Mortality After Femoral Neck Fractures: A Two-Year Follow-up

Jaunius Kurtinaitis[1], Jolanta Dadonienė[1], Giedrius Kvederas[2], Narūnas Porvaneckas[1], Tomas Butėnas[2]

[1]Clinic of Rheumatology, Traumatology Orthopaedic and Reconstructive Surgery, Medical Faculty, Vilnius University, [2]2nd Department of Orthopaedic Surgery, Vilniaus University Emergency Hospital, Lithuania

Key words: *femoral neck fracture; survival; standardized mortality ratio.*

Summary. *Background and Objective. To identify the survival and standardized mortality ratio with respect to gender, age, and treatment method of patients treated for femoral neck fractures.*

Material and Methods. A retrospective review of medical records of 736 patients treated for femoral neck fractures at Vilnius University Emergency Hospital during 2004–2006 was carried out.

Results. The overall 1- and 2-year survival rates were 77.4% and 67.1%, respectively. Lower survival rates were observed in the internal fixation group than in the primary and secondary total hip arthroplasty groups (63.2% vs. 72.0% and 75.1%). Cox proportional hazards model analysis showed patient age to be a significant risk factor for survival (hazard ratio, 1.05; 95% CI, 1.04–1.07; P<0.001). The overall standardized mortality ratio was 2.50. The standardized mortality ratios for men and women were 3.07 and 2.27, respectively, but the difference between these groups was not significant.

Conclusions. Standardized mortality and survival rates decreased with increasing patients' age. Significantly lower survival rates were documented in the internal fixation group as compared with primary and secondary total hip arthroplasty groups. There was a trend toward a higher standardized mortality ratio in men than women, but the difference was not significant.

Introduction

Femoral neck fracture is one of the most common consequences of injuries in the elderly population. It is estimated that the incidence of these fractures may increase threefold because of the rising life expectancy during the next 50 years, especially in the developed countries (1, 2). The literature states that during the first year, patients' survival rate is 64%–86% (2). According to some authors, mortality due to femoral neck fractures might be even the same to that due to malignant cancer (3). Only one-third of patients regain the quality of life equal to that before the injury (4). Treatment type and outcomes depend on the patient's condition (physical activity before the injury, the time elapsed from fracture, age, perception, concomitant diseases) (5), as well as the fracture type itself. The aim of this study was to determine the standardized mortality ratio (SMR) and survival rate of patients after femoral neck fracture.

Material and Methods

A retrospective analysis of medical records included 736 patients treated for femoral neck fractures at Vilnius University Emergency Hospital during 2004–2006. The distribution of patients by gender and age is shown in Table 1.

Correspondence to J. Kurtinaitis, 2nd Department of Orthopaedic Surgery, Vilnius University Emergency Hospital, Šiltnamių 29, 04130 Vilnius, Lithuania. E-mail: jauniusk1@yahoo.com

The male-to-female ratio was 1:2.1. The mean age of male and female patients was 71 years (95% CI, 69–73 years) and 78 (95% CI, 77–79 years), respectively. The distribution of patients according the treatment method is shown in Table 2.

The start point of the case analysis was the date of the first surgery or the date of hospitalization for patients who did not undergo surgery. The end of the case analysis was December 31, 2007, or the date of death. The mean follow-up was 21.5 months (95% CI, 20.5–22.5 months).

Patients' death dates were obtained from the Lithuanian population register using the personal identification numbers. Fourteen patients were excluded from the study due to mistakes in identity numbers in medical charts. The data of 10 nonoperated patients were analyzed separately. The final analysis included 702 patients who underwent surgery.

Statistical analysis was performed using the statistical analysis program STATA version 9 (Statacorp LP). Survival analysis was conducted using the life table method with the differences between the curves compared using the log-rank test. A Cox proportional hazards model was used to assess the dependence of survival on age. The survival and mortality rates were assessed with respect to age, gender, and operative methods of treatment. According to the method of treatment, the patients were divided into 3 groups: internal fixation, primary total hip

Table 1. Distribution of Patients Treated for Femoral Neck Fractures by Gender and Age

Age group, years	Men	Women	Total	%
<50	23	12	35	4.76
50–59	32	26	58	7.88
60–69	55	73	128	17.39
70–79	79	179	258	35.05
>80	50	207	257	34.92
Total	239	497	736	100

Table 2. Distribution of Patients Treated for Femoral Neck Fractures by Treatment Method

Treatment Method	No. of Patients
Internal fixation	458
Primary total hip arthroplasty	125
Secondary total hip arthroplasty	143
Nonoperated	10
Total	736

arthroplasty, and secondary total hip arthroplasty after failed internal fixation. Standardized mortality ratios were calculated based on the 2004–2007 Lithuanian population mortality structure.

The SMR is an indirect indicator of mortality rate. It is expressed as a ratio of observed to expected deaths. The expected number of deaths is calculated from the general mortality of population by age indicators. The SMR is superior to the relative risk rate, because of the assessment in relation to the general population rather than the control group chosen (6, 7). For this reason, the SMR can be greater than the corresponding relative risk indicators, as there is no comparison with the corresponding group of patients, but with the general population, where all concomitant diseases are taken into consideration.

Results

The overall 1- and 2-year survival rates of patients who were operated on were 77.4% (95% CI, 74.1%–80.3%) and 67.1% (95% CI, 63.3%–70.7%), respectively (Table 3). The survival rates of patients who did not undergo surgery after 1-month and 3-month follow-ups were 40% (95% CI, 12.3%–67.0%) and 10% (95% CI, 0.5%–35.8%), respectively. Although the 1- and 2-year survival rates were found to be higher for women than men, the differences were not significant (77.7% vs. 76.5% and 68.8% vs. 63.7%, respectively; P=0.083). Eleven patients died in hospital during the postoperative period (1.5%). The highest survival rate was observed in the youngest patients' group, while it was significantly decreased in the oldest patients' group (P<0.001) (Table 3). Patient age was found to be a significant risk factor in assessing survival with the Cox proportional hazards model (HR, 1.05; 95% CI, 1.04–1.07; P<0.001). The lowest survival rate was found to be in the internal fixation group (63.2%; 95% CI, 56.2%–67.7%); significantly higher survival rates were recorded in the primary and secondary THA groups (72.0%; 95% CI, 62.6%–79.4%; and 75.1%; 95% CI, 66.6%–81.7%, respectively; P=0.009) (Table 3).

The 3-month survival rate for patients who did not undergo surgery was 10%. Due to a small sample size, i.e., 10 patients, further analysis was not performed.

The overall SMR was 2.50 (95% CI, 2.20–2.82) (Table 4). The SMR for men was greater than for women (3.07; 95% CI, 2.47–3.74; vs. 2.27; 95% CI, 1.93–2.63), but the difference between these groups was not significant. Comparison by different age groups showed that the SMR was greater for younger patients, but the difference was not significant as

Table 3. Survival Data of Patients Treated for Femoral Neck Fractures by Age, Gender, and Surgical Treatment Method

	Time (months)				
	1	3	6	12	24
Overall	94.9	89.2	83.9	77.4	67.1
Gender			P=0.083		
Male	94.7	89.8	85.0	76.5	63.7
Female	95.0	88.9	83.4	77.7	68.8
Age group, years			P<0.001		
<50	100.0	96.9	93.7	93.7	90.0
50–59	100.0	100.0	96.2	90.6	79.1
60–69	98.4	96.0	92.7	88.7	83.9
70–79	95.1	90.3	84.6	77.3	69.9
>80	91.1	81.3	74.8	66.7	51.3
Surgical treatment method			P=0.009		
Internal fixation	93.2	87.0	80.6	74.9	63.2
Primary total hip arthroplasty	97.5	93.4	88.4	82.7	72.0
Secondary total hip arthroplasty	97.9	92.3	90.2	82.5	75.1

Values are percentage.

Table 4. Standardized Mortality Ratio Data of Patients Treated for Femoral Neck Fractures by Age, Gender, and Surgical Treatment Method

	Men	95% CI	Women	95% CI	Overall	95% CI
	3.07	2.47–3.74	2.27	1.93–2.63	2.50	2.20–2.82
Age group, years						
<50	6.78	0.00–26.58	4.84	0.45–13.87	5.35	1.01–13.12
50–59	5.62	2.23–10.55	3.14	1.13–6.15	4.11	3.15–4.11
60–69	3.55	1.88–5.74	2.47	1.11–4.34	3.01	1.88–4.40
70–79	2.81	1.98–3.79	2.23	1.62–2.92	2.45	1.96–3.02
80 and more	2.22	1.51–3.07	1.87	1.51–2.25	1.94	1.62–2.29
Surgical treatment method						
Internal fixation	3.16	2.44–3.97	2.50	2.03–3.01	2.72	2.33–3.16
Primary THA	1.77	1.07–1.55	2.10	1.39–2.95	2.02	1.41–2.75
Secondary THA	3.16	1.48–1.95	2.10	1.38–2.97	2.35	1.68–3.14

THA, total hip arthroplasty.

well. The small sample size may be the reason for such findings. The mortality ratio was lowest in the primary THA group as compared with the secondary THA and internal fixation groups (Table 4).

Discussion

Our study showed that patients with surgically treated femoral neck fractures had a 2-year survival rate of 67.1%. The survival rates for men and women were 63.7% and 68.8%, respectively. The overall SMR was 2.50; this indicator was particularly higher for young people and decreased with increasing patients' age. Male survival and mortality were worse, but the difference was statistically insignificant. Outcomes after internal fixation were worse with respect to survival (P=0.009).

Proximal femoral fracture is one of the most common injuries as well as an indirect cause of death in the elderly population. The only data on patient survival after femoral neck fractures in Lithuania were presented in a study by Vertelis and others, published in 2002 (8), with the highest numbers of deaths among patients aged 80 years and more. Unfortunately, more detailed analysis of deaths in comparison with the general Lithuanian population has not been carried out yet.

Randomized study overviews (meta-analyses) have presented the 1-year survival rates after femoral neck fractures varying from 35% to 100% (9). In most studies, the survival rates ranged from 64% to 86% (2). According to the study by Faraj (10), the 1-year survival rate for men was slightly lower than that for women (52.3% vs. 59.1%). Vertelis et al. in their study (8) enrolling 232 patients treated for femoral neck fractures reported a 76.7% 1-year survival rate, which is similar to that in our study. Our results showed a survival rate of 77.4% during the first year after surgery for femoral neck fractures. Although the 1- and 2-year survival rates were found to be higher for women than men, the differences were not significant (P=0.083). The higher SMRs in the male group might be due to a shorter life expectancy of Lithuanian men (an average of 66.3 years in 2008). Therefore, the mortality structure of the Lithuanian population was taken into consideration. The SMR was found to be greater for men than women (3.07 vs. 2.27), and although the difference was not significant, the greater SMR for men might be caused not only by differences in the population mortality structure, but by gender as well. A significantly lower male survival rate was published by Rogmark et al. (79% and 89%, P=0.036) (3). Asnis and Wanek-Sgaglione found significant differences in survival comparing men and women (79% vs. 96%) (11).

The 2-year survival rate was highest among the patients younger than 50 years, and it was 5-fold greater as that for patients aged 80 years and more. However, it does not reflect a mortality risk compared with the general population. With regard to age, the SMR declined steadily. The SMR was greatest in the youngest patients' group (5.35), while in the group of patients aged 80 years and more, the SMR was 1.94. However, our data analysis leaves space for questions, because the patients' groups were small, particularly those of younger patients, and the confidence intervals were very wide.

Treatment methods depend on the patients' activity level before the injury, their general health status, concomitant diseases, and mental condition, as well as fracture anatomy and time elapsed from the fracture. Treatment is aimed at restoring patient's medical condition to that before the injury. Only in exceptional cases, femoral neck fractures are inoperable due to serious concomitant diseases. In our study, the survival of nonsurgically managed patients after 3 months reached only 10%. Ions and Stevens reported a survival rate of 39.2% in the

group of 23 patients treated nonsurgically within the first 6 months after the fracture, while the 6-month survival of 135 patients who underwent surgey was as high as 90.4% ($P<0.05$) (6). According to Faraj, because of contraindications to regional or general anesthesia, only 1.47% of all patients (21 of 1420) were treated nonsurgically (10). Although the study population and the selection criteria were similar to those in our investigation, Faraj did not find any significant difference in survival rates comparing operated and nonoperated patients.

Parker et al. reported a 70% 1-year survival for undisplaced femoral neck fractures (12). In our study, the largest group containing 62.2% of patients accounted for patients that underwent closed reduction and internal fixation. Many studies did not report any significant differences in survival rates comparing internal fixation with hip replacement (3, 9, 13–19). Blomfeldt et al. noted a significantly higher relative mortality risk during the first 4 months after hip replacement compared with internal fixation (relative risk, 1.27), but after 1 year, the difference in mortality between the two groups was insignificant (relative risk, 1.04) (20). Parker and Pryor reported higher survival rates after internal fixation at 3 years after operation (Table 5) (20, 21). Tidermark et al. in a randomized study also demonstrated a lower survival rate after internal fixation in comparison with total hip replacement (22).

According to our data, the survival rate was significantly lower in the internal fixation group compared with the primary hip replacement group (63.2% and 72.0%, respectively). In our opinion, the selection of patients could have contributed to the potentially higher survival rate in the hip replacement group. The overall medical condition and mental disorders of a patient can be contraindications for hip replacement. According to some authors, these factors also correlate with lower survival rates. Van Dortmont et al. reported that the 1-year survival rate of patients without impaired perception was 80.4%, while the mortality rate in the group with impaired perception was 56.4% (5).

Lie et al. showed an 8-year survival rate of 56% and SMR of 1.11 (95% CI, 1.06 to 1.17) for femoral neck fractures treated with the primary total hip arthroplasty (23). Our analysis showed that the SMR after the primary total hip arthroplasty was much greater, i.e., 2.02, possibly due to the shorter follow-up (mean follow-up, 21.5 months).

Our study data show femoral neck fractures to be a potential risk of higher mortality. A higher SMR was detected in the young patients' group when compared to the general population where it was 5.35 times greater within the first year after injury. Although the survival estimates show significantly contrary results, survival is decreasing according to the patients' age. Conversely, if the survival of the patients aged more than 80 years reached 51.3%, the SMR was the lowest (1.94). The survival in a particular group of patients is not a sufficiently informative indicator because it does not reflect how much the number of deaths has increased due to pathology in the investigated pool of patients relative to the general population. The greatest shortcoming of the SMR analysis in our study was a small sample size. Although our analysis revealed that the survival rate was lowest and the SMR was greatest in the internal fixation group, only a randomized study could confirm such data. A randomized prospective analysis requires a large number of patients in order to reliably prove the influence of one or other treatment modality on mortality rates. Unfortunately, due to large patients' sample sizes and ethical concerns, it is difficult to evaluate the impact of treatment methods on mortality indicators.

Conclusions

Standardized mortality and survival rates decreased with increasing patients' age. Significantly lower survival rates and higher standardized mortality ratios were documented in the internal fixation group as compared with primary and secondary total hip arthroplasty groups. There was a trend toward a higher standardized mortality ratio in men than women, but the difference was not significant.

Statement of Conflicts of Interest

The authors state no conflicts of interest.

Table 5. Survival Data of Patients Treated for Femoral Neck Fractures by Internal Fixation and Hip Replacement (Literature Data)

Study	No. of Patients	Age, years	Survival (%)		Follow-up, years
			Internal Fixation	Hip Replacement	
Rogmark and Johnell (3)	409	>70	88	85	1
Tidermark et al. (22)	102	≥70	81	90	2
Parker et al. (18)	455	>70	73	73	1
Ravikumar and Marsh (19)	271	≥65	75	77	1
Parker and Pryor (21)	208	>70	55	42	3
Johansson et al. (14)	100	≥75	70	78	1

References

1. Kannus P, Parkkari J, Sievanen H, Heinonen A, Vuori I, Jarvinen M. Epidemiology of hip fractures. Bone 1996;18: 57S-63S.
2. Miyamoto RG, Kaplan KM, Levine BR, Egol KA, Zuckerman JD. Surgical management of hip fractures: an evidence-based review of the literature. I: femoral neck fractures. J Am Acad Orthop Surg 2008;16:596-607.
3. Rogmark C, Johnell O. Primary arthroplasty is better than internal fixation of displaced femoral neck fractures: a meta-analysis of 14 randomized studies with 2,289 patients. Acta Orthop 2006;77:359-67.
4. Iorio R, Healy WL, Appleby D, Milligan J, Dube M. Displaced femoral neck fractures in the elderly: disposition and outcome after 3- to 6-year follow-up evaluation. J Arthroplasty 2004;19:175-9.
5. van Dortmont LM, Douw CM, van Breukelen AM, Laurens DR, Mulder PG, Wereldsma JC, et al. Outcome after hemi-arthroplasty for displaced intracapsular femoral neck fracture related to mental state. Injury 2000;31:327-31.
6. Ions GK, Stevens J. Prediction of survival in patients with femoral neck fractures. J Bone Joint Surg Br 1987;69:384-7.
7. Hennekens CH, Buring JE. Epidemiology in medicine. Boston/Toronto: Little, Brown and company; 1987. p. 383.
8. Vertelis A, Petrulis A, Jermolajevas V. Treatment outcome in femoral neck fractures. Medicina (Kaunas) 2002;38:505-9.
9. Bhandari M, Devereaux PJ, Swiontkowski MF, Tornetta P 3rd, Obremskey W, Koval KJ, et al. Internal fixation compared with arthroplasty for displaced fractures of the femoral neck. A meta-analysis. J Bone Joint Surg Am 2003;85: 1673-81.
10. Faraj AA. Non-operative treatment of elderly patients with femoral neck fracture. Acta Orthop Belg 2008;74:627-9.
11. Asnis SE, Wanek-Sgaglione L. Intracapsular fractures of the femoral neck. Results of cannulated screw fixation. J Bone Joint Surg Am 1994;76:1793-803.
12. Parker MJ, Myles JW, Anand JK, Drewett R. Cost-benefit analysis of hip fracture treatment. J Bone Joint Surg Br 1992;74:261-4.
13. Abboud JA, Patel RV, Booth RE Jr, Nazarian DG. Outcomes of total hip arthroplasty are similar for patients with displaced femoral neck fractures and osteoarthritis. Clin Orthop Relat Res 2004;421:151-4.
14. Johansson T, Jacobsson SA, Ivarsson I, Knutsson A, Wahlstrom O. Internal fixation versus total hip arthroplasty in the treatment of displaced femoral neck fractures: a prospective randomized study of 100 hips. Acta Orthop Scand 2000;71:597-602.
15. Keating JF, Grant A, Masson M, Scott NW, Forbes JF. Randomized comparison of reduction and fixation, bipolar hemiarthroplasty, and total hip arthroplasty. Treatment of displaced intracapsular hip fractures in healthy older patients. J Bone Joint Surg Am 2006;88:249-60.
16. Lu-Yao GL, Keller RB, Littenberg B, Wennberg JE. Outcomes after displaced fractures of the femoral neck. A meta-analysis of one hundred and six published reports. J Bone Joint Surg Am 1994;76:15-25.
17. Masson M, Parker MJ, Fleischer S. Internal fixation versus arthroplasty for intracapsular proximal femoral fractures in adults. Cochrane Database Syst Rev 2003;2:CD001708.
18. Parker MJ, Khan RJ, Crawford J, Pryor GA. Hemiarthroplasty versus internal fixation for displaced intracapsular hip fractures in the elderly. A randomised trial of 455 patients. J Bone Joint Surg Br 2002;84:1150-5.
19. Ravikumar KJ, Marsh G. Internal fixation versus hemiarthroplasty versus total hip arthroplasty for displaced subcapital fractures of femur – 13 year results of a prospective randomised study. Injury 2000;31:793-7.
20. Blomfeldt R, Tornkvist H, Ponzer S, Soderqvist A, Tidermark J. Comparison of internal fixation with total hip replacement for displaced femoral neck fractures. Randomized, controlled trial performed at four years. J Bone Joint Surg Am 2005;87:1680-8.
21. Parker MJ, Pryor GA. Internal fixation or arthroplasty for displaced cervical hip fractures in the elderly: a randomised controlled trial of 208 patients. Acta Orthop Scand 2000;71: 440-6.
22. Tidermark J, Ponzer S, Svensson O, Soderqvist A, Tornkvist H. Internal fixation compared with total hip replacement for displaced femoral neck fractures in the elderly. A randomised, controlled trial. J Bone Joint Surg Br 2003;85: 380-8.
23. Lie SA, Engesaeter LB, Havelin LI, Gjessing HK, Vollset SE. Mortality after total hip replacement: 0-10-year follow-up of 39,543 patients in the Norwegian Arthroplasty Register. Acta Orthop Scand 2000;71:19-27.

Received 3 August 2011, accepted 30 March 2012