Clin Orthop Relat Res (2011) 469:3218–3221
DOI 10.1007/s11999-010-1756-z

CLINICAL RESEARCH

Effects of Delayed Hip Fracture Surgery on Mortality and Morbidity in Elderly Patients

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Received: 12 September 2010 / Accepted: 20 December 2010 / Published online: 6 January 2011

Abstract
Background The effects of delaying hip fracture surgery on mortality and morbidity in elderly patients are not completely understood.
Questions/purposes We examined the effects of delays in surgical treatment of hip fracture on mortality, postoperative complications, length of stay in hospital, and functional recovery, in elderly patients.
Patients and Methods We studied two groups of patients with hip fractures. The first group was studied retrospectively (n = 109); these patients had been exposed to an average delay in receiving surgical treatment of more than 1 week owing to a fire at our hospital. Patients in the second group (n = 79), which we studied prospectively, were operated on within 48 hours of experiencing the fracture or as soon as their medical condition permitted. Rates of mortality and complications were registered for each group.
Results We found a larger number of complications in the group with a delay in surgical treatment (pressure ulcer, urinary infection, deep vein thrombosis, and postoperative length of stay), but there were no differences in mortality or functional recovery at 3 months and 1 year.
Conclusions A 1-week delay in the surgical treatment of elderly patients with hip fractures did not increase the mortality rate or prolong the period of recovery but did increase the incidence of postoperative complications. Our experience suggests elderly patients with hip fractures should be operated on as soon as their medical condition permits.
Level of Evidence Level III, therapeutic study. See Guidelines for Authors for a complete description of levels of evidence.

Introduction

Although clinical guidelines [8] recommend performing surgical interventions as soon as possible for elderly patients with hip fractures, scientific evidence for this practice is still inconclusive. The literature offers contradictory evidence regarding the optimal time for surgery [6, 9]. Studies concluding better results are obtained in patients who undergo early surgery may be biased because patients with a delay in surgical treatment tend to have a higher rate of comorbidities [4], which means the groups being compared are not identical [5]. At the same time, for ethical reasons, the influence of delaying surgery on morbidity and mortality cannot be determined via randomized, controlled studies.

Our study compared two groups of patients with hip fractures, the first of which had a delay of more than 1 week before surgery owing to a fire in our hospital that

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Each author certifies that his or her institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.
This work was performed at University Hospital "Reina Sofia."

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resulted in reduction of our surgical activities to ¼ the normal level for approximately 6 months. The second group, which had similar clinical characteristics, was treated in the same hospital and by the same service once the problems caused by the fire had been resolved. These patients were operated on within 48 hours of experiencing the fracture or as soon as their medical condition permitted.

The comparison of these two groups may be regarded as less biased by unequal comorbid status as the delay in surgical treatment cannot be attributed to the patients' state of health but solely to the lack of operating facilities as a consequence of the fire.

We evaluated the effects of the delay in operating on patients with hip fractures on the clinical progress of these patients in terms of the occurrence of complications, including development of pressure ulcers, urinary tract infection, venous thromboembolism, and postoperative pneumonia, at discharge from the hospital. We also compared the recovery of ambulatory function and survival rate at 3 months and 1 year after surgery.

Patients and Methods

We studied two groups of patients with hip fractures; all patients were older than 70 years. Group 1 was studied retrospectively and comprised 106 patients, of whom 81 were women and 25 were men. This group consisted of all patients with hip fractures who had been admitted during the months when surgical activity was limited to extremely urgent cases, owing to a fire at our hospital complex.

Seventy-nine patients were studied and reviewed in Group 2, which comprised all patients admitted consecutively during the course of 6 months and who were surgically treated within 48 hours of admission. Of this group, 62 were women and 15 were men. Only 79 patients were included in this group to select only patients given the same treatments, osteosynthesis and arthroplasty, as Group 1. During the course of the study, our group changed the type of arthroplasty used to manage displaced femoral neck fractures, excluding them from this comparison.

There were no differences between the groups in terms of demographic characteristics, such as age or gender, type of fracture, ambulatory ability, and the evaluation of surgical risk according to the American Society of Anesthesiologists (ASA) scale (Table 1). The only difference was in the length of time between hospital admission and surgical treatment (Group 1 = 9.62 ± 2.86 days; Group 2 = 2.42 ± 1.74 days; $p < 0.001$).

From the first day of admission, each patient was visited daily by a medical team of three specialists in trauma and orthopaedic surgery and one in internal medicine. The criteria for the choice of treatment were the same for both groups: osteosynthesis with gamma nail (Stryker Orthopaedics, Mahwah, NJ, USA) in extracapsular fractures, osteosynthesis with cannulated screws (Stryker) in nondisplaced intracapsular fractures, and Thompson monoblock arthroplasty (Stryker) in displaced intracapsular fractures.

Table 1. General characteristics of the study groups

Characteristic	Group 1 (n = 106)	Group 2 (n = 79)	p Value
Age (years)*	82.7 ± 6.4	82.4 ± 6.7	0.758
Gender			
Male	25 (24%)	17 (21%)	0.79
Female	81 (76%)	62 (79%)	0.9
Type of fracture			
Intracapsular	42 (39.7%)	33 (41.8%)	0.892
Male	11 (10.4%)	8 (10.1%)	0.457
Female	32 (29.3%)	25 (31.7%)	0.922
Nondisplaced or impacted†	7 (6.6%)	6 (7.6%)	0.31
Displaced‡	35 (33.1%)	27 (34.2%)	0.857
Extracapsular	64 (60.3%)	46 (58.2%)	0.892
Male	14 (13.2%)	9 (11.3%)	0.608
Female	50 (47.1%)	37 (46.9%)	0.842
Unstable fracture§	15 (14.1%)	13 (16.44%)	0.727
Stable fracture‖	49 (46.2%)	33 (41.76%)	0.865
ASA score			
I	0	0	
II	35 (33%)	28 (35.4%)	0.854
III	63 (59.4%)	50 (63.2%)	0.71
IV	8 (7.5%)	5 (6.3%)	0.98
V	0	0	
Preoperative length of stay (days)*	9.62 ± 2.86	2.42 ± 1.74	< 0.001

* Values are expressed as mean ± SD; †Garden grade 1 or 2; ‡Garden grade 3 or 4; §OTA A.2.2; A.2.3; A.3.1; A.3.2; A.3.3; ‖OTA A.1.1; A.1.2; A.1.3, A.2.1; ASA = American Society of Anesthesiologists.

All patients were operated on by the same team of surgeons and anesthesiologists. Patients underwent anticoagulation prophylaxis with low-molecular-weight heparin as soon as they were admitted for treatment.

Postoperative complications such as pressure sores, urinary infections, deep vein thromboses, and pneumonia were recorded, as was postoperative length of stay. Deaths were recorded at 3 months and 1 year. Two of us (PR-F, DA-C) assessed functional recovery, which was stratified into five levels, scored from 1 to 5 (Table 2), depending on the ambulatory capacity of the patient before and 1 year after the fracture.

Absolute frequencies and percentages were calculated for qualitative variables, and arithmetical means, SDs, and minimum/maximum values for quantitative variables. Qualitative variables were compared using Pearson's chi

square test (gender, fracture types, ASA score, postoperative mobility, pressure sores, 1-year mortality) or Fisher's exact test when any expected frequency was lower than 5 for 2 × 2 comparisons (preoperative mobility, urinary infection, deep venous thrombosis, pneumonia, 23-month mortality); chi square was applied to h × k comparisons. Quantitative variables were compared using Student's t test for independent variables. Statistical significance was set at $p < 0.05$. The SPSS® Version 17.0 statistical software package (SPSS Inc, Chicago, IL, USA) was used for statistical analyses.

Table 2. Assessment of functional recovery

Level	Description
1	Patients walk without help inside and outside their homes
2	Patients walk without help at home but require help to walk in the street
3	Patients walk with help inside and outside their homes
4	Patients walk with help at home but unable to go out
5	Patients completely unable to walk

Table 3. Complications, postoperative length of stay, and mortality

Variable	Group 1 (n = 106)	Group 2 (n = 79)	p Value
Pressure sores	19 (17.4%)	5 (6.3%)	0.02
Urinary infection	18 (17%)	4 (5.1 %)	0.013
Deep venous thrombosis	10 (9.4%)	1 (1.3%)	0.026
Pneumonia	13 (12.3%)	3 (3.8%)	0.043
Postoperative length of stay (days)*	16.24 ± 5.8	10.59 ± 4.9	0.001
3-month mortality	7 (6.6%)	4 (5.1%)	0.67
Male	3 (2.8%)	2 (2.55%)	0.9
Female	4 (3.8%)	2 (2.55%)	0.03
1-year mortality	30 (28.3%)	19 (24.05%)	0.62
Male	11 (10.3%)	7 (8.86%)	0.47
Female	19 (18%)	12 (15.19%)	0.73

* Values are expressed as mean ± SD.

Results

Complications occurred more frequently in Group 1, which experienced a 1-week delay in surgery. The rates of appearance of pressure sores ($p = 0.02$), urinary infections ($p = 0.013$), deep vein thrombosis ($p = 0.026$), and pneumonia ($p = 0.043$) were greater for patients who experienced a delay in obtaining surgical treatment (Table 3). There was also an increase in the length of postoperative stay in hospital for this group ($p = 0.001$).

Comparison of the functional recovery level of the two groups of patients (Table 4) revealed no differences at 1 year postsurgery. No differences in the functional assessments were found: needs help outside home ($p = 0.86$), needs help in and outside home ($p = 0.73$), unable to go out ($p = 0.63$), and not walking at all ($p = 0.94$).

There also were no differences in mortality between the two groups at either 3 months ($p = 0.67$) or 1 year postfracture ($p = 0.62$).

Discussion

The effects of delaying hip fracture surgery on mobility and mortality in elderly patients remains controversial [6, 8, 9, 11]. The aims of our study were to investigate the effects of the delay in operating on patients with hip fractures on the clinical progress of these patients in terms of occurrence of complications (development of pressure sores, urinary tract infection, venous thromboembolism, and postoperative pneumonia), functional recovery, and survival rates at 3 months and 1 year after the fracture.

Our study is original as far as the sources of the patient sample are concerned. No other study in the current literature has been based on a hospital crisis situation that made it necessary to delay surgical treatment of all patients with hip fractures, regardless of their state of health or comorbidities. Nevertheless, we realize the study has some potential limitations. For instance, the classification of functional recovery we used has not been validated and

Table 4. Comparison of functional level before and 1 year after fracture between the two groups

Functional level*	Before fracture			After fracture		
	Group 1 (number)	Group 2 (number)	p Value	Group 1 (number)	Group 2 (number)	p Value
1	8 (7.5%)	5 (6.3%)	0.76	0	0	
2	32 (30.2%)	22 (27.8%)	0.79	27 (35.52%)	19 (31.6%)	0.86
3	37 (34.9%)	31 (39.2%)	0.68	29 (38.15%)	24 (40%)	0.73
4	22 (20.7%)	17 (21.5 %)	0.92	12 (15.78%)	11 (16.1%)	0.63
5	7 (6.6 %)	4 (5.1 %)	0.67	8 (10.52 %)	6 (10%)	0.94

* Descriptions of functional levels provided in Table 2.

could have introduced some intraobserver variability. Group 1 patient data were gathered retrospectively, and the number of patients in Group 2 was relatively small, although we designed the study in this way to make the two groups as homogeneous as possible. This probably ensured the state of health, type of fracture, and treatment received by the two groups were not different; only the preoperative stay in hospital differed.

We found differences in the incidence of postoperative complications, which always occurred more frequently in the patients with delayed treatment; these complications included pressure sores, urinary tract infections, deep vein thrombosis, and pneumonia. There also was a difference in postsurgical hospitalization, which was longer for the Group 1 patients. However, we found no differences in either early or late mortality or in functional recovery. Our findings agree with those of prior studies in which the relationship between longer time to surgery and decubitus ulcer already has been described [3, 7], as has the relationship with urinary tract infections [10], and the incidence of pneumonia and deep vein thrombosis [1].

In agreement with other studies [6, 10], we believe the increase in the length of postoperative stay in hospital we observed in our Group 1 patients can be explained precisely by the greater number of postoperative complications mentioned above, which required medical intervention in the hospital and a longer stay in hospital.

Mortality at 3 months and 1 year was greater in the late-operated group than for patients operated on within 48 hours, although the difference was not statistically significant. This suggests the delay in treatment had no influence on the survival of our patients. Data in the literature regarding the influence of the timing of hip fracture surgery on mortality in elderly patients are controversial, in that we can find data supporting an association [1, 2, 9] and other studies finding no relationship between a delay in surgery and mortality [3, 6, 10]. In these prior studies, the suggestion of higher mortality for patients whose surgery is delayed may be the result of inherent bias because the patients experiencing delayed surgery tended to be in a poorer state of health.

A similar controversy concerns the influence of the timing of surgery on functional recovery; we found no differences between the two groups, as some authors have found [6, 10], yet others have found a relationship between delayed surgery and loss of functional capacity [2].

We believe our study is unique in its ability to compare two homogeneous groups of patients with hip fractures, in that the delay in surgical treatment of one group was not attributable to their medical condition but to a lack of surgical facilities. We found no relationship of delayed surgery with either higher mortality in elderly patients with hip fractures, even when the delay was longer than 5 days, or poorer functional recovery of such patients. A relationship does exist between delayed surgery and the incidence of postoperative complications and longer stays in hospital. This leads us to suggest elderly patients with hip fractures should be treated as soon as their medical condition permits to avoid the occurrence of such complications and to reduce unnecessary suffering, shorten the length of hospital stay, and lower the costs of health care.

Acknowledgments We thank Drs J.A. Serrano, L. Castro, and P. Serrano for help in completing this article.

References

1. Chilov MN, Cameron ID, March LM; Australian National Health and Medical Research Council. Evidence-based guidelines for fixing broken hips: an update. *Med J Aust*. 2003;179:489–493.
2. Doruk H, Mas MR, Yildiz C, Sonmez A, Kyrdemir V. The effect of the timing of hip fracture surgery on the activity on daily living and mortality in elderly. *Arch Gerontol Geriatr*. 2004;39:179–185.
3. Grimes JP, Gregory PM, Noveck H, Butler MS, Carson JL. The effects of time-to-surgery on mortality and morbidity in patients following hip fracture. *Am J Med*. 2002;112:702–709.
4. Kesmezacar H, Ayhan E, Unlu MC, Seker A, Karaca S. Predictors of mortality in elderly patients with an intertrochanteric or a femoral neck fracture. *J Trauma*. 2010;68:153–158.
5. Lefaivre KA, Macadam SA, Davidson DJ, Gandhi R, Chan H, Broekhuyse HM. Length of stay, mortality, morbidity and delay to surgery in hip fractures. *J Bone Joint Surg Br*. 2009;91:922–927.
6. Orosz GM, Magaziner J, Hannan EL, Morrison RS, Koval K, Gilbrt M, McLaughlin M, Halm EA, Wang JJ, Litke A, Silberzweig SB, Siu AL. Association of timing of surgery for hip fracture and patient outcome. *JAMA*. 2004;291:1738–1743.
7. Parker MJ, Pryor GA. The timing of surgery for proximal femoral fractures. *J Bone Joint Surg Br*. 1992;74:203–205.
8. Scottish Intercollegiate Guidelines Network. *Prevention and Management of Hip Fracture in Older People: A National Clinical Guideline*. Edinburgh, UK: Scottish Intercollegiate Guidelines Network; 2002.
9. Shiga T, Wajima Z, Ohe Y. Is operative delay associated with increased mortality of hip fracture patients? Systematic review, meta-analysis, and meta-regresion. *Can J Anesth*. 2008;55:146–154.
10. Verbeek DO, Ponsen KJ, Goslings JC, Heetveld MJ. Effect of surgical delay on outcome in hip fracture patients: a retrospective multivariate analysis of 192 patients. *Int Orthop*. 2008;32:13–18.
11. Zuckerman JD. Hip fracture. *N Engl J Med*. 1996;334:1519–1525.