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A Comparative Analysis Between Spinal and General Anesthesia for Orthopedic Surgery

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Abstract

Background: Many surgeries can be performed with spinal anesthesia (SA) or general anesthesia (GA). However, there are only limited and confounding data available regarding costs and anesthesia-related times. Hip or knee replacement are common orthopedic surgeries that can be performed using SA or GA without differences regarding mortality or morbidity. Observational studies have suggested that spinal anesthesia may be associated with lower risks of death, delirium and major medical complications and with shorter lengths of stay in the hospital than general anesthesia. The aim of this study was to assess and compare the effects of spinal versus general anesthesia on postoperative outcomes in patients undergoing orthopedic surgery. **Material & Methods:** This was a comparative observational study and was conducted in the Department of Anesthesiology of Holy Family red crescent Medical College Hospital, Dhaka, Bangladesh during the period from March,2021 to March,2023. In this study we included 200 patients undergoing orthopedic surgery. The patients were randomly divided into two groups – Group A (Patients who were given general anesthesia) & Group B (Patients who were given spinal anesthesia). **Results:** In total 200 patients from both the groups completed the study. In our study we found majority (44.5%) of our patients were aged 60-69 years and most of our patients were female (56%) compared to male (44%).The mean age of our patients was 61.73 ± 7.92 years. The mean BMI was 31.67±3.24 kg/m.2Among all patients ,48% had mild systemic disease and followed by 31.5% had severe systemic disease. Majority (43.5%) of our patients had hypertension, 31% had diabetes. Vomiting was found 47% in group A on contrary only 23% had vomiting in spinal group. We found the mean anesthesia induction time was significantly higher in spinal group. Anesthesia time was lower in spinal group while PACU time was higher in group B. Time duration of surgery was significantly lower in spinal group. After 24 hours, spinal group showed less pain score than general anesthesia group. **Conclusion:** In our study, we found that SA is associated with less fixed and variable costs and lower postoperative pain scores during the stay in the PACU. Therefore, SA is a more reasonable alternative to GA in the immediate postoperative period for patients undergoing hip or knee replacement. When compared to general anaesthesia, spinal anaesthesia provides better operating circumstances, better postoperative pain control, and faster postoperative recovery.

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Keywords:- Hip replacement, TKA, Spinal anesthesia, General anesthesia.

INTRODUCTION

Many surgeries can be performed with spinal anesthesia (SA) or general anesthesia (GA). However, there are only limited and confounding data available regarding costs and anesthesia-related times.[1,2,3,4,5,6] Hip or knee replacement are common orthopedic surgeries that can be performed using SA or GA without differences regarding mortality or morbidity.[7,8]

The demand for total knee arthroplasty (TKA) is expected to increase exponentially by 2050, and healthcare systems are exploring strategies to meet this demand in a safe and cost-effective manner.[9,10] This has resulted in significantly more TKA procedures being performed on an outpatient basis in selected patients.[11] The shift from inpatient to outpatient TKA has significant potential of cost savings for health care systems and government payers (e.g., Medicare).[12] Postoperative adverse events in patients undergoing TKA may increase the probability of disability and affect the quality of recovery. Previous investigations have reported the adverse events and serious adverse events ranging from 1 month to several years in duration.[13,14,15] Patients in the ambulatory setting cannot rely on hospital support (e.g., nurses, intravenous medications) to manage their postoperative recovery and are expected to provide self-care after surgery.[16] The type of anesthetic plan, general versus spinal anesthesia has been shown to influence the postoperative outcomes in patients undergoing TKA surgery.[17] Nearly all patients with hip fracture undergo surgery, most commonly with spinal anesthesia or general anesthesia.[18,19] Observational studies have suggested that spinal anesthesia may be associated with lower risks of death, delirium and major medical complications and with shorter lengths of stay in the hospital than general anesthesia.[20,21,22,23,24] Randomized trials have shown conflicting results regarding differences in outcomes according to anesthesia type, but most of these trials were conducted more than 30 years ago and do not reflect current practice, had small numbers of participants, or were not designed to assess outcomes beyond the hospital stay.[25] Patients may view recovery of independence in walking after hip fracture as a priority, but studies evaluating the effect of anesthesia technique on this outcome are lacking.[25,26] In contrast to patients under general anesthesia, we predicted that patients undergoing orthopedic surgery under spinal anesthesia would experience a reduced rate of significant postoperative complications. Also, we compared the patient outcomes of the two anesthetic methods.

Hence, in this study we aimed to compare the association between spinal versus general anesthesia on early postoperative outcomes.

Objective of the study

The main objective of the study was to assess and compare the effects of spinal versus general anesthesia on postoperative outcomes in patients undergoing orthopedic surgery.

MATERIAL AND METHODS

This was a comparative observational study and was conducted in the Department of

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Anesthesiology of Holy Family red crescent Medical College Hospital, Dhaka, Bangladesh during the period from March, 2021 to March, 2023. In this study we included 200 patients undergoing orthopedic surgery. The patients were randomly divided into two groups – Group A (Patients who were given general anesthesia) & Group B (Patients who were given spinal anesthesia).

These are the following criteria to be eligible for the enrollment as our study participants: a) Patients aged up to 80 years old; b)Patients undergoing total knee arthroplasty; c) Patients undergoing hip surgery; d) Patients admitted in the orthopedic surgery department; e) Patients who were willing to participate were included in the study And a) Patients with uncontrolled DM, b) Patients with Coagulopathy; c) Patients with previous surgical history; d) Patients with known allergy to anesthesia; e) Patients with any history acute illness (e.g., renal or pancreatic diseases, ischemic heart disease etc.) were excluded from our study.

Patients in the GA group were anaesthetised with Propofol 2.5 mg/kg, fentanyl 2mcg/kg and rocuronium 0.6mg/kg to facilitate endotracheal intubation and mechanical ventilation. After achieving a general anaesthesia patients were then log rolled on to a prone position frame and special care was taken to protect the patient"s arms, face, eyes and airway.[14,27] General anaesthesia was maintained with the use of halothane 0.8% conveyed with a mixture of 40% O2 (FiO2 =0.4) and N2O 60%. Neuromuscular block was antagonised with neostigmine 0.4mg/kg and atropine 0.02mg/ kg at the end of the surgical procedure.[28]

Patients in the SA group received their block in a sitting position with hyperflexion of the lumbar spine. After the lower back was prepared and draped, the skin was infiltrated with 2-3 ml of 1% Lignocaine. Then a 25 G Quinkee spinal needle was introduced one or two levels above the herniated disc. 2.5 to 2.8ml of 0.5% Bupivacaine Heavyt + inj. fentanyl 12.5 mg was injected into the subarachnoid space. Postoperative analgesia was administered in the form of Injection pethedine 2 mg/kg intramuscularly in both group of patient stat and 6 (six) hourly. Comprehensive postoperative evaluation concentrated on documenting any complications specific to the particular mode of anaesthesia, recording the pace at which the various milestones of physiological and functional recovery were reached and the level of patient satisfaction with the type of anaesthesia used.[28]

Urinary catheterization was performed in each patient immediately after induction of anesthesia. All patients were discharged from the operating room to the postanesthesia care unit (PACU) for recovery. Postoperative pain was evaluated with a visual analog scale (VAS) from 0 no pain to 10 the worst pain imaginable.

Statistical Analysis

All data were recorded systematically in preformed data collection form and quantitative data was expressed as mean and standard deviation and qualitative data was expressed as frequency distribution and percentage. Statistical analysis was performed by using SPSS (Statistical Package for Social Sciences) for windows version 10. Probability value <0.05 was considered as level of significance. The study was approved by Ethical

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Review Committee of Holy Family red crescent Medical College and Hospital, Dhaka, Bangladesh.

RESULTS

[Figure 1] shows that majority (44.5%) of our patients were aged 60-69 years, followed by 23% & 19.5% were more than 70 years & 50-59 years old respectively. The least prevalence 8.5%, followed by 4.5% were aged 40-49 years & less than 40 years old respectively.

[Figure 2] shows that most of our patients were female (56%) compared to male (44%).

[Table 1] shows the mean age of our patients was 61.73 ± 7.92 years. The mean BMI was 31.67±3.24 kg/m2 , mean SBP & DBP was 135.24 ± 20.78 mm HG & 83.94 ± 10.69 mm HG. Most of our patients (89.5%) were independent before surgery. Among all patients ,48% had mild systemic disease and followed by 31.5% had severe systemic disease. Majority (43.5%) of our patients had hypertension, 31% had diabetes, 23.5% had COPD and followed by 15.5% had dementia.

[Table 2] shows that most of the complications were found in group A. Vomiting was found 47% in group A on contrary only 23% had vomiting in spinal group. In group A, 31% patients had shivering whilst 14% had in group B. Hypertension was found 27% & 21% in group A & B respectively.

[Table 3] shows the effectiveness of general & spinal anesthesia. We found the mean anesthesia induction time was significantly higher in spinal group. Anesthesia time was lower in spinal group while PACU time was higher in group B. Time duration of surgery was significantly lower in spinal group. After 24 hours, spinal group showed less pain score than general anesthesia group.

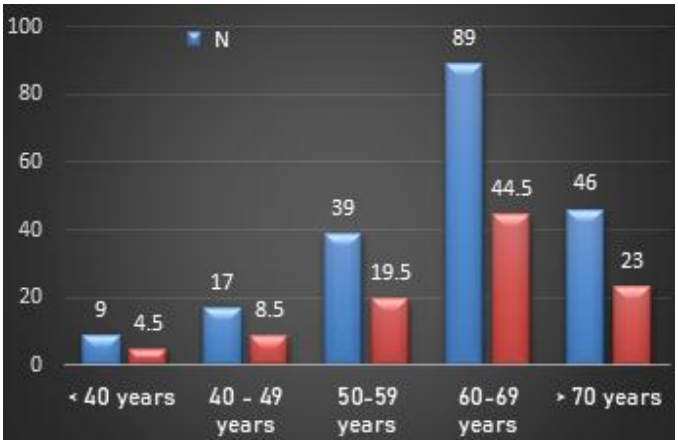

Figure 1: Age distribution of our study patients

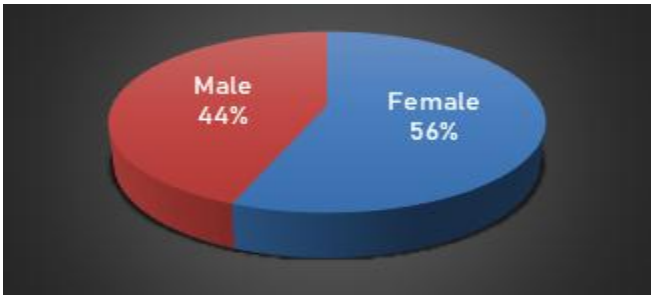

Figure 2: Gender Distribution of our study patients

Table 1: Demographic characteristics of our study participants

Baseline	N	P (%)	P-value
Mean age (years)	61.73 ± 7.92		0.186
Weight (kg)	81.53 ± 17.42		0.412
Height (cm)	171.34 ± 7.82		0.214

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BMI (kg/m2)	31.67±3.24		0.528
Heart Rate (per minute)	86 ± 17		0.214
Systolic blood pressure (mm Hg)	135.24 ± 20.78		0.481
Diastolic blood pressure (mm Hg)	83.94 ± 10.69		0.241
Functional status before surgery			
Independent	179	89.5	0.187
Partially dependent	21	10.5	
Totally dependent	0	0	
American Society of Anesthesiologists Physical Status Classification			
I-no systemic disease	17	8.5	0.273
II-mild systemic disease	96	48	
III-severe systemic disease	63	31.5	
IV-severe systemic disease that is a constant threat to life	24	12	
Co-morbidities			
Diabetes	62	31	0.124
Hypertension	87	43.5	
Congestive Heart Failure	27	13.5	
Bleeding disorder	13	6.5	
COPD	47	23.5	
Dementia	31	15.5	

Table 2: Post-operative complications of our study patients

Complications	**Group A**		**Group B**		**P-value**
	N=100	**P(%)**	**N=100**	**P(%)**	
Hypertension	27	27%	21	21%	0.025
Hypotension	11	11%	4	4%	0.034
Bradycardia	6	6%	2	2%	0.051
Tachycardia	3	3%	0	0	0.141
Vomiting/Nausea	47	47%	23	23%	0.042
Shivering	31	31%	14	14%	0.041
Urinary retention	15	15%	7	7%	0.024

Table 3: Effectiveness of General and Spinal Anesthesia

	Group A N=100	**Group B N=100**	**P-value**
Anesthesia induction time (min)	10.6 ± 5.2	15.9 ± 5.8	0.02
End of surgery to transfer (min)	5.8 ± 4.6	0	0.03
Anesthesia time (min)	151.7 ± 40.3	145.3 ± 27.9	0.25
PACU time (min)	146.5 ± 37.6	163.8 ± 55.4	0.14
Time of total duration of Surgery (min)	85.05± 5.12	74.06 ± 4.81	0.04
Pain at admission to PACU (VAS)	4.7 ± 4.0	0.4 ± 1.2	0.01
After 01 hrs	39.1± 12.3	29.5 ±10.6	0.02

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After 6 hrs	46.2 ±7.5	38.8 ±12.5	0.01
After 12 hrs	41.3 ±9.7	34.3 ±8.6	0.03
After 24 hrs	39.3 ±10.2	32.4± 10.6	0.04

DISCUSSION

In our study the mean age was 61.73 ± 7.92 years. Among all patients ,48% had mild systemic disease and followed by 31.5% had severe systemic disease. Majority (43.5%) of our patients had hypertension, 31% had diabetes, 23.5% had COPD and followed by 15.5% had dementia. [Table 1] Kendell et al found the mean age was 65.61±9.34 years.[17] Most of our patients were female (56%) compared to male (44%). In other studies, done by Kendell et al & Gonano et al found female predominance over man.[17,29] The most important finding of the current investigation was the lack of a difference in early serious adverse events when spinal anesthesia and general anesthesia were used for outpatient TKA. Kendell et al found the composite rate of early minor adverse events and any adverse events were greater in patients receiving general anesthesia compared to spinal anesthesia for outpatient TKA. Specifically, the need of postoperative blood transfusion was greater in patients receiving general anesthesia compared to regional anesthesia.[17] Taken together, our results suggest that spinal anesthesia provides selective clinical advantages in the early recovery period when compared to general anesthesia for patients undergoing outpatient TKA. Previous studies have compared general anesthesia to spinal anesthesia with conflicting results in patients undergoing TKAs in the inpatient setting. For example, Warren et al. detected a decreased rate of complications in patients undergoing inpatient TKA with spinal anesthesia compared to those receiving general anesthesia.[30] In contrast, Nakamura et al. reported an increased rate of venous thromboembolism in patients receiving spinal anesthesia for TKA.[31] Nevertheless, as far as we are aware, no study has evaluated the impact between the type of anesthesia technique on patient outcomes after outpatient TKAs. Our results are clinically important given the current shift of practice towards the performance of total knee replacement in the outpatient setting.[32] Given the current financial incentives and economic pressures to reduce costs, it is expected that the number of outpatient total knee replacement procedures are expected to grow substantially over the following years.[33] Prior studies examining inpatient TKAs have resulted in conflicting results regarding the effect of spinal anesthesia in reducing transfusion rates when compared to general anesthesia. Rashiq et al. did not detect a benefit of spinal anesthesia to reduce transfusion after inpatient TKAs.[34] In contrast, Wei et al. detected a benefit of spinal anesthesia to reduce transfusion after inpatient TKAs.[35] It was also interesting to note the selection process for the patients undergoing outpatient TKA who received spinal anesthesia. In the original cohort, TKA patients who received spinal anesthesia showed less complications than patients who received general anesthesia. [Table 2]

Trials evaluating spinal anesthesia as compared with general anesthesia for hip-fracture surgery have primarily assessed differences in intraoperative events and in-hospital

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complications and have not been powered to test for differences in outcomes beyond hospital discharge.[36,37,38,39,40] Hruslinski et al evaluated recovery of the ability to walk 10 ft or across a room without the assistance of another person, an outcome that is of importance to patients and families,9 and delirium, an outcome that our patient partners identified as a priority.[41]

In our study patients with hip surgery in spinal group showed less complications than in general anesthesia group. [Table 2] Gonano et al found no difference in the hemodynamic profile between the groups. No anesthesia-related complications, except PONV and hypotension, occurred. No spinal block failed, so data of all patients were analyzed. Residual motor block from SA had no impact, as physical therapy started on the first postoperative day.[29] In this study we found the mean anesthesia induction time was significantly higher in spinal group. Anesthesia time was lower in spinal group while PACU time was higher in group B. Time duration of surgery was significantly lower in spinal group. After 24 hours, spinal group showed less pain score than general anesthesia group. [Table 3]

Gonano et al found no clinically relevant differences regarding anesthesia-related times between groups. The induction time was shorter in the GA group, this was offset by the increased "end of surgery to transfer time" in the GA group. Time for recovery and total time were similar in both groups. Patients in the GA group were admitted to PACU with a higher pain score and needed more analgesics than patients in the SA group [Table 4]. Five patients in each group received antiemetic therapy with ondansetron.[29]

Limitations of the study

Our study was a single centre study. We took a small sample size due to our short study period and limited resources. There are more postoperative events of undergoing orthopedic surgery like wound related infection, thromboembolic event, renal failure, myocardial infarction, cardiac arrest requiring cardiopulmonary resuscitation, stroke or cerebrovascular accident, on ventilator > 48 h, unplanned intubation, sepsis/septic shock, and death needs to be evaluated. After evaluating once those patients we did not follow them up for a long term and have not known other possible interference that may happen in the long term with these patients.

CONCLUSIONS

In our study, we found that SA is associated with less fixed and variable costs and lower postoperative pain scores during the stay in the PACU. Therefore, SA is a more reasonable alternative to GA in the immediate postoperative period for patients undergoing hip or knee replacement. When compared to general anaesthesia, spinal anaesthesia provides better operating circumstances, better postoperative pain control, and faster postoperative recovery. Specifically, the rate of blood transfusions was reduced in patients who received spinal anesthesia compared to general anesthesia in the early postoperative period.
So further study with a prospective and longitudinal study design including larger sample size needs to be done to determine cost-effectiveness of SA for different indications, durations of surgery and patient collectives.

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