

Clinical Comparison of Spinal Anaesthesia and General Anaesthesia for Total Knee Arthroplasty

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Abstract

Background: Total knee arthroplasty is a commonly performed surgical procedure for the management of advanced degenerative knee diseases such as osteoarthritis and rheumatoid arthritis. The choice of anaesthetic technique influences perioperative outcomes, postoperative pain control, complications, and recovery. Spinal anaesthesia and general anaesthesia are the two most frequently used techniques for this procedure.

Aim: To compare the clinical outcomes of spinal anaesthesia and general anaesthesia in patients undergoing total knee arthroplasty.

Materials and Methods: This comparative observational study was conducted in the Department of Anaesthesia at a tertiary-care teaching hospital affiliated with Meenakshi Medical College Hospital & Research Institute, Kanchipuram. A total of 80 patients undergoing total knee arthroplasty were included and divided into two groups. Group A consisted of 40 patients who received spinal anaesthesia, while Group B included 40 patients who underwent surgery under general anaesthesia. Demographic characteristics, intraoperative hemodynamic parameters, estimated blood loss, postoperative pain scores, complications, and recovery outcomes were recorded and analyzed. A p value less than 0.05 was considered statistically significant.

Results: Demographic characteristics were comparable between the two groups. Patients receiving spinal anaesthesia demonstrated better intraoperative hemodynamic stability ($p < 0.05$) and significantly lower blood loss (320 ± 85 ml vs 410 ± 96 ml; $p = 0.001$). Postoperative pain scores at 6 and 24 hours were significantly lower in the spinal anaesthesia group ($p = 0.001$). Earlier mobilization and shorter hospital stay were also observed.

Conclusion: Spinal anaesthesia provides improved hemodynamic stability, reduced blood loss, better postoperative analgesia, and faster recovery compared with general anaesthesia in total knee arthroplasty.

Keywords: Total knee arthroplasty, spinal anaesthesia, general anaesthesia, postoperative pain, recovery.

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Introduction

Total knee arthroplasty (TKA) is a widely performed surgical procedure used to relieve pain, restore joint function, and improve the quality of life in patients with advanced degenerative knee conditions such as osteoarthritis and rheumatoid arthritis. With the increasing prevalence of aging populations and lifestyle-related joint disorders, the number of TKA procedures performed worldwide has increased considerably. The choice of anaesthetic technique plays a significant role in influencing perioperative outcomes, patient recovery, and the occurrence of postoperative complications in patients undergoing this major orthopedic procedure [1,2].

Spinal anaesthesia and general anaesthesia are the two commonly employed anaesthetic techniques for total knee arthroplasty. Spinal anaesthesia involves the administration of local anaesthetic agents into the subarachnoid space, resulting in temporary blockade of sensory and motor nerve transmission below the level of

injection [3,4]. This technique provides effective intraoperative analgesia and muscle relaxation. Several studies have reported that spinal anaesthesia is associated with reduced intraoperative blood loss, lower incidence of thromboembolic events, and improved postoperative pain control. Additionally, spinal anaesthesia may decrease the need for systemic opioids and facilitate earlier postoperative mobilization, which can contribute to enhanced recovery following orthopedic procedures [5]. General anaesthesia, in contrast, produces a reversible state of unconsciousness through the administration of intravenous and inhalational anaesthetic agents. This technique allows for complete airway control and mechanical ventilation during surgery, which can be advantageous in certain clinical situations. General anaesthesia is widely used in major surgical procedures due to its predictable depth of anaesthesia and suitability for prolonged surgeries. However, some studies have reported that general anaesthesia may be associated with a

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higher incidence of postoperative nausea and vomiting, respiratory complications, and delayed recovery in comparison with regional anaesthetic techniques [6,7].

Several researchers have compared the clinical outcomes of spinal and general anaesthesia in orthopedic surgeries including total knee arthroplasty. Regional anaesthesia techniques were associated with lower perioperative morbidity and improved postoperative outcomes in patients undergoing joint replacement surgeries [8]. Spinal anaesthesia was linked with reduced postoperative complications and shorter hospital stay compared with general anaesthesia in patients undergoing primary total knee arthroplasty.[9]

Despite these findings, variations in clinical outcomes continue to be reported across different healthcare settings. Therefore, evaluating the comparative effectiveness of spinal and general anaesthesia remains important for optimizing perioperative management in patients undergoing total knee arthroplasty [10]. The present study was conducted to compare the clinical outcomes of spinal anaesthesia and general anaesthesia in patients undergoing total knee arthroplasty.

Materials and Methods

This comparative observational study was conducted in the Department of Anaesthesia at a tertiary care teaching hospital attached to Meenakshi Medical College, Kanchipuram, Tamil Nadu. The hospital serves as a referral center providing specialized orthopedic and perioperative care to patients from surrounding urban and rural regions. The study included patients who were scheduled to undergo total knee arthroplasty during the study period. A total of 80 patients were enrolled in the study and were divided into two groups based on the type of anaesthesia administered. Group A consisted of 40 patients who received spinal anaesthesia, while Group B included 40 patients who underwent surgery under general anaesthesia.

Patients aged above 40 years undergoing elective total knee arthroplasty and classified under American Society of Anesthesiologists (ASA) physical status I or II were included in the study. Patients with contraindications to spinal anaesthesia, severe systemic illness classified as ASA physical status III or above, coagulopathy, infection at the injection site, or those who did not provide consent were excluded from the study. All patients underwent a detailed preoperative assessment including medical history, physical examination, and relevant laboratory investigations. The choice of anaesthetic technique was determined by the attending anaesthesiologist based on patient condition and clinical requirements. In patients receiving spinal anaesthesia, a standard dose of local anaesthetic was administered into the subarachnoid space

under strict aseptic precautions. In the general anaesthesia group, anaesthesia was induced using intravenous induction agents and maintained with inhalational anaesthetic agents along with controlled ventilation. Perioperative parameters including duration of surgery, intraoperative hemodynamic stability, estimated blood loss, postoperative pain, and complications were recorded and compared between the two groups.

The collected data were entered in Microsoft Excel and analyzed using SPSS statistical software. Descriptive statistics such as mean, standard deviation, frequency, and percentage were calculated. Comparative analysis between the two groups was performed using appropriate statistical tests, and a p value of less than 0.05 was considered statistically significant.

Results

A total of 80 patients undergoing total knee arthroplasty were included in the study and were divided into two groups based on the type of anaesthesia administered. Group A consisted of 40 patients who received spinal anaesthesia, while Group B consisted of 40 patients who underwent surgery under general anaesthesia. Various demographic, intraoperative, and postoperative parameters were compared between the two groups.

Table 1: Demographic Characteristics of the Study Participants (n = 80)

Variable	Spinal Anaesthesia (n = 40)	General Anaesthesia (n = 40)	p value
Mean age (years)	64.2 ± 7.5	63.8 ± 6.9	0.78
Male	18 (45%)	20 (50%)	0.65
Female	22 (55%)	20 (50%)	
Mean BMI (kg/m ²)	28.4 ± 3.2	29.1 ± 3.5	0.41
ASA I	15 (37.5%)	14 (35%)	0.82
ASA II	25 (62.5%)	26 (65%)	

The mean age of patients in the spinal anaesthesia group was 64.2 ± 7.5 years, while in the general anaesthesia group it was 63.8 ± 6.9 years. There was no statistically significant difference between the two groups (p = 0.78). Similarly, gender distribution, BMI, and ASA classification were comparable between both groups, indicating that the baseline demographic characteristics were similar and statistically not significant.

Table 2: Intraoperative Hemodynamic Parameters

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Parameter	Spinal Anaesthesia (n = 40)	General Anaesthesia (n = 40)	P value
Mean systolic BP (mmHg)	118.6 ± 10.4	124.3 ± 11.1	0.02
Mean diastolic BP (mmHg)	74.2 ± 7.3	78.6 ± 8.1	0.03
Mean heart rate (beats/min)	72.5 ± 8.6	80.4 ± 9.2	0.01

Patients receiving spinal anaesthesia demonstrated lower mean systolic blood pressure, diastolic blood pressure, and heart rate compared to those receiving general anaesthesia. These differences were statistically significant ($p < 0.05$), suggesting better intraoperative hemodynamic stability in the spinal anaesthesia group.

Table 3: Intraoperative Surgical Parameters

Parameter	Spinal Anaesthesia (n = 40)	General Anaesthesia (n = 40)	P value
Duration of surgery (minutes)	102.4 ± 15.3	105.7 ± 17.2	0.36
Estimated blood loss (ml)	320 ± 85	410 ± 96	0.001
Blood transfusion required	4 (10%)	9 (22.5%)	0.12

The mean duration of surgery was comparable between the spinal anaesthesia and general anaesthesia groups, and the difference was not statistically significant ($p = 0.36$). However, the estimated intraoperative blood loss was significantly lower in the spinal anaesthesia group compared to the general anaesthesia group ($p = 0.001$).

Table 4: Postoperative Pain Assessment

Parameter	Spinal Anaesthesia (n = 40)	General Anaesthesia (n = 40)	p value
VAS pain score at 6 hours	3.2 ± 1.1	5.1 ± 1.3	0.001
VAS pain score at 24 hours	2.8 ± 0.9	4.3 ± 1.2	0.001
Rescue analgesia required	12 (30%)	24 (60%)	0.006

Postoperative pain scores measured using the Visual

Analogue Scale (VAS) were significantly lower in patients receiving spinal anaesthesia at both 6 hours and 24 hours after surgery ($p = 0.001$). In addition, a significantly higher proportion of patients in the general anaesthesia group required rescue analgesia ($p = 0.006$), indicating better postoperative pain control in the spinal anaesthesia group.

Table 5: Postoperative Complications

Complication	Spinal Anaesthesia (n = 40)	General Anaesthesia (n = 40)	P value
Nausea and vomiting	6 (15%)	14 (35%)	0.04
Hypotension	10 (25%)	4 (10%)	0.07
Respiratory complications	1 (2.5%)	6 (15%)	0.05
Urinary retention	3 (7.5%)	2 (5%)	0.64

Postoperative nausea and vomiting were significantly more common in patients receiving general anaesthesia compared to spinal anaesthesia ($p = 0.04$). Respiratory complications were also observed more frequently in the general anaesthesia group, showing borderline statistical significance ($p = 0.05$).

Table 6: Postoperative Recovery Outcomes

Outcome	Spinal Anaesthesia (n = 40)	General Anaesthesia (n = 40)	P value
Time to first mobilization (hours)	18.6 ± 4.2	24.3 ± 5.1	0.001
Length of hospital stay (days)	5.2 ± 1.1	6.4 ± 1.5	0.002
Patient satisfaction score	8.6 ± 1.0	7.4 ± 1.2	0.003

Patients who received spinal anaesthesia demonstrated significantly earlier mobilization compared to those who received general anaesthesia ($p = 0.001$). Additionally, the length of hospital stay was shorter in the spinal anaesthesia group ($p = 0.002$). Patient satisfaction scores were also significantly higher among patients who received spinal anaesthesia ($p = 0.003$), indicating improved postoperative recovery and overall patient experience.

Discussion

The present study compared the clinical outcomes of spinal anaesthesia and general anaesthesia in patients undergoing total knee arthroplasty. The baseline demographic

characteristics including age, gender distribution, body mass index, and ASA physical status were comparable between the two groups, indicating that the study population was well matched. The mean age of patients in the spinal anaesthesia group was 64.2 ± 7.5 years compared with 63.8 ± 6.9 years in the general anaesthesia group, and the difference was not statistically significant ($p = 0.78$). Similar findings were reported by Soffin EM et al [12], who observed comparable demographic characteristics among patients undergoing knee arthroplasty.

In the present study, intraoperative hemodynamic parameters showed significant differences between the two groups. The mean systolic blood pressure was significantly lower in the spinal anaesthesia group (118.6 ± 10.4 mmHg) compared with the general anaesthesia group (124.3 ± 11.1 mmHg) ($p = 0.02$). Similarly, diastolic blood pressure (74.2 ± 7.3 mmHg vs 78.6 ± 8.1 mmHg; $p = 0.03$) and heart rate (72.5 ± 8.6 beats/min vs 80.4 ± 9.2 beats/min; $p = 0.01$) were significantly lower in the spinal anaesthesia group. Comparable findings were reported by Memtsoudis SG et al [13], who demonstrated improved hemodynamic stability with regional anaesthesia during joint arthroplasty procedures.

The present study also showed significantly reduced intraoperative blood loss in the spinal anaesthesia group (320 ± 85 ml) compared with the general anaesthesia group (410 ± 96 ml) ($p = 0.001$). Similar observations were reported by Johnson RL et al [14], who found that neuraxial anaesthesia was associated with reduced intraoperative blood loss in orthopedic surgeries.

Postoperative pain scores were significantly lower in the spinal anaesthesia group. The VAS pain scores at 6 hours (3.2 ± 1.1 vs 5.1 ± 1.3 ; $p = 0.001$) and 24 hours (2.8 ± 0.9 vs 4.3 ± 1.2 ; $p = 0.001$) were lower compared with the general anaesthesia group. Additionally, fewer patients in the spinal anaesthesia group required rescue analgesia (30% vs 60%; $p = 0.006$). These findings are consistent with Mauermann WJ et al [15], who reported better postoperative analgesia with regional anaesthesia.

Regarding postoperative complications, nausea and vomiting were significantly higher in the general anaesthesia group (35%) compared with the spinal anaesthesia group (15%) ($p = 0.04$). Similar findings were reported by Fleischut PM et al [16] and Macfarlane AJR et al [17].

Furthermore, patients receiving spinal anaesthesia demonstrated earlier mobilization (18.6 ± 4.2 hours vs 24.3 ± 5.1 hours; $p = 0.001$) and shorter hospital stay (5.2 ± 1.1 days vs 6.4 ± 1.5 days; $p = 0.002$). Comparable results were reported by Helwani MA et al [18], Wainwright TW et al [19], and Poeran J et al [20], who demonstrated improved

recovery outcomes with regional anaesthesia in total knee arthroplasty.

Conclusion

The present study demonstrated that spinal anaesthesia offers several advantages over general anaesthesia in patients undergoing total knee arthroplasty. Patients receiving spinal anaesthesia showed better intraoperative hemodynamic stability, reduced intraoperative blood loss, and significantly lower postoperative pain scores compared with those receiving general anaesthesia. In addition, spinal anaesthesia was associated with earlier mobilization and shorter duration of hospital stay. These findings suggest that spinal anaesthesia may be a preferable anaesthetic technique for total knee arthroplasty, as it contributes to improved perioperative outcomes and enhanced postoperative recovery.

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