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ORIGINAL ARTICLE

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A study of male patients with forearm fracture in Northern Ireland

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Abstract Osteoporosis, although considered less common, still occurs in men. We present a cross-sectional study of a group of Northern Ireland men with low-trauma forearm fractures to determine the presence of osteoporosis and screen for secondary causes of low bone mineral density. Male patients aged 30–75 years, presenting with distal forearm fracture in 2000–2001 in Northern Ireland, were identified through a Colles fracture database. A total of 37 subjects consented to have bone mineral density measurements undertaken at the femoral neck, spine and forearm using a Lunar expert bone densitometer. Twenty-seven percent of the men had osteoporosis at the spine, femoral neck or forearm, as defined by a bone mineral density score of less than −2.5. We also found that 49% of patients had vitamin D insufficiency or deficiency, 27% had low serum testosterone, 14% had abnormal liver function test results, and 14% had raised parathyroid hormone. Only one patient received advice or treatment regarding osteoporosis at the time of fracture. Increased awareness of male osteoporosis and the need for screening for potential secondary causes in this group of patients is required, both at primary and secondary care level.

Keywords Colles fracture · Male osteoporosis

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Introduction

Osteoporosis is common among the growing population of older men, with almost 20% of men over 50 years of age having osteoporosis of the hip, spine or wrist [1]. In men, as in women, the incidence of hip fractures increases exponentially with age although the increase begins approximately 5 to 10 years later [2]. The degree of prevalence of distal forearm fractures or Colles' fractures in men is lower than in women (2.5 vs 14%) [3, 4]. Colles fractures can be a marker of underlying osteopenia or osteoporosis, with increases of two to three times of the expected rate of subsequent vertebral or hip fracture in comparison to the general population [5–8]. Bone density measurement and treatment of osteoporosis, where appropriate, should be undertaken after a low-trauma fragility forearm fracture [9, 10], but this is often not undertaken [11–13]. The mortality associated with osteoporotic fractures is higher in men than in women [14–16]. In addition, men are even less likely than women to be evaluated or to receive anti-resorptive treatment after a hip fracture (4.5 vs 49.5%, respectively) [15, 17]. Primary osteoporosis is common in women, occurring primarily due to an imbalance in oestrogen, but secondary causes can

be identified in up to 55% of men [18–20], thus leading to further treatment strategies.

In view of the poor investigation and treatment of male osteoporosis, we performed a cross-sectional study of a group of men from Northern Ireland with low-trauma forearm fracture to establish the current provision of treatment and to document the prevalence of secondary causes.

Materials and methods

From 1997 to 1998, the Northern Ireland Colles database was set up. The results on the female Colles fracture group were already reported [21].

Male patients aged 30–75 years, presenting with distal forearm fracture in 2000–2001 in Northern Ireland, were identified. Ethical approval was obtained for the study from the Ethical Committee of The Queen's University of Belfast. Fracture subjects were identified from accident and emergency records, fracture clinic attendance and radiology records. Subjects were deemed to have a low-trauma fracture if the injury occurred from a fall from standing height or less. Following written informed consent, an osteoporosis specialist nurse obtained information on risk factors for osteoporosis. The information was gathered on a standard proforma including demographic details, alcohol intake, dietary calcium intake, smoking history, falls in the preceding 6 months, fractures, patient education after attendance at a clinic and medication.

Bone mineral density measurement (BMD) of the lumbar spine (L2–L4), neck of femur (femoral neck region) and non-dominant forearm (radius total region) were measured in grams per square centimeters by dual energy X-ray absorptometry using a Lunar Expert Bone Densitometer. The T-score reference population for each region was the UK male reference population supplied by the manufacturer. Subjects were categorised using the World Health Organization recommendations, at each region of interest, as normal if bone mineral density was above −1 standard deviations (SD) of the young adult mean, as osteopenia if between −1 and −2.5 SD and as osteoporotic if below −2.5 SD [22].

The following blood investigations were undertaken in each patient: liver function tests, bone profile, full blood picture, hormone profile including testosterone, parathormone, vitamin D and coeliac screen.

Results were analysed using the Statistical Package for Social Sciences (SPSS).

Results

A total of 37 male subjects, aged 30–71 years with low-trauma forearm fracture, were identified in 2000 and 2001 throughout Northern Ireland. Table 1 shows the patient characteristics. All subjects attended for BMD measurement. A comparison of the prevalence of osteoporosis in those above and below the age of 60 years is outlined in Table 2. Overall, a total of ten (27%) subjects was osteoporotic at one or measured sites, of which only one patient was on treatment (calcium supplement).

Risk factor collection revealed that 37% were current smokers, 8% were current or previous corticosteroid users, 8% had fallen within the previous 6 months and 68% consumed alcohol, with 30% admitting to over 20 units of alcohol per week.

At the time of attendance at the fracture clinic, only one patient received advice regarding osteoporosis and treatment, and none of the patients received advice on fall prevention.

Table 3 outlines the results of investigation for secondary causes of osteoporosis. Ten (27%) patients had low serum testosterone (mean 5 nmol/l; range 1–11 nmol/l; normal laboratory range 12–30 nmol/l). Five (14%) patients had significantly abnormal liver function test results (alkaline phosphatase and gamma glutamyl transferase > twice the upper limit of normal or aspartate aminotransferase and alanine aminotransferase >100 U/l). One of these five patients had an isolated raised alkaline phosphatase (153 U/l; laboratory normal range 45–105 U/l). However, they had normal serum vitamin D and parathormone levels. Five (14%) patients had raised antibodies indicative of coeliac disease (IgA Anti-gliadin Ab, IgA Anti-transglutaminase Ab and IgA Anti-endomysial Ab); however, none of these patients has undergone biopsy to prove this finding. Five (14%) patients had high parathormone (mean 178 pg/ml; range 92–498 pg/ml; normal laboratory range 10–85 pg/ml) and 18 (49%) had evidence of low serum vitamin D levels. No patient had abnormal levels of serum corrected calcium (normal laboratory range 2.2–2.6 mmol/l) or serum phosphate (normal laboratory range 0.8–1.4 mmol/l).

Discussion

We have shown in this cohort of male patients, presenting with a low impact fracture, that a significant proportion

Table 1 Characteristics of subjects with low trauma forearm fracture (n=37)

Mean age (years)	54
Age range (years)	30–71
Mean BMI (kg/m^2)	26.8
Number of patients (%) with previous fracture	
Hip	1 (2.7%)
Spine	1 (2.7%)
Forearm	2 (5.4%)
All fractures	4 (11%)
Median spine T-score (range)	−1.081 (−4 to 2.1)
Median spine BMD g/cm^2 (range)	1.110 (0.766 to 1.493)
Median hip T-score (range)	−1.391 (−3.2 to 0)
Median hip BMD g/cm^2 (range)	0.889 (0.649 to 1.089)
Median forearm T-score (range)	−0.981 (−4.9 to 2)
Median forearm BMD g/cm^2 (range)	0.553 (0.34 to 0.726)

Table 2 Prevalence of osteoporosis (T-score less than −2.5) by age group and measurement site

Measurement site	Age <60 years *n*=25	Age >60 years *n*=12	All subjects *n*=37
Hip	2 (8%)	2 (17%)	4 (11%)
Spine	4 (16%)	2 (17%)	6 (16%)
Forearm	3 (12%)	4 (33%)	7 (19%)
Hip or spine	5 (20%)	3 (25%)	8 (22%)
All sites	1 (4%)	1 (8%)	2 (5%)
Any site	6 (24%)	4 (33%)	10 (27%)

have osteoporosis at one of three sites and that secondary causes are common.

Bone mineral density measurements have been widely used in women to identify those with osteoporosis; however, there remains some uncertainty on how to interpret BMD in men, and few prospective studies exist on the relationship between BMD in men and fracture risk. The current World Health Organization definition of osteoporosis relies on a T-score of less than −2.5 and this is widely used in clinical practice and in research. This definition, however, applies to Caucasian post-menopausal women, and BMD criteria for men are still debated. Some investigators have suggested that the −2.5 T-score criterion may not be appropriate for men and that perhaps a T-score of less than −2 should be adopted [23]. If we apply this rule to our cohort, the number of men with osteoporosis at one of three sites would change from 27 to 51%, which is a considerable increase.

Despite numerous therapies having a licence for the treatment of osteoporosis in women, in men there are fewer options. Alendronate is currently the only licensed bisphosphonate in the UK for the treatment of male osteoporosis, and human recombinant parathyroid hormone (teriparatide) has no male license in the UK, despite good clinical evidence for its efficacy in men [24, 25].

Patients at greatest risk of an osteoporotic fracture are those subjects who have already sustained a fracture [26], and in our cohort, 11% of patients had a history of previous fracture. It is already known that a fracture at any site, independent of bone mineral density, is associated with a twofold increased risk of subsequent fracture at the same or another site [27]. Despite these facts, only one of our patients had received any form of treatment or advice for osteoporosis (calcium and vitamin D), and no patient received advice on fall prevention. These results may reflect the busy working environment of the fracture clinics; however, a patient's first attendance at a fracture clinic should be an opportunity to assess further fracture risk and to enable interventions to be introduced for secondary fracture prevention. A fracture liaison service, similar to that in Glasgow [28], has now been established in Belfast to identify and treat at risk patients [29].

Reported estimates of the prevalence of secondary osteoporosis in men vary considerably but have approached 70% in some studies [30–32]. These studies have come from specialist centres and, therefore, may overestimate the true prevalence. In routine clinical practice, the percentage of cases of osteoporosis in men that can be attributed to secondary causes is probably less than 30% [33]. In this cohort, although small, 84% of patients had evidence of an underlying condition that could predispose to poor bone health.

Hypogonadism, which has a clear pathological basis and is associated with clinical signs and symptoms, has a clear detrimental effect on bone health that can be alleviated by the administration of exogenous testosterone [34, 35]. The effect of an isolated low serum testosterone not accompanied by clinical evidence of hypogonadism on bone health is less clearly defined. In our cohort, 27% of patients had a low serum testosterone, but there was no record of appropriate clinical signs or symptoms that could be related to hypogonadism. There remains no clear evidence that treatment of this group of patients with testosterone will improve their bone mineral density. However, one study has suggested that, in those patients with the lowest serum testosterone (<6.9 nmol/l), testosterone replacement increases spinal bone mineral density by 5.9% when compared to placebo [36]. Seven of our patients had a serum testosterone <6.9 nmol/l, and testosterone replacement in these patients may be beneficial.

Fourteen percent of patients had significantly abnormal liver function test results, and overall, 38% of patients had some abnormality in their liver functions. All patients with abnormal liver function tests results admitted to consuming alcohol, and similarly, the five patients with significantly abnormal liver test results came from the group who consumed >20 units of alcohol per week. Alcohol intake is inversely associated with bone mineral density in men [37], and osteoporotic fractures are common in men who abuse

Table 3 Results of investigations for secondary causes in male subjects with low-trauma fracture (*n*=37)

Investigation	*N* (%)	Mean (range)	Normal Mean (range)	Laboratory reference range
Low testosterone	10 (27%)	5 nmol/l (1–11 nmol/l)	14.8 nmol/l (12–30 nmol/l)	12–30 nmol/l
High parathormone	5 (14%)	178 pg/ml (92–498 pg/ml)	46 pg/ml (14–83 pg/ml)	10–85 pg/ml
Vitamin D level (nmol/l)				
Deficient ≤25	5 (14%)			
Insufficient 26–50	13 (35%)			
Normal 51–100	19 (51%)			

alcohol [38]. Similarly, cigarette smoking has been shown to have a detrimental effect on bone health in men [37]. Alcohol and cigarette smoking are modifiable lifestyle factors that could be changed through the appropriate education and support.

The high prevalence of coeliac disease in Northern Ireland has already been established with 6.2% of random subjects from a cross-sectional study having evidence of the disease [39]. Although not biopsy-proven, the higher number of patients (14%) with positive serology for coeliac disease in this cohort would indicate the importance of screening for coeliac in this group of patients. Both liver disease and coeliac disease can result in osteomalacia, due to disruption in the metabolism and absorption of vitamin D, respectively. Measurement of bone mineral density cannot discriminate between osteoporosis and osteomalacia; however, none of our patients had abnormal serum levels of calcium or phosphate, making the diagnosis of osteomalacia less likely. However, for a definitive diagnosis of osteomalacia, a bone biopsy would be required.

A considerable number (49%) of patients had a vitamin D concentration classed as insufficient or deficient (Table 3). Vitamin D status is of increasing interest with regard to bone health, with calcium homeostasis critically dependent upon 25 hydroxyvitamin D (25OHD) metabolism. Vitamin D is important in maintaining bone mineral density and neuromuscular function, both of which contribute to a patient's fracture risk [40]. Recent evidence has suggested that 25OHD levels at the lower range of 'normal' can lead to impairment in calcium absorption [41]. Thus, these patients should be identified and targeted with appropriate supplements.

In this cross-sectional study of men who presented with a low-trauma forearm fracture, we have discovered that a significant number had osteoporosis and risk factors for poor bone health. The main contributing risk factors would appear to be excessive alcohol consumption, positive coeliac serology and insufficient vitamin D status. This can be confirmed with future case control studies. Identification of this high-risk group through the introduction of specific-care pathways can hopefully lead to earlier and more appropriate screening and therapy.

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