

# Economic Analysis of Regional Versus General Anesthesia for Hip Fracture Surgery

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## Abstract

**Background:** The economic burden of the treatment of hip fracture would be enormous, especially in countries like Iran with an aging population and limited financial resources. The choice of anesthetic technique for hip fracture surgery is controversial. We conducted this retrospective 4 year study to evaluate the effect of regional versus general anesthesia on the length of hospital stay and the cost of hospitalization in an academic governmental setting.

**Methods:** We reviewed the medical records of 751 adult patients who underwent a surgery for intertrochanteric or femoral neck fracture since 2008 to 2012 in a University hospital located in Tehran, Iran. Data regarding days of hospital stay and total direct hospitalization costs as well as patients' demographics were analyzed based on the type of planned anesthesia. The source of data collection was local electronic database.

**Results:** Neuraxial anesthesia was associated with less hospital stay and costs in patients with intertrochanteric fracture surgery. The advantage of neuraxial over general anesthesia was not statistically significant in patients with femoral neck fracture.

**Conclusions:** Neuraxial anesthesia followed by meticulous postoperative pain control may reduce the hospitalization period and costs of hip fracture treatment. This is especially true for the patients with intertrochanteric fracture.

**Keywords:** Anesthesia, Economic, Hip Fracture

## 1. Introduction

Hip fracture, especially in the elderly population, is a global public health problem with an annual incidence of approximately 1.6 million events worldwide (1). The annual incidence of hip fracture per 100,000 people is approximately 115 in the Iranian population (2), which is a proportion believed to be a high rate among the Asian countries (3). This incidence is anticipated to grow rapidly during the next decades because of the aging of the population (4-7). A recent study in Iran estimated that the average total hospitalization costs for hip fracture surgery is US\$774 (8). Besides the huge economic burden, hip fracture is associated with a high incidence of morbidity and mortality (9-11). Several attempts have been made to improve the outcome and, simultaneously, reduce the costs of the hip fracture surgery. Among these, there are new strategies for the management of anesthesia as well as the implementation of postoperative acute pain services.

The choice of the anesthetic technique for hip fracture surgery is controversial. Past observational studies and a few available clinical trials showed no significant difference in the mortality rates according to the anesthesia type (12-15).

Nonetheless, it has been suggested that regional anes-

thetia via epidural, spinal, or peripheral neural blockade may reduce the postoperative morbidities (16, 17). Proposed reasons for the improved outcome with regional anesthesia include decreased blood loss and less required blood transfusions, the reduced risk of the deep vein thrombosis and emboli, and improved postoperative analgesia (18).

In our center, the anesthesia technique for hip fracture surgery before 2008 included general anesthesia or single shot neuraxial anesthesia. After the involvement of the acute pain service, femoral and sciatic nerve blocks as the intraoperative anesthetic technique as well as epidural/peripheral catheter insertion for postoperative pain management have been added to the routine plans of anesthesia (19). This retrospective study was conducted to evaluate the effect of the anesthesia type on the length of hospital stay and the cost of hospitalization in a four year period.

## 2. Methods

### 2.1. Data Sources and Study Sample

We reviewed the records of adults aged 18 years and older undergoing hip fracture surgery at Rasoul Akram university hospital between April 1, 2009 and March 31,

2012. We identified 842 patients who underwent a surgery for intertrochanteric or femoral neck fractures using the national procedure terminology codes. The selected codes identified patients with open reduction internal fixation, percutaneous pinning, or bipolar arthroplasty. The available electronic database included information on the patients' demographics, inpatient procedures, anesthesia type, discharge status, the duration of hospital stay, the costs of hospitalization, and the insurance status.

Patients receiving both general and regional anesthesia for a single procedure were listed as having received general anesthesia. We excluded the patients with multiple surgical procedures within one hospitalization requiring general or neuraxial anesthesia. Patients with a secondary procedure under local anesthesia or sedation such as casting or central venous catheterization were not excluded. Patients with no insurance coverage were excluded because of the outlier data. Finally, the patients with missing anesthesia type codes were excluded and 751 patients were enrolled for analysis.

## 2.2. Outcome and Control Variables

The primary outcomes of this study were the length of hospital stay and the total direct hospitalization costs. The types of anesthesia and the patients' demographics were recorded for analysis. We could not evaluate the information regarding the patients' co-morbidities, the administered drugs for either general or neuraxial anesthesia, the selected method of postoperative pain control, ICU length of stay, and condition at discharge due to the limitations in the electronic data collection system. The collection of these data required the review of paper records which was not attempted in this study.

## 2.3. Statistical Analyses

For analysis, the patients were categorized as general anesthesia (GA) group versus those who received either neuraxial anesthesia or peripheral nerve block (RA) group. We used the independent t-test to compare the hospital stay and costs in the GA and RA groups. We estimated the cost of hospitalization by applying the ratio of cost-to-charge for governmental hospitals with respect to the type of the patients' insurance. The cost of hospitalization for the patients with motor vehicle accidents, which is free in governmental hospitals, was calculated separately and was included in the analyses. The demographic variables between the two groups were compared with an appropriate test including t-test or Chi-square test. P values < 0.05 were considered statistically significant. All the comparisons were two-tailed. Statistical analyses were performed with SPSS version 16.0 software (SPSS, Inc., Chicago, IL, USA).

## 3. Results

We enrolled 508 patients with intertrochanteric fracture and 243 patients with femoral neck fracture in the analysis. The distribution of anesthesia techniques is presented in Table 1. The most commonly selected method of anesthesia in either fracture was spinal anesthesia. General anesthesia was applied for 24% of the intertrochanteric fractures and 28% of the femoral neck fractures. The majority of the patients were female and 44% were older than 70 years of age.

**Table 1.** The Distribution of Applied Anesthesia Techniques in Patients with Hip Fracture<sup>a</sup>

	<b>Intertrochanteric Fracture (n = 508)</b>	<b>Femoral Neck Fracture (n = 243)</b>
<b>General</b>	124 (24.4)	70 (28.8)
<b>Spinal</b>	173 (34.1)	77 (31.7)
<b>Epidural</b>	129 (25.4)	48 (19.8)
<b>Combined Spinal-epidural</b>	72 (14.2)	47 (19.3)
<b>Nerve block</b>	10 (2.0)	1 (0.4)

<sup>a</sup>Values are expressed as No. (%).

The distribution of the sex and average age of the patients were comparable in GA and RA groups (Table 2). Subgroup analysis showed that the duration of the hospital stay in patients who received RA for intertrochanteric fracture was 3 days shorter than that of the GA group. The hospital charge in the RA group was, also, significantly less than that in the GA group. In the patients with femoral neck fracture, the values for hospital stay and charges in the RA group were less than those in the GA group, but the differences were not statistically significant (Table 2).

## 4. Discussion

The results of this study suggest that RA may reduce the costs and the duration of hospitalization in patients with intertrochanteric fracture. Most of patients with either epidural or combined spinal-epidural anesthesia received postoperative pain control using patient-controlled epidural analgesia (PCEA) pumps. A small number of patients were operated after the implementation of sciatic and femoral nerve blocks. The postoperative pain control for these patients was mostly achieved using patient-controlled regional anesthesia (PCRA) pumps. A shortened duration of hospitalization and less costs in these subsets of patients could be reasonably explained by lower degrees of postoperative stress response, earlier ambulation, and,

**Table 2.** Study Measurements Between Different Anesthesia Techniques in Patients with Hip Fracture<sup>a</sup>

	Intertrochanteric Fracture (n = 508)			Femoral Neck Fracture (n = 243)		
	General (n = 120)	Regional (n = 388)	P Value	General (n = 70)	Regional (n = 173)	P Value
Hospital stay, days	15 (10)	12 (8)	0.003	12 (8)	11 (8)	0.45
Total cost, IRR (*10 <sup>5</sup> ) <sup>b</sup>	237 (225)	194 (150)	0.01	212 (194)	206 (156)	0.75
Age, yr	67 (18)	69 (17)	0.53	62 (21)	63 (18)	0.71
Male sex	52 (43.3)	164 (42.2)	0.83	31 (44.2)	71 (41.0)	0.66

<sup>a</sup>Values are expressed as No. (%).

<sup>b</sup>One US dollar in the study period was 20095 IRR on average according to the formal reports of the central bank of the I.R. Iran.

probably, lower complications of prolonged bed rest attributable to optimal pain control.

The treatment of osteoporotic hip fracture is an economic burden on the health care systems in the aging populations, because older patients are vulnerable to several perioperative morbidities and a longer duration of hospital stay. There is little data considering the impact of anesthesia type on the costs of hip fracture repair. In this study, the mean cost of hospitalization was 20,531,291 IRR (US\$ 1021) with an 18.2 percent reduction attributable to the application of neuraxial anesthesia in the patients with intertrochanteric fracture. The reported cost of hip fracture treatment is highly variable among the earlier studies worldwide (20-22). The characteristics of the included patients, variations in the average hospital stay, and the different methods of treatment make these differences explainable. However, all of these studies highlighted the economic burden of hip fracture treatment in their communities. The projected increase of the life expectancy and the number of the elderly in Iran make the costs of osteoporotic hip fracture repair substantial in the future. The application of neuraxial anesthesia and PCEA may improve the outcome and, simultaneously, reduce the costs of treatment by 18%, approximately. This will deliver a great benefit, especially in the countries with limited financial resources like Iran.

The duration of hospital stay in our patients was longer than the reported values in other studies. A study in the United States reported an average length of hospital stay of 7 days in patients with hip fracture surgery (22). Even, another Iranian study on 103 patients reported the mean duration of hospitalization of 9.7 days, ranging from 5 to 38 days. The average total hospitalization cost was 7,208,588 IRR (US\$774) in that survey (8). The observed difference in the hospital stay duration could be attributed to the heavy workload and, somehow, prolonged attendance for the operating room in our governmental university-affiliated hospital. However, most of the earlier studies have limited their study population to the patients with ASA physical

status I and II, while we enrolled a population-based sample of patients including elderly ones with a poor medical condition. Thus, the generalization of the current results to the community would be feasible.

From our experience, epidural anesthesia is a feasible and relatively safe option for the elderly patients undergoing hip fracture surgery. In addition, it offers optimal flexibility in the duration of the surgery. In our hospital, the epidural catheter remains in situ for an average of two postoperative days and provides an optimal postoperative pain control for the patients. However, the advantage of neuraxial anesthesia over general anesthesia was less evident in the surgical treatment of femoral neck fracture. It is noteworthy that the mean age of the patients with intertrochanteric fracture was higher than that of the subjects with femoral neck fracture. Similarly, an earlier study has suggested that neuraxial anesthesia may reduce the morbidity and mortality in the patients with intertrochanteric but not femoral neck fracture (23). It may be reasonable to conclude that the older patients with intertrochanteric hip fracture may benefit more from neuraxial anesthesia and meticulous postoperative pain control than the younger, healthier ones.

#### 4.1. Study Limitations

The most important limitation of this study is its retrospective nature. It is possible that we were unable to identify and adjust for important variables namely patients' comorbidities that might influence the results. Specifically, if sicker patients were more likely to receive either of the anesthesia methods, our findings of the shorter duration of hospitalization and reduced costs are prone to selection bias. In such studies, a 'propensity score matching' could compensate for the unequal chance of inclusion in the study groups. We could not design this analysis as the coding structure of the study database prevented the identification of co-morbidities or the ASA physical status of the patients. To improve the reliability, we require a conclusive

database or we should conduct a large scale clinical trial in the future.

A limitation to use the raw data regarding the costs of hospitalization is that we did not adjust the data for annual inflation. However, because the inflation for the medical equipment and other charges of hospitalization were comparable in the study period, it was felt that inflation could not influence the interpretation of the results.

Despite these limitations, this study has important implications for health policy makers and clinicians related to the treatment of hip fracture in the geriatric population. Regarding the aging population of Iran, a rapid increase in the need for the treatment of hip fracture is expected in the coming decades. This economic burden is especially important because of the limited financial resources. The results of this study suggest that neuraxial anesthesia followed by meticulous postoperative pain control may reduce the hospitalization period and costs of hip fracture treatment. This is especially true for the patients with intertrochanteric fracture. Further validation of these findings requires a database with an improved coding structure or optimistically implementing a large scale clinical trial.

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