

# Men with hip fractures have poorer nutritional status and survival than women

## A prospective study of 165 patients

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Submitted 02-04-05. Accepted 04-09-29

**Background** Many hip fracture patients have a poor nutritional status which may be one explanation for their increased mortality.

**Patients and methods** We studied nutritional status and other mortality-related factors prospectively in 165 patients with hip fractures (85 women). We concentrated on differences between death rates and survival rates at 3 months and at 1 year, and between those patients who died within 3 months and those who died later.

**Results** In general, men had a poorer nutritional status and a larger number of comorbidities. Also, there were more smokers and alcohol abusers amongst the men. Of the patients who died during the first 3 months, most were men, and their initial nutritional status was poorer than that of women. Multivariate logistic regression analysis revealed a correlation between mortality and total serum protein, retinol binding protein and the number of comorbidities. Among patients who died after 3 months, mortality was associated with the number of comorbidities and smoking.

**Interpretation** The higher mortality rate in men than in women after hip fracture may in part be explained by the poor nutritional status in men.

It has been known for a long time that hip fracture patients frequently have an impaired nutritional status (Patterson et al. 1992, Rico et al. 1995, Bonjour et al. 1996, Huang et al. 1996, Mussolino et al. 1998). Also, malnutrition is recognized to be a

risk factor for increased mortality in these patients (Delmi et al. 1990, Foster et al. 1990, Patterson et al. 1992, Koval et al. 1999). This study aimed to ascertain whether this finding was related to the higher mortality rate among men than in women with hip fractures (Center et al. 1999, Forsen et al. 1999, Cree et al. 2000, Francis 2000, Orwoll 2000). We initiated this comparative study because male patients admitted to our hospital with hip fracture appeared to have poorer nutritional status—as judged by biochemical parameters—than women. We also aimed to determine possible links to other factors associated with posttraumatic mortality, such as the number of preexisting medical conditions, age, type of fracture, smoking habits and alcohol consumption (Aharanoff et al. 1997, Tosi and Lane 1998, Koval et al. 1999, Balen et al. 2001, Hannan et al. 2001).

### Patients and methods

We performed a prospective study of 165 patients (85 females) over 65 years of age with hip fractures caused by minimal injury between March 1998 and June 1999 (women) and March 1998 and February 2000 (men). The recruitment period was longer for men because hip fractures are less common in men than in women (Balen et al. 2001). Patients with pathological fractures, non-osteoporotic osteopathies or renal disease were not included. 64 patients

had cervical hip fractures, 48 were displaced (grade 3 or 4). 101 patients had trochanteric fractures, 53 of which were unstable according to Evan's classification (Saudan et al. 2002).

Blood samples were taken from all patients within 12 h of admission and prior to administration of any medication. The following nutritional markers were determined for each patient: total serum protein, albumin, pre-albumin, transferrin, retinol binding protein, hemoglobin and total lymphocyte count. These markers were thought to reflect the visceral (non-muscular) protein status.

Comorbidities (such as dementia or cerebral dysfunction, stroke, cardiopulmonary disease, diabetes mellitus) and alcohol and tobacco consumption were recorded. We used the description habitual alcohol consumers for those patients who consumed more than 60 g of alcohol per day, and habitual smokers for those who smoked more than 20 cigarettes per day. Patients who had these habits at the time of fracture, and those who had consumed equivalent amounts of alcohol or tobacco for at least 3 consecutive years in the 5 years prior to sustaining the fracture, were included in these groups. If possible, all information was obtained directly from the patients; otherwise, details were obtained from the next of kin or caregiver.

All patients were operated on by the same team of surgeons and anesthetists from the hospital hip fracture unit. Spinal anesthesia was administered in all cases. Patients underwent anticoagulation prophylaxis with low molecular weight heparin from the moment they were admitted for treatment. Patients with cervical fractures were treated with cannulated screws (undisplaced fractures), or arthroplasty (displaced fractures). Patients with trochanteric fractures were treated with plates and sliding screws. Deaths were recorded at 3 months and after 1 year. 10 patients were lost to follow-up, leaving 555 patients for the study. Comparisons were made between data for men and for women on admission, between deceased patients and survivors after 3 months and after 1 year, and between patients dying during the first 3 months and those dying between months 4 and 12 after fracture.

### Statistics

Inter-group statistical differences were analyzed using Student's t-test for continuous variables and

Fisher's exact test for categorical variables. We used stepwise multivariate logistic regression analysis to determine the factors most predictive of mortality at 3 months and at 1 year. For all statistical tests, a p-value of less than 0.05 was considered significant.

### Results

The following complications were recorded: superficial wound infection in 12 cases (8%), and deep infection in 4 cases. All 4 cases showed decreased biochemical markers of nutrition. 12 patients (8%) had deep venous thrombosis, confirmed venographically. No association was found between these complications and either early or late death, except in hemiarthroplasty patients with infection, 2 of whom died during the first year (Table 1).

The mean biochemical nutritional parameters in males were lower than those recorded for females, the difference being statistically significant for albumin, pre-albumin, retinol binding protein and transferrin, and number of comorbidities. Significant differences were also recorded for percentage of smokers, percentage of alcohol abusers and age of patients (Table 2). No significant gender-related differences were detected for total serum protein, hemoglobin, total lymphocyte counts or fracture type.

27 patients (17%) died during the first 3 months after fracture: 5 women and 22 men ( $p = 0.001$ ). These patients had lower nutritional parameters than the survivors, the difference being statistically significant for albumin, total serum proteins, pre-albumin, retinol binding protein, transferrin, and total lymphocyte count. The number of comorbidities, and percentage of smokers and drinkers was higher in the patients who died before 3 months (Table 2). No significant differences were observed for age or fracture type. When all variables were subjected to multivariate logistic regression analysis, a statistically significant relationship was observed between death in the first 3 months and total serum protein values (OR 2.4; CI 3.5–166;  $p = 0.001$ ), retinol binding protein (OR 9; CI 2.4–33;  $p = 0.001$ ) and number of comorbidities (OR 51; CI 2.3–11;  $p = 0.001$ ). (For every unit fall in serum protein value, the odds of dying increased by a factor of 2.8. A unit fall in the value of retinol

Table 1. Comparison of variables between men and women

Group	Men (n = 75) mean (SD)	Women (n = 80) mean (SD)	P-value	95% CI
Age (years)	77 (7.6)	81.4 (6.9)	0.01	1.8–6.3
Albumin (g/dL)	3.1 (0.4)	3.5 (0.3)	0.001	0.2–0.5
Total serum protein (g/dL)	6 (0.6)	6.2 (0.5)	0.1	-0.03–0.3
Pre-albumin (mg/dL)	12.2 (3.6)	14.03 (3.1)	0.001	0.7–2.9
RBP <sup>a</sup> (mg/dL)	3. (0.7)	3.6 (0.6)	0.0001	0.4–0.8
Transferrin (mg/dL)	147 (34)	178 (40.4)	0.001	18–42
Lymphocytes	1.5 (0.4)	1.5 (0.3)	0.6	-0.09–0.1
Comorbidities	1.9 (1.4)	1.2 (1.2)	0.001	
Smoking	55	2	0.01	
Alcohol abuse	28	5	0.0001	
Fracture type <sup>b</sup>	33 Intracap 42 Extracap	30 C 50 T	0.09	

<sup>a</sup> Retinol binding protein

<sup>b</sup> Nutritional markers. C cervical, T trochanteric.

binding protein meant that the odds of dying were up to 9 times greater. Each concomitant disease meant a five-fold increase in the odds of dying). After 1 year, one-third of all patients (51) had died: 33 men and 18 women.

As regards differences between survivors and non-survivors between months 4 and 12 after hip fracture, non-survivors also presented lower mean biochemical nutritional parameters than survivors, although this difference was not statistically significant. Significant differences were recorded only for number of comorbidities and number of smokers (data not shown).

Multivariate logistic regression analysis of variables proving statistically significant at bivariate analysis of 1 year death rates revealed a significant relationship between death and number of comorbidities (OR 8.3; CI 1.9–11;  $p = 0.001$ ) and smoking (OR 7.3; CI 1.9–29;  $p = 0.009$ ). In this patient group, the presence of a concomitant illness or disease increased the risk of dying eight-fold. Smokers were 7 times more likely to die.

Comparison of variables between patients dying during the first 3 months and those dying between months 4 and 12 after fracture revealed significant differences for all biochemical nutritional parameters, for number of comorbidities, for number of alcohol abusers and for number of males, but no differences were observed for age, number of smokers or fracture type (Table 3).

## Discussion

In the hip-fracture patients we studied, we found lower values for biochemical nutritional markers in male patients than in female patients, suggesting that at the time of fracture male patients had worse nutritional status.

Albumin has a serum half-life of about 20 days. Mild protein deficiency is said to be associated with albumin levels of 3.0–3.5 gr/dL, and severe deficiency with levels below 2.1 gr/dL. Transferrin has a serum half-life of about 9 days. Mild protein deficiency correlates with transferrin levels of 150–175 mg/dL, and severe deficiency, with levels less than 100 mg/dL. Serum pre-albumin has a serum half-life of 2 days. Pre-albumin levels of between 10 and 15 mg/dL, and less than 5 mg/dL, are labeled mild and severe visceral protein depletion, respectively. Retinol binding protein is the specific binding protein for vitamin A. Its serum half-life is only about 10 hours and its normal value is 3.4–5.6 mg/dL. There is a rough correlation between total lymphocyte count and degree of malnutrition. Total lymphocyte counts of 1 200–2 000/mm<sup>3</sup> are said to be associated with mild protein depletion, and counts of less than 800/mm<sup>3</sup> with severe depletion (Ravel 1995).

Men generally have a greater bone mass and a more resistant proximal femur bone structure than women (Baudoin 1997, Seeman 1999). Therefore,

**Table 2.** Comparison of variables between patients dying during the first 3 months and those surviving

Group	Died (n = 27) Mean (SD)	Survived (n = 128) Mean (SD)	P-value
Age (years)	77 (7.8)	80 (7.3)	0.5
Gender: Men	22	53	< 0.001
Women	5	75	
Albumin (g/dL)	2.8 (0.3)	3.4 (0.3)	< 0.001
Total serum protein (g/dL)	5.5 (0.5)	6.2 (0.4)	< 0.001
Pre-albumin (mg/dL)	10.6 (3.4)	13.7 (3.2)	< 0.001
RBP <sup>a</sup> (mg/dL)	2.7 (0.8)	3.5 (0.6)	0.001
Transferrin (mg/dL)	131 (30)	170 (39)	0.001
Lymphocytes	1.2 (0.3)	1.6 (0.4)	0.01
Comorbidities	3.3 (1)	1.2 (1.1)	< 0.001
Smoking	19	38	< 0.001
Alcohol abuse	16	17	0.001
Fracture type <sup>b</sup>	13 C 14 C	52 C 76 T	0.07

<sup>a</sup> Retinol binding protein  
<sup>b</sup> Nutritional markers. C cervical, T trochanteric.

**Table 3.** Comparison of variables between patients dying during the first 3 months and those dying between months 4 and 12 after fracture

Group	Died within 3 months (n = 27) Mean (SD)	Died 4–12 months (n = 23) Mean (SD)	P-values
Age (years)	77 (7.8)	81 (8.4)	0.1
Gender: Men	22	11	
Women	5	12	0.01
Albumin (g/dL)	2.8 (0.3)	3.3 (0.4)	< 0.001
Total serum protein (g/dL)	5.5 (0.5)	6.2 (0.4)	< 0.001
Pre-albumin (mg/dL)	10.5 (3.4)	12.7 (3.1)	0.02
RBP <sup>a</sup> (mg/dL)	2.7 (0.8)	3.3 (0.5)	0.006
Transferrin (mg/dL)	131 (30)	164 (45)	0.003
Lymphocytes	11.6 (1.1)	1.4 (0.2)	0.02
Comorbidities	3.3 (1)	1.9 (1.1)	< 0.001
Smoking	19	10	0.10
Alcohol abuse	16	5	0.08
Fracture type	13 Intracap 14 Intracap	12 Intracap 11 Extracap	0.9

<sup>a</sup> Retinol binding protein  
 Nutritional markers in patients who died during the first 3 months and those who died between 3–12 months after fracture.

in order for the proximal femur to become sufficiently brittle to fracture, there must be a loss of bone mass or a decrease in the width of the bone cortex—as occurs with malnutrition. It has been shown that reduced serum albumin concentration

is associated with a higher risk of hip fracture (Huang et al. 1996).

Poorer nutritional status among men may be due to the larger number of associated diseases and to overconsumption of alcohol (Bonjour et al. 1996, Yuang et al. 2001). Our findings of poor health in the male hip fracture patients agree with those reported by other authors (Baudoin 1997, Mussolino et al. 1998, Cree et al. 2000). This, together with greater alcohol abuse, would also account for a larger number of falls (Fink et al. 1996, Aharonoff et al. 1997, Bilezikian 1999, Turner 2000). These associations would also explain why men with hip fracture are younger on average than women (Lyons 1997).

Patients dying during the first 3 months after fracture displayed poorer nutritional status than 3-month survivors, with lower serum concentrations of albumin, total serum proteins, pre-albumin, retinol binding protein, transferrin and lymphocyte counts; these findings are in agreement with those of other authors (Delmi et al. 1990, Patterson et al. 1992, Schroder and Erlandsen 1993, Bonjour et al. 1996, Baudoin 1997).

Patients who did not survive also presented a greater number of comorbidities, confirming other studies (Mussolino et al. 1998, Cree et al. 2000). We found no relationship between 1-year mortality and decreased total lymphocyte counts on hospital admission, as has been reported (Koval et al. 1999). Male gender per se does not seem to be a mortality risk in hip fracture patients; rather, men have a greater number of factors that increase the risk of death. This was confirmed by multivariate logistic regression analysis, which showed number of comorbidities, total serum proteins and retinol binding protein to be factors predictive of mortality.

In our study, the mortality is higher (33%) than in other reports (Koval et al. 1999) because the percentage of men in our series was higher (Center et

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