increases with age. In one study over 87% of community dwelling 75-year-olds received prescription drugs, and in a Swedish study the biggest rise in drug use over a 15-year period was among those aged 80 years and over, followed by those aged 60-79 years.

Previous studies have identified inequalities in the management of chronic conditions such as diabetes and cardiovascular disease with associated risk factors including increasing age, female gender and deprivation.

There are very few national or international studies that have attempted to quantify and examine the distribution of chronic disease or explore regional variation in prescribing for chronic conditions among a national elderly population. The most recent estimate of prevalence of chronic conditions in an elderly population was provided by the first Health and Social Service for Older People survey (HeSSOP I) in 2000. This was a random sample of community dwelling people aged 65 years or older living in either the Eastern or Western health boards. People surveyed were asked to identify from a written list which chronic conditions they experienced. This was the largest survey of elderly people in Ireland but only a single question focused on types of chronic illness. Similar to other surveys there are limitations, with those who experience ill health less likely to participate in surveys, also relying on self reported illness is likely to underestimate chronic conditions. In addition only two health boards were sampled and people in nursing homes were excluded.

The potential for national claims prescribing databases to explore such topics is increasingly being recognised. Data are continuously collected, are often population based and usually contain individual patient level data. The primary limitation is lack of direct diagnosis data, therefore combinations of drug therapies are used as surrogate markers of disease e.g. insulin and diabetes.

C Naughton, K Bennett, J Feely
Dept Pharmacology & Therapeutics, Trinity College Dublin, Trinity Centre for Health Science, St James’s Hospital, Dublin
The aim of this study is to compare the regional distribution of chronic disease among those aged 70 years and older and to examine variation in quality prescribing across age, gender and regions.

**Setting**

The Irish HSE-Primary care reimbursement services (HSE–PCRS) pharmacy database was used. The HSE-PCRS provides free health services, including provision of medicines, without charge to 1.2 million people in Ireland. Since July 2001 it incorporates all those aged 70 years and over. In 2004 there was an estimated 316,928 people aged 70 years and older with HSE-PCRS medical cards; one survey suggests over 95% uptake of the scheme. The HSE-PCRS prescription database records the unique patient identifying number, basic demographic information (age, sex and region residing), and full details of all items dispensed by community pharmacists for people within the scheme. The information is centrally held and coded using the WHO Anatomical Therapeutic Chemical (ATC) classification system. The primary limitation of the prescribing database is the lack of information on diagnosis, thus combinations of drug therapies must be used as surrogate markers of disease. The majority of drugs available in Ireland are eligible for reimbursement under this scheme, with the exception of drugs provided under the ‘High Tech medicines scheme’ such as some anti-neoplastic, anti-rejection drugs or growth hormones.

Ireland is divided into eight healthcare regions. The largest is the Eastern Regional Health Authority (ERHA) with over 1.4 million people, followed by the Southern (SHB) and South-Eastern (SEHB) with 0.42-0.58 million, the Western (WHB), North-Eastern (NEHB) and Mid Western (MWHB) have over 0.3 million people each and the two smallest Midland (MHB) and North-Western (NWHB) each have over 0.22 million people. The health board the patient is resident in is identified through the unique patient identification number, with each number being specific to the health board in which the number was issued. If a patient avails of healthcare in a different health board they will still be considered according to their health board of residence.

**Disease Identification**

A framework for identifying conditions from the pharmacy database was developed from the chronic disease classification reported by Von Korff et al, and Maio et al and adapted to an Irish healthcare system. Nine conditions were identified using the associated drug ATC codes, as indicated in Table 1. Cancer prevalence was estimated using both PCRS and High Tech data, but pharmacy databases underestimate cancer prevalence as over 70% of cancers do not receive drug therapy. More complete information on regional distribution of cancer can be obtained from the national cancer registry. In conditions with overlapping drug therapy only broad disease classification is possible e.g. CVD includes ischaemic conditions such as ischaemic heart disease (IHD), cerebrovascular and peripheral vascular disease (PVD), also heart failure and hypertension. In addition to insulin and oral hypoglycaemic agents, diabetic test kits were included in an attempt to identify those patients managed by diet only, but this is not likely to identify all such patients.

Quality prescribing indicators were used to compare patterns of prescribing across regions. The indicators selected were: (1) a high level of co-prescribing of statins with antiplatelet therapy +/- coronary vasodilators (markers for ischemic cardiovascular conditions), (2) a high level of antiplatelet prescribing in patients receiving coronary vasodilators (marker for IHD) (3) a high level of prescribing of antiplatelet therapy and statins in patients with diabetes, (4) a low level of long acting benzodiazepine prescribing in the elderly (flurazepam, chlordiazepoxide and diazepam) and (5) low prescribing of antidepressants with strong anticholinergic and sedation properties (amitriptyline, doxepin and imipramine).

The PCRS prescribing database for 2004 covering the eight health boards was used. The individual drug or drug class was identified in the database using their ATC codes. The study population was defined as all individuals aged 70 years and over who were dispensed three or more items associated with a specific chronic condition during the 12-month period. This restriction reduced identification of prescribing associated with misdiagnosis or incidental users.

**Statistical Analysis**

Simple chronic disease prevalence rates were calculated for the elderly population based on the total number of eligible patients aged 70 years and over with a medical card in each region. Age and sex standardised prescribing ratios (SPR) were calculated for each region. The SPR is similar to the standardised mortality ratio, where a high
SPR (>100) indicates that prescribing for a particular condition in that region is above the national average. The SPR ratio is the ratio of maximum to minimum prescribing in each category. Logistic regression was used to explore the association between each of the five quality prescribing indicators and the study population age, gender and regional prescribing patterns. Odds ratios and 95% confidence intervals are presented. The availability of specialist consultant services per 100,000 population were calculated based on the number of specialists employed in each HB in 2004, and the associated HB total population size. All analysis was performed using SAS (v 9.1 SAS institute, Cary, NC).

**RESULTS**

In this population 86% (271,518) of those over 70 years received a minimum of three drug items for a chronic condition in 2004, and a further 8% received less than three items. Males accounted

<table>
<thead>
<tr>
<th>DISEASE GROUP</th>
<th>SPECIFIC CONDITIONS</th>
<th>ASSOCIATED MEDICATION</th>
<th>WHO ATC CODES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular disease (CVD)</td>
<td>Ischemic Heart disease (IHD), Cerebrovascular disease, Peripheral vascular disease (PVD)</td>
<td>Antianginals e.g. Nitrates Platelet inhibitors</td>
<td>C01DA &amp; C01DA B01AC</td>
</tr>
<tr>
<td></td>
<td>Arrhythmic</td>
<td>Anti-arrhythmic warfarin</td>
<td>C01AA05 &amp; C01B B01AA03</td>
</tr>
<tr>
<td></td>
<td>Hypertension/Heart failure</td>
<td>Antihypertensives Diuretic ACE/AIIA inhibitors Beta blockers Calcium channel blockers</td>
<td>C02 C03 C09 C07 C08</td>
</tr>
<tr>
<td></td>
<td>Hypercholesteraemia</td>
<td>Anti-lipids including statins</td>
<td>C10</td>
</tr>
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<td>Central nervous system (CNS)</td>
<td>Parkinson’s disease</td>
<td>L-dopa</td>
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<td>Anticonvulsants</td>
<td>N03</td>
</tr>
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<td>Depression psychosis</td>
<td>Psycholeptics</td>
<td>N05A &amp; N06A</td>
</tr>
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<td>Anxiolytics</td>
<td>N05B</td>
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<td>Hypnotics/sedatives</td>
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<td>Antidementia</td>
<td>N06D</td>
</tr>
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<td>Musculo-skeletal</td>
<td>Rheumatoid Arthritis</td>
<td>Anti-inflammatory Anti-rheumatoid</td>
<td>M01A M01C</td>
</tr>
<tr>
<td></td>
<td>Osteoporosis/Pagets disease</td>
<td>Mineral substitutes &amp; Vit D analogues</td>
<td>M05 A11CC</td>
</tr>
<tr>
<td></td>
<td>Gout</td>
<td>Antiacids/ anti-ulcer</td>
<td>A02A &amp; A02B</td>
</tr>
<tr>
<td>Upper Gastro-intestinal (GI)</td>
<td>Respiratory</td>
<td>COPD/Asthma</td>
<td>R03BB R03A &amp; R03C R03BA</td>
</tr>
<tr>
<td></td>
<td>Diabetes</td>
<td>Insulin Oral hypoglycaemics Diabetic test kits</td>
<td>A10A A10B V04CA</td>
</tr>
<tr>
<td></td>
<td>Thyroid</td>
<td></td>
<td>H03</td>
</tr>
<tr>
<td></td>
<td>Glaucoma</td>
<td>Ophthalmic miotics</td>
<td>S01E</td>
</tr>
<tr>
<td></td>
<td>Cancer</td>
<td>Anti-neoplastic Immunostimulants</td>
<td>L01 &amp; L02 L03</td>
</tr>
</tbody>
</table>

**Table 1**

**COMBINATIONS OF DRUGS USED AS SURROGATE MARKERS OF DISEASE**

<table>
<thead>
<tr>
<th>DISEASE GROUP</th>
<th>SPECIFIC CONDITIONS</th>
<th>ASSOCIATED MEDICATION</th>
<th>WHO ATC CODES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular disease (CVD)</td>
<td>Ischemic Heart disease (IHD), Cerebrovascular disease, Peripheral vascular disease (PVD)</td>
<td>Antianginals e.g. Nitrates Platelet inhibitors</td>
<td>C01DA &amp; C01DA B01AC</td>
</tr>
<tr>
<td></td>
<td>Arrhythmic</td>
<td>Anti-arrhythmic warfarin</td>
<td>C01AA05 &amp; C01B B01AA03</td>
</tr>
<tr>
<td></td>
<td>Hypertension/Heart failure</td>
<td>Antihypertensives Diuretic ACE/AIIA inhibitors Beta blockers Calcium channel blockers</td>
<td>C02 C03 C09 C07 C08</td>
</tr>
<tr>
<td></td>
<td>Hypercholesteraemia</td>
<td>Anti-lipids including statins</td>
<td>C10</td>
</tr>
<tr>
<td>Central nervous system (CNS)</td>
<td>Parkinson’s disease</td>
<td>L-dopa</td>
<td>N04</td>
</tr>
<tr>
<td></td>
<td>Epilepsy</td>
<td>Anticonvulsants</td>
<td>N03</td>
</tr>
<tr>
<td></td>
<td>Depression psychosis</td>
<td>Psycholeptics</td>
<td>N05A &amp; N06A</td>
</tr>
<tr>
<td></td>
<td>Anxiety</td>
<td>Anxiolytics</td>
<td>N05B</td>
</tr>
<tr>
<td></td>
<td>Sleep disturbance/Sedation</td>
<td>Hypnotics/sedatives</td>
<td>N05C</td>
</tr>
<tr>
<td></td>
<td>Dementia</td>
<td>Antidementia</td>
<td>N06D</td>
</tr>
<tr>
<td>Musculo-skeletal</td>
<td>Rheumatoid Arthritis</td>
<td>Anti-inflammatory Anti-rheumatoid</td>
<td>M01A M01C</td>
</tr>
<tr>
<td></td>
<td>Osteoporosis/Pagets disease</td>
<td>Mineral substitutes &amp; Vit D analogues</td>
<td>M05 A11CC</td>
</tr>
<tr>
<td></td>
<td>Gout</td>
<td>Antiacids/ anti-ulcer</td>
<td>A02A &amp; A02B</td>
</tr>
<tr>
<td>Upper Gastro-intestinal (GI)</td>
<td>Respiratory</td>
<td>COPD/Asthma</td>
<td>R03BB R03A &amp; R03C R03BA</td>
</tr>
<tr>
<td></td>
<td>Diabetes</td>
<td>Insulin Oral hypoglycaemics Diabetic test kits</td>
<td>A10A A10B V04CA</td>
</tr>
<tr>
<td></td>
<td>Thyroid</td>
<td></td>
<td>H03</td>
</tr>
<tr>
<td></td>
<td>Glaucoma</td>
<td>Ophthalmic miotics</td>
<td>S01E</td>
</tr>
<tr>
<td></td>
<td>Cancer</td>
<td>Anti-neoplastic Immunostimulants</td>
<td>L01 &amp; L02 L03</td>
</tr>
</tbody>
</table>
for 41% (136,473) of the total population which dropped to 38% in those aged 75 years or older. There was a significant difference in the gender distribution between the two age groups (p<0.001). Not surprisingly the highest concentration of elderly patients was in the most densely populated areas, 32% in the ERHA, 16% in the SHB, 10-11% in the SEHB and WHB, with 6-8% distributed in the MHB, MWHB, NEHB and NWHB.

In Table 2 the most prevalent condition in all regions was cardiovascular disease with over 60% of the elderly population receiving regular cardiovascular medication, followed by CNS with over 30% on regular medication, musculo-skeletal and upper GI prescribing was between 20-30% in most regions. Diabetes, respiratory and thyroid conditions had a prevalence of between 7-17%, while glaucoma and cancer had the lowest prevalence at 2-6%, but cancer is likely to be underestimated in this population.
Prescribing for CVD, CNS, and thyroid conditions showed the least variation between regions (see Table 3). Musculo-skeletal, GI, respiratory, diabetes and cancer showed over a 30% variation between the region with the lowest and highest prescribing. Glaucoma had over a 50% variation but this may be exaggerated due to small patient numbers. There were persistent trends across the health boards with the ERHA, MHB, NEHB, and MWHB having similar or above average prescribing for the majority of conditions examined, while the NWHB, SEHB and WHB had below average prescribing for many of the conditions.

Table 4 shows the performance based on the quality prescribing indicators for CVD, diabetes and CNS across the regions adjusting for the effects of age and gender. In ischaemic CVD and diabetes those aged 70-74 years were more likely to receive a statin compared to those aged 75 years and older. Also statin and antiplatelet prescribing tended to be higher in males but this did not always reach statistical significance. The ERHA, MHB, SEHB and WHB had similar or above average statin prescribing in CVD, and higher co-prescribing of antiplatelet and statin in diabetes. In contrast the NEHB, MWHB,

### Table 4

**ODDS RATIOS AND 95% CI FOR QUALITY PRESCRIBING INDICATORS IN CVD, DIABETES & CNS**

<table>
<thead>
<tr>
<th>HB</th>
<th>CARDIOVASCULAR DISEASE</th>
<th>DIABETES</th>
<th>CENTRAL NERVOUS SYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Statins in ischaemic CVD</td>
<td>Antiplatelet with coronary dilators</td>
<td>Antiplatelet &amp; statin</td>
</tr>
<tr>
<td></td>
<td>OR 95% CI</td>
<td>OR 95% CI</td>
<td>OR 95% CI</td>
</tr>
<tr>
<td>70-74 yrs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>2.17 2.12-2.22</td>
<td>1.33 1.16-1.30</td>
<td>1.62 1.53-1.70</td>
</tr>
<tr>
<td>Female</td>
<td>1.10 1.08-1.12</td>
<td>1.04 0.98-1.09</td>
<td>1.02 0.97-1.08</td>
</tr>
<tr>
<td>ERHA</td>
<td>1.11 1.09-1.14</td>
<td>1.04 0.98-1.09</td>
<td>1.37 1.30-1.45</td>
</tr>
<tr>
<td>MHB</td>
<td>1.47 1.41-1.54</td>
<td>0.98 0.88-1.09</td>
<td>1.98 1.79-2.19</td>
</tr>
<tr>
<td>MWHB</td>
<td>0.82 0.79-0.85</td>
<td>0.83 0.76-0.91</td>
<td>0.72 0.66-0.79</td>
</tr>
<tr>
<td>NEHB</td>
<td>0.81 0.78-0.84</td>
<td>0.81 0.74-0.89</td>
<td>0.72 0.66-0.79</td>
</tr>
<tr>
<td>NWHB</td>
<td>0.86 0.83-0.90</td>
<td>1.08 0.98-1.20</td>
<td>0.73 0.66-0.82</td>
</tr>
<tr>
<td>SEHB</td>
<td>1.12 1.07-1.16</td>
<td>1.06 0.97-1.16</td>
<td>0.95 0.88-1.03</td>
</tr>
<tr>
<td>SHB</td>
<td>0.86 0.83-0.88</td>
<td>1.18 1.09-1.27</td>
<td>0.78 0.73-0.84</td>
</tr>
<tr>
<td>WHB</td>
<td>1.04 1.00-1.08</td>
<td>0.95 0.87-1.03</td>
<td>0.95 0.88-1.03</td>
</tr>
</tbody>
</table>

1. Ischaemic conditions = patient receiving antiplatelet or coronary artery vasodilators; 2. Coronary vasodilators e.g. nitrates are used as a surrogate marker for angina; 3. Reference group = age ≥75 years & female gender; 4. Individual regions are compared to all other regions.

### Table 5

**CONCENTRATION OF SPECIALISTS CONSULTANTS PER HB RATES PER 100,000 TOTAL HEALTH BOARD POPULATION**

<table>
<thead>
<tr>
<th>HB</th>
<th>TOTAL HB POPULATION</th>
<th>GERIATRICIAN</th>
<th>CARDIOLGIST</th>
<th>ENDOCRINE/DIABETIC</th>
<th>ADULT PSYCHIATRY</th>
<th>PSYCHIATRY OF OLD AGE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>n rate</td>
<td>n rate</td>
<td>n rate</td>
<td>n rate</td>
<td>n rate</td>
</tr>
<tr>
<td>ERHA</td>
<td>1,401,314</td>
<td>19 1.4</td>
<td>25 1.8</td>
<td>15 1.1</td>
<td>62 4.4</td>
<td>5 0.4</td>
</tr>
<tr>
<td>MHB</td>
<td>225,588</td>
<td>2 0.9</td>
<td>3 1.3</td>
<td>0 0.0</td>
<td>9 0.4</td>
<td>2 0.9</td>
</tr>
<tr>
<td>MWHB</td>
<td>339,930</td>
<td>4 1.2</td>
<td>2 0.6</td>
<td>2 0.6</td>
<td>14 4.1</td>
<td>2 0.6</td>
</tr>
<tr>
<td>NEHB</td>
<td>344,926</td>
<td>5 1.4</td>
<td>2 0.6</td>
<td>2 0.6</td>
<td>12 3.5</td>
<td>3 0.9</td>
</tr>
<tr>
<td>NWHB</td>
<td>221,376</td>
<td>5 2.3</td>
<td>2 0.9</td>
<td>0 0.0</td>
<td>11 5.0</td>
<td>2 0.9</td>
</tr>
<tr>
<td>SEHB</td>
<td>423,540</td>
<td>8 1.9</td>
<td>3 0.7</td>
<td>3 0.7</td>
<td>16 3.8</td>
<td>4 0.9</td>
</tr>
<tr>
<td>SHB</td>
<td>580,605</td>
<td>8 1.4</td>
<td>7 1.2</td>
<td>4 0.7</td>
<td>25 4.3</td>
<td>1 0.2</td>
</tr>
<tr>
<td>WHB</td>
<td>380,057</td>
<td>6 1.6</td>
<td>4 1.1</td>
<td>5 1.3</td>
<td>18 4.7</td>
<td>2 0.5</td>
</tr>
</tbody>
</table>
NWHR and SHB had consistently lower levels of prescribing of these therapies in the elderly population after standardising for different gender and age structures within the regions.

The quality prescribing indicators related to CNS prescribing show that the 70-74 year age group were more likely to receive long acting benzodiazepines or antidepressants with anticholinergic side-effects than those aged 75 years and older, however there were no gender differences. The prescribing of the two drug types appear inversely related. Long acting benzodiazepines were more likely to be prescribed in the ERHA, MWHB, NEHB, while anticholinergic antidepressants were more likely to be prescribed in the MHB, NWHR, SEHB, SHB, and WHB.

Table 5 shows the concentration of specialist consultants per HB. There is little association between number of consultant specialist and the prevalence or pattern of prescribing in chronic conditions, except for CVD. Regions with a higher number of cardiologists per 100,000 population tend to have higher prescribing of cardiovascular medication, these regions also performed better on the CVD and diabetes quality prescribing indicators. Concentration of geriatricians was not proportional to the size of the regional populations. The ERHA had 1.4 geriatricians per 100,000 population which is less than both the NW and SE health boards with smaller elderly populations. There was no obvious trend between psychiatric consultants and prescribing in CNS conditions or in the CNS quality prescribing indicators.

**DISCUSSION**

This study, based on pharmacy claims data, suggests a high prevalence of chronic conditions among the elderly population. In each of the health boards over 60% of those aged 70 years and older were prescribed regular cardiovascular medication. There was also a significant number receiving treatment for CNS, musculo-skeletal and gastrointestinal conditions. The other conditions had a lower prevalence but added to the burden of chronic disease among this population. The SPRs indicate that there is a 20%-40% variation in the treatment of the most common conditions between the regions. Quality prescribing indicators provide more detailed insight into these regional differences. Those aged 70-74 years are more likely to receive CVD and diabetic preventative therapy than those aged 75 years and over while elderly men with CVD are more likely than elderly women to receive statin therapy, but this gender differences is not statistically different in other conditions.

Direct comparison of disease prevalence with the HeSSOP I study is difficult because of the variation in the disease definitions used; also the population in the current study is older and includes people in nursing homes. However for many conditions there is broad agreement. In HeSSOP I, CVD was identified by 56% of the population compared to 60-70% in our study and the reported prevalence in HeSSOP I of CNS conditions (47%) respiratory (14%) and diabetes (6%) were similar to that identified in our study. The widest discrepancy was seen in musculo-skeletal conditions, in HeSSOP I this was reported by 46% of the population compared to 20-30 % in our study. In addition upper GI conditions in HeSSOP I was confined to peptic ulcers which was reported by 6% of the population.

The current study has identified variation in prescribing practices across the regions which can be explored using robust prescribing indicators. Current European CVD guidelines and clinical trials recommend statin therapy in all patients with established cardiovascular disease and diabetes, regardless of age and gender. This study suggests that statins are under prescribed in those aged 75 years and over, females and in some regions. The MWHB, NEHB, NWHR, SHB had 15-30% less prescribing of preventative therapies for patients with ischaemic CVD or diabetes compared to the rest of the country. Age and sex differences in CVD prescribing have been reported elsewhere, but there are few studies looking at regional variation. This study is similar to others which found that prescribing for chronic conditions is not uniform within countries with the same healthcare systems.

We find evidence of wide disparities in prescribing for chronic conditions between the regions after adjusting for the age and gender differences in the regional populations. The reasons are likely to be multifactorial but possible explanations are genuine differences in the health status of individuals within regions, or a more compelling factor may be the level of primary, secondary and specialist healthcare provision within the regions. Cardiovascular disease has only a 20% variation in prevalence across the eight regions, but CVD quality prescribing indicators show that patients in some regions are 10-20% less likely to receive a statin than others. Disparity is also apparent in prescribing secondary preventative therapies...
in diabetes. Elderly patients with diabetes in the midlands region, which participated in the ‘Diabetic Shared Care Scheme’, are nearly twice as likely to receive antiplatelet and statin therapy compared to other regions especially MWHB, NEHB and SHB.

The NWHB had the lowest prevalence for nearly all the conditions investigated and the lowest performance in the quality prescribing indicators. This region is also recognised as having the lowest concentration of healthcare service provision. In contrast, the Eastern region has the highest concentration of acute hospital and specialist services. In our analysis the ERHA had above average drug treatment for all the conditions investigated including higher prescribing of preventative therapies in CVD and diabetes and low use of antidepressants with anticholinergic side-effects. There is a broad association between number of cardiologists employed in the health boards and both the identification of and quality prescribing indicators in CVD. Regions with the highest concentration of cardiologists (ERHA and MHB) had higher levels of statin prescribing in both patients with CVD and diabetes than regions with less than one cardiologist per 100,000 population (NWHB, NEHB and MWHB). Prescribing in the SEHB and MHB may be influenced by proximity to the ERHA and perhaps easier referral to cardiologists.

Concentration of specialist services is one possible factor in explaining regional variation but others are control of drug budgets, individual health board priorities, patient access to services, patient education and socioeconomic status. More specific research is required to fully explain the observed variations and to determine whether this applies across all age groups.

STUDY LIMITATIONS
Using a pharmacy database to estimate prevalence is a new methodological approach and needs to be further validated against Irish survey data ideally with clinical evidence of diagnosis. Validation against such data would allow for identification of under or overestimation of prevalence of a condition. In this database a condition which is not managed with standard medication or for which regular medication is not prescribed e.g. musculo-skeletal disease will be underestimated, while prophylactic use of medication e.g. proton pump inhibitors in GI conditions may overestimate disease prevalence. The database does not contain information on patient socioeconomic status, or whether the original prescription was given by a GP or specialist consultant. Therefore it was not possible to control for these factors in our analysis.

CONCLUSION
There is a lack of primary data estimating disease prevalence in the Irish population. The HSE-PCRS pharmacy claims database can be used to identify disease prevalence and regional variation in those aged 70 years and older. Significant regional variation in the prescribing for chronic diseases, adjusting for population age and gender, was observed. In particular the very elderly, women and those living in more isolated regions such as the north-western and north-eastern areas appear less likely to receive optimal treatment for certain conditions. Current levels of specialist health care provision within these regions may be a factor but more in depth research is required to validate and explain these observations and make recommendations on the appropriate provision of health care in this population.

ACKNOWLEDGEMENTS
We would like to thank the Health Research Board, Ireland for financial support. Also the HSE-PCRS payments board for the data on which this study is based and Prof Hannah McGee for her advice and support.

REFERENCES


Correspondence to: C Naughton
email: naughtc@tcd.ie; Tel:01 896 3404 fax 01 453 9033
Pack-size legislation reduces severity of paracetamol overdoses in Ireland

ABSTRACT

**Background** Legislation was introduced in Ireland in October 2001 to control the sale of paracetamol in non-pharmacy outlets. Preparations are now limited to 12 tablets per pack and only one pack can be sold per transaction.

**Aim** To assess the impact of this legislation on acute deliberate paracetamol overdoses.

**Methods** We reviewed acute deliberate paracetamol overdoses reported during two 24-month periods before and after October 2001. We grouped cases according to the number of tablets taken and compared the periods using chi-square and Mann-Whitney tests.

**Results** The number of tablets taken in acute deliberate paracetamol overdose fell significantly after October 2001 ($\chi^2 = 11.663$, $P = 0.0029$). Fewer cases involved 12-24 tablets ($U = 74$, $P < 0.001$) and fewer cases involved more than 24 tablets ($U = 131.5$, $P = 0.0006$).

**Conclusion** Legislation controlling sale and packaging of paracetamol preparations appears to be associated with a significant fall in the number of tablets taken in acute deliberate paracetamol overdoses.

INTRODUCTION

Parasuicide remains a cause for concern in Ireland with an annual incidence of more than 10,000 cases reported by the National Parasuicide Registry. Drug overdoses are the most common method of parasuicide in Ireland making up more than 75% of all incidents, and paracetamol remains one of the top three drugs involved in these cases. It has been shown previously that paracetamol overdoses are often spontaneous or impulsive acts and the ready availability of over-the-counter products allows easy access to large quantities of tablets. In October 2001, legislation was introduced in Ireland to restrict the pack-size of single-ingredient paracetamol preparations. Under this legislation, non-pharmacy retail outlets may supply single-ingredient paracetamol products provided that, “in the case of dosage units each of which contains... not more than 500mg, the pack-size does not exceed 12 such units.”

The legislation also prohibits the sale of multiple packs of paracetamol in the course of a single transaction. Pharmacy outlets may supply more tablets at the discretion of an authorised person in the pharmacy. A major determinant in the outcome of paracetamol poisoning is the number of tablets taken in the overdose. A limit on the number of tablets available for purchase should reduce the number of tablets being taken in overdose. In other countries with similar legislation, smaller pack-sizes have been associated with a fall in the number of fatalities due to paracetamol, and a fall in the number of people attending liver units after paracetamol overdoses. In 1997, recommendations on pack-size were issued by the Irish Medicines Board and restrictions were implemented on a voluntary basis. These voluntary restrictions did not appear to have any impact on incidents of self-poisoning however, possibly due to non-compliance by retailers. This study asks the question; has legislation governing the pack-size of paracetamol products had any effect on the severity of paracetamol overdoses in Ireland?

METHODS

The National Poisons Information Centre (NPIC) in Ireland receives enquiries about overdose cases from all general hospitals in the Republic of Ireland. We carried out a retrospective study of paracetamol enquiries received by the NPIC during two 24-month periods before and after October 2001. NPIC records were reviewed by a single investigator to identify cases of paracetamol overdoses. Inclusion criteria for our data-set were all acute deliberate overdoses involving single-ingredient tablet or capsule formulations in patients over 10 years of age.
Overdoses were classified as acute if they occurred as a once-off incident over a short period of time. Exclusion criteria were children under 10, chronic overdose, and staggered overdoses. Also excluded were any cases where the number of tablets taken in the overdose not known at the time of the enquiry.

**Statistical Analysis**

We performed a Relative Risk assessment on the number of paracetamol overdoses relative to the total number of deliberate self-poisonings reported during the same period. We then analysed our data by grouping the cases according to the number of tablets taken (0-12, 13-24, >24). We used the non-parametric Chi square test to compare the incidence of cases in each group before and after legislation was introduced. We then assessed each group using directional Mann-Whitney tests to determine where changes had occurred. P values less than 0.05 were considered statistically significant.

**Results**

A total of 2132 paracetamol overdoses met the inclusion criteria for this study: 1198 cases in the period before October 2001, and 934 cases in the period after October 2001. The ratio of paracetamol overdoses to deliberate self-poisoning cases remained the same before and after October 2001 (Table 1). There was, however, a significant change in the size of acute deliberate paracetamol overdoses after introduction of pack-size restrictions ($\chi^2 = 11.663, P = 0.0029$) (Table 2). There was a small but not significant decrease in the number of cases involving 12 tablets or less ($U_{12} = 253.5, P = 0.242$).

There was a significant decrease in the number of cases involving 13-24 tablets ($U_{13-24} = 74, P < 0.001$). There was also a significant drop in the number of cases involving potentially hepatotoxic doses of paracetamol (i.e. more than 24 tablets) ($U_{>24} = 131.5, P = 0.0006$).

**Discussion**

It has been suggested that smaller pack-sizes of paracetamol preparations can reduce paracetamol related morbidity and mortality. In the majority of cases, the number of tablets ingested in a paracetamol overdose largely determines the outcome; it is rare for doses <150mg/kg to cause toxicity in patients unless additional risk factors are present. Over-the-counter preparations of paracetamol in Ireland contain no more than 500mg. An average sized adult of 60-70kg can tolerate no more than 18-20 tablets without toxicity. Single packets of paracetamol preparations available in non-pharmacy retail outlets previously contained up to 24 tablets (12g). The main aim of pack-size restrictions is to reduce the severity of toxic paracetamol overdoses. Similar legislation introduced in Britain in 1998 seemed to result in less severe paracetamol poisoning. In this study, we looked at the size of paracetamol overdoses in terms of tablets taken. We observed a significant drop in the number of cases involving between 12 and 24 tablets. There was also a significant drop in the number of overdoses involving more than 24 tablets of paracetamol.

The spontaneous nature of paracetamol overdoses implies that patients will often take whatever

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**Table 1**

<table>
<thead>
<tr>
<th>OVERDOSES EXPRESSED AS A PROPORTION OF TOTAL DELIBERATE SELF-POISONINGS</th>
<th>BEFORE LEGISLATION</th>
<th>AFTER LEGISLATION</th>
<th>RELATIVE RISK (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total paracetamol</td>
<td>1198</td>
<td>934</td>
<td>0.99 (0.90-1.0)</td>
</tr>
<tr>
<td>Total DSP</td>
<td>8502</td>
<td>6618</td>
<td></td>
</tr>
</tbody>
</table>

**Table 2**

<table>
<thead>
<tr>
<th>PARACETAMOL OVERDOSES GROUPED ACCORDING TO NUMBER OF TABLETS TAKEN</th>
<th>BEFORE LEGISLATION (N=1198)</th>
<th>AFTER LEGISLATION (N=934)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-12</td>
<td>379</td>
<td>358</td>
<td>0.242</td>
</tr>
<tr>
<td>13-24</td>
<td>412</td>
<td>272</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>&gt;24</td>
<td>407</td>
<td>304</td>
<td>0.0006</td>
</tr>
</tbody>
</table>

$\chi^2 = 11.663, P=0.0029$
medication is readily to hand. A partially used or unused packet of paracetamol found in the home will now contain a maximum of 12 tablets where previously it could contain up to 24. The legislation introduced in Ireland does not limit the number of retail outlets where paracetamol can be obtained. However, purchase of numerous packs of paracetamol in one outlet is not permitted. We observed no change in the frequency of paracetamol overdoses after October 2001 but the possibility of taking a large number of tablets, and therefore a toxic dose of paracetamol, has been reduced. There is no reason to believe that compliance by retailers will diminish in the future, and it is reasonable to believe that access to large numbers of paracetamol tablets will remain difficult. Further follow-up studies over a longer period of time will be useful to determine whether pack-size restrictions have continuing benefits.

**STUDY LIMITATIONS**

Our study was carried out as a retrospective observational “before and after” study using data reported to the Poisons Information Centre. We acknowledge that other unknown factors may have contributed to a drop in our actual numbers, but by assessing the proportional incidence of paracetamol cases relative to total deliberate self-poisonings, we could allow for any underlying trends.

**CONCLUSION**

There was a significant fall in the proportion of paracetamol overdoses involving more than 12 tablets after October 2001. No significant change was seen in overdoses involving less than 12 tablets. It is reasonable to assume that these observations may be related to the reduction of paracetamol pack-sizes from 24 tablets to 12. Legislation governing the sale of single-ingredient paracetamol preparations appears to have successfully reduced the availability of large quantities of tablets and thus the severity of paracetamol overdoses.

**REFERENCES**

2. National Parsuicide Registry Ireland, Annual Report 2003

Correspondence to: Elaine Donohoe
Tel: 01-809 2566 / 01-837 9964
e-mail: elainedonohoe@beaumont.ie
Socio-economic gradients in self-reported health in Ireland and Northern Ireland

ABSTRACT

Background Research and policy related to reducing health inequalities has progressed separately within Ireland and Northern Ireland. This paper describes the first exploration of the socio-economic influences on health on the island of Ireland since 1922.

Methods Postal survey.

Results The response rate was 52%; 11,870 respondents. Men reported more long-standing illness (LLTI) or poor general health (PGH); depression was more common amongst women. Socio-economic gradients in health were evident in both jurisdictions, with the effects of household income being particularly marked. Overall, morbidity levels were significantly better in Ireland than in Northern Ireland: adjusted odds ratio of 0.79 (95% CI 0.71-0.88) for LLTI; 0.64 (0.57-0.72) for PGH; 0.90 (0.82-0.99) for depression.

Conclusions There is evidence of strong and similar socio-economic gradients in health throughout the island of Ireland. This would suggest joint policy approaches or at least further comparative evaluation of the initiatives in each jurisdiction.

INTRODUCTION

In 1922 the island of Ireland was partitioned into Northern Ireland (NI) and Ireland. The last census to be undertaken of the island as a whole was in 1911 and the last all-Ireland Registrar General’s report was in 1921. Since then each jurisdiction has produced separate demographic statistics, separate recording of vital registration events and health policy has developed along separate lines.

There has been a realisation in recent years that the respective health strategies have much in common and that it made sense for such close neighbours to share information and see what could be learnt from the others’ experiences. This is particularly so in the field of health inequalities which is now a priority for both governments. Research into inequalities in health has been slow to develop on the island and it has been suggested that the health status of Ireland’s diaspora has probably been better studied than those who remained behind. Research has also progressed on independent, albeit parallel lines within the two jurisdictions and there has been a noticeable paucity of studies that have attempted to compare and contrast the relative health of the two populations or the magnitude and relative distribution of health inequalities. This has been due to a combination of methodological difficulties, differing perspectives and, initially, a lack of political will.

Obtaining comparable data for socio-economic and health indicators has been a major problem for researchers. NI has tended to follow the UK and use deprivation indicators such as the Townsend or Carstairs; Ireland has developed a modification of these that is quite distinct from either. Alternatively, researchers in Ireland sometimes also use the proportion of GMS patients as a proxy for low income, but this has no equivalent in NI where, as in the rest of the UK, all services are free at the point of delivery. It was only recently that a comparison of mortality by cause, sex and socio-economic status in Ireland and NI was attempted though the researchers experienced difficulties with data incompatibilities at all stages, occupation classifications proving particularly troublesome.

The respective Cancer Registries, because they are conforming to internationally agreed definitions and protocols, have been able to collate their findings and produce an all-Ireland report on the incidence and mortality from cancer.

Morbidity data are more relevant to public health but present the greatest dearth of comparable studies. A good example of the lack of coordination and missed
opportunities for North/South comparative work is the parallel development of health surveys. The SLÁN survey in Ireland and the Health and Wellbeing Survey in NI (modelled on the Health Surveys in England) used completely different questionnaires and contrasting survey methods.

The development of health information systems with standardisation of datasets is seen as prerequisite for integrating public health within the European arena. However, recent reports on cross-border cooperation in health services and mental health and social wellbeing have highlighted the absence of harmonized datasets, which is one of the obstacles to collaboration. Within the health inequalities arena this means that socio-economic and health status of the population be assessed using exactly the same measurement tools, which in the absence of harmonized existing datasets, requires a dedicated study.

The aim of this paper is to report on an analysis of data from such a dedicated survey that was carried out simultaneously in Ireland and NI using the same questionnaire and survey methodology.

**METHODS**

The data for this study was collected as part of a larger study comparing aspects of the primary care systems in the two jurisdictions. The first part of that study involved conducting a baseline survey of the health and socio-economic status of patients in selected practices. It is an analysis of these data that forms the basis for the current paper.

Twenty practices were selected in Ireland to provide a representative mix of national practice according to location (rural, small town, city) and practice size (one of three groups based on whole-time-equivalent GPs principals). Practices in NI were then classified according to these criteria and a random selection of twenty practices drawn to match those in Ireland. A random selection of 625 patients were selected from the patient lists of each practice in Ireland and NI including no more than two people from a household. Randomisation was based on computer generated random numbers. The survey was preceded by a personalised letter from the patient’s GP and non-responders were sent two reminders, the second containing another copy of the questionnaire. Parents/guardians were asked to complete questionnaires on behalf of patients aged less than 16 years old. Mailing took place during October and November 2003.

The selection of variables for inclusion into the questionnaire was informed by those factors which previous studies had demonstrated to be important determinants of GP attendance. In addition to the usual demographic variables, an array of socio-economic data was collected based on questions asked in the UK 2001 census. This included car ownership (categorised as no car, one or more car, two or more cars); tenure (dichotomised into renting and non-renting) and academic attainment (three levels of educational attainment; primary school only, secondary level, and tertiary level were used to accommodate differences in academic qualifications in Ireland and NI). The survey also captured data relating to gross annual household income, the question being identical to the one initially proposed for the 2001 UK census. Income from all sources was assessed, including earned income, pensions, benefits, allowances, interest or annuities etc., with no deductions for taxes, national insurance contributions, etc. Respondents were asked which of fourteen income bands (in pounds or Euros) best represented their household income.

Health measures included the limiting long-term illness (LLTI) and general health questions and two questions on depression (see Box 1). The LLTI question was identical to that used in the UK 2001 census. The general health question has been used in both of the SLÁN surveys and also the Health Survey in England. Limitations on space and a desire to keep responder burden to a minimum precluded the inclusion of a more recognised measure of mental health status such as the GHQ12 and so we used a two-question

**Box 1 — HEALTH QUESTIONS USED IN THE SURVEY**

**LLTI**

Do you have any long-term illness, health problem or disability which limits your daily activities or the work that you do? Include problems that are due to old age.

Responses: Yes: No

**GENERAL HEALTH**

In general, would you say your health is:

Excellent; very good; good; fair; poor.

**CASE-FINDING FOR DEPRESSION**

Q1. During the past month, have you often felt bothered by feeling down, depressed or hopeless? Responses: Yes: No

Q2. During the past month, have you been bothered by having little interest or pleasure in doing things? Responses: Yes: No
instrument that has been recommended for use in a primary care setting as an aid for detecting patients at high risk of depression. Only adult respondents were asked to complete the two mental health questions.

A series of logistic regression analyses were undertaken to examine the relationship between each of the three measures of self-reported health and demographic and socio-economic factors within each jurisdiction. A final set of regression analyses was undertaken for the Island as a whole with jurisdiction entered as a covariate to compare the health of the respondents in Ireland and NI.

RESULTS

The overall response rate was 52% (Ireland=50%, NI=54%). In Ireland almost 10% (195) of the sample was returned as ‘undeliverable mail’ and were excluded from the study. In NI the figure was only 3% (398). The high rate of undeliverable mail was most likely due to the difficulties of maintaining up-to-date patient addresses in Ireland. For this reason, although the response rates were relatively similar, the number of respondents in NI was notably larger (6579) than in Ireland (5291). Respondents in Ireland and NI had a similar demographic profile (Table 1), though there were a slightly greater proportion of people who were never married in Ireland. Over 80% of people in both jurisdictions owned their own house and had access to at least one car, though the proportion renting or without a car in Ireland was almost twice that in NI. This may by partially explained by the greater proportion of city dwellers amongst the Irish sample.

The age-specific rates of LLTI and poor general health were generally higher in NI than in Ireland (Figure 1) with the differences more marked for poor general health. The prevalence of depression does not vary greatly with age in either jurisdiction but, in NI, appears highest between the ages of 35 and 54.

The results of the separate logistic regression analyses with each of the three health indicators as dependent are shown in Table 2. A second series of analyses, stratified by sex within jurisdiction was also undertaken but, as there were few differences, these are reported in the context of the overall results. The expected sharp increase in the likelihood of LLTI and poor general health with age was seen in both jurisdictions, though the gradients were more marked in NI than in Ireland. Men in both Ireland and NI showed greater age-related increases in the likelihood of poor general health than women. The association between age and depression was markedly different to that of the other two health indicators. After controlling for other socio-demographic factors, in Ireland there was a gradual decline in the prevalence of depression with age for women, such that a woman aged 75 or over was only half as likely to suffer from depression as one aged 16-24. A marked increased likelihood of depression in middle age was evident for both sexes in NI and for men in Ireland.

<table>
<thead>
<tr>
<th>Table 1</th>
<th>BASIC DEMOGRAPHIC, SOCIAL AND SOCIO-ECONOMIC CHARACTERISTICS OF THE RESPONDENTS IN IRELAND AND NI</th>
</tr>
</thead>
<tbody>
<tr>
<td>NI</td>
<td>IRELAND</td>
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<tr>
<td>RESPONDENTS</td>
<td>5143</td>
</tr>
<tr>
<td>AGE MEAN (SD)</td>
<td>479 (18.1)</td>
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<td>SEX</td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>2985 (45.5%)</td>
</tr>
<tr>
<td>Women</td>
<td>3574 (54.5%)</td>
</tr>
<tr>
<td>MARITAL STATUS</td>
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</tr>
<tr>
<td>Single</td>
<td>1080 (21.4%)</td>
</tr>
<tr>
<td>Married</td>
<td>3303 (65.3%)</td>
</tr>
<tr>
<td>Sep/widowed/Div.</td>
<td>672 (13.3%)</td>
</tr>
<tr>
<td>CAR OWNERSHIP</td>
<td></td>
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<tr>
<td>0</td>
<td>496 (9.7%)</td>
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<tr>
<td>1</td>
<td>2000 (39.1%)</td>
</tr>
<tr>
<td>2+</td>
<td>2613 (51.1%)</td>
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<tr>
<td>TENURE</td>
<td></td>
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<tr>
<td>Not renting</td>
<td>4363 (85.5%)</td>
</tr>
<tr>
<td>Renting</td>
<td>711 (14.5%)</td>
</tr>
<tr>
<td>EDUCATION ATTAINMENT</td>
<td></td>
</tr>
<tr>
<td>Primary level</td>
<td>1893 (37.3%)</td>
</tr>
<tr>
<td>Secondary level</td>
<td>2189 (44.5%)</td>
</tr>
<tr>
<td>Tertiary level</td>
<td>1182 (24.2%)</td>
</tr>
<tr>
<td>LOCATION</td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>1893 (37.3%)</td>
</tr>
<tr>
<td>Small town</td>
<td>973 (19.2%)</td>
</tr>
<tr>
<td>Large town</td>
<td>1528 (30.1%)</td>
</tr>
<tr>
<td>City</td>
<td>682 (13.4%)</td>
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<tr>
<td>INCOME BAND</td>
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<tr>
<td>Lowest</td>
<td>759 (15.6%)</td>
</tr>
<tr>
<td>2nd</td>
<td>741 (15.2%)</td>
</tr>
<tr>
<td>3rd</td>
<td>659 (13.5%)</td>
</tr>
<tr>
<td>4th</td>
<td>974 (20.2%)</td>
</tr>
<tr>
<td>5th</td>
<td>884 (18.1%)</td>
</tr>
<tr>
<td>6th</td>
<td>642 (13.2%)</td>
</tr>
<tr>
<td>Highest</td>
<td>222 (4.5%)</td>
</tr>
</tbody>
</table>
People with lower educational attainment and of lower socio-economic status were more likely to suffer from poorer health however measured, though the relationship with indicators of material deprivation varied somewhat between jurisdictions and according to the measure of health status. Tenure was more strongly linked with LLTI and poor health in NI than in Ireland, though for depression the converse was true. Educational attainment was more predictive of poor health in Ireland. Household income levels were strongly linked to health status with similar steep gradients evident in both jurisdictions. The slightly more muted relationship between income and likelihood of depression in Ireland was due to the virtual absence of an association between income and depression for Irish women.

Table 3 shows the results of the final regression models for the island of Ireland as a whole. As the data are combined, the odds ratios here are almost an average of those presented earlier. Women were respectively 22% and 23% less likely to have a LLTI or to have poor general health and 30% more likely to suffer from depression. When age, gender and socio-economic factors had been considered, there was no significant association between marital status and the prevalence of LLTI though single people reported better general health and less depression while widowed, separated or divorced respondents had poorer general health and more depression. The main point of interest of this table is the comparison of health status in the two jurisdictions, which shows NI to be in the less favourable position. All other things considered, respondents in Ireland were 21% (95% confidence intervals 12-29%) less likely to have a LLTI, 36% (95%CI 28-43%) less likely to report poor general health and 10% (1-18%) less likely to suffer from depression, than people in NI.

**DISCUSSION**

To the authors knowledge this is the first time that the same questions have been asked to assess both socio-economic status and health in a large-scale survey in both jurisdictions, thereby obviating problems of comparability and contemporaneity. The shortcomings of the study should be acknowledged. The response rate raises concerns about response bias and the representativeness of the results to the wider population. Inaccuracies in the GP lists, which were used as the sampling frame, may have contributed to the low response rate, especially in Ireland where there is no universal registration and therefore it
<table>
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<tr>
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<th>N. Ireland</th>
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<tr>
<td>16-24</td>
<td>p = 0.001</td>
<td>p = 0.001</td>
<td>p = 0.001</td>
<td>p = 0.001</td>
<td>p = 0.001</td>
<td>p = 0.001</td>
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<tr>
<td>25-34</td>
<td>1.7 (1.1, 2.6)</td>
<td>1.2 (0.8, 1.8)</td>
<td>1.8 (1.1, 2.9)</td>
<td>1.2 (0.7, 2.1)</td>
<td>1.4 (1.0, 1.8)</td>
<td>0.9 (0.7, 1.2)</td>
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<td>35-44</td>
<td>2.4 (1.6, 3.6)</td>
<td>1.4 (0.9, 2.1)</td>
<td>2.8 (1.8, 4.5)</td>
<td>1.7 (1.2, 2.8)</td>
<td>1.8 (1.3, 2.4)</td>
<td>0.9 (0.7, 1.3)</td>
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<td>45-54</td>
<td>3.4 (2.3, 5.2)</td>
<td>1.9 (1.3, 2.8)</td>
<td>4.7 (2.9, 7.5)</td>
<td>2.4 (1.5, 3.9)</td>
<td>1.7 (1.2, 2.2)</td>
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<tr>
<td>55-64</td>
<td>5.5 (3.6, 8.3)</td>
<td>3.2 (2.2, 4.7)</td>
<td>6.4 (4.0, 10.3)</td>
<td>4.1 (2.5, 6.7)</td>
<td>1.2 (0.8, 1.6)</td>
<td>0.7 (0.5, 0.9)</td>
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<tr>
<td>65-74</td>
<td>6.1 (3.9, 9.4)</td>
<td>4.8 (3.2, 7.2)</td>
<td>6.5 (4.0, 10.6)</td>
<td>4.7 (2.8, 7.7)</td>
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<td>75+</td>
<td>9.5 (6.0, 15.1)</td>
<td>6.1 (3.9, 9.4)</td>
<td>7.2 (4.3, 11.9)</td>
<td>4.6 (2.7, 7.8)</td>
<td>0.8 (0.6, 1.2)</td>
<td>0.6 (0.4, 0.9)</td>
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<td><strong>SEX</strong></td>
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<tr>
<td>Female</td>
<td>0.78 (0.69, 0.92)</td>
<td>0.77 (0.66, 0.90)</td>
<td>0.87 (0.74, 1.01)</td>
<td>0.87 (0.73, 1.05)</td>
<td>1.24 (1.01, 1.41)</td>
<td>1.37 (1.19, 1.58)</td>
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<tr>
<td>Married</td>
<td>1.26 (0.98, 1.60)</td>
<td>0.91 (0.72, 1.15)</td>
<td>1.25 (0.96, 1.63)</td>
<td>1.24 (0.95, 1.62)</td>
<td>1.00 (0.82, 1.23)</td>
<td>0.96 (0.79, 1.17)</td>
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<tr>
<td>Sep/Wid/Div</td>
<td>1.26 (0.94, 1.68)</td>
<td>0.97 (0.71, 1.31)</td>
<td>1.22 (0.90, 1.66)</td>
<td>1.28 (0.92, 1.77)</td>
<td>1.05 (0.81, 1.36)</td>
<td>1.45 (1.10, 1.90)</td>
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<td><strong>TENURE</strong></td>
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<td>1.42 (1.14, 1.76)</td>
<td>0.97 (0.77, 1.21)</td>
<td>1.71 (1.37, 2.14)</td>
<td>1.29 (0.88, 1.45)</td>
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<tr>
<td>Secondary level</td>
<td>0.89 (0.74, 1.06)</td>
<td>0.86 (0.71, 1.05)</td>
<td>0.69 (0.57, 0.82)</td>
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<td>0.80 (0.67, 0.95)</td>
</tr>
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<td>Tertiary level</td>
<td>0.86 (0.68, 1.07)</td>
<td>0.72 (0.56, 0.92)</td>
<td>0.54 (0.42, 0.69)</td>
<td>0.45 (0.34, 0.61)</td>
<td>0.83 (0.68, 1.02)</td>
<td>0.69 (0.56, 0.86)</td>
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<td><strong>CAR AVAILABILITY</strong></td>
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<tr>
<td>1</td>
<td>0.88 (0.67, 1.14)</td>
<td>0.80 (0.63, 1.00)</td>
<td>0.93 (0.72, 1.22)</td>
<td>0.72 (0.57, 0.92)</td>
<td>0.83 (0.65, 1.06)</td>
<td>0.84 (0.68, 1.04)</td>
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<tr>
<td>2+</td>
<td>0.74 (0.55, 0.99)</td>
<td>0.64 (0.49, 0.84)</td>
<td>0.69 (0.51, 0.94)</td>
<td>0.57 (0.42, 0.76)</td>
<td>0.66 (0.51, 0.87)</td>
<td>0.76 (0.60, 0.97)</td>
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<tr>
<td>2nd</td>
<td>0.82 (0.65, 1.04)</td>
<td>0.93 (0.73, 1.18)</td>
<td>0.74 (0.59, 0.94)</td>
<td>0.79 (0.61, 1.01)</td>
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<td>3rd</td>
<td>0.52 (0.40, 0.67)</td>
<td>0.63 (0.48, 0.83)</td>
<td>0.43 (0.33, 0.57)</td>
<td>0.60 (0.45, 0.80)</td>
<td>0.59 (0.47, 0.76)</td>
<td>0.83 (0.65, 1.06)</td>
</tr>
<tr>
<td>4th</td>
<td>0.44 (0.34, 0.57)</td>
<td>0.49 (0.37, 0.65)</td>
<td>0.40 (0.30, 0.52)</td>
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<td>0.49 (0.39, 0.62)</td>
<td>0.72 (0.56, 0.91)</td>
</tr>
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<td>5th</td>
<td>0.39 (0.29, 0.53)</td>
<td>0.49 (0.36, 0.68)</td>
<td>0.39 (0.29, 0.53)</td>
<td>0.34 (0.23, 0.50)</td>
<td>0.42 (0.32, 0.54)</td>
<td>0.59 (0.45, 0.78)</td>
</tr>
<tr>
<td>6th</td>
<td>0.23 (0.16, 0.33)</td>
<td>0.35 (0.29, 0.48)</td>
<td>0.23 (0.18, 0.34)</td>
<td>0.23 (0.14, 0.37)</td>
<td>0.38 (0.28, 0.51)</td>
<td>0.61 (0.45, 0.83)</td>
</tr>
<tr>
<td>Highest</td>
<td>0.19 (0.10, 0.29)</td>
<td>0.24 (0.12, 0.46)</td>
<td>0.23 (0.13, 0.40)</td>
<td>0.13 (0.05, 0.38)</td>
<td>0.29 (0.19, 0.44)</td>
<td>0.52 (0.33, 0.80)</td>
</tr>
</tbody>
</table>

Table 2
THE ASSOCIATION BETWEEN HEALTH AND DEMOGRAPHIC, SOCIAL AND SOCIO-ECONOMIC FACTORS FOR EACH JURISDICTION SEPARATELY. DATA REPRESENTS THE RESULTS OF MULTIPLE LOGISTIC REGRESSION ANALYSES (ODDS RATIOS AND 95% CONFIDENCE INTERVALS) WITH HEALTH MEASURES AS THE DEPENDENT.
Table 3  
THE ASSOCIATION BETWEEN HEALTH AND DEMOGRAPHIC, SOCIAL AND SOCIO-ECONOMIC FACTORS FOR THE WHOLE ISLAND OF IRELAND. DATA REPRESENTS THE RESULTS OF MULTIPLE LOGISTIC REGRESSION ANALYSES (ODDS RATIOS AND 95% CONFIDENCE INTERVALS) WITH HEALTH MEASURES AS THE DEPENDENT

<table>
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<tr>
<th></th>
<th>LTLI</th>
<th>GENERAL HEALTH 'POOR'</th>
<th>DEPRESSION</th>
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<tr>
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<td>P &lt; 0.001</td>
<td>P &lt; 0.001</td>
<td>P &lt; 0.001</td>
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<td><strong>AGE</strong></td>
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<td>1.00</td>
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<tr>
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<td>6.04 (4.19, 8.70)</td>
<td>0.71 (0.54, 0.92)</td>
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<tr>
<td>Female</td>
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<td>0.87 (0.77, 0.97)</td>
<td>1.30 (1.18, 1.42)</td>
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<td>1.00</td>
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<tr>
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<td>1.26 (1.04, 1.52)</td>
<td>1.00 (0.86, 1.15)</td>
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<td>Sep/Wid/Div</td>
<td>1.12 (0.91, 1.37)</td>
<td>1.26 (1.01, 1.57)</td>
<td>1.24 (1.03, 1.49)</td>
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<tr>
<td><strong>TENURE</strong></td>
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<td>1.00</td>
<td>1.00</td>
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<tr>
<td>Renting</td>
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<td>1.42 (1.20, 1.67)</td>
<td>1.28 (1.12, 1.47)</td>
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<tr>
<td><strong>EDUCATION</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Primary level</td>
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<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Secondary level</td>
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<td>0.70 (0.61, 0.80)</td>
<td>0.88 (0.78, 0.99)</td>
</tr>
<tr>
<td>Tertiary level</td>
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<td>0.50 (0.42, 0.61)</td>
<td>0.77 (0.66, 0.89)</td>
</tr>
<tr>
<td><strong>CAR AVAILABILITY</strong></td>
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</tr>
<tr>
<td>0</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>1</td>
<td>0.84 (0.71, 0.99)</td>
<td>0.81 (0.68, 0.97)</td>
<td>0.84 (0.72, 0.98)</td>
</tr>
<tr>
<td>2+</td>
<td>0.69 (0.56, 0.84)</td>
<td>0.62 (0.50, 0.76)</td>
<td>0.71 (0.59, 0.85)</td>
</tr>
<tr>
<td><strong>INCOME BAND</strong></td>
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</tr>
<tr>
<td>Lowest</td>
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<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2nd</td>
<td>0.88 (0.75, 1.04)</td>
<td>0.76 (0.64, 0.90)</td>
<td>0.94 (0.80, 1.10)</td>
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<tr>
<td>3rd</td>
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<td>0.49 (0.40, 0.60)</td>
<td>0.71 (0.60, 0.85)</td>
</tr>
<tr>
<td>4th</td>
<td>0.47 (0.39, 0.57)</td>
<td>0.40 (0.33, 0.49)</td>
<td>0.60 (0.51, 0.72)</td>
</tr>
<tr>
<td>5th</td>
<td>0.45 (0.36, 0.55)</td>
<td>0.38 (0.30, 0.48)</td>
<td>0.51 (0.42, 0.61)</td>
</tr>
<tr>
<td>6th</td>
<td>0.35 (0.27, 0.45)</td>
<td>0.23 (0.17, 0.31)</td>
<td>0.49 (0.39, 0.60)</td>
</tr>
<tr>
<td>Highest</td>
<td>0.20 (0.13, 0.31)</td>
<td>0.20 (0.12, 0.33)</td>
<td>0.39 (0.29, 0.53)</td>
</tr>
<tr>
<td><strong>JURISDICTION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NI</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Ireland</td>
<td>0.79 (0.71, 0.88)</td>
<td>0.64 (0.57, 0.72)</td>
<td>0.90 (0.82, 0.99)</td>
</tr>
</tbody>
</table>
is difficult to keep patient lists current. Even in NI, where central monitoring of patient registration occurs, it is known that there are inaccuracies in the lists with an inflation (compared to census estimates) of approximately 6% and address inaccuracies of perhaps 20% in some practices. The low response rates are similar to other field studies, for example 53% for the 2001 SLAN survey (Friel S, personal communication) and perhaps reflects a growing disenchantment or survey fatigue amongst the general population.

The study has demonstrated marked socio-economic gradients in self-reported health in both Ireland and NI. The likelihood that this represents health selection effects can be discounted, as it is now fairly well established that they have only a relatively minor role to play in explaining socio-economic gradients. It is difficult to know whether the differences in the explanatory power of the various indicators represents variation in the underlying determinants of health inequalities or, some subtle difference in the meaning of the indicators, as other studies have reported difficulties finding indicators that had the same understanding across international boundaries. What the analyses do underscore is the importance of income in determining health status, which is in keeping with health inequalities research throughout Europe.22-26

The study also shows that, when assessed using levels of self-reported ill-health, Ireland appears to be appreciably healthier than NI. This is not the picture that is obtained using other, subjective indicators of health status. Life expectancy at birth has been remarkably similar over the last 40 years in Ireland and NI19 and a comparison of all-cause mortality between 1989 and 1999 showed that, while they both compare unfavourably with the rest of Europe, they were 6% higher in Ireland than in NI. A comparison of cancer incidence on the island of Ireland14 provides a mixed picture, for while incidence rates were very slightly higher in NI; mortality rates were slightly higher in Ireland. These findings may be due to differences in case ascertainment and/or case survival rates. Collectively, these objective measures of health suggest that the two jurisdictions enjoy remarkably similar levels of health, though where differences exist, it would appear to favour NI. There is therefore a dissonance between objective and subjective measures of health which prompts the question; to what extent are these due to perceptual rather than real differences?

One possibility is that self-reported measures of health are ‘picking up’ conditions, such as musculo-skeletal complaints or minor psychological problems that are poorly reflected in mortality or cancer data. A comparison of national health surveys showed that NI has higher levels of minor psychological disturbance (as measured by the GHQ12) than the rest of the UK and (if differences in survey methodology are disregarded) also higher than those in Ireland. It is possible that the recent economic success in Ireland has produced a feel-good factor that has percolated through to produce a more generally favourable view of health.

Another possibility is that current mortality patterns reflect the morbidity status of previous decades but not current health status which is best assessed using the self-reported measures. If this is true then the better levels of self-reported health in Ireland now may predict a change in the trajectories of the relative mortality experience of the two jurisdictions.

A third possibility is that there are systematic differences between the two jurisdictions in the way that health is perceived and reported and the inclusion of anchoring vignettes has been proposed as a way of identifying and overcoming differences in both health expectations and reporting between populations. These describe fixed levels of health and responses to them can then be used to adjust the self ratings of health, making them more comparable across populations. This is something that could be considered as a next step before definitively concluding that the differences in levels of self-reported ill health between Ireland and NI are substantive.

ACKNOWLEDGEMENTS

Sincere thanks go to all the staff at the following GP practices who agreed to take part in the research:

In NI – Dr Morrison, Cherryvalley Family Practice; Glenavy Family Practice, Glenavy; Oriel Surgery, Antrim; Tramways Medical Centre, Newtownabbey; The Bell Practice, Holywood Arches Health Centre; Dr Robert Henry Surgery, Comber; The Health Centre, Comber; Rathfriland Surgery, Rathfriland; Dr JG McAnallen’s Practice, The Health Centre, Portadown; The Surgery, Crossgar; Irvinestown Health Centre, Irvinestown; Errigal Medical Centre, Ballygawley; The Health Centre, Richill; Dr Finlay, Dr McQuillan, and Dr Ollerenshaw, Bovally Medical Centre, Limavady; Dr J D Lennox Practice, Skegonneil Health Centre; The Health Centre, Downpatrick; The Montalto Medical
Centre, Ballynahinch; Campbell Surgery, Dungannon; The Archway Surgery, Armagh; The Meadows Family Practice, Portadown.

In Ireland – Coombe Healthcare Centre, Dublin; Whitworth Medical Centre, Dublin; Rialto Medical Centre, Dublin; Blackrock Medical Centre, Blackrock; Dr Emer Loughrey / Dr Conor Ceaney, Inchicore; Springfield Medical Centre, Tallaght; Dr Connolly, 1 Duncairn Terrace, Bray; Lifford Health Centre, Donegal; Dr Cryan’s Practice, Galway; Dr Desmond Bluett, Dr Mairead Cashman and Dr Terese Dillon, Galway; Health Centre, Roundstone; Turloughmore Health Centre, Lackagh; Dr Flynn’s Practice, Shannon; No 47 Medical Practice, Drogheda; Skreen Family Practice, Sligo; Bedford Place, Navan; The Palms, Gorey; Ennistymon Medical Centre, Main Street; Moyview Family Practice, Ballina; Garden Vale Court, Athlone.

FUNDING
Health Research Board, Ireland & Research and Development Office, Northern Ireland

REFERENCES
9. McQuoid J. Feasibility study for a crossborder assessment of social deprivation need and service provision. Centre for policy research University of Ulster, Jordanstown and Economic and Social Research Institute, Dublin 1994.
SOCI-ECONOMIC GRADIENTS IN SELF-REPORTED HEALTH IN IRELAND AND NORTHERN IRELAND


Correspondence to: Dr D O’Reilly, Dept Epidemiology and Public Health, Mullhouse Building, Royal Group of Hospitals, Grosvenor Road, Belfast BT12 6BJ
Tel: 028 90 240503 ext 2738; Fax: 028 90 231907
Email: d.reilly@qub.ac.uk
Completeness and accuracy of the drug treatment reporting system in Dublin, Ireland

ABSTRACT

Background The National Drug Treatment Reporting System (NDTRS) is the Irish treated-drug misuse surveillance system.

Aim To measure completeness and accuracy of the NDTRS

Methods Cross-sectional survey of clinical records and matching NDTRS reporting forms of a random sample of 520 clients attending 4 Dublin treatment centres. Using clients’ clinical records as the gold standard, system completeness (proportion of sample reported to the NDTRS) and accuracy of selected variables (proportion of reported clients’ information on the NDTRS that matched clinical record information) were measured.

Results 452/520 (87%) selected records were retrieved. The NDTRS was only 61.1% (95% CI 56.5-65.5) complete; completeness differed across treatment centres (21.8%-85.6%, p<0.0001) and was greater for new and returning clients than for continuing clients (81.7% versus 53.9% respectively, p<0.0001). Problems were identified with the accuracy of some key variables.

Conclusions Urgent actions have been taken to improve the completeness and accuracy of the reporting system.

INTRODUCTION

Evidence is increasingly used to inform public health policy and practice. An evidence-based approach requires the collection and use of high quality health information, which can identify priorities, steer the implementation of policies and plans and facilitate evaluation of interventions. In relation to drug misuse in Ireland, the current national drug strategy identifies the importance of valid, timely and comparable data on the extent of drug use as the cornerstone which underpins its actions.

Drug treatment data are viewed as an indirect indicator of drug misuse as well as a direct indicator of demand for treatment services. The National Drug Treatment Reporting System (NDTRS) is an epidemiological database on treated problem drug use in Ireland. It was established in 1990 in the Greater Dublin Area and was extended in 1995 to cover other areas of the country. The reporting system was originally developed in line with the Pompidou Group’s Definitive Protocol, and subsequently refined in accordance with the Treatment Demand Indicator Protocol. Data are collected on treatment status, demographic profile, current problem drug use, risk behaviour and initial intervention(s). Compliance with the NDTRS requires that one form be completed for each person who receives treatment for problematic drug use at each treatment centre in a calendar year: some clients are new or returning after a period of absence to treatment providers (“new or return clients”); some are continuing in treatment from the preceding year (“continuing clients”); and a subset of those new to treatment providers have never been previously treated (“true incident clients”). Service providers at drug treatment centres throughout Ireland collect data on each individual treated for drug misuse, and make reports to the NDTRS. At national level, staff at the Drug Misuse Research Division (DMRD) of the Health Research Board (HRB), who manage the NDTRS, compile anonymous, aggregated data for use at a local and national level. The NDTRS also provides data to the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA), a key component of the knowledge infrastructure underpinning drug policy for the European Union.

There is concern over the quality of information used for drug policy. In the UK, drug treatment surveillance systems have been found to be incomplete and inaccurate. Given that the Irish Government endorses the intelligence role of the NDTRS in its drugs strategy, and that co-operation
with the system is a stated action for treatment providers, we set out to estimate the completeness of reporting and measure the accuracy of the data reported to the NDTRS.

**METHODS**

We restricted the study to statutory treatment centres in the Greater Dublin Area with more than 100 clients who were treated with methadone. This allowed us to use the Central Treatment List (CTL) as a sampling frame. All individuals dispensed methadone in Ireland are, by statutory requirement, notified to this list. Eleven of the 55 treatment centres in the Dublin area had over 100 clients. These eleven treatment centres comprised 46.3% of notifications to the CTL in 2001 (personal communication, Central Treatment List). The Dublin area has three health board areas and one large treatment centre was randomly selected from each. In addition, a large tertiary specialist drug treatment centre located in the city centre was included in the study. Thus, four large treatment centres were included in the study.

Based on previous studies, we estimated that the completeness of the NDTRS was 70% (with a precision of ± 5% at the 95% confidence level) and the required sample size for measurement was 520. We randomly selected 130 records on the CTL from each of the study centres for the reporting year 2001. For each selected client, the clinical notes were examined for 2001 and data on each client, within a six-month period of entry, were extracted using a pre-designed data collection tool. The data collection tool contained key variables from the NDTRS reporting form: client’s case number, age, gender, date of treatment contact, incident versus prevalent client status, previous treatment status, name of main problem drug, route of main problem drug, frequency of main problem drug and lifetime injecting status.

One author (PK) located the clinical records and extracted the data from each clinical file. Each client was identified using his/her case number. PK then matched the case number to the NDTRS form stored in the filing system at the DMRD and extracted the individual data already submitted to the NDTRS. Matching by date of birth was attempted for clients not initially identified by case number.

A client was classified as reported to the NDTRS if the client’s NDTRS form for 2001 was located in the filing system. The proportion of clients treated that were correctly reported to the NDTRS was calculated using a sensitivity calculation and this estimated the completeness of the NDTRS; 95% confidence intervals (CI) were calculated around this estimate. Associations between treatment centre, client treatment status and completeness of data were tested.

Using the clinical records as the gold standard, the clients’ information for a particular variable on the original NDTRS form was compared to the information extracted from the clinical record by PK. The accuracy of the data collected by the NDTRS for each of the selected variables was measured using a positive predictive value calculation; the denominator was the total number of clients classified as reported who had information extracted for the variable, and the numerator was the proportion whose corresponding information on their NDTRS original submission matched the extracted information. Clients who had no information in their clinical records for a particular variable were excluded from the denominator of this measurement. Ninety-five per cent confidence intervals were calculated around the estimates of accuracy for each variable. JMP-In and STATA were used for all data analysis.

**RESULTS**

Of the 520 records randomly selected, 452 (87%) were retrieved and reviewed; 68 records (13%) could not be located at the centre. Of these 452, 276 (61.1% (95% CI 56.5-65.5%)) of the clients receiving methadone treatment in the study centres were correctly reported to the NDTRS in 2001. Table 1 presents the distribution of completeness across client type and study centre. New and returning clients were more likely to be reported than those clients continuing in treatment from the preceding year (98/120 (81.7%) versus 178/330 (53.9%) respectively, p<0.01). The level of completeness differed across the four study centres and ranged between 24/110 (21.8%) and 95/111 (85.6%), p<0.001. Stratified analysis illustrates that centres also varied in their completeness by client type. Of note, a higher proportion (78.6%) of continuing care cases was reported by treatment centre number 2 than their new and returning cases (62.5%). For the other three centres, the opposite reporting pattern was found.

Table 2 presents the accuracy of the data reported to the NDTRS for each of the selected variables. The accuracy of the data reported to the NDTRS was
## Table 1
### DISTRIBUTION OF COMPLETENESS ACROSS CLIENT TYPE AND STUDY CENTRE

<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>TOTAL</th>
<th>COMPLETENESS</th>
<th>95% CONFIDENCE INTERVAL</th>
<th>P VALUE*</th>
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<tr>
<td></td>
<td>n</td>
<td>n</td>
<td>%</td>
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<tr>
<td><strong>ALL CLIENTS</strong></td>
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<tr>
<td>Client type</td>
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</tr>
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<td>81.7</td>
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</tr>
<tr>
<td>Continuing</td>
<td>330</td>
<td>178</td>
<td>53.9</td>
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</tr>
<tr>
<td>Total</td>
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<td>276</td>
<td></td>
<td></td>
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<td>111</td>
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<td>77</td>
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<td>Total</td>
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<td>Study centre 1</td>
<td>28</td>
<td>26</td>
<td>92.9</td>
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<td>16</td>
<td>10</td>
<td>62.5</td>
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<td>41</td>
<td>93.2</td>
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</tr>
<tr>
<td>Study centre 4</td>
<td>32</td>
<td>21</td>
<td>65.6</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>120</td>
<td>98</td>
<td></td>
<td></td>
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<tr>
<td><strong>CONTINUING CLIENTS</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Study centre 1</td>
<td>83</td>
<td>69</td>
<td>83.1</td>
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<td>Study centre 2</td>
<td>89</td>
<td>70</td>
<td>78.6</td>
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<tr>
<td>Study centre 3</td>
<td>82</td>
<td>36</td>
<td>43.9</td>
<td></td>
</tr>
<tr>
<td>Study centre 4</td>
<td>76</td>
<td>3</td>
<td>4.0</td>
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</tr>
<tr>
<td>Total</td>
<td>330</td>
<td>178</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Chi square tests of difference in completeness across characteristics shown
†2 records had undetermined client type

## Table 2
### ACCURACY (PREDICTIVE VALUE POSITIVE) OF SELECTED NDTRS VARIABLES

<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>REPORTED (N)</th>
<th>PREDICTIVE POSITIVE VALUE (%)</th>
<th>95% CI</th>
</tr>
</thead>
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<td><strong>GENDER</strong></td>
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<td></td>
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<tr>
<td>Male</td>
<td>162</td>
<td>100.0</td>
<td>97.7-100.0</td>
</tr>
<tr>
<td>Female</td>
<td>111</td>
<td>96.4</td>
<td>91.1-98.6</td>
</tr>
<tr>
<td><strong>AGE CATEGORIES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 19</td>
<td>16</td>
<td>100.0</td>
<td>80.1-100.0</td>
</tr>
<tr>
<td>20-24</td>
<td>70</td>
<td>98.6</td>
<td>92.3-99.7</td>
</tr>
<tr>
<td>25-29</td>
<td>89</td>
<td>97.8</td>
<td>92.2-99.4</td>
</tr>
<tr>
<td>30-34</td>
<td>46</td>
<td>97.8</td>
<td>88.7-99.6</td>
</tr>
<tr>
<td>35-39</td>
<td>39</td>
<td>94.9</td>
<td>83.1-98.6</td>
</tr>
<tr>
<td>≥ 40</td>
<td>16</td>
<td>93.8</td>
<td>71.7-98.9</td>
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<td><strong>CLIENT TYPE</strong></td>
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<tr>
<td>New or returning</td>
<td>98</td>
<td>95.7</td>
<td>89.6-98.3</td>
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<tr>
<td>Continuing</td>
<td>178</td>
<td>95.6</td>
<td>91.6-97.8</td>
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<td><strong>PREVIOUS TREATMENT</strong></td>
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<td>97.4</td>
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<td></td>
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<td>Other opiate</td>
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<tr>
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<tr>
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<td>97.4</td>
<td>94.0-98.9</td>
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<tr>
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</tr>
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<td>9.7-56.6</td>
</tr>
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<td>8.2-50.3</td>
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<td></td>
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<td>96.8-99.8</td>
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<tr>
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<td>72.8-92.8</td>
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greater than 90% for the variables age, gender, new versus old client status and main problem drug. The data for some important variables had low levels of accuracy. Only 70% of true incidence cases (no previous treatment) were correctly reported. Non-injector status was correctly reported for 85.4% of cases. Less than daily use of the main problem drug was correctly reported for only one-fifth of cases.

DISCUSSION

MAIN FINDINGS

Reporting to the NDTRS in 2001 was incomplete and not representative of the methadone treatment population in the Greater Dublin Area. Benchmarked against the clinical records, most variables reported to the NDTRS were accurate. However some key policy indicators, in particular true incidence and non-injector status, were less accurate.

STRENGTHS AND LIMITATIONS OF THE STUDY

The study sample was extracted from the CTL. Since it is a statutory requirement to notify all clients to be dispensed methadone in Ireland to this list, it is unlikely that the sampling frame was incomplete. In addition, a manual review of clinical records was undertaken to ensure that clients sampled were active in treatment at the study centres in 2001 and therefore required a report to the NDTRS. This approach to measurement of completeness has greater internal validity than the use of incomplete or uncorroborated client lists. The extent to which the clinical records represent a gold standard for accuracy is arguable. Since the reporting form may be completed by face-to-face interview, no other reference standard was available. However, the inaccurate variables of concern in this study (true incidence, non-injector and infrequent drug user status) are also important for clinical decision-making in methadone initiation and maintenance. Therefore the clinical records would be expected to approach a gold standard for these variables. These results cannot be generalised outside the Greater Dublin Area (2% of clients dispensed methadone in 2001, personal communication CTL) or to clients not prescribed methadone. Within this population, we confined our study to four clinics, one of which (centre 4) had an extremely low completeness, particularly for continuing clients. While this may have biased the result for overall completeness of the system, further investigation by the NDTRS showed that it reflected reporting practices of centres in that health administrative area (personal communication NDTRS).

COMPARISON WITH OTHER STUDIES

The NDTRS was less complete than UK drug treatment monitoring systems evaluated using similar methods. However, at the time of these studies, UK systems only required reports of new clients and those returning to treatment after an absence of over six months, whereas the NDTRS required reports on all treated clients. NDTRS completeness for new and returning clients was 81.7% (95% CI 73.8-87.6%) and compared favourably with the UK systems. Subsequent to a review in 1999, the UK drug treatment monitoring system was extended to include reports on clients continuing in treatment from the previous year. Since this extension of reporting requirements, there has not been a published evaluation of the completeness and accuracy of UK drug monitoring systems. A recent paper examining the trends in demand for drug treatment in the South West of England from 1996/7 to 2000/1 reported a rise in the incidence of treatment for drug misuse and unexplained variations in the pattern of reporting over the period. We found incomplete and inaccurate reporting that was not representative of true drug treatment service activity in a system requiring reports on all clients in treatment. This would suggest that changes in reporting practices of treatment providers, subsequent to the extension of reporting requirements, may be contributing to observed variations in the treatment population size and characteristics in the UK. There are no published evaluations of other systems in Europe that have implemented the EMCDDA treatment demand protocol. Such evaluations could improve the quality of this indicator for national and European drugs policy. Estimates of the completeness and accuracy of treatment demand indicators should be provided on a regular basis if valid comparisons between countries and time periods are to be drawn with confidence.

IMPLICATIONS FOR POLICY, PROCEDURES AND PRACTICE

As soon as the results of this analysis became apparent urgent actions were taken by one of us (JK), to improve the completeness and accuracy of the reporting system for data from 2001 onwards. This included a crude comparison of the number of reports to NDTRS in the three area health boards with the number of notifications to the Central Treatment List for 2001, 2002 and 2003. It was noted that returns were incomplete for the majority of clinics in the three area health boards of the Greater Dublin area. The staff of the NDTRS presented summary findings to and negotiated solutions with...
the management teams of these health boards. By June 2004 all health boards had submitted complete data. NDTRS staff agreed that they would revise the methods used to collect the number of clients continuing in care from the previous year from 2004 onwards. Each health board would send the total number of clients in treatment on January 1st each year to the staff of the NDTRS and a form would be completed for each client new to or returning to treatment that year. It was also agreed that the Addiction Service’s performance indicators would be included in the NDTRS and that data would be collected on clients reporting alcohol as their main problem drug. This complies fully with the EMCDDA requirements for implementation of the treatment demand indicator. This demonstrates that when research institutions present facts and identify barriers to compliance to service managers, solutions can be found and the completeness, accuracy and usefulness of reporting systems can be improved.

ACKNOWLEDGEMENTS

We wish to thank Dr Hamish Sinclair and Ms Fionnula Kelly at the Drug Misuse Research Division of the Health Research Board, Dr Eamon Keenan at the Drug Treatment Centre Board, Ms Fionnuala Rafferty at the Central Treatment List, the Area Operations Managers of each of the area health boards included in the study, the General Manager of the Drug Treatment Centre Board and the staff at the study centres for their support and assistance in undertaking this study.

REFERENCES


Correspondence to: Paul Kavanagh, Health Protection Surveillance Centre, 25-27 Middle Gardiner Street, Dublin 1. E-mail: paul.kavanagh@mailx.hse.ie
Coracoid Impingement Syndrome: A treatable cause of anterior shoulder pain

ABSTRACT
Background Coracoid Impingement Syndrome is a relatively uncommon but generally treatable cause of anterior shoulder pain that can be easily overlooked. It typically presents with anterior shoulder joint pain in activities involving forward flexion, adduction and internal rotation.

Aims To assess the outcome of a cohort of patients diagnosed with Coracoid Impingement Syndrome.

Methods Patients were investigated clinically and radiologically. They received appropriate therapeutic measures and were followed-up in an orthopaedic outpatient setting.

Results Twelve patients were identified over a four-year period. All patients have made good progress. Thus far, none have needed operative intervention for symptom relief.

Conclusion Coracoid impingement syndrome is an uncommon cause of anterior shoulder pain but diagnosed patients can expect good symptomatic relief following referral to a dedicated shoulder unit. An increase in clinical awareness of the condition may prevent undue diagnostic delay in such cases.

INTRODUCTION
Anterior shoulder pain can be particularly difficult to diagnose. The differential diagnosis includes impingement syndromes, rotator cuff injury and shoulder instability. Overlap between diagnoses can be present in certain cases leading to complex clinical findings. This can lead to diagnostic delay and therefore prolonged symptomatology. Many clinical shoulder tests have been documented but these sometimes prove difficult to interpret if the examiner does not routinely treat advanced shoulder problems.

Coracoid Impingement Syndrome is a relatively uncommon but treatable cause of shoulder pain. It usually presents with anterior shoulder discomfort in activities involving forward flexion, adduction and internal rotation. A literature review identifies three main causes of the condition: idiopathic, traumatic and iatrogenic. The condition is usually very difficult to diagnose due to the paucity of consistently reproducible clinical signs. This syndrome is sparsely documented but has been shown to be treatable with both conservative and operative measures. The coracoid impingement test is presently the best diagnostic indicator of the condition. We found that patients with a positive coracoid impingement test often reported that their pain was also aggravated by a shoulder position of abduction and internal rotation. In this case series we have demonstrated that diagnosed patients can expect good symptom relief from appropriate therapeutic regimens. An increased clinical awareness of this condition may obviate undue diagnostic delay in otherwise unresolved cases of chronic anterior shoulder pain.

MATERIAL AND METHODS
A prospective review of patients presenting with anterior shoulder pain to a regional orthopaedic shoulder service was carried out. Each individual was assessed both clinically and radiologically in an outpatient clinic setting by a single consultant orthopaedic surgeon.

Radiographic views comprised antero-posterior views in internal and external rotation of the shoulder in addition to axillary lateral views. In all cases these revealed no obvious radiological abnormality. Although magnetic resonance imaging and shoulder arthrography may prove helpful in diagnosing certain cases of anterior shoulder pain, we employed the former as a baseline investigation whenever other diagnoses were strongly suspected.

Tenderness was present in the antero-medial shoulder over the coracoid process in all patients. Neurological function was normal and muscle power was MRC grade 5 in the affected limbs. Other causes of shoulder pain were excluded. Subacromial
impingement syndromes, rotator cuff pathology, biceps disorders, labral lesions and radiculopathy were outruled as the primary cause of each patient’s symptoms. Specific impingement tests were undertaken including Yergason’s and Speed’s tests and all proved to be negative. The entire cohort had a positive coracoid impingement test on the side of the affected shoulder.

All cases were initiated on a treatment ladder that progressed in a stepwise fashion from activity modification and further courses of non-steroidal anti-inflammatory drugs with physiotherapy, to infiltration of the coraco-humeral interval with a lignocaine/hydrocortisone solution. The same consultant surgeon reassessed each patient at subsequent clinic visits. The duration of follow-up was largely determined by the response to treatment. The results were recorded in a computerised database enabling detailed analysis (Microsoft® Access, Microsoft Corporation).

RESULTS
The duration of the study was a four-year period (1999 to 2003). Twelve patients in total were identified as having coracoid impingement syndrome. The study group comprised eight men and four women. The average age was 44.3 years (range 26 to 54 years). The average duration of patient follow-up was 14.4 months (range 3 to 35 months).

The mean duration of shoulder symptoms, namely point tenderness of the coracoid and anterior shoulder pain or discomfort, was 8.9 months (range 1 to 25 months; standard deviation 6.33 months). Two thirds of the cases involved the dominant side (Table 1).

Six of the cases were of idiopathic origin and six were associated with trauma of varying aetiology. The traumatic cases comprised a fall down stairs, a fall from a stepladder, two road traffic accidents, an old lifting injury and a case of presumed repeated micro-trauma to the shoulder joint secondary to strenuous gym activity. There were no incidences of iatrogenic causation. None involved major trauma (i.e. there were no associated fractures of the shoulder girdle or upper limb). All cases involved anterior shoulder pain of a chronic nature. Every patient experienced activity related symptomatology. The age distribution of the patients was slightly different to other published series in that there was preponderance towards individuals over 50 years of age (42%).

Only one patient had definite signs of concurrent shoulder pathology. This 54-year-old male was diagnosed with coracoid impingement syndrome in addition to evidence, of rotator cuff degeneration as confirmed by clinical findings and magnetic resonance imaging. This patient responded well to treatment with a subcoracoid nonsteroidal anti-inflammatory injection in addition to rotator cuff strengthening physiotherapy.

The entire study group was evaluated with plain films. The diagnostic yield was poor as no cases of the ailment could be confirmed based on these findings. In one instance, the plain films showed an aberrant coracoid morphology but no definite coraco-humeral narrowing. Five patients were further assessed with magnetic resonance imaging and this measure served mainly to exclude concurrent shoulder pathology i.e. rotator cuff lesions and other bony abnormalities. None of these cases showed conclusive evidence of abnormal spatial relationships between the position of the coracoid process in relation to either the humeral head or glenoid. One set of MRI films suggested a reduced coraco-humeral interval while another showed evidence of rotator cuff degeneration.

All patients were tender in the region overlying the coracoid process. All cases were positive for the coracoid impingement test. Pain and discomfort was elicited to a varying degree when the shoulder was placed in a position of cross arm adduction, forward elevation and internal rotation.

It was also noted that discomfort was evoked in extremes of shoulder abduction and internal rotation. Five of the patients were able to voluntarily identify this position as a source of discomfort and described situations such as depressing the door lock button in their cars as being painful. The arm is in a position of ninety degrees of abduction and maximal internal rotation during this manoeuvre.

All cases were given trial courses of non-steroidal anti-inflammatory medication. Most cases had already been trialled previously with anti-inflammatories by their primary healthcare providers. One patient responded well to activity modification and physiotherapy alone. The remainder had symptomatic relief following an injection of local anaesthetic and steroid solution into the subcoracoid region. Seven have had complete resolution of normal shoulder function.
# Table 1

**PATIENT DETAILS**

<table>
<thead>
<tr>
<th>GENDER</th>
<th>AGE</th>
<th>CAUSE</th>
<th>TREATMENT</th>
<th>SYMPTOM DURATION (MONTHS)</th>
<th>FOLLOW-UP (MONTHS)</th>
<th>DOMINANT HAND AFFECTED</th>
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<td>11</td>
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Figure 1—**ANTERIOR VIEW OF THE SHOULDER JOINT DEMONSTRATING THE CORACOID PROCESS AND SURROUNDING STRUCTURES**

CORACOID IMPINGEMENT SYNDROME: A TREATABLE CAUSE OF ANTERIOR SHOULDER PAIN
following intra-articular injection. The remainder obtained temporary relief of varying durations and are being actively reviewed on an outpatient basis with further physiotherapy. Nobody in the series has undergone a coracoplasty but this may be necessary if symptoms persist on present treatment regimens.

**DISCUSSION**

Although coracoid impingement is an acknowledged cause of chronic shoulder pain since 1909, it may still go unrecognised when evaluating affected patients. The classical presentation is chronic anterior shoulder pain with marked tenderness to palpation over the coracoid. The condition is precipitated by idiopathic, traumatic and iatrogenic causes. Any process which diminishes the coracohumeral interval can lead to significant impingement.

Many studies have attempted to definitively outline the pathogenesis of this condition. It is thought that impingement of the rotator cuff between the lesser tuberosity of the humeral head and the lateral aspect of the coracoid leads to shoulder pain. Spatial relationships between the coracoid tip and surrounding bony structures have been analysed with both radiographic and cadaveric studies. Rotator cuff outlet morphology has also been assessed in affected patients.

Gerber et al were first to assess the significance of the coracohumeral interval (Figure 1). Dines et al later showed that coracohumeral decompression by excision of the lateral 1.5cm of the coracoid and re-attachment of the conjoint tendon lead to reproducible relief of symptoms. Friedman et al were the first to note degeneration of the subscapularis tendon in affected patients. This degeneration of the subcoracoid soft tissue was interpreted as the result of mechanical bony irritation and thus the morphologic pathological correlate for the coracoid impingement syndrome.

A recent cadaveric study suggests that anatomic variations of the coracoid are not the main cause of the pathology in this condition. It suggests that the problem is functional with anterior instability leading to a functional narrowing of the coracohumeral distance.

As has been stated in the literature, the diagnosis of coracoid impingement syndrome can be made most reliably on clinical findings. Radiological findings can help but no single radiological test can guarantee the diagnosis. MRI has been shown to be the most useful imaging modality as it can assess both the subcoracoid space and the coracohumeral distance. Shoulder arthrography can also be used to out-rule other diagnoses. The clinical test presently regarded as the gold standard is the coracoid impingement test. It describes painful clicking in a position of forward flexion and medial rotation of the shoulder in varying degrees of horizontal adduction. As has been demonstrated in cadaveric studies and MRI findings, internal rotation reduces the coracohumeral distance, thus leading to soft tissue subcoracoid impingement. The subscapularis is the tendon most likely to be involved. Forward flexion with internal rotation is a functional position of the shoulder and will readily be identified as a provocative position even before the test is carried out in most patients.

Coracoid impingement is generally treatable once identified. The usual treatment regimen involves a stepwise process encompassing both conservative measures as a first line preference before proceeding to operative intervention in a minority of cases. It is important to remember that a possible overlap with other shoulder pathology may occur even in cases that respond to conventional therapeutic measures for this unusual condition. Most patients, as was seen in this series, will benefit from avoidance of the painful shoulder position, physiotherapy, anti-inflammatories and injections of local anaesthetic into the affected subcoracoid area. Various surgical procedures are documented and have proven successful in those not benefiting from other treatment modalities.

In addition to open surgical decompression of the coracohumeral space with limited coracoplasty, arthroscopic treatment has also been shown to be effective. Assuming that no other significant cause of shoulder pain is present, patients can expect effective relief from symptoms without compromising shoulder function in the long-term. This can be postulated from analysis of follow-up data in this unit and other published series.

**CONCLUSION**

Coracoid impingement syndrome is a relatively rare but well-defined clinical diagnosis that is worthy of consideration in the differential diagnosis of anterior shoulder pain. Further investigation is required to conclusively delineate its pathogenesis. This case series demonstrates the effectiveness of present treatment options once the diagnosis has been established. Clinical detection of the condition
is not unduly difficult when given appropriate consideration by the clinician. A heightened clinical awareness can help avoid undue diagnostic delay in cases where the condition is the primary cause of unresolved anterior shoulder pain.

REFERENCES

Correspondence to: Simon Roche, 50 Carrigeen, Knocknacarra, Galway. Tel: 00353 87 9180248 E-mail: sroche1975@yahoo.co.uk
CASE REPORT

A 74-year-old lady presented with a four-month history of constant severe perianal pain, constipation, bright red PR bleeding, and anal discharge. She had a history of ischaemic heart disease and hypertension. She was on several cardiac medications including aspirin, clopidogrel, amlodipine, doxazosin, lisinopril, and nicorandil. On perianal examination a well-circumscribed 3x4 cm posterior anal ulcer was noted. This was a deep ‘punched out’ ulcer with slough, and visible fibres of the internal anal sphincter in its base (photo 1). The surrounding skin was normal, and the ulcer was remote from pressure points. EUA and ulcer biopsy was performed. Histology revealed fibroadipose tissue with fibrosis and chronic inflammation, but no evidence of granulomata or malignancy. Stains for *Mycobacterium tuberculosis* and *Treponema pallidum* were negative. Colonoscopy and small bowel follow through were normal. Despite treatment with oral laxatives and regular dressings, her severe pain persisted with no evidence of ulcer healing. Defunctioning loop colostomy was performed to address her debilitating anal pain.

Around this time the authors became aware of nicorandil induced anal ulceration; the macroscopic and microscopic features of which are similar to those described in our patient. On this basis nicorandil was discontinued. The combination of faecal diversion and discontinuation of nicorandil resulted in progressive ulcer healing.

**DISCUSSION**

Nicorandil is an oral potassium channel activator with a nitrate component, used as a third line adjunct in the treatment of resistant angina. The potassium activation dilates coronary and systemic arteries, while its nitrate component dilates venous capacitance vessels, thereby reducing both preload and afterload. However, it has been hypothesized that this drug results in a vascular steal phenomenon leading to redistribution of blood at vulnerable sites.

Nicorandil associated anal ulceration was first reported in 2002. Our patient commenced nicorandil 10mg twice daily four years prior to developing anal ulceration, and her dose was increased to the maximal dose of 40mg twice daily ten months before presentation with the ulcer. All reported cases have ulcer morphology similar to that seen in our patient, specifically a deep ‘punched out’ ulcer with well-circumscribed...
edges. Our patient also had severe debilitating pain in common with other reported cases. Histology of this ulcer revealed inflamed epithelium with no evidence of granulation tissue or malignancy and gastrointestinal visualization failed to show other abnormalities. Histological and serological tests for other causes of anal ulceration, namely neoplastic, inflammatory (Crohn’s disease and Behcet’s disease), and infective causes (tuberculosis, syphilis, and HIV) were negative. Schistosomiasis and amebiasis were both excluded on the basis of a negative travel history. Analgesics, laxatives, and local debridement were unsuccessful in either healing the ulcer or relieving the pain, so a loop colostomy was fashioned prior to noting the association between nicorandil and anal ulcerations. This has resulted in complete pain relief and re-epithelialisation of the ulcer. Future cases might best be managed by discontinuation of the medication with cardiology input, reserving surgery for resistant cases only.

**CONCLUSION**

Anal ulceration is a debilitating condition that patients may be reluctant to discuss with their cardiologist, and they are frequently referred to another specialist. Increased awareness of the potential link between nicorandil and anal ulceration may lead to more timely, and less aggressive management, by early modification of anti-anginal treatment.

**REFERENCES**


Correspondence to: Ms. D. McNamara, Consultant General and Colorectal Surgeon, Suite 18, Beaumont Private Clinic, Beaumont Hospital, Dublin 9
Tel: 01-8574885; Fax: 01-8574885
Email: d_mcnamara@eircom.net
Taxane-resistant lymphoepithelial-like carcinoma: Excellent response to VIP chemotherapy

**ABSTRACT**

**Background** Lymphoepithelial-like carcinoma is a rare tumour type. The optimal treatment for this disease is not known. No effective therapies are described in the literature.

**Aims** This report describes a case of lymphoepithelial-like carcinoma and documents a therapeutic strategy which has proved effective.

**Results** The patient was initially treated with a common platinum-based chemotherapy regimen incorporating a taxane (Carboplatin and Docetaxel). Disease stabilization initially occurred but the patient soon progressed. The patient was then treated with VIP chemotherapy and had a complete response.

**Conclusion** VIP chemotherapy appears to be an effective therapeutic strategy in lymphoepithelial-like carcinoma.

**CASE REPORT**

A 29-year-old man presented with a month-long history of left-sided groin discomfort. He was unable to straighten his left leg and had to stoop on walking. He had no 'B' symptoms. Physical examination revealed non-bulky right inguinal lymphadenopathy and fullness in the left flank. Testicular examination was normal. Haematological and biochemical parameters were normal. AFP and bHCG were normal.

Computed tomography (CT) showed invasion of the left psoas muscle and extensive intra-abdominal adenopathy involving the inguinal, iliac, para-vertebral, pre-vertebral and mesenteric nodes (Figure 1a). There was also left-sided hydrenephrosis and hydroureter identified. Positron emission tomography (PET) showed areas of increased uptake of fluorodeoxyglucose (FDG) in the abnormal areas identified on CT (Figure 2a). There were no additional areas of increased tracer uptake identified. Excisional biopsy of the right inguinal node showed lymphoepithelial – like carcinoma.

The patient was commenced on Docetaxel and Carboplatin chemotherapy. After two cycles of therapy, the patient underwent repeat CT scanning. This showed stable disease when compared to his baseline scan. His symptoms, which had initially improved, recurred and he once more complained of back pain on straight leg raising and his posture became stooped. It was decided to alter his chemotherapy and he was commenced on Etoposide, Cisplatin and Ifosfamide (VIP). The patient’s symptoms improved dramatically after cycle 1 chemotherapy. After three cycles of VIP, a restaging CT scan was performed (Figure 1b). This demonstrated resolution of the extensive lymphadenopathy previously identified and disappearance of the hydrenephrosis. The only abnormality was some residual asymmetry of the ilio-pectoral musculature. At this point, the patient reported tinnitus affecting his right ear. Audiometry showed a mild high frequency hearing deficit. For the remaining treatment course, carboplatin was interchanged with cisplatin. The patient received six cycles of VIP chemotherapy in total. At the end of treatment, a repeat CT scan showed persistence of asymmetry in the ilio-pectoral region with no other abnormality. A PET scan was performed which showed no evidence of active disease (Figure 2b). In view of his excellent response to treatment, the patient was referred for consolidation radiotherapy to the para-aortic, psoas, iliac, inguinal, and upper femoral nodal areas and he received 45 Gy in 25 fractions (left dog-leg distribution).

Lymphoepithelial-like carcinoma is a rare tumour type which has been described in multiple sites including uterine cervix, lung, stomach, skin and salivary glands. Its aetiology is unknown, however EBV-encoded RNA transcript has been detected in the lymphoepithelial-like genome of tumour cells from various primary sites. It is possible therefore that Epstein-Barr virus is involved in tumorogenesis. There is scant information in the literature regarding
prognosis and the natural biology of the disease. In an attempt to provide the most effective therapy, we conducted an extensive literature search of searchable databases. However, we were unable to find any case series or even any reference to therapeutic regimens. We commenced the patient on a Taxane/Platinum combination as this is a well-tolerated regimen and effective against a broad range of cancer types. Though the patient had an initial clinical response, he quickly relapsed and VIP chemotherapy was commenced. The rationale behind this choice was that it is an effective regimen in the treatment of germ cell tumours and sarcomas. The patient responded very well to this regimen with resolution of his symptoms and normalisation of his PET scan. The use of consolidation external beam radiotherapy is not supported by any evidence based medicine and was employed here empirically. On last review, eighteen months after completion of treatment, the patient remains in remission.

REFERENCES

Correspondence to:
Austin Duffy, email:austinduffy@hotmail.com
Collecting Duct Carcinoma of the kidney: A case report with variable immunohistochemistry

ABSTRACT

Background Collecting duct carcinoma of the kidney is a rare tumour with distinctive clinical and histopathological features. Management of this malignancy remains a challenge because of advanced stage at presentation and aggressive clinical course.

Aims We describe a case of Collecting Duct Carcinoma with variable immunohistochemistry and review the pathology and management.

Results Our patient died shortly after commencing systemic chemotherapy.

Conclusion Advances in immunohistochemistry have aided in diagnosis of this tumour. Early detection and nephrectomy offer the best chance of cure. Newer chemotherapeutic regimens may improve survival in more advanced disease.

INTRODUCTION

Bellini Duct carcinoma, or Collecting Duct carcinoma (CDC), is a rare and aggressive tumour believed to arise from the distal collecting ducts of the nephron. It has been classified as a variant of renal cell carcinoma by the WHO. It has distinctive clinical and histopathological features, and there have been approximately 100 case reports in the English literature since it was first reported in 1976.

CASE REPORT

A 61-year old man complained of a short history of back pain and fatigue. He had no relevant past medical history. No signs were evident on clinical examination. An irregular 3.5cm cystic lesion was seen on CT in the lower pole of the left kidney, with stranding of adjacent fat (Figure 1). MRI lumbar spine demonstrated a large L4 metastatic deposit with extension into the spinal canal. (Figure 2) PET scan revealed multiple bony metastases only. A biopsy of L4 revealed metastatic adenocarcinoma. Immunohistochemistry was strongly positive for CK20. CK7 and CAM5 were negative. Renal biopsy reported an infiltrating adenocarcinoma in a desmoplastic stroma positive for low molecular weight cytokeratins, with perineural invasion (Figure 3). These tumour cells stained strongly CK7 positive (Figure 5) and there was focal restaining of CK20 (Figure 4). Despite the variation in immunohistochemistry findings, a diagnosis of Collecting Duct Tumour of the kidney with vertebral metastases was made. In January 2005, chemotherapy was commenced. After his second cycle he became profoundly neutropaenic and was treated for MRSA septicaemia. He succumbed to this over a short time.

DISCUSSION

Renal carcinoma accounts for 3% of all adult malignancies, 0.4-2% of which are Collecting Duct Carcinoma. It affects a young population, the mean age at presentation being 55 years.

The majority of patients with CDC will present with stage IV disease, one series reporting a figure of 83%. It is associated with a higher incidence of regional node involvement (50%), distant metastases (67%) and capsular invasion (83%) than other forms of renal neoplasm. Median survival after nephrectomy is 22 months.

The diagnosis of CDC should be considered in those with a rapidly progressive cancer, or a large invasive renal tumour on CT imaging. A biopsy should be performed to distinguish it from other renal neoplasms as the prognosis is dismal despite radical nephrectomy.

The microscopic appearance is non specific, with a duct like or papillary architecture surrounded by a desmoplastic stroma. The columnar or cuboidal shaped cells can give rise to a hobnail appearance. The papillary appearance of the tumour can make it difficult to distinguish from papillary renal cell carcinoma.
Immunohistochemistry has been used to make a more definitive diagnosis in recent times. Staining of lectins such as soyabean, peanut, wheatgerm and Ulex europaeus 1 agglutinins and antibodies to high molecular weight keratins indicate a distal collecting duct origin to these tumours. This is in contrast to most renal cell cancers which express vimentin, and antibodies to low molecular weight cytokeratins. Immunohistochemistry results have not always been consistent, however, and diagnostic confusion can still occur.

Because of its low incidence, CDC does not have a cytogenetic characteristic but a variety of heterogeneous chromosomal alterations unrelated
to other variants of renal cell carcinoma have been reported.\textsuperscript{8,9} It has been postulated that a better understanding of the genetics of this tumour will help explain the biological aggressiveness of most CDCs, while a small subset follow a relatively benign course.

Management of patients with CDC remains a challenge because of the advanced stage of presentation and often aggressive clinical course. Radical nephrectomy and loco-regional lymphadenectomy appears to be curative for organ confined cancer. Long-term disease-free survival has been reported in this setting after treatment with adjuvant therapy.\textsuperscript{6} Several combinations of chemotherapy have been investigated previously for advanced disease and have been found to be ineffective, such as MVAC and vincristine/actinomycin D.\textsuperscript{6} In recent times it has been suggested that CDC may behave more like urothelial than clear cell renal cancer. To investigate this theory a French group used the combination of cisplatin and gemcitabine, known to be effective and well tolerated in patients with transitional cell carcinoma. A complete response was achieved in two patients with metastatic disease.\textsuperscript{5} They have recently reported further success in treating twenty patients with this regimen, resulting in 7.9 and 9.5 months progression free survival and overall survival respectively.\textsuperscript{5}

In conclusion, Collecting Duct Carcinoma is a rare tumour, with an aggressive clinical course. Recent advances in immunohistochemistry have aided immensely in diagnosis. Further studies to investigate the genetic characteristics of the disease will allow better understanding of its biology and classification. Early detection and subsequent nephrectomy appears to offer the best chance of survival. Newer combinations of chemotherapy or targeted therapies may have a greater role in the future.

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Correspondence to: Dr. Roisin M Connolly,
Tel: 00 353 1 6581334; Fax- 00 353 1 4972782
Email- roisinconnolly@gmail.com
Walking on water: The biomechanics of Michael A. MacConaill (1902-1987)

Biomechanics is a subject that draws on knowledge from many disciplines. One of its great practitioners in the last century was the Irish anatomist M.A. MacConaill. In this paper, we review some of MacConaill’s fundamental contributions to biomechanics, namely: the hydrodynamic theory of synovial joint lubrication, the kinematics of joint motion and conjunct rotations; and the theory of spurt and shunt muscles. The aim is to revisit these topics in the light of current research, and to draw some conclusions about the import of his research in the context of recent developments in the field. The paper concludes with a discussion of science in Ireland, the development of the field of biomechanics since MacConaill’s time, and some other matters.

INTRODUCTION

Michael Aloysius MacConaill was born in Ballymena, Co. Antrim in 1902; the eldest of five children; his father was a merchant and his mother was a mezzo-soprano. His family moved to Belfast and Michael attended St Mary’s Christian Brothers School from where, in 1919, he obtained first place in the Queen’s University entrance scholarship examination. The first Dáil had met in Dublin’s Mansion House on the 21st of January in that year and MacConaill joined its “parliamentary army”, becoming a field ambulance officer in Belfast during the War of Independence. At Queen’s, he broke the mould by becoming the first Catholic to be elected to the Students’ Representative Council and to become President of the Literary and Scientific Society. In the Medical School, he was encouraged by the Professor of Anatomy, Thomas Walmsley, to take an intercalated BSc degree and he graduated in Human Embryology and Anthropology with honours in July 1922. He was a clinical student in the Mater, graduating in 1925, and was a house-surgeon there. Walmsley wished to appoint him as an Anatomy Demonstrator and, when this was blocked, Walmsley arranged for a postgraduate scholarship.
He was, however, appointed a Demonstrator in the following year and promoted to Senior Demonstrator in 1928. He was awarded his MSc in July 1928 for a thesis titled “The correlations of length, breadth, and height in forty mixed crania”, and he presented this work to a meeting of the Anatomical Society at Queen’s in 1931 (Figure 1).

MacConaill was awarded the Queen’s University Medical Travelling Studentship for 1929-30 to visit University College, London where he continued his work on statistical anthropology. From there he went to the University of Sheffield, initially as a Senior Demonstrator, but he was promoted to Lecturer by mid-1930. In 1942, MacConaill returned to Ireland to take up the Chair of Anatomy in University College, Cork. He revitalised the Department’s teaching and research, collaborating with Edward Gurr to develop tissue staining methods, with Eric Scher on the geometry of the dental arcades, and applied Boolean algebra to neuronal networks. He was elected a Member of the Royal Irish Academy in 1945 and awarded a DSc by the Queen’s University of Belfast in 1950 and an MA by the National University of Ireland in 1964. In 1950 he took on the role Officer Commanding the Army’s First Field Medical Company, from which he retired in 1967 with the rank of Commandant. Michael MacConaill retired from UCC in 1973 and died in 1987.

MacConaill was one of the most prolific scientists in mid 20th Century Ireland. He published a great number of scientific articles and invited book chapters, and co-authored two highly regarded books: Synovial Joints: Their Structure and Mechanics and Muscles and Movements: A Basis for Human Kinesiology (Figure 2); this latter book also appearing in a second edition. Besides these two books, MacConaill published two comprehensive series of papers on the mechanics of synovial joints, one series in the Irish Journal of Medical Science and another in the Journal of Bone and Joint Surgery. His work on the mode of lubrication in synovial joints is still widely cited and his research into generalised methods for describing and analysing the motion of joints is well known as part of the science of kinesology which is central to medical specialities from orthopaedics and physiotherapy to rheumatology and rehabilitation. It is perhaps an indication of his reputation that he was asked to contribute the chapter on human joints to the 15th Edition of the Encyclopaedia Britannica. MacConaill can be justly seen as one of the pioneering contributors to biomechanics and it is appropriate to revisit and reinterpret his original work in the context of present research. Our aim is not only to draw some conclusions about the importance of his work for the development of the field but also to comment on the inter-relationship between anatomy, biomechanics, and rehabilitation in the wider sense.

RESEARCH IN BIOMECHANICS
SYNOVIAL JOINT LUBRICATION

According to MacConaill’s own recollections he was skimming through a physics textbook in a Sheffield bookshop when he noticed an account of the lubricating mechanism in engineering bearings that reminded him of synovial joints. This led him to theorize on the lubrication of mammalian joints, and develop the concept of ‘hydrodynamic’ lubrication of synovial joints; hydrodynamic lubrication occurs when one surface is slightly inclined relative to another so that, when the surfaces move, a wedge of fluid is trapped and pressurized between them, see Figure 3.

MacConaill claimed that the slight incongruence in the surfaces in synovial joints allows the synovial fluid to be trapped between the cartilage layers as the bones rotate relative to each other. Furthermore, he contended that the menisci of joints did not exist, as had been usually assumed, to “abolish the effects of incongruity between male and female surfaces”, but rather to provide a flexible wedge to allow the joint...
surfaces to maintain the correct relative inclination for hydrodynamic lubrication (Figure 4). This was an ingenious hypothesis and involved a completely new way of thinking about diarthrodial joints and the role of menisci. Later MacConaill followed-up his study of the knee and inferior radio-ulnar joints with an analysis of the acromio-clavicular joint, and of the foot and carpus.

MacConaill’s contribution is acknowledged by Duncan Dowson, the world’s foremost authority on tribology when he states: “MacConaill (1932) studied the structure of joints… and concluded that the mode of lubrication must be hydrodynamic”. MacConaill’s analysis of synovial joint lubrication stood unchallenged for some time. His contribution is often referred to in biomechanics textbooks, and is still widely cited. However, several explanations have now supplanted it, one of which is ‘weeping lubrication’ whereby synovial fluid is exuded by the spongy cartilage to form the fluid layer separating the cartilages – therefore according to ‘weeping lubrication’ the synovial fluid is not dragged between the layers by the relative movement of the surfaces as MacConaill had theorized. MacConaill had a spat with the proponents of weeping lubrication in the journal Nature; he maintained that the source of the fluid layer, though interesting, was a “physiological problem” and that weeping lubrication “appears to complete the existing theory rather than supplant it, and is a valuable addition to our knowledge of biomechanics”. In a subsequent paper, MacConaill presents further arguments in favour of hydrodynamic lubrication. One argument was that the incongruency of the joint surfaces will always permit a layer of synovial fluid to be present except in one localised contact area. However, recent research has made it clear that the relative motion between cartilage layers at human joints is simply not fast enough for hydrodynamic lubrication to act alone. More recently, a theory of elasto-hydrodynamic lubrication has shown that the pressures generated are sufficient to deform the cartilage layers and therefore exude fluid. Furthermore, even more recently, a theory of ‘boosted lubrication’ proposes that when the joint is unloaded the cartilage expands again imbibing fluid and leaving the large hyaluronic acid molecules on the cartilage surface to act as a lubricating gel.

KINESIOLOGY AND THE MECHANICS OF JOINT MOTION

The motion of one bone relative to another at a joint may seem straightforward – it is not. In the most general case we can assume that one bone moves relative to another by translation in three directions and rotation in three directions, i.e. has six degrees-of-freedom. MacConaill begins his analysis by recapitulating the seemingly obvious fact that all motions of one limb relative to another are either spins or a swings. However, a thought-experiment will make it clear that, say, flexion-extension of the lower limb (what one might think of as a swing) involves also spin at the ball-and-socket joint of the hip. Therefore, most motions of joints are composite motions of swings and spins. The next step in the analysis is to define a pure swing; to do this MacConaill draws on the concept of the ‘ovoid-of-motion’: if a bone is rotated into every possible position then the locus of a point on the bone would describe a closed surface – this surface is the ovoid-of-motion (Figure 5). The shape of the ovoid-of-motion depends on the geometry of the articulating surfaces and their degree of congruency.

Any swing that describes a line that is the shortest possible distance between two points on the ovoid of motion (the line would be a ‘great circle’ if the ovoid of motion was a sphere) is defined as a cardinal swing. MacConaill’s insight came from an analysis of a succession of cardinal swings. Consider making, say, three cardinal swings of the upper limb as follows: (i) hold the upper limb by the side, elbow straight,
palm facing the thigh; (ii) flex the shoulder through 90 degrees in the AP plane (the palm faces medially), (iii) swing the upper limb through 90 degrees (the palm faces forward), (iv) lower the upper limb through 90 degrees towards the body (the palm remains facing forward). This succession of three cardinal swings will not have returned the arm to the same position; a consequential motion of external rotation of the arm will have occurred. Naming the closed loop of cardinal swings as diadochal motion (Gr. diadochos, successive), MacConaill noted that any set of three swings that form a closed loop (not just 90 degree swings as in the foregoing example) on the ovoid of motion would result in a net rotation of some magnitude, which he termed a conjunct rotation.

MacConaill worked out the magnitude of the conjunct rotation from first principles and computed the relationship between the degree of conjunct rotation consequent on a diadochal motion. He examined how the articular kinematics depends on the shape of the articulating surface. Furthermore, “the arrangement of articular ligaments... must allow the conjunct rotation imposed on the moving part by the shape of the fixed surface”. If several diadochal motions are carried out in succession, eventually the ligaments will restrain conjunct rotation at the joint. The only way to avoid this is to apply counter-rotations, and this requires counter-rotatory muscle actions. Therefore rotary muscles are brought into play even in pure (i.e. cardinal) swings. MacConaill emphasised the importance of understanding this for rehabilitation and physiotherapy. These concepts, while not generally common knowledge in biomechanics, are invoked as the theoretical foundation of various therapies. Zatsiorsky, a leading biomechanician of the former USSR and now working in Penn State University describes MacConaill’s contribution to articular kinematics in his textbook *Kinematics of Human Motion*, and a recent editorial by Di Fabio concludes “The conceptual and intuitive framework provided by MacConaill many years ago still provides a wonderful anatomical and mechanical conceptualisation for justifying [...] treatments in the clinic”.

**SPURT AND SHUNT MUSCLES**

In an article published in the *Irish Journal of Medical Science* in 1946, MacConaill introduced the concept of spurt and shunt muscles (Figure 6a). The biomechanical basis for the classification may be summarized using the following notation:

- let  be the distance along the stable bone between a muscle’s attachment site and the joint (called the cisarticular length).
- let  be the distance between the joint and the attachment site on the moving bone (called the transarticular length).

Figure 6b shows  and  for the spurt muscle. Taking the spurt muscle and resolving its force into a component perpendicular to the moving bone (denoted ), and a component parallel to the moving bone (denoted ), simple mechanics shows that, when , then will be greater than (for all but extreme extension) whereas the opposite would be the case for shunt muscles with greater component of the force (a centripedal force) being towards the joint which tends to ‘shunt’ the bones together. Spurt muscles need an antagonist but shunt muscles do not. (A complete mathematical treatment is given in MacConaill). Based on the argument that shunt muscles will be required in rapid limb rotations to provide a centripedal force, Basmajian performed electromyographic experiments to confirm the spurt/shunt classification system.

The concept of spurt and shunt muscles is not without its critics, even though it is treated as
settled knowledge in reference works such as Gray’s Anatomy. The modern treatment of this subject focuses on calculation of forces exerted by muscles by assuming an optimization function such as a minimization of muscle stresses.

DISCUSSION

Michael MacConaill was a notably original thinker in biomechanics and an interdisciplinary researcher avant-la-lettre. Though discussion of his personality is, of course, not within our remit yet we note Professor John A. Murphy, in his history of UCC, describes him as: learned, idiosyncratic, redoubtable, erudite. Not only could MacConaill make the fundamental contributions to biomechanics, but he could turn his hand to publishing a ran in the Irish Times to the memory of the Lecky Professor of History in another University.

IN MEMORIAM: EDMUND CURTIS, M.A.

A mhic dhílis d’Eirinn, a chara do cháirdibh Shasana,
A ghíolla na h-éigse do neartuigh le mórshaothar staíre,
A ghóisce na nGoadh: ba chathbhuiileach láidir do bhearta,
’S ag caoineadh do dhéidh-se le gér-ghol atámuíad, a Eamuinn.’

MacConaill’s scientific papers have proved to be enduring contributions to several problems in biomechanics, particularly understanding of the lubrication of synovial joints. However, his more widely published work on the movement of joints has been eclipsed by more rigorous treatments based on control systems theory incorporating the central nervous system as the controller. Nonetheless the concept of consequential movements is still used, it seems, particularly among practitioners. The theory of spurt and shunt muscles has been the subject of some criticism, and rightly so in our opinion. A robust defence is given by MacConaill in the Journal of Anatomy but, from a biomechanical point of view, it is unclear why the moving (i.e. distal) bone should be distinguished from the stationary (i.e. proximal) bone when all movements are relative.

MacConaill was also prepared to make some futuristic speculations in his papers. For example, in his classic 1932 paper referred to above, he studied how collagen fibres are aligned in a stress field; he hypothesised as follows: “as iron filings are to a magnetic field so are collagen fibres to a tension field”. This was a function/form relationship for cartilage, and it anticipated current research on the relationship between the microstructure of tissues and stresses to which they are exposed during growth, a subject that is now seen as central to tissue engineering and regenerative medicine. His theoretical paper on myomechanics concludes with the statement that our neuromuscular circuits are geared to gravity.

It is interesting to note that MacConaill’s early research had been in ethnology. In fact, it seems MacConaill’s first paper was published (when MacConaill was only 21 years of age) on the subject of the ethnology of the people of Rathlin Island. He continued to study ethnology while in Sheffield where he published several papers reporting correlations between hair and eye colour, and stature. However, this kind of research was discontinued in the early 1940s, perhaps because, to quote a modern historian, “it [became] virtually unthinkable for liberal intellectuals (which included most scientists) to operate with this concept [of race]. Indeed many doubted that it was legitimate to enquire systematically into the genetically determined differences between human groups, for fear that the results might provide encouragement for racist opinions”. In this respect it is interesting to note the renewed interest in genotype variations in human populations.

From the early 1930s onwards, MacConaill maintained a research interest in the biomechanics of the locomotor system. He applied a rigorous mathematical approach for each problem he tackled. In this we can see similarities with the work of the Trinity polymath of an earlier generation, the Rev. Samuel Haughton, MD. Haughton also used mathematics to analyse the musculoskeletal system. For both Haughton and MacConaill, mathematics (and particularly geometry) had pride of place among the approaches for understanding the behaviour of biological systems – this was, and is, rather unusual. (However it was not an Irish trait; another Irish anatomist, Abraham Colles declared: “Mathematics applied to the human body is altogether impractical”.)

* O loyal son of Erin, O friend of the friends of England,
O servant of learning fortified by great works of history.
O valiant Gael, great and powerful thy deeds.
And, Edmund, ‘tis keening with bitter tears after you we are.
Herries Davies suggests that the relative lack of success of science in “Free State Ireland” was because the people were “too introspective to display much enthusiasm for the thoroughgoing internationalism basic to science – too concerned with Irish language revival and literary censorship to be aware of the momentous developments taking place elsewhere”.

It is interesting that Herries Davies would make such a speculation and the impetus for him to do so is perhaps worthy of investigation in itself; but, in the one case we have before us, MacConaill was both a language enthusiast and an internationalist – his books were translated into several languages, and he was a founding member of the International Society of Electrophysiology and Kinesiology (see Figure 7) – a society which is very active today. Perhaps the explanation does not lie in the introspection of the people, but in the lack of funding for research prevented the continuity essential to building up research strength within the universities. Today research in biomechanics is inter-institutional, inter-disciplinary, and international in a way that was not possible in MacConaill’s time. It is inspiring to have Irish names of the reputation of Michael MacConaill to number among the founders of the field.

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Figure 7 — During the International Congress of Anatomy in Wiesbaden, Germany in the Summer of 1965, “several anatomists gathered for a luncheon to discuss the organization of a small society in electrophysiological kinesiology. They were J.V. Basmajian of Canada, S. Carlsøø and B. Jonsson of Sweden, M.A. MacConaill of Ireland, and J. Pauly and L. Scheving of the USA. On that date, on August 13, 1965, this group agreed to found ISEK, the International Society of Electrophysiological Kinesiology. There and then Dr. Scheving took a photograph of the birth of ISEK which appeared on the cover of the June 1973 Newsletter” (see http://www.isek-online.org/history.html). MacConaill is in the centre.


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The burning of Bridget Cleary: Psychiatric aspects of a tragic tale

ABSTRACT

Background Bridget Cleary was brutally burned to death by her husband in the presence of her father and several close relatives in rural Ireland in 1895. The story has attracted public attention for more than a century now, for numerous reasons.

Aims The issue of psychiatric illness in this tragedy, and the role of fairy mythology in belief systems in 19th Century rural Ireland are reviewed, particularly in relation to providing explanations for physical and psychiatric illness, along with learning disability.

Methods Reference was made to a wide range of sources featuring the burning of Bridget Cleary.

Results There is some evidence to suggest that the actions of Michael Cleary and other key protagonists were influenced by Capgras syndrome and folie a plusiers.

Conclusions Delusional belief in fairy mythology may have coloured the psychological make-up, motivations and behaviour of some of the people involved in the killing of Bridget Cleary.

'Are you a witch or are you a fairy, Or are you the wife of Michael Cleary?'
(Childrens' nursery rhyme)

Bridget Cleary (nee Boland) was brutally burned to death by her husband, in the presence of her father and several other close relatives, in the kitchen of her small cottage in rural Tipperary in 1895. She was twenty-six years old at the time of her death and worked as a dress-maker. Her husband was thirty-five and worked as a cooper; they had been married for seven years and had no children.

The story of Bridget Cleary’s death, sometimes mistakenly referred to as the last witch-burning in Ireland, has from the outset excited both scholarly interest and the interest of the general public in this country and further afield. A recent RTE documentary and a feature film proposed for 2006 has again brought this story to public attention.

Bridget Cleary had been unwell, possibly with bronchitis or pneumonia and an associated delirium, for the two weeks prior to her death. Testimony in court from the key witnesses to her killing suggested that Michael Cleary became convinced during her illness and, possibly, in the months beforehand, that his wife had been abducted by the fairies, and that they had left a changeling in her place. He seems to have been supported in this view by Jack Dunne, a local storyteller or seanchai and cousin of Bridget Cleary. Dunne was an expert in fairy mythology and some locals believed that he had himself ‘spent time with the fairies’ in the past. Other members of Bridget Cleary’s family also appear to have colluded with the story of fairy possession to a greater or lesser extent, and cooperated with Michael Cleary in performing several rituals and administration of herbal medication to his wife in the days leading up to her death.

Michael Cleary consulted a priest, doctor and two local herbal medicine experts in the days prior to killing his wife, in efforts to help her. Several days of ritualised cruelty, involving forced administration of herbal medicines, threatened burning and interrogation as to her true identity ended when Michael Cleary doused his wife with paraffin oil and burned her to death. Bridget’s father, aunt and three of her first cousins were present in the small house at the time of her death but later claimed they were so intimidated by Michael Cleary that they could not intervene to stop the worsening violence in the days leading up to this. After killing his wife, Michael Cleary claimed that he had killed only a fairy changeling and, as a result, his real wife would be returned to him within three days. Following her death and burial by himself in a shallow grave near their home, he waited for three consecutive nights at a nearby ancient ring-fort or ‘fairy-fort’, apparently in wait for her return to him.
In the subsequent trial he was found guilty of manslaughter and served fifteen years of a twenty-year prison sentence before emigrating to Canada. Bridget Cleary’s father, Patrick Boland, and her cousins Jack Dunne, Patrick and Michael Kennedy were found guilty of lesser crimes for their roles in her death and the concealment of her body.

**PSYCHIATRIC ASPECTS**

Michael Cleary was undoubtedly sleep deprived, agitated and distressed in the days prior to killing his wife. In a petition to the Lord Lieutenant written by him in 1905, appealing for part of his sentence to be remitted, he wrote: ‘Petitioner (i.e. Michael Cleary) attended to the wants of his wife during her illness both night and day until he was in a manner just as bad as deceased’.

He went to considerable lengths to arrange that Mass be said in his cottage to help his wife. He also arranged for the local doctor to call and assess his wife. Most controversially of all the aid he sought, he acquired herbs from a local ‘herb doctor’ and went to considerable lengths to make his wife take them, along with boiled ‘new’ milk or ‘beestings’ (i.e. the milk first produced by a cow after calving, thought to have curative properties). Micheal Cleary’s father also died during this time and he did not leave tending his sick wife to attend the wake or funeral.

In this stressful context, it is possible that Michael Cleary may have developed a brief psychotic episode around the time he killed his wife. There is no evidence to suggest that he had a history of psychiatric illness prior to or subsequent to killing his wife, but his mental state and psychiatric history was not formally assessed as part of the investigation into her death.

The particular phenomenology of such a psychotic state may be described as the Capgras syndrome. First described by Capgras and Reboul-Lachaux in 1923, the Capgras syndrome involves delusional misidentification of a person or people, usually someone who has close emotional ties to the patient. While the form of this phenomenon is a delusion, the content is culture-dependent. For example, a present day manifestation may involve the development of a delusion that an extraterrestrial impostor has replaced the person in question. The patient will often acknowledge the similarities in physical appearance between their loved one and the impostor, but they may perceive minor and telling differences.

For Michael Cleary, the cultural context was that of 19th Century working-class rural Ireland where belief in fairy mythology and a plethora of associated superstitions was still strong in many places. Therefore (assuming that he was psychotic), for Michael Cleary to become convinced that his wife was actually a changeling left by the fairies would not have been a surprising manifestation of Capgras syndrome.

It has also been suggested that Michael Cleary, who was a stronger and more dominant character than the others involved, may have induced some of them to share in his delusional beliefs. This phenomenon has been described as ‘folie a deux’ or, when more than two people are involved as in this case, ‘folie a plusiers. It may in part explain the actions of Bridget Cleary’s father and male cousins who cooperated with her husband in holding her down, forcibly giving her herbs and milk and interrogating her as to her true identity in the days leading up to her death.

Furthermore, it is possible that delusional misidentification and fairy possession may have been suggested to Michael Cleary by the comments of Jack Dunne (‘That is not Bridgie Boland’), whose expertise in the area of fairy mythology was acknowledged in the local community.

A less likely possibility is that Michael Cleary was fabricating psychiatric symptoms both before and after killing his wife, in an effort to avoid the charges of murder or manslaughter.

The possibility that the some of the key protagonists in this tragedy may have had learning disabilities has never been explored. The presence of learning disability might explain in part why fairy mythology was invoked so readily by some of them to explain events. Michael and Bridget Cleary were both literate and had their own trades, so they were unlikely to be disabled. Jack Dunne, however, who was illiterate and whose limp and short stature were likely to be vestiges of childhood polio, may have had a learning disability and this may have been a factor in his enthusiasm for fairy mythology.

Angela Bourke’s masterly review of this case also raises other psychiatric aspects relating to the treatment of people with both psychiatric illness and learning disabilities in 19th Century Ireland. Bourke cites other examples of perceived fairy possession and burning in rural Ireland, involving children with physical deformities or mental retardation. She argues...
that fairy mythology may have been used to provide a rationale for such conditions, which may have been puzzling and difficult to accept for parents and other family members. At a more sinister level, fairy mythology may have been consciously used to justify both ambivalent feelings towards and cruel treatment of people who were different from the norm.

Bourke also highlights the stark contrast between the rapid advances in science, technology, literacy and the organization of society that was taking place in 1895 (a year that saw the discovery of X-rays and the first cinema shows) and the more traditional society of the Clearys and their relatives, based as it was on oral history and traditions such as fairy mythology. Transcultural psychiatry did not then exist as a discipline, but if it had it might have shed some light on the sociocultural context of Michael Cleary’s beliefs about his wife’s fairy possession.

CONCLUSIONS
The burning of Bridget Cleary was undoubtedly a gruesome tragedy, yet it has fascinated people for over a century now, for different reasons. Political opponents of the Home Rule movement in Ireland at the time used the story to suggest that the Irish were incapable of self-government. Writers and folklorists such as Lady Gregory and William Butler Yeats were drawn to the fairy-mythology aspects of the story. Only in more recent years has the story attracted the attention of psychiatrists.

As Michael Cleary and the other people involved in Bridget Cleary’s killing were never formally psychiatrically assessed, an article such as this can only speculate on their psychological make-up and the role, if any, of psychiatric illness on their actions. Nevertheless, this story is useful in highlighting how a distinctly Irish sociocultural context may have coloured psychological make-up, motivations and behaviour in a time not long before the increasingly globalized Ireland of today.

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Correspondence to: Henry O’Connell, Tel: 061-452971 Email: hpoconnell@yahoo.ie
Autism, Brain, and Environment

Richard Lathe
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The author of this book Richard Lathe has a background in brain research, neuroscience research, as well as industrial research. In the book he moves from diagnostic issues to the genetic contributions to autism. Then he discusses prevalence of autism and proposes an additional element from the environment i.e. that the limbic brain is damaged by environmental toxins including heavy metals. Controversially he suggests that this accounts for the increasing diagnosis of autism are not just due to changes in diagnostic criteria or greater awareness of the condition which most of us believe. He discusses in considerable detail the physiological changes in the body, which affect the brain and behaviour. These matters are discussed in much greater detail and with much greater expertise than in other books on autism. For that very reason this is an original book on autism. Many books on autism don’t cover or cover in minimal detail the material that he covers. For that reason this is a significant addition to anybody’s autism library and would be of interest to all those professional and lay people with an interest in autism. For the lay person there are abbreviations and a glossary at the end which is most helpful. This glossary will considerably extend the targeted readership for the book. He deals with many issues which parents ask clinicians but clinicians wouldn’t be in a position to answer because the majority of clinicians don’t have his understanding of basic science. His hypotheses are of great importance because there is still much that we don’t know about autism and autism is a condition with genetic and environmental inputs. Clearly the major strength of the book is on the environmental inputs to autism. There is no doubt that there are gastrointestinal tract problems in autism but these are given minimal attention in books on autism. This is corrected in this book. When I received this book to review I already had my copy of it and had read it in advance of the request to review it. I had already recognised the importance and the uniqueness of the book. The references in the book are exhaustive and indeed take up 59 pages. This makes the book very useful to postgraduate students, to researchers in autism, and anybody who wants to pursue their knowledge to a deeper level.
Clinical Practice, American College of Physicians Guidelines and US Preventative Services Task Force Recommendations

American College of Physicians
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Edited by Vincenza Snow, MD

The background to this book is that in 1981 the American College of Physicians received a three-year grant to develop a programme called the "Clinical Efficacy Assessment Project". This project aimed to review the clinical literature on specific topics so that they may best identify the best scientific papers, then reanalyse, reformulate and present information on these to practitioners so that they could readily determine the use of diagnostic tests, procedures and treatments.

The latest outcome from this project which has continued through to the current time is a synopsis of clinical guidelines which cover the management of several chronic diseases and in a separate section appropriate use of antibiotics in respiratory tract infections and a further section of screening and prevention of several chronic conditions.

In general this evidence based practice guideline book has many valuable benefits which would make it an attractive proposition for any Physician in practice. The most important being that these are practical evidence based guidelines on important topics. The consensus printed is a joint opinion of several of the world leading authorities and thus is of a sound nature and maturely conceived. Another advantage to this book is that it is written in a uniform style with careful editing and in addition the papers whilst concise are quite pithy in nature. It is a particular aim of the clinical practice guidelines to take on difficult areas of management, for example, management of newly detected atrial fibrillation. I found this chapter and that on the management of Type II diabetes and the pharmacological treatment of acute major depression particularly valuable.

I would recommend this book whole-heartedly to anybody in clinical practice dealing with such common clinical issues.
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