Retrospective Evaluation of Anaesthesia Techniques for Hip Replacement Operations

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Objective: In this retrospective study, we evaluated the demographic characteristics of patients that underwent hip replacement surgery in our orthopedic clinic. Associated diseases, preoperative laboratory findings, intraoperative findings, and the effect of admission or refusal to the intensive care unit on postoperative mortality and morbidity were recorded. Furthermore, we tried to identify surgical and anaesthetic methods applied, intraoperative hemodynamic changes, length of stay in the post-anaesthesia care unit, and postoperative complications.

Methods: Demographic characteristics, co-morbidities, preoperative laboratory findings, intraoperative findings, and admission or refusal to the intensive care unit of patients who underwent hip replacement surgery between January 2008-December 2010 were enrolled.

Results: Out of 500 patients, 33.4% (n=164) were operated under general anaesthesia, 34% (n=170) under combined spinal-epidural anaesthesia, 22.2% (n=111) under spinal anaesthesia, 6.4% (n=32) under combined lumbar plexus block and sciatic nerve block, and 4% (n=20) under epidural anaesthesia. Mean hospital stay was 7 days in the general anaesthesia group and 5 days in the regional anaesthesia group.

Conclusion: American Society of Anesthesiologists (ASA) scores and incidence of co-morbidities were higher in the partial hip replacement group. Admission to the intensive care unit was lower in the total hip replacement group. Hospital stay was shorter in the partial hip replacement group. Mortality rates on the 7th and 30th days were higher in the partial hip replacement group.

Key Words: Hip replacement, anaesthesia, retrospective evaluation

Introduction

Systemic diseases, decrease in reflexes, and sudden events such as cerebrovascular diseases seen in advanced ages may cause the elderly people to be exposed to environmental traumas more frequently. Moreover, decrease in bone mass in that age group increases the incidence of fractures (1). Hip prosthesis surgery in elderly may result in high morbidity and mortality both due to the characteristics of the surgery and the patient (2).

Although it is a common intervention, the optional anaesthetic technique for hip replacement surgeries remains debatable (3).

It has been reported that the use of neuraxial anaesthesia techniques reduce mortality, and the incidence of venous thromboembolism, myocardial infarction, and various other complications (3). Comparing with general anaesthesia implementations, neuraxial anaesthesia techniques were reported to reduce perioperative blood loss and need for transfusion (4). Neuraxial anaesthesia techniques may shorten the length of stay in post-anaesthesia care units and provide stable haemodynamic conditions even during surgery, but these favourable effects could not be demonstrated in all studies (5). By providing regional analgesia, peripheral nerve blocks may eliminate the adverse effects of neuraxial anaesthesia techniques.

Regional anaesthesia techniques have some disadvantages as well as advantages. Inadequate block, prolonged time to surgery, need for experienced personnel, and expensiveness of equipment required for a safe regional anaesthesia are among these disadvantages (6, 7). In addition, many patients are afraid of and misinformed about regional anaesthesia techniques.

Table 1. Demographic characteristics of the cases according to the type of anaesthesia technique

	General (n=167)	NAT (n=301)			LPB/SB (n=32)	Total (n=500)	p
		CSE (n=170)	SA (n=111)	EA (n=20)			
Age (years) (mean±SD)	67.5±16.6 ^{*,†}	68.3±14.2 ^{‡,§}	78.2±12.2 ^{*,‡}	68.9±13.7	82.9±7.6 ^{†,§,}	71.2±15.1	<0.001
Gender (n,%)							
M	52, 31.1	63, 37.1	40.36	5.25	8.25	168, 33.6	
F	115, 68.9	107, 62.9	71.64	15.75	24.75	332, 66.4	0.496
ASA (min, max)	3 (1-4) ^{*,†,§}	2 (1-4) ^{‡,§,¶}	3 (1-4) ^{*,‡,**,¶}	2 (14) ^{,**,¶}	3 (3-4) ^{†,§,}	3 (1-4)	<0.001

SA: spinal anaesthesia; CSE: combined spinal epidural anaesthesia; NAT: neuraxial technique; LPB/SB: lumbar plexus block/sciatic block; EA: epidural anaesthesia
^{*}The difference between general anaesthesia and SA is statistically significant (p<0.001), [†]The difference between general anaesthesia and LPB/SB is statistically significant (p<0.001), [‡]The difference between CSE and SA is statistically significant (p<0.001), [§]The difference between CSE and LPB/SB is statistically significant (p<0.001), ^{||}The difference between EA and LPB/SB is statistically significant (p<0.01), [¶]The difference between general anaesthesia and CSE is statistically significant (p=0.008), ^{**}The difference between SA and EA is statistically significant (p=0.039)

Table 2. Distribution of cases among surgical groups according to anaesthetic techniques

	Total (n=105)	Partial (n=359)	Revision (n=36)
General (n, %)	37, 35.2	110, 30.6	20, 55.6
NAT (n, %)			
CSE (n, %)	55, 52.4	100, 27.9	15, 41.7
SA (n, %)	5, 4.8	106, 29.5	-
EA (n, %)	8, 7.6	11, 3.1	1, 2.8
LPB+SB (n, %)	-	32, 8.9	-

NAT: neuraxial technique; SA: spinal anaesthesia; CSE: combined spinal epidural anaesthesia; LPB/SB: lumbar plexus block/sciatic block; EA: epidural anaesthesia

This retrospective study investigated the surgical and anaesthetic methods performed for hip arthroplasty in our hospital, in addition, intraoperative hemodynamic changes, length of stay at post-anaesthesia care unit, complications of surgery, and the effects of surgical and anaesthetic methods and pre-operative status of patient on perioperative morbidity and mortality were evaluated.

Methods

After the approval of Ankara Numune Training and Research Hospital Scientific Review Board (decision no: 2010-029), medical archive and anaesthesia records of 500 patients that underwent hip prosthesis surgery between 2008 and 2010 were retrospectively reviewed.

Demographic data, ASA physical status scores, concomitant systemic diseases, and haemoglobin values of patients were recorded from the preoperative recordings.

Anaesthetic and surgical method, duration of procedure, the type and amount of fluids administered, the amount of blood and blood products, blood pressure, heart rate, need for additional anaesthetic technique, and morbidity and mortality were recorded from the perioperative recordings. Patients that received more than 3 units of blood during surgery were considered as patients with excessive bleeding.

Duration of recovery unit stay, morbidity during recovery, interventions and medications used in recovery unit, postoperative analgesia method, need for and duration of intensive care unit stay, postoperative haemoglobin value, duration of hospital stay, mortality rates and reasons within postoperative 7 days and 30 days were recorded from the postoperative recordings.

Statistical analysis

Data were analysed using Statistical Package for the Social Sciences (SPSS) for Windows version 11.5 package program. Shapiro Wilk test was used to test the normality of continuous variables. Descriptive statistics were expressed as mean±standard deviation or median (minimum-maximum) for continuous variables, and as case number and (%) for categorical variables.

Significance of difference between the means of the groups was assessed by one-way analysis of variance (One-Way ANOVA) and by Kruskal Wallis test for median values. In case the result of ANOVA or Kruskal Wallis test statistics was significant, the conditions that caused the difference was determined by post hoc Tukey or Conover's non-parametric multiple comparison tests. Categorical variables were analysed by Pearson's Chi-square or Fisher's Exact Chi-square tests. A p<0.05 was considered statistically significant for the results.

Results

Five hundred patients that underwent hip prosthesis surgery were classified according to anaesthetic methods and surgical intervention types. General anaesthesia was performed in 167 (33.4%), combined spinal-epidural (CSE) anaesthesia was performed in 170 (34%), spinal anaesthesia was performed in 111 (22.2%), combined lumbar plexus - sciatic nerve blockade was performed in 32 (6.4%), and epidural anaesthesia was performed in 20 (4%) of the patients (Table 1).

It was determined that 105 (21%) of the patients underwent total hip prosthesis, 359 (71.8%) underwent partial hip prosthesis and 36 (7.2%) underwent hip prosthesis revision surgery (Table 2).

Table 3. Distribution of concomitant diseases according to anaesthesia techniques

Anaesthesia method	General	NAT (n=301)			
		CSE (n=170)	SA (n=111)	EA (n=20)	LPB/SB (n=32)
Concomitant diseases	129 (77.2%)	121 (71.2%)	99 (89.2%)	15 (75.0%)	27 (84.4%)
HT	84 (50.3%)	85 (50.0%)	67 (60.4%)	10 (50.0%)	18 (56.3%)
DM	51 (30.5%)	33 (19.4%)	34 (30.6%)	6 (30.0%)	4 (12.5%)
COPD	48 (28.7%)	48 (28.2%)	46 (41.4%)	7 (35.0%)	7 (21.9%)
CAD	21 (12.6%)	17 (10.0%)	14 (12.6%)	0 (0%)	7 (21.9%)
AF	4 (2.4%)	1 (0.6%)	1 (0.9%)	0 (0%)	2 (6.3%)
CRI	7 (4.2%)	6 (3.5%)	6 (5.4%)	0 (0%)	1 (3.1%)
CHF	18 (10.8%)	20 (11.8%)	14 (12.6%)	3 (15.0%)	10 (31.3%)
CVA	21 (12.6%)	6 (3.5%)	6 (5.4%)	0 (0%)	4 (12.5%)
Alzheimer	8 (4.8%)	5 (2.9%)	12 (10.8%)	1 (5.0%)	3 (9.4%)
Parkinson	2 (1.2%)	2 (1.2%)	1 (0.9%)	0 (0%)	1 (3.1%)
Rheumatoid Arthritis	3 (1.8%)	2 (1.2%)	1 (0.9%)	0 (0%)	0 (0%)

HT: hypertension; DM: diabetes mellitus; COPD: chronic obstructive pulmonary disease; CAD: coronary artery disease; AF: atrial fibrillation; CRI: chronic renal insufficiency; CHF: congestive heart failure; CVA: cerebrovascular accident; NAT: neuraxial technique; SA: spinal anaesthesia; CSE: combined spinal epidural anaesthesia; LPB/SB: lumbar plexus block/sciatic block; EA: epidural anaesthesia

Table 4. Duration of surgery and recovery, amount of fluid, blood and medications administered according to anaesthesia methods

	General (n=167)	NAT (n=301)			
		CSE (n=170)	SA (n=111)	EA (n=20)	Nerve Block (n=32)
Duration of surgery (min)	120 (45-250)	120 (60-270)	105 (45-150)	120 (90-150)	105 (90-150)
Fluid administered (mL)	2000 (300-5000)	2500 (750-5000)	2000 (1000-4000)	2000 (1000-3000)	2000 (500-3500)
Blood transfused (unit)	1 (0-3)	1 (0-5)	1 (0-3)	1 (0-2)	1 (0-3)
Duration of recovery (min)	50 (30-160)	60 (20-160)	50 (30-130)	45 (30-80)	50 (30-80)
Medication use (n)	2 (1.9%)	7 (4.8%)	0 (0%)	0 (0%)	1 (5.3%)

NAT: neuraxial technique; SA: spinal anaesthesia; CSE: combined spinal epidural anaesthesia; LPB/SB: lumbar plexus block/sciatic block; EA: epidural anaesthesia

Concomitant disease was present in 77.2% and 78.7% of the patients in whom general anaesthesia and regional anaesthesia was performed. The most common concomitant disease was hypertension (52.8%) followed by COPD (31.2%). Diabetes mellitus and coronary artery disease was encountered at rates of 25.6% and 11.8%, respectively (Table 3).

The amount of fluid infused during surgery was similar for the patients that underwent general or regional anaesthesia, and was 2000 mL in average. The mean amount of blood transfused was 1 unit. Independent from the method of anaesthesia, duration of intervention and recovery unit stay was 120 minutes and 50 minutes, respectively. Only 10 patients required additional medication (atropine, ephedrine) for bradycardia and hypotension in the recovery unit. The use of additional medication was most common in patients, in whom CSE anaesthesia was performed (Table 4).

Complication after anaesthesia or during surgery was determined in approximately 40% of the patients. The most frequent complication was hypotension followed by bleeding. Hypotension was determined in 12% of the patients that had general anaesthesia and in approximately 30% of the patients that had regional anaesthesia. Bleeding was less common in patients that had regional anaesthesia. Intraoperative cardiac arrest was detected in 9 out of 500 patients (Table 5).

It was determined that spinal anaesthesia was performed in 6, general anaesthesia was performed in 1, and combined lumbar plexus-sciatic nerve blockade was performed in 2 of the patients that had cardiac arrest during surgery. One of these patients was at the age of 65 years, whereas the remaining 8 patients were at the age of 75 years and over. Cardiac arrest had occurred soon after cement implementation in 8 patients. While 6 patients responded to cardiopulmonary resuscitation, 3 patients did not respond and died. Surgery had been performed due to trauma in all of the patients that

Table 5. Complications according to anaesthesia methods

	General (n=167)	NAT (n=301)			LPB/SB (n=32)	p
		CSE (n=170)	SA (n=111)	EA (n=20)		
Complication (n)	59 (35.3%)	63 (37.1%)	44 (39.6%)	8 (40.0%)	15 (46.9%)	0.773
Hypotension	20 (12.0%)	42 (24.7%)	34 (30.6%)	7 (35.0%)	12 (37.5%)	<0.001
Bleeding	40 (24.0%)	30 (17.6%)	11 (9.9%)	2 (10.0%)	6 (18.8%)	0.042
Embolism	1 (0.6%)	2 (1.2%)	4 (3.6%)	1 (5.0%)	0 (0%)	0.225
Cardiac arrest	1 (0.6%)	2 (1.2%)	4 (3.6%)	0 (0%)	2 (6.3%)	0.149

NAT: neuraxial technique; SA: spinal anaesthesia; CSE: combined spinal epidural anaesthesia; lumbar plexus block/sciatic block; EA: epidural anaesthesia

Table 6. The need for postoperative intensive care, length of intensive care unit stay, time to hospital discharge, and mortality according to anaesthesia techniques

	General (n=167)	NAT (n=301)			LPB and SNB (n=32)	p
		CSE (n=170)	SA (n=111)	EA (n=20)		
Need for ICU (n)	67 (40.1%)	33 (19.4%)	43 (38.7%)	2 (10%)	16 (50%)	<0.001
Duration of ICU stay (days)	4 (1-75)	8 (1-30)	4.5 (1-30)	1	9 (1-17)	0.552
Time to hospital discharge (days)	7 (1-25)	5 (1-27)	5 (1-17)	5 (3-22)	6 (1-24)	<0.001
Mortality (n/%)	Intraoperative	-	3 (0.99%)	-	0.059	
	Postop. 7 days	4 (2.4%)	8 (2.7%)	4 (12.5%)	0.008	
	Postop. 30 days	8 (4.8%)	14 (4.6%)	9 (28.1%)	<0.001	

NAT: neuraxial technique; SA: spinal anaesthesia; CSE: combined spinal epidural anaesthesia; LPB/SB: lumbar plexus block/sciatic block; EA: epidural anaesthesia

had cardiac arrest. Two of the patients that had cardiac arrest during surgery were ASA grade III, whereas 7 of them were ASA grade IV.

Need for intensive care unit treatment was statistically significantly lower in patients that underwent surgery under combined spinal-epidural or epidural anaesthesia as compared to the other patient groups ($p<0.001$). While time to discharge was 5 days in the regional anaesthesia group, it was 7 days in the general anaesthesia group. Patients, in whom spinal anaesthesia was performed, had been discharged earlier. It was determined that intraoperative mortality rate was 0.6%, mortality rate within postoperative 7 days was 3%, and mortality rate within postoperative 30 days was 6.2% (Table 6).

Discussion

There are arguments concerning the optimal anaesthetic technique in patients undergoing hip prosthesis surgery. Rodgers et al. (3) published a meta-analysis demonstrating that neuraxial anaesthesia techniques performed for various surgical procedures reduce mortality, and the incidence of venous thromboembolism, myocardial infarction and various other complications. In this meta-analysis, no conclusion could be drawn for specific surgical procedures or patient groups. Previous studies have reported that the incidence of thromboembolism and pulmonary embolism, the amount of intraoperative blood loss, and need for transfusion are lower

in patients undergoing neuraxial block compared with those operated under general anaesthesia (8-11).

O'Hara et al. (12) stated that risk assessment about anaesthetic technique should consider technical factors such as airway management, convenience for regional block and invasive monitoring, anaesthetic agent toxicity, determination of significant intraoperative and postoperative outcomes, and postoperative pain treatment.

As in many cases, choice of anaesthetic method in hip prosthesis surgeries depends on patient's preference and concomitant diseases, experience of anaesthesiologist, duration of surgery, and surgeon's preference (13, 14). In the present study, we determined that surgical procedures had been performed under three types of anaesthetic methods including general anaesthesia, neuraxial techniques and nerve blockade and that regional anaesthesia had been preferred in 66.6% of the cases. It was determined that epidural anaesthesia had been preferred as the anaesthetic method in only 4% of the patients, whereas combined lumbar plexus-sciatic nerve blockade had been used in 6.4%. General anaesthesia was combined with regional anaesthesia because of inadequate blockade in 12 of the patients that underwent different types of regional blockade. Liu et al. (15) reported that there is a tendency towards regional techniques in the recent years and patients that receive regional anaesthesia are usually at advanced age, have concomitant diseases and are more dependent patients with

lower ASA physical scores. The rate of anaesthetic methods performed in our hospital is consistent with this opinion. The patients who received combined lumbar plexus-sciatic nerve blockade were more dependent patients at older ages with higher ASA scores and higher number of concomitant disease as compared to the patients that received other types of anaesthesia.

There is no study evaluating mortality as the primary outcome after hip prosthesis surgery performed under general or regional anaesthesia. Mortality has usually been presented as secondary outcome and follow-up periods in the studies are different. Liu et al. (15) reported the mortality rate as 1 out of 276 patients in the literature review they performed. O'Hara et al. (12) investigated 7-day and 30-day mortality rates in a retrospective study and found the 7-day mortality rate to be 1.3% and 1.6% in the general anaesthesia and regional anaesthesia groups, respectively, whereas 30-day mortality rate was 4.4% in the general anaesthesia group and 5.4% in the regional anaesthesia group. In the present study, overall mortality rate was 0.6% during intraoperative period, and 7-day and 30-day mortality rates were 3.2% and 6.4%. While 7-day and 30-day mortality rates were 2.7% and 4.6% in patients who received anaesthesia by neuraxial techniques, the corresponding figures were 2.4% and 4.8%, respectively in patients, who received general anaesthesia. Overall, 97% of the deaths occurred in patients that underwent partial hip surgery due to trauma. Only one patient that underwent elective surgery died on the postoperative Day 1 due to acute disseminated intravascular coagulation (DIC). These results are comparable with the mortality rates reported in the literature.

Lumbar plexus blockade for anaesthesia and analgesia in THP surgeries is extensively in use in the recent days. Perfect analgesia and limited motor and sympathetic blockade and lower rates of haemorrhagic complications are the main advantages of peripheral nerve blockade (16-18). In the present study, the highest mortality rate was seen in patients that received combined lumbar plexus-sciatic nerve blockade, and it was 12.5% for 7 days and 28.1% for 30 days. The patients who were operated under this technique had both high ASA scores and high mean age (82.9 ± 7.6 years).

The risk of post-anaesthesia morbidity and mortality is influenced by many factors. Advanced age, cardiovascular disease, pulmonary disease, diabetes mellitus and poor health status is associated with increased mortality during anaesthesia regardless of the type of anaesthesia (19-22).

Svensson et al. (23) stated that there was an association between postoperative one-year mortality rate and the number of preoperative concomitant health problems; they reported that mortality rate of patients, who were otherwise healthy was zero, that of those with one or two health problems was 14%, and the mortality rate of patients with three or four health problems was 24%. Hole et al. (24) demonstrated an increase in the incidence of postoperative pulmonary com-

plications in male gender, at the age over 60 years and in the presence of obesity, diabetes and COPD. Meyer et al. (25) have reported that mortality rates notably increase in patients with hip fracture, who had low scores of mental state tests and two or more chronic diseases and were not able to walk alone outside before the fracture, but no increase in mortality rates of patients without these risk factors was observed.

In the present study, hypotension was the most frequently encountered intraoperative problem. The incidence of hypotension was 12% in the patients that received general anaesthesia, whereas it was 30% in the patients that received regional anaesthesia. The increase in the incidence of hypotension and in the use of vasopressors is an expected finding due to the loss of vascular tonus in patients receiving regional anaesthesia (12). Significant hypotension that occurs immediately after THP surgeries with cement implementation results in cardiac arrest and death. These findings are not seen in prosthesis surgeries without cement implementation. In the present study, intraoperative cardiac arrest developed in 9 patients. Cement-induced embolism was considered in 8 of these patients. Six of nine patients had responded to cardiopulmonary resuscitation.

Pulmonary embolism is a probable catastrophic complication of total hip replacement. Its incidence is reported between 0.2% and 2.0%. Mauermann et al. (26) reported that neuraxial anaesthesia techniques reduce the incidence of deep venous thrombosis from 56% to 29% and pulmonary embolism from 20% to 7.2%. Epidural anaesthesia has potential physiological advantages such as suppression of stress response to surgery, and decrease in the rate of postoperative hypercoagulopathy and the risk of postoperative respiratory depression (27, 28). Previous studies demonstrated that sympatholytic effect caused by epidural anaesthesia may reduce the incidence of thromboembolism. It is probable that early mobilization favourably influences the decrease in the incidence of thromboembolism.

Mauermann and colleagues (26) reported that the most frequently mentioned advantage of THP that is performed under neuraxial anaesthesia is the decrease in the incidence of intraoperative bleeding. It has been reported that the need for transfusion is lower in such patients. In the present study, intraoperative blood loss was lower in the patients that received regional anaesthesia.

Despite the opinions that using regional anaesthesia techniques in total hip prosthesis surgeries would prolong the time to surgery and surgery duration due to delay in the onset of blockade, possibility of shifting to general anaesthesia in case of adequate blockade, less muscle relaxation, and difficulty in dissection and placing the prosthesis, Mauermann et al. (26) reported that surgery duration under neuraxial anaesthesia techniques is 7.1 minutes shorter, however, this difference is not clinically significant. Parker et al. stated that anaesthesia method had no effect on surgery duration (29).

In the present study, surgery duration was 120 minutes in general anaesthesia group, 114 minutes in the neuraxial anaesthesia group, and 105 minutes in the group that underwent combined lumbar plexus-sciatic nerve blockade. There was no significant difference between anaesthesia methods in terms of surgery duration.

In the present study, the need for intensive care unit stay was 40% in the patients that received general anaesthesia, 25% in the patients that received neuraxial anaesthesia, and 50% in the patients that underwent combined lumbar plexus-sciatic nerve blockade. Duration of intensive care unit stay was longer in the patients that underwent combined lumbar plexus-sciatic nerve blockade. We think that the presence of concomitant diseases contribute to the need for and duration of intensive care unit stay. Kaufmann et al. (30) state that neuraxial anaesthesia might reduce the probability of admission to postoperative intensive care unit in high-risk patients that undergo elective hip and knee prosthesis surgery. In the literature, it was reported that neuraxial anaesthesia could reduce the need for postoperative mechanical ventilation even in elderly patients and in high-risk patients with myasthenia gravis (31).

In the present study, the mean time to hospital discharge was 5 days for the patients that received regional anaesthesia, which was 2 days shorter than that of the patients that received general anaesthesia. Liu et al. (15) reported that time to hospital discharge has been shortened over time and is reduced to 4.5 days recently. Time to hospital discharge determined in our study was comparable with that reported in the literature.

Conclusion

It was determined that mortality and morbidity in hip prosthesis surgeries are independent from the type of anaesthesia but depends on general condition, ASA score, age and concomitant diseases of the patient. Again, when the patients were evaluated based on the surgical procedure performed, the present study determined that ASA physical status scores were higher, concomitant diseases were more common, time to hospital discharge was shorter and 7-day and 30-day mortality rates were higher in the patients that underwent partial hip prosthesis surgery, whereas the need for intensive care unit stay was lower in the patients that underwent total hip prosthesis.

Ethics Committee Approval: Ethics committee approval was received for this study from the Ethics committee of Ankara Numune Training and Research Hospital.

Informed Consent: Due to the retrospective nature of the study, informed consent was waived.

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