REVIEW ARTICLE

Epidemiology of proximal humerus fractures managed in a trauma center

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Summary Proximal humerus fractures (PHF) are osteoporotic fractures that affect women over 70 years of age. Like fractures of the femoral neck they have become a public health concern. As the population ages there is an increase in the number of people in poor general condition with an increased risk of falls on fragile bones. The incidence of these fractures has increased by 15% per year. All patients managed for PHF in our center in the past year were included in this prospective study (prospective cohort study; level 2). Three hundred and twenty-five patients were included with 329 fractures. There was a ratio of two women to one man. At the final follow-up 50 patients had died (15%) and 25 patients were lost to follow-up. The mean age was 70 years old. There were two types of risk factors. The first was fragile bones, and the second was patient specific risk of falls. The severity of the fracture increased with the age of the population. In the study by Charles S. Neer in 1970, 85% of PHF were not or were only slightly displaced, while this category percentage was only 42% in our study. Hospitalization was necessary in 43% of the cases in our study. Surgical management was necessary in 21%. This lack of relationship between the percentage of displaced fractures (58%) and the percentage of surgically treated fractures is a sign of the difficulties of managing this population, which is usually in poor general condition.

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Introduction

Proximal humerus fractures (PHF) are the seventh most frequent fracture in adults, and the third in patients over 65 following wrist and femoral neck fractures. They represent 5.7% of all fractures. This is mainly an osteoporotic fracture and its prevalence increases as one moves north in Europe. There is a linear increase in the incidence of this entity after the age of 40. Like fractures of the femoral neck, PHF have become a public health issue (French Law No. 2004-806, August 2004, on public health policy). The ageing population means there is an increase in the number of people poor general condition with a greater risk of falling on weak bones. This regular increase in the prevalence of osteoporotic fractures results in higher medical costs (hospitalization, treatment, convalescence...) and can result in loss of autonomy. The management of these fractures will be a real challenge for future healthcare policies in the upcoming years. Kannus et al. [1,2] studied PHF between 1970 and 1998 in patients over the age of 60 admitted to hospitals in Finland. The number of patients went from 208 fractures in 1970 to 1105 in 1998 or increased by 15% per year. In 28 years and if the ageing of the population is taken into account, this fracture has increased by 166% in women and 250% in men. These fractures will probably become more difficult to treat due to delayed union, an increase in the number of complications and in the rate of pseudarthrosis. Palaven et al. [3] estimated that the number of shoulder fractures would increase three fold in the next 30 years. Court-Brown and Caesar [4] talk about a revolution in the management of fractures because trauma centers were created in the developed countries between 1970–1980 to manage trauma secondary to high-energy traumas, which mainly affect young men. At present, the prevalence of that type of trauma is decreasing while traumas on osteoporotic bone are increasing. The latter are managed differently because the short and long-term aims are different. Lind T et al. [5] noted that in 730 fractures, 29% of the patients needed to be hospitalized; 75% of these were over 60 and only 21% underwent surgery, which represents 583 hospital days per year for a Danish city of 250,000 inhabitants. The aims of the present study were to define the epidemiology of this population presenting a PHF and evaluate the severity of the fracture and its therapeutic management in relation to different subgroups in this population.

Materials and methods

All the patients managed in the emergency unit of Nice University Hospital (CHU Nice) between November 2009 and November 2010 for PHF were included in this prospective study. The initial evaluation included double oblique AP view X-rays of the shoulder and a Lamy view while MRI was requested for more complex fractures. These different imaging techniques were visualized digitally. Initial management of each patient was noted in the medical file (number of days of hospitalization, period of the trauma, surgical procedures, type of immobilization). Each fracture was classified twice by three senior surgeons at 3-month intervals based on the Neer classification [6]. The most frequent response was taken for each fracture. All of the patients were seen for postoperative follow-up in an outpatient consultation at 3 weeks, 6 weeks and 3 months. We contacted all the patients by telephone at 10 months of follow-up. They responded to a medical questionnaire concerning: risk factors (osteoporosis, history of falling, low level of physical activity, hip fracture in the mother, trouble walking, pain in the lower limbs, trouble seeing, trouble hearing, alcoholism, tobacco use), comorbidities (diabetes, epilepsy, depression, dementia, Parkinson’s disease, others), the causes of the fracture, medical history in the fractured shoulder, associated traumas, the patient’s notion of his/her own general condition on a three point scale (good, average, poor) and the MOS SF12 quality of life score [7]. All of these data were noted on an excel table. This was a prospective cohort study (level 2).

Results

Three hundred and twenty-five patients were included with 329 fractures. The population included 224 women (69%) including three with bilateral fractures and 101 men (31%) one with a bilateral fracture, for a ratio of two women/one man. PHF was associated with another fracture in 34 cases. PHF represented 0.4% of adult emergency room consultations at the CHU Nice (70,000 consultations per year). On a national level, there are 15,500,000 visits to the emergency room per year and an estimated 65,000 isolated PHF per year in France. At the final follow-up, 50 patients had died (15%) and 25 patients were lost to follow-up. Initial data included the entire study population, while at the final follow-up questionnaires were sent to 250 patients with 253 fractures (185 women and 65 men). The mean age was 70 (16–97). The fractured shoulder was on the right side 156 times and on the left side 173 times. The fracture affects the dominant side in 48% of cases. Analysis of the distribution of fractures throughout the year showed that most of these fractures occurred during the "cold" season with 60% between October and March. Figs. 1 and 2 show that there is a peak in the prevalence of fractures in patients in their eighties and this is only found in women. The causes of fracture are summarized in Table 1. In men, 55% of the fractures were due to a simple fall and 45% to a high-energy kinetic trauma. In women, the cause was a simple fall in 82% of the cases. The cause of fracture was a high energy trauma in young patients and low energy trauma in older patients, which can be found as of the age of 60 because in 56% of cases it was due to a fall from standing height and this percentage regularly increased until it reached 100% at the age of 100. The risk factors and comorbidities are summarized.
respectively in Tables 2 and 3. The patients felt that they were in good general condition in 154 cases (62%), average in 66 cases and poor in 30 cases. The objective measurement of the general condition of this population based on the MOS SF12 quality of life scale showed a mean 41 for the physical score and 53 for the psychological score (the normal score is 50 for each). There was a history of shoulder injury in 10 patients (4%), (three fractures, two dislocations, five rotator cuff tears, one arthritis and two anti-inflammatory injections). Fig. 3 shows the distribution of the different fractures according to the Neer classification. Forty-two percent of the fractures were NEER type 1; these are considered to be slightly or not displaced. Fifty-nine percent of the fractures were displaced. The type of fracture varied depending upon the age group. Under the age of 40, 41% were slightly or not displaced (Neer type 1), the rest were two part fractures (Neer type 3, 4 or 6). Following this, fracture displacement worsened. In the 41–70 year old age group, the percentage of Neer type 1 fractures was similar (43%) but three or four part fractures are found and represent 16% of all fractures. In the 71–100 year old age group, the percentage of type 1 Neer fractures was only 33% and the percentage of three or four part fractures was 19%; this is also the only age group with six patients with articular fractures of the humeral head. Fractures were managed by conservative treatment in 79% of the cases (256 patients) and surgery in 21% (69 patients). Surgical treatment included internal fixation in 57 cases (53 intramedullary nails and four ORIF with screws in the greater/lesser tuberosity) and 12 shoulder arthroplasties (four anatomical replacements and eight reverse total shoulder replacements). Hospitalization was necessary in 43% of the patients (139 patients). Therapeutic management varied depending upon the type of fracture. Surgery was performed in three Neer type 1 fractures. Two presented with a diaphyseal fracture of the humerus associated with the PHF, while the third presented with a bilateral fracture, and it was decided to stabilize both shoulder fractures for the patient’s comfort. Neer type 3 fractures (surgical neck fracture) were treated surgically in 39% of cases, Neer type 8 fractures (surgical neck fractures and the greater tuberosity) in 41% of the cases and Neer type 12 (four part fractures) in 45% of cases. The other types of fractures were rarely operated on (Table 4). Thirty-seven percent of the patients (125) who presented with displaced PHF were not operated on. Conservative treatment was indicated because of the patient’s poor general condition and the risk of anesthesia. This population was a mean 78 years old, older than the overall population, and in poorer general condition (22% had died at 10 months, 14% had dementia, 20% had comorbidities, 26% had difficulty walking). At the
Table 4 Percentage of patients who underwent surgery for PHF in relation to the Neer classification of fracture.

<table>
<thead>
<tr>
<th>Neer</th>
<th>Number of shoulders</th>
<th>Surgery</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>136</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>III</td>
<td>102</td>
<td>40</td>
<td>39</td>
</tr>
<tr>
<td>IV</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>VI</td>
<td>33</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>VII</td>
<td>1</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>VIII</td>
<td>27</td>
<td>11</td>
<td>45</td>
</tr>
<tr>
<td>IX</td>
<td>1</td>
<td>9</td>
<td>45</td>
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<tr>
<td>XII</td>
<td>20</td>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>XV</td>
<td>6</td>
<td>2</td>
<td>33</td>
</tr>
</tbody>
</table>

final follow-up our questionnaire was filled out by 88 of these patients (27 had died, eight were lost to follow-up, two had severe dementia). From a subjective point of view 52% (46) of these patients considered themselves to be in good general condition 36% (32) in average condition and 11% (10) in poor condition. Objectively the mean SF 12 physical score was 39 and the mean SF 12 psychological score was 53. The results of these two scores were similar to those in the overall study population.

Discussion

Like the studies by Kannus et al. [1] and Court-Brown et al. [4,8], this epidemiological study shows that most PHF are osteoporotic fractures in women over the age of 70. The risk of fracture begins to increase linearly in women in their fifties [9,10]. The prevalence of PHF increases as the population ages. There are two main types of risk factors for osteoporotic fractures, in particular for PHF. The first risk is fragile bones and the second is the risk of falling. The more fragile the bones are the more severe the fracture is [8]. Nguyen et al. [11] found that osteoporotic vertebral compression fractures with loss of height, which is one of the most typical signs of existing osteoporosis, were a predictive factor for these fractures. Ethnicity is also a risk factor of fragile bones [12,13]. The prospective EPOS [9] study showed that in osteoporotic fractures, PHF were more frequent in women in northern Europe with an incidence of 5.2/1000/year, while in the rest of Europe it was 1.3–1.9/1000/year. In men the incidence was comparable in the different European regions with figures between 0.4 and 1.2/1000/year. One or several risk factors of falling were found in more than half of our population: 33% had a history of falling and 30% had low level of physical activity which could indicate worsening of the patient’s general condition which was identified as a risk factor for PHF by Kelsey et al. [14]. Difficulty seeing was identified in 26% of patients. Difficulty walking and pain in the lower limbs was identified respectively in 25 and 19% of the cases. Cardiovascular diseases were found in 16% of cases, but their frequency in the general population makes it difficult to confirm that this increases the risk of PHF, although in the elderly this is probably the cause of attacks, which result in falls. Diseases, which increase the risk of PHF, are diabetes, epilepsy, depression and dementia. In our study, 10.4% of patients were diabetics (1 and 2 combined) while this figure is 3.8% in the general French population. In our study 21% of patients were depressive. Lind T et al. [5] found an increase in these fractures in the winter, which we also observed usually in the middle of the day, but cannot confirm statistically. Although alcohol or tobacco consumption was not considered to be a risk factor by Chu et al. [12] they were present in 15 and 28% of our cases respectively. The patient’s general condition is an equally important risk factor because an autonomous person in good condition will be less apt to fall and his/her bones will be less fragile. In a 5-year prospective study (1027 PHF) Court-Brown et al. [8] found that this population was in poorer general condition than the population presenting with wrist fractures, but in better general condition than the population presenting with hip fractures. Only 10% were in an institution when the fracture occurred. Measures taken to limit these risk factors and the lifestyle in certain areas of the world can reduce the prevalence of PHF. In a study performed between 1970 and 1995 and published in 2008 in a population that was 80 or older, Kannus et al. [15], showed that the number of fractures increased from 88 to 304/per 100,000 women. However the number of fractures has stabilized since 1995 suggesting that this population is in better health, that preventive measures have been taken, and that management of osteoporotic bone has improved. Hagino et al. [10] found that the traditional Japanese way of life decreased the risk of falling, and therefore reduced the prevalence of these fractures. The prospective study EPIDOS [16] in osteoporotic fractures of the shoulder showed that a patient with osteoporosis with falling risk factors, has a greater risk of fracture than a patient without osteoporosis or falling risk factors. On the other hand, s/he has the same risks as a patient without osteoporosis with high falling risks.

The severity of the fracture increases as the population ages. In his article in 1970, Charles S. Neer [17] reported type 1 fractures (not or slightly displaced - less than one centimeter of displacement and an angle of less than 45°) in 85% of the population. On the other hand in a prospective 5-year study (1027 FESH) in 2001, Court-Brown et al. [8] found Neer type 1 fractures in 49%, two part fractures in 37%, three part in 9% and four part in 4%. We identified Neer type 1 fractures in 42% of the patients in our study in 2010 in 329 fractures. The percentage of non-displaced fractures has decreased by 50% in 40 years. This increase in the number of displaced fractures suggests that there is theoretically a greater need for surgical management and a risk of poorer functional outcome. However, compared to the results by Charles S. Neer [17] in which approximately 15% of FEUH were considered to be displaced, and thus require surgical management, the percentage of surgically treated fractures in our study (21%) was similar to that in the Neer study. This lack of relationship between the percentage of displaced fractures (58%) and the percentage of fractures that were surgically treated (21%) is a sign of the difficulties of managing this population. The technical difficulties associated with fixation material that is not always adapted to mediocre bone quality and the general condition of patients who are usually extremely elderly with multiple comorbidities, are the main reasons for this low percentage of surgeries. At 10 months of follow-up the level of satisfaction in this specific population is similar to that in the overall study population, but no firm conclusions can be drawn due after such a short amount of time.
Conclusion

PHF is now usually an osteoporotic fracture in women over the age of 70. It is frequent and its prevalence is increasing. The ageing population is the cause, resulting in a population that is in poor general condition with an increased risk of falling on increasingly fragile bone. PHF are displaced in 50% of the cases, requiring hospitalization in at least one out of two cases while surgery was performed in one out of five. Measures must be taken in this growing population to prevent the risk factors of PHF because management of these fractures may become another source of dependency in the elderly population.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References
