

Proximal Femoral Fractures in Geriatric Patients: Identifying the Major Risk Factors for Postoperative Infection in a Single-Center Study

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ABSTRACT **Background:** Proximal femoral fractures (PFF) are among the most common injuries in the elderly population treated by orthopedic surgeons. Postoperative complications, especially infections, are of great importance due to their effect on patient mortality and morbidity and healthcare costs.

Objectives: To assess the main causes for postoperative infection among PFF patients.

Methods: We conducted a retrospective analysis of PFF patients in our medical center between 2015 and 2017. Patients were divided into two groups based on whether there was postoperative infection during immediate hospitalization and 30 days after surgery. Factors such as time from admission to surgery, duration of surgery, and length of stay were analyzed. Groups were analyzed and compared using a *t*-test, chi-squared and Fisher's exact tests.

Results: Of 1276 patients, 859 (67%) underwent closed reduction internal fixation, 67 (5%) underwent total hip arthroplasty, and 350 (28%) underwent hemiarthroplasty. Of the total, 38 patients (3%) were diagnosed with postoperative infection. The demographics and co-morbidities were similar between the two study groups. The incident of infection was the highest among patients undergoing hemiarthroplasty (6%, $P < 0.0001$). Length of hospitalization (15 vs. 8 days, $P = 0.0001$) and operative time (117 vs. 77 minutes, $P = 0.0001$) were found to be the most significant risk factors for postoperative infection.

Conclusions: Predisposition to postoperative infections in PFF patients was associated with prolonged length of surgery and longer hospitalization. We recommend optimizing fast discharge, selecting the appropriate type of surgery, and improving surgical planning to reduce intraoperative delays and length of surgery.

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KEY WORDS: co-morbidity, duration of surgery, mortality, postoperative infection, proximal femoral fracture

Proximal femoral fractures (PFF) are common injuries, particularly in the elderly population [1,2]. According to recent studies, the population is aging rapidly [1,3,4]. This demographic change requires adjustments of techniques and approaches in order to address the needs of elderly patients. For example, shorter rehabilitation, faster surgeries, and quicker discharge from the hospital are of great importance for elderly patients with co-morbidities and reduced physiological reserve. As these patients are at greater risk for postoperative complications [1,5], identifying factor that increase this risk is a major concern. One of the most common postoperative complications is infection. Postoperative infection in patients with PFF prolongs hospital stay, requires antibiotics treatment, and is associated with higher healthcare costs and a significant rise in mortality rates [3,6-8].

According to recent studies [6-11], postoperative infection rates after surgical treatment for PFF are 2–7%. Identified risk factors for postoperative infections include co-morbidities and open fractures [7-10]. Other suggested factors are the experience of the surgeon, length of surgery, time from admission to surgery, and prophylactic antibiotics [6,11-13]. Understanding these factors can bring change to the way we treat elderly patients with PFFs, thus reducing the postoperative infection rate. In this study, we performed a retrospective analysis on patients who had undergone surgical treatment due to PFF in our institution to identify major risk factors that increased the rate of postoperative infection during hospitalization and 30 days after surgery.

PATIENTS AND METHODS

We conducted a retrospective analysis by reviewing medical records and surgical reports. Only patients with acute postoperative infection, such as deep infection that required surgical intervention or long-term antibiotic treatment during immediate hospitalization and 30 days after surgery, were included in this study due to the strong effect on morbidity. Deep infections were diagnosed by an experienced surgeon considering blood

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tests, wound purulent drainage, wound sterile culture positive for organisms, abnormal swelling of the surgical area, local heat, erythema, and pain. We analyzed different possible risk factors, such as time from admission to surgery, duration of surgery, type of surgery, time of surgery, length of hospitalization, and surgeon’s experience.

A total of 1276 patients who underwent surgical treatment for PFF in our medical center between the years 2015 and 2017 were included in this study. Type of surgery performed was decided according to the type of fracture and the patient’s medical status and health. For example, pertrochanteric fractures were treated with closed reduction and internal fixation (CRIF) and subcapital fractures were treated with either hemiarthroplasty for low demand patients or total hip arthroplasty (THA) for high demand patients. All patients returned to follow-up in the outpatient clinic 3 and 6 months after surgery; 985 (77%) returned at the 12-month follow-up. This study was approved by the institutional ethics committee.

STATISTICAL ANALYSIS

Statistical analyses were performed using IBM Statistical Package for the Social Sciences statistics software, version 25 (SPSS, IBM Corp, Armonk, NY, USA). Data are presented as numbers and percentages. Study groups were compared using the chi-square test. Quantitative variables were compared using a *t*-test. A multivariate analysis of risk factors for postoperative infection after hip fracture surgery was performed using the multivariate model of logistic regression. Results were statistically significant if *P* < 0.05.

RESULTS

Of the 1276 patients who were treated surgically for PFF, 67 (5%) underwent THA, 859 (67%) underwent CRIF, and 350 (28%) underwent hemiarthroplasty. Infection rates were the highest after hemiarthroplasty and lowest after CRIF [Table 1]. Thirty-eight patients (3%) were diagnosed with postoperative infection. One patient (2%) was diagnosed with postoperative infection during immediate hospitalization. Average hospitalization length was 7.9 days in the non-infection group and 15.5 days in the postoperative infection group [Table 2].

In our medical center, CRIF is performed using a fixation by intramedullary nail. THA was performed exclusively by experienced surgeons. Hemiarthroplasty was performed mostly by senior surgeons with one-third of the cases conducted by residents. Postoperative infection rates were 5% and 7%, respectively. Almost half of the CRIF procedures were conducted by a resident surgeon, with similar postoperative infection rates (2% vs. 1%) for senior surgeons. Overall, surgeon experience was not a statistically significant risk factor for postoperative infection. Likewise, the demographics were similar in infected and non-infected patients [Table 1].

Of all of the possible risk factors that were tested, length of hospitalization, type of surgery and duration of surgery were found to be the most statistically significant as risk factors for postoperative infection. Other measured variables were not statistically significant [Table 2].

Table 1. Patient demographics and comparison between infected and non-infected patients after surgical treatment for proximal femur fractures

	Infected	Non-infected
Age, years	83.5 ± 8.7	83.7 ± 8.6
Sex		
Male	10 (27%)	375 (30%)
Female	28 (73%)	863 (70%)
Procedure		
Closed reduction and internal fixation	14 (2%)	845 (98%)
Hemiarthroplasty	21 (6%)	329 (94%)
Total hip arthroplasty	3 (4%)	64 (96%)

Table 2. Comparison of risk factors between infected and non-infected patients after surgical treatment for proximal femur fractures

	Infected	Non-infected	<i>P</i> value
Duration of surgery (minutes)	116.9 ± 53.2	76.8 ± 48.7	< 0.0001
Time from admission to surgery (hours)	38.9 ± 30.4	30.8 ± 25.7	0.06
Patients operated > 48 hours after admission	7 (18%)	121 (10%)	0.079
Surgeon seniority			
Specialist	22 (58%)	735 (59%)	0.869
Resident	16 (42%)	506 (41%)	0.869
Hospitalization length (days)	15.5 ± 17.1	7.9 ± 3.6	< 0.0001
Time of surgery			
07:00–21:00	37 (97%)	1192 (96%)	1
21:00–07:00	1 (3%)	46 (4%)	1

Data are presented as value (percentage) or as mean ± standard deviation

DISCUSSION

In this retrospective study, data collected over 3 years in our medical center illustrated that extended hospitalization, type of surgery, and prolonged duration of surgery predisposed PPF patients to postoperative infections.

Postoperative infection rate was 3%, which is similar to reported rates in the literature and previous studies. For example, Ridgeway et al. [10] reported a postoperative infection incidence between 2.23% and 4.97% in 20,060 patients who underwent primary THA or hemiarthroplasty for PFF.

Numerous studies were conducted in order to identify major risk factors for postoperative infection following PFF surgical treatment (Harrison [11], de Jong [12], Lau [13], and Noailles [6]). Some of the suggested risk factors, such as ASA score, gender, co-morbidities and age, were not analyzed in this study.

In our cohort, the type of surgery was found to have a statistically significant effect on postoperative infection, as described in previous studies (Edwards [7]), with hemiarthroplasty having the highest incidence of 6% infected patients. The other two factors that we identified—length of surgery and extended hospitalization period—were found to be statistically significant in some studies (Harrison [11], de Jong [12]). Trying to distinguish whether prolonged hospitalization is a result or cause for postoperative infection, considering that only one patient was diagnosed with infection during immediate hospitalization, it is clear from the results that prolonged hospitalization is a risk factor for postoperative infection rather than a result.

Although it was not statistically significant, it is reasonable to assume that the difference in postoperative infection rate between THA and hemiarthroplasty (5% and 6%, respectively) were likely due to the fact that THA is performed exclusively by senior surgeon specialists with a skilled surgical team, whereas hemiarthroplasty is more commonly performed by less skilled residents. In addition, THA is performed in high demand patients whereas HA is performed in low demand patients with co-morbidities, which by themselves, can be a risk factor for postoperative infection. In our study, we found that CRIF had the lowest postoperative infection rate, most likely due to the surgical technique of closed reduction with no involvement of the capsule and joint, unlike in hemiarthroplasty and THA.

LIMITATIONS

Being a single-center study reduces the diversity of surgeons, hospital facilities and surgical equipment. Furthermore, the large dis-

parity between the numbers of performed procedures of different types (859 CRIF vs. 67 THA) affected the statistical comparison.

CONCLUSIONS

We identified significant risk factors that must be considered to reduce infection rates following surgical treatment for PFF. Our results highlight the importance of reducing the duration of surgery, selecting the type of surgery, and optimizing the process of fast discharge to rehabilitation or home care for the prevention of postoperative infections.

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It is not the mountain we conquer but ourselves.

Edmund Hillary (1919–2008), New Zealand mountaineer, explorer, and philanthropist,

Hillary and Sherpa mountaineer Tenzing Norgay became the first climbers confirmed to have reached the summit of Mount Everest