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The outcome of fractures in very elderly patients

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We compared case-mix and outcome variables in 1310 patients who sustained an acute fracture at the age of 80 years or over. A group of 318 very elderly patients (≥ 90 years) was compared with a group of 992 elderly patients (80 to 89 years), all of whom presented to a single trauma unit between July 2007 and June 2008. The very elderly group represented only 0.6% of the overall population, but accounted for 4.1% of all fractures and 9.3% of all orthopaedic trauma admissions. Patients in this group were more likely to require hospital admission (odds ratio 1.4), less likely to return to independent living (odds ratio 3.1), and to have a significantly longer hospital stay (ten days, p = 0.01).

The 30- and 120-day unadjusted mortality was greater in the very elderly group. The 120-day mortality associated with non-hip fractures of the lower limb was equal to that of proximal femoral fractures, and was significantly increased with a delay to surgery > 48 hours for both age groups (p = 0.04). This suggests that the principle of early surgery and mobilisation of elderly patients with hip fractures should be extended to include all those in this vulnerable age group.

About 23% of all fractures occur in patients over the age of 75 years, the majority of which involve the proximal femur.1 Only one study has described the epidemiology of fractures in very elderly patients, aged 90 years or more.2 Most of the literature focuses on fractures of the proximal femur, which have a major impact on the patient, their family, and social and other healthcare services. When the figures are adjusted for age and gender, these patients have an increased mortality rate compared to the general population.3 Their outcome deteriorates with increasing age and mortality increases, and the patient is less likely to mobilise and return to independent living.4 It is unknown whether these outcomes relate to all fractures in the elderly.

It is predicted that the elderly population will increase over the next decade in Western society.5 It is anticipated that the Scottish population aged 75 years and over will increase by 81% by 2031.6 Currently, extremely old patients represent a small subgroup of those presenting with fractures, but they account for nearly 8% of those needing acute orthopaedic trauma surgery2 and are accordingly expected to form a greater proportion of the trauma workload in future. This will place a major burden on medical resources, both acutely and in terms of continuing care.7,8

The term ‘super-elderly’ has been used in orthopaedics for trauma patients to describe those either > 80 or > 90 years old.9,10

We present the epidemiology and outcomes of fractures in this group. The implications of our results for future healthcare of this growing population are discussed.

Patients and Methods

All patients with non-spinal fractures, both inpatients and outpatients, who presented to The Royal Infirmary of Edinburgh between July 2007 and June 2008 were analysed. The hospital receives all adult orthopaedic trauma cases from the City of Edinburgh, Midlothian and East Lothian, from which previous epidemiological studies have been reported.1,2 However, the hospital also treats patients from other parts of central Scotland, and in this study all patients who were managed as in-patients were included. A standard core dataset consisting of patient demographics, date of injury, hospital admission, and type and mechanism of fracture was collected prospectively by a dedicated trauma fellow (SAA).

All patients aged ≥ 80 years were analysed. A retrospective review of case notes and the hospital patient database was carried out for all inpatient admissions, and the patients’ residence, mobility, comorbidities, length of stay, fracture...
management, time to theatre (if applicable) and place of discharge were recorded. Nursing home residents were not included in the length of stay analysis as these patients already had a maximum care package in place, and we felt that this might conceal a true delay in their time to discharge. Data on mortality at 30 and 120 days after injury were obtained from the General Register Office for Scotland.11

**Patients.** Two groups were compared: the elderly, defined as being 80 to 89 years of age; and the very elderly, defined as 90 years of age and over. The epidemiology and outcomes of these groups were compared. The mean age of patients in Scotland who sustain a hip fracture is currently 83 years,12 and therefore an 80- to 89-year-old age group was thought to be sufficiently representative of our typical elderly fracture population to enable valid comparisons.

**Statistical analysis.** Variables were studied in two groups: 1) case-mix variables included age, gender, pre-fracture mobility, pre-fracture residence, comorbidity and fracture type; 2) outcome variables included operative management, time to theatre, length of hospital stay (excluding nursing home residence), place of residence at 120 days post-fracture if the patient lived at home, and 30- and 120-day unadjusted mortality rates. The most common fractures (n ≥ 5) were divided into four cohorts (upper limb; lower limb excluding hip; pelvis; and proximal femur) to allow comparison of operative intervention, time to theatre and mortality for similar fractures between the two groups. A chi-squared test was used to compare the unadjusted frequencies of case-mix and outcome variables between the two groups. The outcomes in the groups were then compared using a multivariable regression model to control for differences in case-mix variables between groups, including comorbidities, gender, the type of fracture, pre-fracture mobility and pre-fracture residence. A Mann-Whitney U test was used to compare mean time to operative intervention and length of stay between the two groups. A p-value ≤ 0.05 was deemed to be statistically significant.

**Results**

A total of 7701 fractures were prospectively recorded. Patients aged ≥ 80 years accounted for 1310 fractures (17.0%) and 986 hospital admissions, 33.7% of all acute orthopaedic trauma admissions (Table I). Excluding hip fractures, all of which were admitted, the very elderly group were more likely to be admitted to hospital for their injury (odds ratio (OR) 2.1, p < 0.001, after adjusting for other case-mix variables). In the very elderly group the mean age was 93.0 years (90 to 102, SD 2.2), compared with 84.2 years (80 to 89, SD 3.4) in the elderly group.

There were significant differences in case-mix variables between the groups (Table II). The very elderly patients were less likely (OR 3.0, chi-squared p < 0.001) to live in their own home and less likely (OR 4.5, chi-squared p < 0.001) to be independently mobile. There was no significant difference in the distribution of gender between the two groups (OR 1.0, chi-squared p = 0.94). The presence of dementia was significantly more common in the very elderly group (OR 2.4, chi-squared p = 0.0001).

The very elderly group were more likely to have sustained a fracture of the proximal femur (OR 1.4, chi-squared p = 0.01) or pelvis (OR 1.7, chi-squared p = 0.05), but less likely to have sustained a fracture of the distal radius (OR 1.8, chi-squared p = 0.003) or finger (OR 2.0, chi-squared p = 0.07).

Table III shows the number of patients in each cohort of site of fracture and the proportion of those who needed surgery. Patients in the very elderly group who sustained a fracture of the upper limb (proximal humerus and distal radius) or proximal femur were more likely to be managed non-operatively (OR 4.1, chi-squared p = 0.006 and OR 2.4, chi-squared p = 0.03, respectively). Very elderly patients with more than two comorbidities were less likely to be treated operatively (OR 2.1, chi-squared p = 0.02). Poor cognition increased the likelihood of non-operative management, as patients with dementia were less likely to undergo surgery (OR 4.8, chi-squared p < 0.001). However, very elderly patients who lived at home were more likely to be treated operatively (OR 3.2, chi-squared p = 0.01), which may reflect an increased functional demand.

Overall, the elderly group had a significantly better unadjusted survival rate at 120 days (Table IV, Fig. 1). The 120-day survival rates for fractures of the hip and lower limb in both the elderly and the very elderly were not significantly different (83.1% versus 86.7%, chi-squared p = 0.53; and 71.5% versus 71.1%, chi-squared p = 0.8, respectively).

The mean delay in getting to theatre differed significantly between the cohorts (excluding the pelvic fracture group, as no patient underwent operative management). The mean time to theatre for fractures of the proximal femur was

### Table I. Number of fractures and in-patient admissions for both groups (percentages given are for that age group)

<table>
<thead>
<tr>
<th>Age group</th>
<th>Elderly</th>
<th>Very elderly</th>
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<tbody>
<tr>
<td>Total</td>
<td>992</td>
<td>318</td>
</tr>
<tr>
<td>In-patients (%)</td>
<td>717 (72.3)</td>
<td>269 (84.6)</td>
</tr>
<tr>
<td>Hip fractures (%)</td>
<td>408 (41.7)</td>
<td>158 (49.7)</td>
</tr>
<tr>
<td>In-patients without hip fractures (%)</td>
<td>309 (31.1)</td>
<td>111 (34.9)</td>
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1.8 days (1 to 6), for lower-limb fractures 2.4 days (1 to 6) and for upper-limb fractures 4.3 days (1 to 9), which was significantly longer (Mann-Whitney U test, p = 0.003). Subgroup analysis of 120-day mortality showed that both elderly and very elderly patients in the lower-limb fracture group who underwent surgery within 48 hours of admission were more likely to survive (OR 6.3, chi-squared p = 0.008 and OR 10.5, chi-squared p = 0.04, respectively).

Only 58.4% of the very elderly patients who survived and had lived independently before their injury returned to their original address after discharge, compared with 81.3% of the patients in the elderly group (OR 3.1, p < 0.001) (Table IV). The very elderly group were also more likely to need transfer to a rehabilitation ward prior to discharge (OR 8.7, p = 0.004).

There was a significant difference in the mean total length of hospital stay (including subsequent rehabilitation and/or acute ward stays) between the groups (32.1 days (2 to 103) versus 22.6 days (3 to 98); Mann-Whitney U test, p = 0.01).

Discussion
We have described the epidemiology and outcome of fractures in the elderly population, that is, those aged 80 years and over, who account for more than one-third of all acute...
orthopaedic trauma admissions. The very elderly group only constitute 0.6% of the overall population but account for 4.1% of adult fractures and 9.3% of all acute orthopaedic trauma admissions. Data from the General Register Office for Scotland predict that the number of individuals aged 90 or more will increase two- to threefold by the year 2031, with implications for an increased demand for orthopaedic trauma services in future.

Increasing age is associated with a higher rate of mortality after hip fracture. This study not only confirms the increased risk of mortality associated with fractures of the proximal femur, but also that it extends across all common fractures. When survival was analysed in detail, the very elderly group was less likely to survive 120 days whatever their fracture. There were no significant differences in patient demographics or number of comorbidities between the two groups. This suggests that extreme old age is an isolated variable associated with a higher mortality after fracture, irrespective of other case-mix variables.

Several studies have shown that advancing age is associated with a longer hospital stay after surgery for a hip fracture. The median stay was significantly longer in the very elderly group. Assuming that the cost of stay per day in an acute ward is similar to that for a fractured hip (£433), this represents an increased cost of £4330 per patient. This will have a significant bearing on the future allocation of resources and provision of services in the face of an ageing population.

Patients admitted from their own home form an important group. The aim of treatment should be to return the patient to independent living, but only 58.4% of very elderly patients who had previously lived independently were able to return to their original address. This may reflect a poorer level of mobility than in the elderly patients.
(see Table II), with their fracture finally precipitating the need for increased care. This may also explain why the length of stay in this group was increased, as there may well have been a delay in organising a safe place of permanent discharge. We have not analysed the cost implications of future care packages after injury, but this financial burden is well recognised in hip fracture studies.\(^7,11\)

The very elderly group were more likely to have sustained a fracture of the proximal femur or pelvis, but less likely to have a fracture of the distal radius. This may be due to a deterioration in mental ability with age, which was reflected by the observed increased prevalence of dementia in this group. As frailter patients are less likely to sustain a fracture of the proximal femur or pelvis, but less likely to have a fracture of the proximal femur or pelvis, patients who retain these protective reflexes sustain distal radial fractures, which may reflect a better overall physiological status.

The very elderly group were more likely to be independently mobile or have more than two comorbidities, or have a diagnosis of dementia, probably because of their diminished functional demands. Nearly a third of these patients lived in care homes. If a patient had previously lived at home, they had higher functional demands and the rate of operative intervention was higher.

Our hospital tries to meet National Health Service targets and operate on fractures of the proximal femur within 48 hours of admission. This figure is based on evidence demonstrating fewer post-operative complications and shorter hospital stays when operations are carried out early.\(^18\) It would seem logical to apply this principle to all fractures of the lower limb in elderly patients that require surgery, in order to allow early rehabilitation. We have shown a significantly increased mortality risk for very elderly patients with lower limb fractures in whom surgery is delayed (> 48 hours). However, this delay may also be due to attempts to improve the condition of the most unfit patients, who may well be at increased risk of dying. This claim needs to be studied independently to confirm that early surgery and mobilisation improves survival for all patients with lower limb fractures.

Owing to the complexity of caring for these very elderly patients a multidisciplinary team approach is probably needed.\(^19,20\) The acute orthopaedic trauma ward may also not be the best place to manage this group of patients.

We have shown that very elderly patients have a similar number of comorbidities to their elderly counterparts, but are less likely to be independently mobile or to live in their own home prior to injury. They are more likely to require admission to hospital, to have a longer in-patient stay, and are less likely to return to independent living. The principle of early surgery and mobilisation of elderly patients with hip fractures may be extended to other lower-limb fractures to aid early rehabilitation and achieve a timely discharge.

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Supplementary Material

A table showing the number of fractures for all patients, 80- to 89-year-olds and those 90 years or older is available with the electronic version of this article on our website at www.jbjs.org.uk

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References


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