A comparative study of spinal anesthesia versus general anesthesia on postoperative recovery and complication rates in elective surgeries

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***Abstract*—Spinal anesthesia and general anesthesia" are widely used techniques for elective surgical procedures, each influencing postoperative recovery and complication profiles differently. The purpose of the study is to compare spinal anesthesia and general anesthesia based on the postoperative recovery parameters and the complication rates in elective surgeries. This was a prospective, comparative observational study that was carried out within a 12-month period in a tertiary care teaching hospital. One hundred and ten adult patients (ASA I-II) going through elective surgeries were randomly divided into a group of "spinal anesthesia (SA) and general anesthesia (GA)" Outcomes such as recovery of consciousness, duration to ambulate, pain scale, analgesic need, hospitalization and postoperative complications were evaluated and statistically compared. The spinal anesthesia patients exhibited faster consciousness recovery, ambulation, better management of postoperative pain, lesser painkiller needs and less hospital stay than the general anesthesia patients ($p < 0.05$). The GA group showed more postoperative nausea, vomiting and respiratory complications whereas transient hypotension and bradycardia were more observed in the SA group. Spinal anesthesia provides a superior postoperative recovery profile compared to general anesthesia in elective surgeries and should be preferred whenever clinically feasible.**

***Index Terms*—Spinal anesthesia; General anesthesia; Postoperative recovery; Elective surgery; Postoperative complications**

I. INTRODUCTION

Anesthesia is an inherent part of contemporary surgical practice that enables surgical operations to be carried out in a safe and pain-free manner with preserving the comfort of the patient and their physiological stability. The field of anesthetic drugs, methods and monitoring has greatly contributed to the increasing success of surgery; nevertheless, the anesthesia type remains a crucial factor to determine postoperative success and comorbidity [1]. General anesthesia and spinal anesthesia are the most common methods of anesthesia applied in cases of elective surgeries in most countries across the world [2].

Inhalational and intravenous drugs cause general anesthesia, which induces a reversible unconsciousness, amnesia, analgesia, and relaxation of the muscles. It offers the best operating conditions and absolute patient immobility, which makes it applicable in a large variety of surgical operations [3]. These benefits notwithstanding, the general anesthesia is commonly linked with postoperative adverse effects including nausea and vomiting, slow awakening, sore throat, respiratory depression and cognitive dysfunction especially at the old age [4,5]. These complications have the potential to lengthen recovery period, extend hospitalization, and have adverse patient satisfaction and healthcare expenses [6].

A local anesthetic is injected into the subarachnoid space to produce spinal anesthesia, a kind of regional anesthesia that results in a transient sensory and

motor blockage underneath the injection site [7]. It is popular in lower abdominal, pelvic, and lower limbs surgeries. Spinal anesthesia was linked to several advantages, such as good postoperative analgesia, less stress response to surgery, less opioid use, early ambulation, and fewer postoperative nausea and vomiting [8, 9]. Also, it keeps spontaneous respiration intact and does not manipulate airways, hence minimizing respiratory complications [10]. Nevertheless, spinal anesthesia does not possess only beneficial outcomes. Bradycardia, post-dural puncture headache, hypotension, urine retention, and in rare instances, neurological problems are the most common side effects [11]. These complications are affected by the characteristics of the patients, dose of anesthesia, duration of surgery, and perioperative care [12].

Postoperative recovery is a complex process, which consists of regaining consciousness, effective pain management, early mobilization, physiological functions recovery, and overall state of the patient [13]. Delayed discharge, high morbidity, financial burden, and poor quality of life may be caused by poor postoperative recovery and high rates of complications [14]. Thus, it is necessary to analyze the effect of anesthetic methods on postoperative outcomes and morbidity to optimize preoperative care.

Elective procedures provide a regulated clinical environment with reduced confounding factors like emergencies and unstable conditions of patients. This renders them suitable in objectively comparing various methods of anesthesia [15]. A comparative evaluation between spinal anesthesia and general anesthesia in elective operations can be very valuable as it can help in the informed anesthetic decision making, positive patient outcome and overall quality of surgery. In this study, individuals who have had elective surgical procedures will have their postoperative recovery metrics and complication rates compared between spinal anesthesia and general anesthetic, the purpose of which will be to find out which of the two anesthetic procedures will give better recovery profiles and lower rates of post operative complication.

Aim

The aim of this study is to compare "spinal anesthesia and general anesthesia" with respect to postoperative recovery and complication rates in patients undergoing elective surgical procedures.

Objectives

- To compare the postoperative recovery profile of patients receiving spinal anesthesia and general anesthesia in elective surgeries.
- To assess and compare the postoperative complication rates associated with spinal anesthesia and general anesthesia.
- To evaluate the difference in postoperative pain and analgesic requirements between the two anesthetic techniques.
- To compare the duration of hospital, stay following spinal anesthesia and general anesthesia in elective surgical patients.

II. REVIEW OF LITERATURE

Shui et al., (2023) examined the effects of various anesthetic methods on the perioperative results of patients having lumbar spine surgery. Lumbar spine surgery may be performed under spinal anesthesia/epidural anesthesia or general anesthesia. The question of whether regional anesthesia or general anesthesia is better suited for lumbar spine surgery with fewer problems is still up for debate. Independent reviewers evaluated the eligibility of included studies after a thorough search of the literature for randomized controlled trials was carried out using the Excerpta Medica database (EMBASE), PubMed, and Cochrane library. Tachycardia, bradycardia, intraoperative hypertension, and hypotension were the main results. Postoperative analgesic need, postoperative nausea and vomiting (PONV), headache, blood loss, urine retention, and duration of hospital stay were secondary outcomes. Spinal or epidural anesthesia may be beneficial for patients having lumbar spine surgery, according to low to intermediate quality of evidence [16].

Neuman et al., (2023) analyzed the Comparative effectiveness study seeks to elucidate the advantages and disadvantages of various therapies to aid patients and physicians in making informed choices. The comparison of results between spinal and general anesthesia in older persons is a significant area of attention in comparative effectiveness studies within anesthesia practice. Patients undergoing vascular surgery, elective knee and hip arthroplasty, or hip fracture surgery are among the populations studied in

this meta-analysis, which also delves into methodological issues surrounding the topic. When it comes to safety and acceptability, randomized trials conducted in different contexts suggest that spinal and general anesthesia are probably about the same for most people who don't have any contraindications [17].

Hernandez et al., (2022) Investigated preventative measures are still inadequate, with current research mostly concentrating on identifying risk factors. Spinal anesthesia has emerged as a compelling "alternative to general anesthesia in elective lumbar surgery, potentially influencing the incidence of postoperative urinary retention (POUR). A total of 422 spinal anesthesia operations were prospectively gathered from 2017 to 2021 and compared to 416 general anesthesia procedures retrospectively collected from 2014 to 2017, all conducted at a single academic site by the same senior neurosurgeon. The primary outcome was POUR, defined as the need for intermittent bladder catheterization or the insertion of an indwelling bladder catheter post-surgery owing to an inability to empty. A power analysis was conducted before data collection. The general anesthesia cohort had a greater incidence of postoperative urinary retention (9.1%) in contrast to the spinal anesthesia cohort (4.3%), p = 0.005. At baseline, the spinal anesthetic group had a higher average age and a lower incidence of patients with a history of prior spine surgery" The other comorbid conditions were similar among the groups [18].

Li et al., (2020) evaluated the effectiveness of general anesthesia (GA) against spinal anesthesia (SA) for adult inguinal hernia repair. Prior to January 2020, relevant studies were found using reference lists, PubMed, Embase, ScienceDirect, Cochrane Library, and Scopus databases. Pain ratings, patient satisfaction, duration of hospital stay, time spent in the operating room, and postoperative complications were among the outcomes. A surgical approach-based subgroup analysis was carried out. There were five cohort studies and six randomized controlled trials (RCTs). In contrast to GA, patients receiving SA were more likely to have headaches and postoperative urine retention (relative ratio [RR]: In that order, the RR was "0.33 (95% CI:0.12,0.92) and the RR was 0.44 (95% CI:0.23, 0.86). Compared to GA, SA had a tendency toward a decreased incidence of postoperative nausea and vomiting, especially in open herniorrhaphy (RR: 2.12, 95%CI: 0.95, 4.73)" [19].

Morris et al., (2019) evaluated the relative cost-effectiveness of general and spinal anesthesia for lumbar laminectomy and microdiscectomy procedures carried out in academic vs private practice hospital settings. From 2012 to 2016, In a hospital setting, whether it be a private practice or an academic institution, the authors reviewed the medical records of "188 consecutive patients who had lumbar laminectomy or microdiscectomy done by a single surgeon. Intraoperative and postoperative outcomes were recorded, and direct variable costs were calculated. Compared to procedures performed using spinal anesthesia, those using general anesthesia for lumbar laminectomy or microdiscectomy at the academic institution were 9.93% more expensive (P =.040). In terms of operating room expenditures, the largest difference was seen between spinal anesthesia and general anesthesia, with the latter being associated with 18.74% greater costs (P =.016)" The cost difference in the private practice hospital scenario was negligible [20].

Finsterwald et al., (2018) investigated Young, healthy patients having lumbar spine surgery with spinal anesthesia (SA) as opposed to general anesthesia (GA) reported more stable perioperative hemodynamic conditions, reduced expenses, and a decreased risk of perioperative complications. Hence, it is debatable whether SA is beneficial for this operation in patients at high risk (ASA > II) who have pulmonary and/or cardiovascular symptoms. Our goal was to compare SA with GA in high-risk patients having this procedure to see whether SA results in better "perioperative hemodynamic stability and more cost-effective care. An analysis of data from 146 ASA II–III patients who had lumbar spine surgeries in South Africa and 292 ASA I–III patients" who had the same procedures performed in Georgia between 2000 and 2014 was conducted in retrospective research. In line with the Swiss billing system, hemodynamic effects, hospital stays, complications, and costs were assessed. To ensure that the data from cohort studies were properly reported, the STROBE approach for epidemiological research was followed [21].

III. METHODOLOGY

The study was a prospective, comparative, observational clinical trial study, which was carried out to assess and compare the outcome of "spinal anesthesia (SA) and general anesthesia (GA)" on post operative recovery parameters and complications in patients who underwent elective surgery.

3.1 Study Setting

This study was carried out at the anaesthesiology department of a large teaching hospital that treats elective surgeries from a wide range of medical subspecialties. The surgeries were carried out in well-equipped operation theatres that had standardized anesthesia machines and monitoring machines and postoperative recovery units.

3.2 Study Duration

The research was conducted during the 12 months, this involved the recruitment of patients, peri operative, and the post operative care, data collection and statistical analysis.

3.3 Study Population

The study sample comprised of adult patients who were undergoing elective surgical operations in which both spinal and general anesthesia could be used as clinical alternatives. To eliminate the risk of selection bias, patients were chosen in a sequential manner depending on the selection criteria.

3.4 Sample Size

Two groups were created from a total of 100-120 patients for the trial:

- Group SA: Patients receiving spinal anesthesia
- Group GA: Patients receiving general anesthesia

The sample size was calculated considering feasibility and past comparative anesthesia research, which guaranteed that there would be sufficient power in determining whether there was any significant difference in the outcomes of the postoperative.

❖ Inclusion Criteria

- Patients aged 18–65 years
- Patients of ASA physical status I and II
- Patients scheduled for elective surgical procedures
- Patients providing written informed consent
- Surgeries suitable for either spinal or general anesthesia

❖ Exclusion Criteria

- Emergency surgical procedures
- Patients with contraindications to spinal anesthesia (coagulopathy, spinal deformity, infection at injection site)
- Patients with known allergy to anesthetic agents
- ASA physical status III or above
- Pregnant patients
- Patients with significant neurological or psychiatric illness

3.5 Preoperative Assessment

All patients underwent a detailed pre-anesthetic evaluation including:

- Complete medical history and physical examination
- Routine laboratory investigations
- Airway assessment
- Baseline vital parameters

Patients were fasted according to standard guidelines and received standard premedication as per institutional protocol.

3.6 Anesthetic Technique

Spinal Anesthesia Group (SA)

- Spinal anesthesia was administered under strict aseptic precautions
- A subarachnoid block is executed in the interspace between lines 3 and 4 or lines 4 and 5
- Standard dose of hyperbaric bupivacaine was used
- Patients were monitored for sensory and motor blockade adequacy before surgery

General Anesthesia Group (GA)

- General anesthesia was induced using intravenous induction agents
- Airway secured with endotracheal tube or supraglottic airway device
- Anesthesia maintained with inhalational agents, muscle relaxants, and oxygen
- Standard monitoring applied throughout surgery.

3.7 Intraoperative Monitoring

For both groups, continuous monitoring included:

- Heart rate
- Blood pressure
- Oxygen saturation (SpO_2)
- Electrocardiography
- Respiratory parameters

Any intraoperative complications such as hypotension, bradycardia, or desaturation were recorded and managed according to standard protocols.

3.8 Postoperative Assessment

Postoperative recovery was assessed using the following parameters:

Primary Outcomes

- Time to recovery of consciousness
- Time to first ambulation
- Postoperative pain scores (using Visual Analog Scale)
- Analgesic requirement within first 24 hours

Secondary Outcomes

- Incidence of postoperative nausea and vomiting (PONV)
- Urinary retention
- Hypotension or bradycardia
- Post-dural puncture headache
- Respiratory complications
- Length of hospital stay

Patients were monitored for at least 24–48 hours postoperatively.

3.9 Data Collection

All observations were recorded in a pre-designed, structured proforma, ensuring uniformity and completeness of data collection.

3.10 Statistical Analysis

- The data was inputted into Excel and then processed using SPSS software.
- Mean ± standard deviation was used to represent continuous variables.
- "Frequencies and percentages were used to represent categorical variables. The following tests were used"
- A chi-square test or Fisher's exact test was utilized for categorical variables
- "A student's t-test was employed for continuous variables Statistical significance was determined by a p-value less than 0.05"

3.11 Ethical Considerations

- The research was only carried out after the Institutional Ethics Committee gave its clearance.
- All participants provided written informed consent.
- Patient confidentiality and ethical principles were strictly maintained throughout the study

IV. RESULT

Table 1 shows that the "spinal anesthesia (SA) and the general anesthesia (GA)" groups were demographically and clinically the same at the start of the operation and did not show statistically significant difference in any of the parameters under evaluation ($p > 0.05$). The patients in both groups were of comparable age, which indicates that they are of similar gender and that they are in similar health conditions and at similar risk for anesthesia. They also had the same ASA physical status (I/II). The groups were also hemodynamically stable prior to anesthesia, as there was no statistically significant difference in physiological markers such as heart rate and mean arterial pressure. The proportion of the type of elective surgeries were also similar making the surgical exposure similar in the two groups. All this homogeneity attests to the fact that the study groups were balanced prior to happening of the intervention, which reinforced the study internal validity and thus subsequent changes in the outcome after the operation could be depended on as being due to the anesthetic technique as opposed to baseline patient-related factors.

Table 1: "Demographic and Baseline Characteristics of Study Participants"

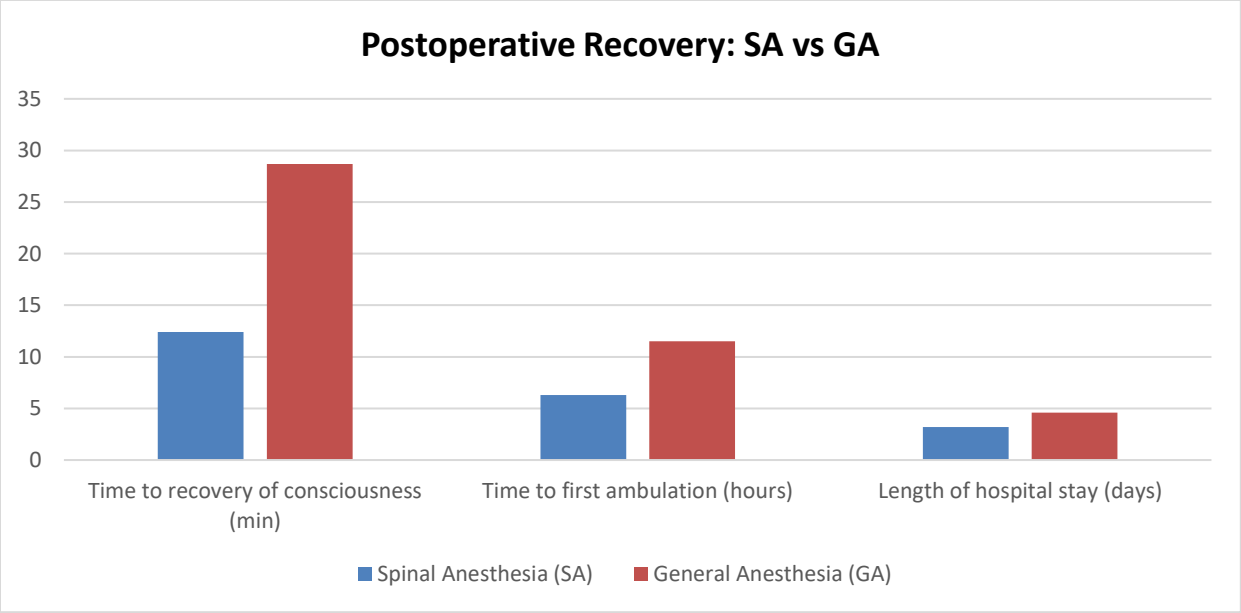
Parameter	Spinal Anesthesia (SA) (n = 55)	General Anesthesia (GA) (n = 55)	*p*-value
Age (years)	42.6 ± 11.2	44.1 ± 10.8	>0.05
Gender (M/F)	Comparable	Comparable	>0.05
ASA Physical Status (I / II)	Similar distribution	Similar distribution	>0.05
Baseline Heart Rate (bpm)	Comparable	Comparable	>0.05
Baseline Mean Arterial Pressure	Comparable	Comparable	>0.05

(mmHg)			
Type of Elective Surgery	Comparable	Comparable	>0.05

The Table 2 shows that patients who had spinal anesthesia (SA) recorded a much better postoperative recovery profile than those having general anesthesia (GA). The recovery of consciousness was significantly reduced in the SA group, which is the faster appearance and the early recovery of neurological activity. In the same way, the patients in the SA group were able to attain first ambulation much earlier than the ones in the GA group indicating better functional recovery and less postoperative impairment. Moreover, hospital stay was much shorter in the patients who were administered spinal anesthesia implying that they were stabilized and prepared to go home earlier. All noticed differences were statistically important, which proves that spinal anesthesia is linked to the faster recovery and better postoperative performance of elective surgical patients in comparison with general anesthesia.

Table 2: Comparison of Postoperative Recovery Parameters

Parameter	Spinal Anesthesia (SA)	General Anesthesia (GA)	*p*-value
Time to recovery of consciousness (min)	12.4 ± 4.6	28.7 ± 6.9	<0.001
Time to first ambulation (hours)	6.3 ± 1.8	11.5 ± 2.6	<0.001
Length of hospital stay (days)	3.2 ± 0.9	4.6 ± 1.2	<0.01

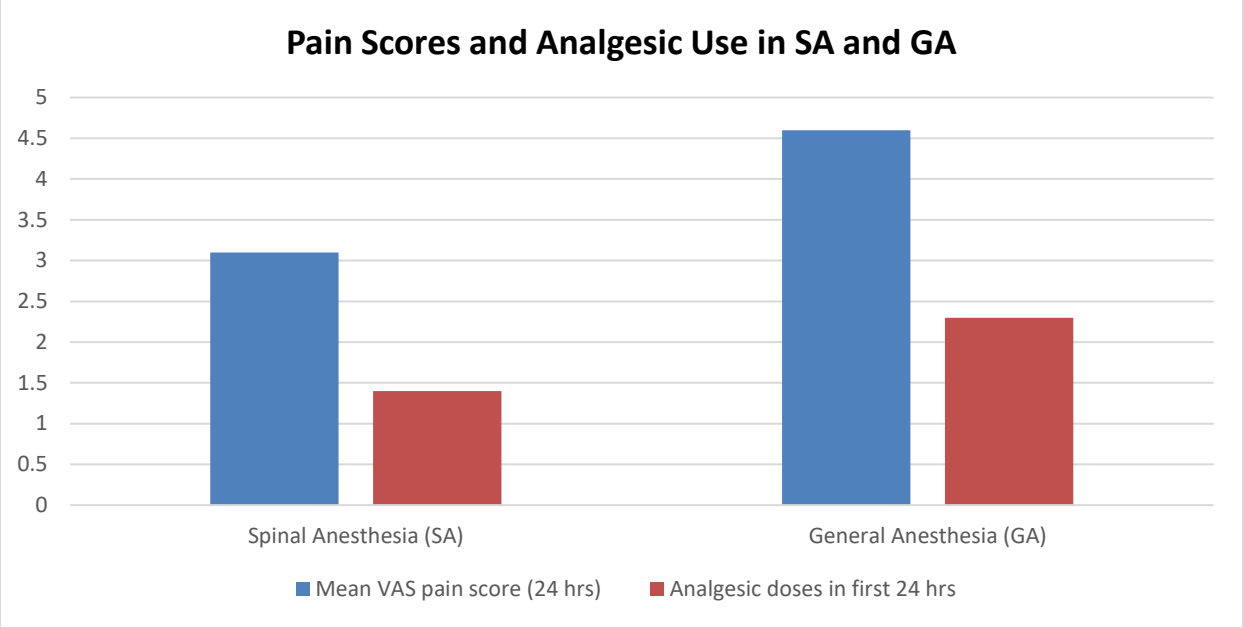


Graph 1: Postoperative Recovery: SA vs GA

Additionally, in the first twenty-four hours after surgery, individuals who had spinal anesthesia (SA) reported much less discomfort than those who underwent general anesthesia (GA), as seen in Table 3. The SA group showed much better pain management in the early postoperative period compared to the control group, as shown by a substantially lower average Visual Analog Scale (VAS) pain level. Similarly, in the first twenty-four hours after surgery, the SA group required fewer doses of rescue analgesics than the control group, suggesting less analgesic demand and better postoperative analgesia success. The significant differences ($p < 0.01$) in the two parameters are statistically significant that indicate that spinal anesthesia offers better pain management after surgery and helps to induce better patient comfort and recovery than general anesthesia.

Table 3: Postoperative Pain and Analgesic Requirement

Parameter	Spinal Anesthesia (SA)	General Anesthesia (GA)	*p*-value
Mean VAS pain score (24 hrs)	3.1 ± 0.9	4.6 ± 1.1	<0.01
Analgesic doses in first 24 hrs	1.4 ± 0.6	2.3 ± 0.8	<0.01



Graph 2: Pain Scores and Analgesic Use in SA and GA

Table 4 gives a comparison of postoperative complications in patients who underwent an operation using "spinal anesthesia (SA) and general anesthesia (GA)". In the GA group, postoperative nausea and vomiting were more prevalent, which implies that there was emetogenic potential that was higher in general anesthesia. The urinary retention was found to be more prevalent in the SA group, but this was not statistically significant indicating that the two methods have similar risks in terms of this complication. Hemodynamic instability like hypotension and bradycardia were much more frequent in patients undergoing spinal anesthesia which is expected due to the sympathetic blockade which is temporary and can be treated. Only SA group reported post-dural puncture headache as it is a known complication of neuraxial anesthesia. Conversely, the GA group showed respiratory complications only, and this showed the higher airways and respiratory risks of general anesthesia. Altogether, the results show that each of the anesthetic methods has its own target of complication, although spinal anesthesia is related to a lesser number of respiratory and gastrointestinal complications, and general anesthesia is connected to the increased hemodynamic stability.

Table 4: Postoperative Complications

Complication	Spinal Anesthesia (SA) n (%)	General Anesthesia (GA) n (%)	*p*-value
Postoperative nausea & vomiting	5 (9.1%)	14 (25.5%)	<0.05
Urinary retention	8 (14.5%)	4 (7.3%)	>0.05
Hypotension / Bradycardia	10 (18.2%)	4 (7.3%)	<0.05
Post-dural puncture headache	3 (5.5%)	0 (0%)	—
Respiratory complications	0 (0%)	6 (10.9%)	<0.05

Table 5 gives the synoptic conclusion of the comparative results between general and spinal anesthesia. As noted, spinal anesthesia was found to perform better on most essential postoperative outcomes such as regaining consciousness faster, leaving hospital sooner, better control of postoperative pain, less analgesic prescriptions, less postoperative nausea and vomiting, and safer respiration. These are benefits that portray a better recovery profile and comfort of the patients undergoing spinal anesthesia. Conversely, the general anesthesia was linked with the improved stability of hemodynamics, probably because of the absence of sympathetic inhibition that occurs under the general anesthesia. All in all, this summary highlights that elective spinal anesthesia has the great postoperative advantages, whereas general anesthesia can be used in situations when the hemodynamics is a primary concern.

Table 5: Summary of Key Outcome Differences

Outcome	Better Outcome Observed In
Recovery of consciousness	Spinal anesthesia
Early ambulation	Spinal anesthesia
Postoperative pain control	Spinal anesthesia
Analgesic requirement	Spinal anesthesia
PONV	Spinal anesthesia
Respiratory safety	Spinal anesthesia
Hemodynamic stability	General anesthesia

V. DISCUSSION

The aim of the current research is in line with some of the recent comparative studies conducted on the assessment of spinal anesthesia (SA) and general anesthesia (GA) in elective surgeries. The systematic review of lumbar spine surgeries Shui et al., (2023) [16] found that SA was linked to a lower rate of postoperative analgesic need, decreased rates of postoperative nausea and vomiting, and a reduction in hospital stay, which is quite similar to the faster recovery, lower pain scores, and decreased hospitalization in the SA group in the current study.

On the same note, Neuman et al. (2023) [17] also emphasized that anesthetic choice preference is sensitive because both SA and GA are generally safe, with benefits in terms of early recovery and patient comfort, which is the case. This goes in line with the results presented in the present study, in which SA exhibited better recovery parameters without reducing the level of safety.

The lower rate of postoperative urinary retention and shorter stay in the hospital observed in the study by Hernandez et al. (2022) [18] is consistent with the current performance which revealed earlier ambulation and faster discharge in the SA group. The present study found that the urinary retention was slightly increased in SA patients, but the difference was not statistically significant and did not negatively influence the overall recovery.

Li et al. (2020) [19] conducted a systematic review and meta-analysis that has shown the superiority of spinal anesthesia over general anesthesia in terms of better postoperative pain management and a lower incidence of PONV, which is directly correlated with the low VAS scores and low analgesic need in the SA group in this experiment.

Moreover, Morris et al. (2019) [20] and Finsterwald et al. (2018) [21] have reported a cost-effectiveness and the decreased use of resources related to spinal anesthesia. Such studies reported that there were shorter operating durations, less hospitalization, and complications in the case of spinal anesthesia (SA) which corroborates the current study which shows that there is an enhancement in recovery efficiency when spinal anesthesia is involved.

All these comparisons support the fact that spinal anesthesia has always been beneficial in the postoperative recovery, analgesia, and patient comfort in a wide range of elective surgical practice.

VI. CONCLUSION

To sum up, the current study is backed up by modern literature that proves that spinal anesthesia has better postoperative recovery than general anesthesia in elective surgeries. Spinal anesthesia is preferred

because it leads to faster regaining consciousness, earlier ambulation, better pain control, shortened hospital stay, and less respiratory and gastrointestinal complication. Even though there may be some short-term hemodynamic consequences, they are treatable and predictable. Spinal anesthesia is thus preferred whenever possible and general anesthesia can be used in cases that have contraindications or special clinical needs.

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