Comparison of Different Anesthetic Techniques on Postoperative Outcomes in Elderly Patients with Hip Fracture

Kalça Kırığı Olan Yaşlı Hastalarda Uygulanan Farklı Anestezi Tekniklerinin Cerrahi Sonrası Sonuçlarının Karşılaştırılması

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ABSTRACT Objective: Determining the type of anesthesia is a complex medical decision that depends on many factors including co-morbidity, age, type of surgery performed, and the risk of the anesthetic techniques. This study evaluated the effects of anesthesia type on postoperative mortality and morbidity in hip fractures. **Material and Methods:** One hundred eighty-five patients older than 60 years who were operated for hip fracture between 2005-2009 were retrospectively analyzed. Patients received general anesthesia (n=67), spinal anesthesia (n=67), or epidural anesthesia (n=51). The clinical features of the patients were obtained from the hospital records. Morbidity outcomes were assessed on postoperative day 7. Mortality rates were calculated on postoperative day 7 and postoperative day 30. **Results:** There were no significant differences between the three groups with regard to intraoperative blood loss, intraoperative blood transfusion, smoking status, length of stay in hospital, American Society of Anesthesiology (ASA) physical status, and Charlson Comorbidity Index (CCI) (p=0.393, p=0.088, p=0.369, p=0.228, p=0.491, p=0.371 respectively). Similarly, no difference was detected between the three groups regarding patient mortality rates for day 7 and 30 (p=0.738, p=0.805 respectively). **Conclusion:** No technique was superior to the others. Due to the similar mortality rates among the groups, we suggest that the proper anesthetic technique selected according to the clinical features of the patient combined with adequate monitorization would yield successful results with all three techniques.

Key Words: Hip fractures; mortality; anesthesia

ÖZET Amaç: Anestezi tipinin belirlenmesi, yaş, uygulanacak cerrahi tipi ve anestezi tekniklerinin riski gibi birçok faktörün göz önüne alınmasını gerektiren, kompleks bir tıbbi karardır. Bu çalışmada, kalça kırıklarında anestezi tipinin cerrahi sonrası mortalite ve morbidite üzerindeki etkileri değerlendirilmiştir. **Gereç ve Yöntemler:** Çalışmada, 2005-2009 yılları arasında kalça kırığı operasyonu geçiren 60 yaş üzeri 185 hasta retrospektif olarak analiz edilmiştir. Hastalara genel anestezi (n=67), spinal anestezi (n=67) ve epidural anestezi (n=51) yöntemlerinden biri uygulanmıştır. Hastalara ait klinik bilgiler hastane kayıtlarından elde edilmiştir. Morbidite sonuçları operasyon sonrası yedinci günde değerlendirilmiştir. Mortalite oranı ise operasyon sonrası 7. ve 30. günlerde hesaplanmıştır. **Bulgular:** Her üç grupta cerrahi sırasındaki kan kaybı ve kan transfüzyonu, sigara içme durumu, hastanede kalış süresi, American Society of Anesthesiology (ASA) skoru ve Charlson morbidite indeksi skoru açısından anlamlı bir fark bulunmamıştır (sırasıyla p=0,393, p=0,088, p=0,369, p=0,228, p=0,491, p=0,371). Hastaların 7. ve 30. günlerdeki mortalite oranları açısından gruplar arasında anlamlı bir fark saptanmamıştır (sırasıyla p=0,738, p=0,805). **Sonuç:** Benzer mortalite oranları nedeniyle hiçbir anestezi tekniği diğerinden üstün değildir. Bu nedenle, perioperatif takibi iyi yapılan hastalarda, anestezi tekniği hastanın klinik özellikleri dikkate alınarak seçildiği müddetçe, her üç anestezi tekniği ile başarılı sonuçlar elde etmek mümkündür.

Anahtar Kelimeler: Kalça kırığı; ölüm oranı; anestezi

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Hip fracture surgery is a common medical procedure in elderly patients. The patient with multiple comorbidities has increased risk for perioperative morbidity and mortality. Quest for determining the factors that may contribute to morbidity and mortality for procedures used in high-risk patients is a constant challenge for physicians. The assessment of the mortality and morbidity risk after surgery should include consideration of anesthesia management (airway, the establishment of regional blocks and invasive monitoring) toxicity of the anesthetic agent used, the incidence of critical intraoperative and postoperative events, and the postoperative treatment of pain.[1-3]

Anesthesiologists should make a choice between regional and general anesthetic techniques. General anesthesia, spinal anesthesia, and epidural anesthesia are the three techniques commonly used during hip fracture repair. All these anesthetic techniques have been proved to be safe. Several clinical studies have compared the outcome of patients after the administration of general or regional anesthesia.[3-5] However, the impact of any of them on postoperative mortality and morbidity has not been clearly determined up to date.

In this study, we aimed to compare the impact of general anesthesia, spinal anesthesia and epidural anesthesia on the postoperative incidence of mortality and morbidity in elderly patients undergoing hip fracture repair.

MATERIAL AND METHODS

Institutional Local Ethics Committee approval was obtained for this study.

PATIENTS

One hundred and eighty-five patients who were older than 60 years and underwent hip fracture repair under general, spinal or epidural anesthesia between 2005 and 2009 were included in the study. Patients were excluded if they had received a combination of regional and general anesthesia or underwent a surgical procedure involving a site other than the hip.

ANESTHETIC TECHNIQUES

The anesthesiologist chose one of the completely standardized anesthetic techniques, general, spinal and epidural anesthesia according to the clinical condition of the patient. In the general anesthesia group, anesthesia was initiated with 2-2.5 $mg \cdot kg^{-1}$ propofol or 0.2-0.4 $mg \cdot kg^{-1}$ etomidate, 1-2 $mcg.kg^{-1}$ fentanyl and 0.1 $mg \cdot kg^{-1}$ vecuronium or 0.6 $mg \cdot kg^{-1}$ rocuronium intravenously and then was maintained with 1-2% sevoflurane or 5-6% desflurane and 70% nitrous oxide in oxygen. The patients in the spinal anesthesia group received 2.5-3 mL of 0.5% isobaric spinal levobupivacaine or bupivacaine solution while the patients in the epidural anesthesia group received 10-15 mL of 0.5% isobaric levobupivacaine or bupivacaine solution via the epidural catheters in the lumbar region. The general, spinal and epidural anesthesia patients received intramuscular nonsteroidal anti-inflammatory drugs (Tenoksikam 20 mg) for the first development of pain or intravenous opioids for postoperative analgesia (Meperidine 1 $mg.kg^{-1}$) if pain persisted. The spinal and epidural block patients did not receive any sedative drug and opioid intraoperatively. Epidural catheter was removed at the end of surgery, due to the procedures applied. Nonsteroidal anti-inflammatory drugs and opioids were used as rescue analgesics if required or Numeric Rating Scale (NRS) was ≥4.

A threshold of hypotension was defined as a mean arterial pressure of <70 mmHg for more than 10 minutes in three groups. Hypotensive episodes were treated by increasing the rate of intravenous fluid infusion (according to the clinical status, patients were administered crystalloid and colloid) and/or by reducing the anesthetic drug concentration in general anesthesia groups. Bradycardia was defined as <45-50 beats min^{-1} in three groups. Bradicardia episodes were treated with intravenous atropine.

The anesthesiologist made the decision of the fluid type according to the clinical condition of the patient. Crystalloid solution 5-6 ml $kg^{-1} \cdot h^{-1}$ or in addition to the colloid solution 10-20 ml kg^{-1} was administered during anesthesia. Vital signs and clinical status were assessed daily postoperatively.

THE METHODS OF EVALUATION

Information on the dates of the operations, demographic features of the patients, Charlson Comorbidity Index (CCI), American Society of Anestesiology (ASA) physical status, smoking status, the duration of surgery, the anesthetic technique used, intraoperative blood loss, transfusion requirement, the length of stay in hospital, and morbidity and mortality were obtained from the hospital records.[6,7]

Several multivariate indices including the CCI and ASA physical status classification system were calculated before the operation. The Charlson Index incorporates many common, serious comorbid conditions in its final score and is a predictor of mortality for medical treatment in the patients (Table 1). In addition, the data regarding the ASA physical status classification system were also collected.

The mortality rates at day 7 and 30 were recorded. The day 7 mortality rate during the early postoperative period may be more likely to reflect the anesthetic-related complications. The primary outcome of the study was defined as the death ratio within the first 30 days of the postoperative period. The thirty-day mortality was the primary outcome because the standard length of time to assess perioperative outcomes.

Morbidity was evaluated within the 7 days after surgery. The anesthesia related complications may be more likely to happen during the postoperative first week. The morbidity outcomes were postoperative myocardial infarction, cardiovascular failure, respiratory failure, renal failure, hepatic failure, gastrointestinal failure, major infections, diabetes mellitus and coagulation disorders.

Blood loss was calculated by subtracting the amount of washing from the amount of blood aspirated from the operative field and removed with sponge and pads. A small sponge was considered to absorb 5 mL and the pad 100 mL of blood.

STATISTICAL ANALYSIS

The results were expressed as the mean±standart deviation or the percentage. The normal distribution of variables was tested using one sample Kolmogorov Smirnov test. The groups were compared by one-way analysis of variance (ANOVA) test for normally distributed data or by Kruskal Wallis test for abnormally distributed data. The categorical variables were compared using the chi-square (Pearson, Yates, or Fisher exact) tests. A *probability* value <0.05 was considered statistically significant. Statistica 7.0 (StatSoft Inc., Tulsa, OK, USA) statistical software was used for the statistical analyses.

RESULTS

One hundred eighty-five patients were included in the study; operations were performed under general anesthesia in 67 patients (36.2%), spinal anesthesia in 67 patients (36.2%) and epidural anesthesia in 51 patients (27.6%). Demographic features of the patients and the duration of operations were similar among the three groups (Table 2). There were no differences between the three groups with regard to intraoperative blood loss, intraoperative blood transfusion, smoking status, length of stay in hospital, ASA physical status, and

TABLE 1: Weights of clinical conditions referring to secondary diagnosis, considered in the Charlson Comorbidity Index.

Assigned weights for diseases	Conditions
1	Myocardial infarct; congestive heart failure; peripheral vascular disease; cerebrovascular disease; dementia; chronic lung disease; connective tissue disease; ulcer disease; mild liver disease; diabetes
2	Hemiplegia; moderate or severe kidney disease; diabetes with complication; tumor; leukemia; lymphoma
3	Moderate or severe liver disease
6	Metastatic solid tumor; AIDS

Assigned weights for each condition that a patient has. The total equals the score. Example: chronic pulmonary (1) and lymphoma (2) = total score (3).

TABLE 2: Patient characteristics (mean values±SD) (Median Range).

	General Anesthesia Group (n=67)	Spinal Anesthesia Group (n=67)	Epidural Anesthesia Group (n=51)	P
Age	73.9±11.6	78.4±11.2	76.9±12.3	0.084
	76 (65-94)	80 (61-104)	78 (63-97)	
BMI (kg/m^2)	28.8±3.3	28.1±3.5	29.2±3.5	0.204
	26 (21-33)	25 (20-32)	27 (22-31)	
Sex, male/female n (%)	33/34 (49.2/50.7)	33/34 (49.2/50.7)	26/25 (50.9/49)	0.978
Operation time (min)	106.3±58.6	87.8±22.6	104±45	0.141
	90 (65-330)	90 (62-210)	90 (63-240)	

BMI: Body Mass Index.
No statistically significant difference was present in any of the parameters between groups (p>0.05).

CCI (p=0.393, p=0.088, p=0.369, p=0.228, p=0.491, p=0.371 respectively; Table 3).

There was no significant hypotension or bradycardia episode intraoperatively in none of the groups. Blood pressure and heart rate were similar among the three groups. Postoperative use of analgesic drugs was also similar in three groups. There were no differences in intraoperative fluid replacement volumes.

The 7-day mortality rate was 4.4% in the general anesthesia group, 2.9% in the spinal anesthesia group and 1.9% in the epidural anesthesia group. The 30-day mortality rate was 1.4% in the general anesthesia group, 5.9% in the spinal anesthesia group and 5.8% in the epidural anesthesia group. Patient mortality rates for postoperative day 7 and 30 were similar for the three groups (p=0.738, p=0.805 respectively; Table 3).

Postoperative morbidity rates for the three groups with regard to myocardial infarction, cardiovascular failure, respiratory failure, renal failure, hepatic failure, gastrointestinal failure, major infections, diabetes mellitus and coagulation disorders were shown in Table 4.

TABLE 3: Intraoperative estimated blood loss (mL), intraoperative blood transfusion (mL), smoking %, hospital days, 7-day mortality, 30-day mortality, ASA physical status, CCI in general, spinal, epidural groups.

	General Anesthesia Group (n=67)	Spinal Anesthesia Group (n=67)	Epidural Anesthesia Group (n=51)	p
Intraoperative estimated	540.3±526.1	432.1±352.8	572.5±467.7	0.393
blood loss (mL)	400 (0-2200)	300 (0-2000)	400 (0-1800)	
Intraoperative blood	322.4±407.4	185.1±313.9	321.6±423.5	0.088
tranfusion (mL)	0 (0-1600)	0 (0-1200)	0 (0-1250)	
Smoking %	46.3	34.3	41.2	0.369
Hospital days	13.6±8.9	12.5±5.2	15.7±9.4	0.228
	13 (2-66)	11 (5-34)	13 (2-42)	
7-day mortality, n (%)	3 (4.4)	2 (2.9)	1 (1.9)	0.738
30-day mortality, n (%)	4 (1.4)	6 (5.9)	4 (5.8)	0.805
ASA physical status, n (%)				
I or II	9 (13.4)	14 (20.8)	10 (19.6)	0.491
≥III	58 (86.5)	53 (79.1)	41 (80.3)	
CCI, n (%)				
<3	62 (92.5)	59 (88)	43 (84.3)	0.371
≥3	5 (7.4)	8 (11.9)	8 (15.6)	

ASA: American Society of Anesthesiology; CCI: Charlson Comorbidity Index.

While there were significant differences regarding CCI between the survivor and non-survivor patients, ASA physical status scores of the patients were similar ($p<0.001$, $p=0.682$ respectively; Table 5).

DISCUSSION

This study shows that anesthetic technique has no effects on the postoperative incidences of mortality within postoperative 7 and 30 days in elderly patients who underwent hip fracture repairment. This finding suggests that no anesthesia technique has any superiority to the others.

There are many studies investigating the effects of anesthetic techniques on postoperative outcome after hip fracture repair.[3-5] In those studies, general and regional anesthesia techniques, including epidural and spinal anesthesia, used during hip fracture repair were compared for postoperative mortality and morbidity. However, studies comparing the correlation of general, spinal and epidural anesthesia on postoperative mortality and morbidity in elderly patients are lacking. Our study investigates the two types of regional anesthesia, spinal and epidural, as well as general anesthesia, as each of them often has different hemodynamic effects on older patients.[8]

Many clinical factors influence the risk of mortality and morbidity after surgery. Clinical studies have suggested that advanced age, cardiovascular disease, pulmonary disease, diabetes mellitus, and poor general medical status are associated with an increased risk of mortality during anesthesia, regardless of the anesthetic technique.[1,2,9-12] Therefore, incorporate multiple medical problems, such as the CCI, Sickness at Admission Scale, and acute physiologic score from the APACHE II scale have also been shown to be associated with mortality and morbidity after surgery.[3] Our study investigated demographic features and critical illness related characteristics of the patients in three groups because those factors might have affected the final results. Fortunately, demographic features of the patients were similar among the groups, and body mass index, CCI, ASA physical status, smoking status, surgery duration, intraoperative blood loss, and transfusion requirement did not show any difference between the three groups.

Previous studies searched whether the type of anesthesia influenced mortality and morbidity and suggested that the anesthesia techniques influenced the incidence of mortality and morbidity.[13-17] Yeager et al. reported that the use of epidural anesthesia and postoperative analgesia in high risk surgery patients was associated with decreased postoperative morbidity and improved operative outcome when compared with general anesthesia with postoperative parenteral opioid analgesia.[13] However, more recent large randomised controlled trials have failed to confirm these findings, because the improvements in perioperative management of patients resulted in increasing safety.[18-20] Such improvements might include the

TABLE 4: Postoperative morbitidy.

	General Anesthesia Group (n=67)	Spinal Anesthesia Group (n=67)	Epidural Anesthesia Group (n=51)
Myocardial infarction, n (%)	0 (0)	0 (0)	0 (0)
Cardiovascular failure, n (%)	15 (22.3)	12 (17.9)	10 (19.6)
Respiratory failure, n (%)	8 (11.9)	5 (7.4)	3 (5.8)
Renal failure, n (%)	2 (2.9)	1 (1.4)	1 (1.9)
Hepatic failure, n (%)	1 (1.4)	0 (0)	0 (0)
Gastrointestinal failure, n (%)	0 (0)	1 (1.4)	0 (0)
Major infections, n (%)	8 (11.9)	5 (7.4)	3 (5.8)
Diabetes Mellitus, n (%)	3 (4.4)	2 (2.9)	1 (1.9)
Coagulation disorder, n (%)	2 (2.9)	0 (0)	0 (0)

TABLE 5: ASA physical status and CCI in survivor and non-survivor groups.

	Survivor Group (n=177)	Non-survivor Group (n=8)	p
ASA physical status, n (%)			
I or II	46 (25.9)	1 (12.5)	0.682
≥III	131 (74)	7 (87.5)	
CCI, n (%)			
<3	165 (93.2)	1 (12.5)	<0.001*
≥3	12 (6.7)	7 (87.5)	

ASA: American Society of Anesthesiology; CCI: Charlson Comorbidity Index.
*p<0.05.

use of shorter acting drugs, high dependency on the intensive care units, improved monitoring standards and vigilance, better preoperative optimization, and less invasive surgical techniques.[18] For instance, in an observational study, Gilbert et al. concluded that general anesthesia was at least as effective as spinal anesthesia, and possibly better in affording good long-term outcomes for hip fracture repair.[19] In addition, Bode et al. investigated the impact of anesthetic choice on cardiac outcome in patients undergoing peripheral vascular surgery.[20] The type of anesthesia did not appear to influence cardiac morbidity or overall mortality. However, the study was interrupted earlier than the normal period because it was unlikely to show differences between the groups. On the other hand, the largest retrospective trial including 9425 patients reveals that the type of anesthesia influences mortality and morbidity in hip fracture repair.[3] They were unable to demonstrate that regional anesthesia was associated with a better outcome than general anesthesia in a retrospective large study of elderly patients with hip fracture. Similarly, we found that anesthesia technique had no effect on the postoperative incidence of mortality in elderly patients undergoing hip fracture repair. In addition, postoperative morbidity rates between the three groups were similar.

ASA classification have been used widely to predict and calculate short- and long-term mortality.[21-23] Hamlet et al. reported a relationship between preoperative health status and the time to postoperative mortality, and late functional outcome in hip fracture patients.[24] Preoperative health status was assessed by the ASA classification. The 3-year mortality was significantly less in ASA I and II patients (23%) than in ASA III, IV, and V patients (39%).[24] Similarly, Donegan et al. showed that ASA classification was a useful variable for the general medical condition of the patient and could be a strong predictor of perioperative medical complications following hip fracture surgery.[25] These findings supported ASA classification as a good predictor of mortality. In this study, we demonstrated that the 30-day mortality was less in ASA I and II patients (12.5%) than in ASA III, IV, and V patients (87.5%), even though there was no significant difference regarding the ASA physical status scores of non-survivors in our study.

The Charlson index incorporates many common, serious comorbid conditions and is a predictor of mortality for medical patients.[6] Souza et al. investigated the use of CCI as a 90-day mortality risk adjustment method in elderly patients hospitalized for hip fracture repair.[26] They found that severity indices based on a single comorbidity could be useful for risk adjustment procedures. Similarly, a risk score such as CCI significantly correlated with mortality rates in our study.

Various studies have commented on the amount of intraoperative blood loss and the effects of different anesthetic techniques on bleeding. Regional anesthesia has been associated with reduced blood loss in patients undergoing hip fracture repair. Sympathetic block, vasodilatation and venous pooling due to neuraxial blockade, reduce venous return to the heart, which leads to hypotension. The phenomena may reduce intraoperative blood loss by decreasing local blood flow to the surgical region.[18] Parker et al. demonstrated a significant reduction in operative blood loss during total hip arthroplasty with regional anesthesia.[15] However, Urwin et al. performed a meta-analysis of randomized trials with data from the three studies showing no difference in blood tranfusion requirements between general and regional anesthesia.[27] In our study, no difference was found between the three groups of patients regarding intraoperative estimated blood loss and blood transfusion. The hemodynamics in patients with stable and similar risk rates (preoperative ASA, CCI) and the appropriate choice of anesthesia may have contributed to these results.

Our study was limited by several factors, particularly the management of hypotension and analgesia. We were unable to control postoperative hypotension and manage analgesia. These might have influenced the mortality and morbidity in the postoperative period. Another limitation is that the blood loss cannot be registered precise with the scientific method and 30-day mortality is difficult to find from hospital records and the same amount of anesthetic doses is difficult to use in all patients.

In conclusion, the clinical characteristics and the associated diseases in patients should be assessed prior to the decision on the anesthesia technique. In addition to good medical support, the appropriate anesthetic approach should be planned. We found no superiority of one technique over another. Therefore, we suggest that as long as the proper anesthetic techniques are chosen according to the clinical features of the patients and good perioperative monitorization is adopted, successful results can be obtained with all three techniques.

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