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# A study on Evaluation of Clinical Efficacy, Feasibility and Safety of Laparoscopic Appendicectomy Under Spinal Anaesthesia Versus General Anaesthesia in a Tertiary Care Centre

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## ABSTRACT

**Background**: Laparoscopic appendicectomy (LA) is the gold standard surgical management for acute appendicitis. General anaesthesia (GA) has traditionally been the anaesthetic technique of choice for laparoscopic procedures. However, spinal anaesthesia (SA) is emerging as a cost-effective, safe, and feasible alternative, particularly in resource-constrained settings of tertiary care centres in developing nations. The haemodynamic profile, postoperative recovery, and analgesic requirements differ significantly between these two modalities. **Objectives**: To compare the clinical efficacy, feasibility, safety, intra-operative and postoperative adverse events, pain profiles (VAS), hospital stay, and patient satisfaction between laparoscopic appendicectomy performed under spinal versus general anaesthesia. **Methods**: This prospective, randomised comparative study was conducted at a tertiary care centre in North Bengal over a period of 12 months (January 2025–January 2026). A total of 63 patients diagnosed with acute or perforated appendicitis and scheduled for laparoscopic appendicectomy were enrolled. Patients were randomised into two groups: Group I (n=32) received spinal anaesthesia and Group II (n=31) received general anaesthesia. Demographic parameters, operative data, intra-operative and postoperative adverse events, Visual Analogue Scale (VAS) pain scores, hospital stay, and patient satisfaction were recorded and compared. **Results**: Both groups were comparable in terms of age, gender, BMI, and ASA grade. The total procedure time was significantly longer in Group I (SA: 68.7 min vs GA: 62.4 min, p=0.01). However, hospital stay was significantly shorter in the SA group (2.1 days vs 2.8 days, p=0.001). VAS pain scores were significantly lower in Group I at all measurement intervals (0h, 6h, 12h, 24h). Anxiety was the only intra-operative adverse event reaching statistical significance (SA 12.5% vs GA 0%, p=0.04). Postoperative complications were comparable between groups. Patient satisfaction was higher in Group I (90.6% vs 74.2%) though not statistically significant (p=0.08). **Conclusion**: Laparoscopic appendicectomy under spinal anaesthesia is a clinically efficacious, technically feasible, and safe alternative to general anaesthesia. It offers superior postoperative analgesia, shorter hospital stays, lower overall cost, and high patient satisfaction. SA should be considered a viable primary anaesthetic strategy, especially in tertiary care centres with resource limitations.

***Keywords***: *Laparoscopic appendicectomy, spinal anaesthesia, general anaesthesia, VAS pain score, North Bengal, comparative study, patient satisfaction, post-operative adverse events.*

## INTRODUCTION

Acute appendicitis remains one of the most common surgical emergencies encountered worldwide, with a lifetime risk estimated at approximately 7–8% in the general population. It disproportionately affects the younger population, with a peak incidence between 10 and 30 years of age. Appendicectomy—whether open or laparoscopic—remains the definitive treatment of choice.

Since its introduction by Semm in 1983, laparoscopic appendicectomy (LA) has progressively replaced open appendicectomy as the preferred surgical modality in most centres globally. The laparoscopic approach offers multiple advantages, including reduced postoperative pain, shorter hospital stays, faster return to normal activity, better cosmesis, lower wound infection rates, and improved visualisation of the abdominal cavity, enabling accurate diagnosis in equivocal cases [1].

Traditionally, laparoscopic procedures have been performed under general anaesthesia (GA) because the creation of a pneumoperitoneum—inflation of the abdominal cavity with carbon dioxide ($CO_2$) at pressures of 10–14 mmHg—was believed to require the controlled airway and muscle relaxation offered only by GA. This assumption prevented consideration of regional anaesthetic techniques for laparoscopic surgery for many decades[2].

However, accumulating evidence from the past two decades has challenged this conventional wisdom. Spinal anaesthesia (SA), a widely practised and cost-effective neuraxial anaesthetic technique, has been successfully employed for various laparoscopic procedures, including diagnostic laparoscopy, gynaecological laparoscopy, laparoscopic cholecystectomy, and appendicectomy. SA offers the potential advantages of superior postoperative analgesia, reduced need for opioids, rapid recovery, reduced cost, and avoidance of airway-related complications associated with GA[3].

The appeal of SA for laparoscopic surgery is particularly compelling in resource-limited settings, such as tertiary care centres in North Bengal, where cost constraints, limited intensive care resources, and variable availability of trained anaesthesiologists make it imperative to explore all safe and cost-effective alternatives. North Bengal, a geographically distinct region in north-eastern India, serves a large rural and semi-urban catchment population with a significant proportion of patients presenting with limited financial resources[4].

Despite growing interest in this area, there remains a paucity of comparative data from tertiary care centres in eastern and north-eastern India regarding the feasibility, safety, and clinical efficacy of laparoscopic appendicectomy under SA versus GA. The present study was therefore designed to rigorously compare these two anaesthetic strategies in a real-world clinical setting, contributing to the evidence base for surgical and anaesthetic practice in resource-limited environments.

## OBJECTIVES

### 1. Primary Objectives

- To compare the clinical efficacy of laparoscopic appendicectomy performed under spinal anaesthesia versus general anaesthesia.
- To evaluate the feasibility of performing laparoscopic appendicectomy under spinal anaesthesia in a tertiary care setting in North Bengal.
- To compare the safety profiles of both anaesthetic techniques by analysing intra-operative and postoperative adverse events.

### 2. Secondary Objectives

- To compare Visual Analogue Scale (VAS) pain scores at 0, 6, 12, and 24 hours postoperatively between both groups.
- To compare total procedure time, surgical duration, and hospital stay.
- To assess and compare patient satisfaction scores between spinal and general anaesthesia groups.
- To compare rates of specific surgical complications including abdominal abscess and trocar site infections.
- To identify patient subgroups that may preferentially benefit from spinal anaesthesia for laparoscopic appendicectomy.

## METHODOLOGY

### 1. Study Design and Setting

This was a prospective, randomised, comparative clinical study conducted in the Department of Surgery in collaboration with the Department of Anaesthesiology at a tertiary care centre in South Bengal, West Bengal, India. The study was conducted over an 12-month period from January 2025 to January 2026. Ethical clearance was obtained from the Institutional Ethics Committee (IEC), and written informed consent was taken from all participants prior to enrolment.

**2. Sample Size and Randomisation**
A total of 63 patients were enrolled in the study. Sample size was calculated using standard formula for comparison of two proportions, with an alpha error of 5% and power of 80%, based on previously published data on patient satisfaction and postoperative pain. Patients were randomised into two groups using a computer-generated randomisation table and sealed envelope method:

- Group I (n=32): Laparoscopic appendicectomy under Spinal Anaesthesia (SA)
- Group II (n=31): Laparoscopic appendicectomy under General Anaesthesia (GA)

**3. Inclusion Criteria**

- Age 18–60 years
- Both male and female patients
- Clinical, biochemical, and radiological diagnosis of acute appendicitis or perforated appendicitis
- ASA Physical Status Classification I or II
- BMI $\leq 35$ kg/m²
- Willing to participate and give informed written consent

**4. Exclusion Criteria**

- ASA Grade III, IV, or V
- Known coagulation disorders or current anticoagulant therapy
- Spinal deformities, previous spinal surgery, or contraindications to spinal anaesthesia
- Severe cardiopulmonary disease or pulmonary hypertension
- Massive obesity (BMI > 35 kg/m²)
- Patients with generalised peritonitis, septic shock, or haemodynamic instability
- Pregnancy
- Refusal to provide consent or participate

**5. Anaesthetic Protocol**
Group I – Spinal Anaesthesia: Patients were positioned in the left lateral decubitus position. Lumbar puncture was performed at the L3–L4 interspace using a 26-gauge Quincke spinal needle. Hyperbaric bupivacaine 0.5% (2.5–3.0 mL, 12.5–15 mg) with fentanyl 25 mcg was injected intrathecally to achieve a sensory block to T4 dermatomal level. Supplemental oxygen (4 L/min) was administered via a Hudson mask. IV midazolam 1–2 mg was administered if the patient exhibited anxiety during the procedure.

Group II – General Anaesthesia: Standard balanced general anaesthesia was administered. Induction was achieved with propofol 2 mg/kg IV, fentanyl 2 mcg/kg IV, and vecuronium 0.1 mg/kg IV for neuromuscular blockade. Anaesthesia was maintained with isoflurane in oxygen/nitrous oxide (50:50) mixture. Neostigmine and glycopyrrolate were administered for reversal of neuromuscular blockade at the conclusion of surgery.

**6. Surgical Technique**
All surgical procedures were performed by the same experienced surgical team (consultant surgeon with > 100 laparoscopic procedures per year) to eliminate operator-related variability. A standard three-trocar technique was employed: a 10 mm umbilical port for the camera, a 5 mm right iliac fossa port, and a 5 mm suprapubic or left iliac fossa port. Carbon dioxide pneumoperitoneum was created at 10–12 mmHg. The appendix was identified, and standard laparoscopic appendicectomy was performed with endoloops or a linear stapler. All patients received perioperative prophylactic antibiotics (cefuroxime 1.5 g IV + metronidazole 500 mg IV).

**7. Data Collection and Outcome Measures**
Primary outcomes included intra-operative feasibility (pneumoperitoneum tolerance, operative field quality, need for conversion to GA or open surgery), safety (intra-operative and postoperative adverse events), and postoperative pain using the Visual Analogue Scale (VAS; 0–10). Secondary outcomes included total procedure time, hospital stay, surgical complications (abdominal abscess, trocar site infection), and patient satisfaction assessed on a 5-point Likert scale at discharge.

**8. Statistical Analysis**
Data were entered and analysed using SPSS Version 20.0 (IBM Corp., Armonk, NY). Continuous variables are expressed as mean ± standard deviation (SD) and compared using the independent samples t-test. Categorical variables are expressed as frequencies and percentages and compared using the chi-squared ($\chi^2$) test or Fisher's exact test, as appropriate. A p-value $< 0.05$ was considered statistically significant.

All collected data was carefully entered in excel spread sheet and biased was removed. Then data was analysed by using SPSS statistical software version 20. Statistical analysis in the form of percentages was done. Data analysis was performed using Statistical package for social sciences (SPSS, IBM, USA) version 20.0. Results were reported as mean ± standard deviation for quantitative variables.

## RESULTS

### 1. Patient Characteristics and Demographic Data

A total of 63 patients were enrolled in the study; 32 were randomised to Group I (SA) and 31 to Group II (GA). Table 1 provides a comprehensive overview of patient characteristics, surgical parameters, diagnoses, complications, and satisfaction scores. No patient in either group required conversion to open appendicectomy. One patient in Group I required conversion from SA to GA due to intra-operative anxiety and discomfort during specimen extraction, yielding an SA-to-GA conversion rate of 3.1%, which is consistent with rates reported in the literature.

**Table 1: Comparison of Patient Characteristics between Group I (SA) and Group II (GA)**

| Parameter | Group I (SA) n=32 | Group II (GA) n=31 | P value |
|---|---|---|---|
| **Demographic Data** | | | |
| **Mean age (years)** | 34.2 ± 10.8 | 36.7 ± 11.3 | 0.31 |
| **Gender (M/F)** | 18/14 | 17/14 | 0.94 |
| **Mean BMI (kg/m²)** | 22.4 ± 3.1 | 23.1 ± 3.4 | 0.38 |
| **ASA I : II** | 22 : 10 | 21 : 10 | 0.91 |
| **Surgical Parameters** | | | |
| **Surgery time (min)** | 48.3 ± 9.4 | 46.1 ± 8.7 | 0.29 |
| **Total procedure time (min)** | 68.7 ± 11.2 | 62.4 ± 10.6 | 0.01* |
| **Diagnosis** | | | |
| **Hospital stay (days)** | 2.1 ± 0.6 | 2.8 ± 0.9 | 0.001* |
| **Acute appendicitis** | 26 (81.3%) | 26 (83.9%) | 0.77 |
| **Surgical Complications & Satisfaction** | | | |
| **Perforated appendicitis** | 6 (18.8%) | 5 (16.1%) | 0.77 |
| **Abdominal abscess** | 1 (3.1%) | 2 (6.5%) | 0.56 |
| **Trocar site skin infections** | 1 (3.1%) | 3 (9.7%) | 0.28 |
| **Patient satisfaction** | 29/32 (90.6%) | 23/31 (74.2%) | 0.08 |

** Statistically significant ($p<0.05$). Values expressed as mean ± SD or n (%). SA = Spinal Anaesthesia; GA = General Anaesthesia; BMI = Body Mass Index; ASA = American Society of Anaesthesiologists.*

**Table 1 – Detailed Explanation**

The demographic parameters including mean age, gender distribution, BMI, and ASA grade were statistically comparable between the two groups ($p>0.05$), confirming that randomisation was effective and the groups were homogeneous at baseline. The mean age in Group I was 34.2 ± 10.8 years and 36.7 ± 11.3 years in Group II. Gender distribution was nearly identical (M: F = 18:14 in Group I and 17:14 in Group II). Mean BMI was 22.4 ± 3.1 kg/m² in the SA group versus 23.1 ± 3.4 kg/m² in GA, both within the normal to overweight range.

Surgery time (skin incision to closure) was comparable between both groups (48.3 vs 46.1 min, p=0.29), indicating that the anaesthetic technique does not significantly affect the technical surgical duration. However, total procedure time—which includes pre-operative setup, induction of anaesthesia, patient positioning, and recovery room time—was significantly longer in the SA group (68.7 vs 62.4 min, p=0.01). This is attributable to the additional time required for spinal injection, waiting for adequate block height, and positioning the patient in Trendelenburg position after confirming dermatomal level.

Hospital stay was significantly shorter in the SA group (2.1 ± 0.6 days vs 2.8 ± 0.9 days, p=0.001). This clinically important finding reflects the superior postoperative analgesia, faster return of gastrointestinal motility, and absence of residual

anaesthetic drug effects associated with spinal anaesthesia. Diagnosis distribution was similar—approximately 82% of patients in both groups had acute appendicitis and ~17% had perforated appendicitis. Surgical complication rates (abdominal abscess and trocar site infections) were low and comparable between groups. Patient satisfaction trended higher in the SA group (90.6% vs 74.2%), though this did not reach statistical significance (p=0.08), likely due to the limited sample size.

**2. Intra-Operative Adverse Events**

**Table 2: Comparison of Intra-Operative Adverse Events between Group I (SA) and Group II (GA)**

| Intra-operative Adverse Event | Group I (SA) n=32 | Group II (GA) n=31 | P value |
|---|---|---|---|
| **Shoulder pain** | 2 (6.3%) | 0 (0%) | 0.24 |
| **Abdominal discomfort** | 5 (15.6%) | 1 (3.2%) | 0.09 |
| **Anxiety** | 4 (12.5%) | 0 (0%) | 0.04* |
| **Hypotension** | 6 (18.8%) | 3 (9.7%) | 0.31 |
| **Nausea / Vomiting** | 3 (9.4%) | 4 (12.9%) | 0.65 |
| **Bradycardia** | 4 (12.5%) | 2 (6.5%) | 0.42 |
| **Respiratory discomfort** | 1 (3.1%) | 0 (0%) | 0.49 |

** Statistically significant (p<0.05). Values expressed as n (%).*

**Table 2 – Detailed Explanation**

Intra-operative adverse events were assessed in real-time by the attending anaesthesiologist. Shoulder pain, which occurs due to diaphragmatic irritation by $CO_2$ and referred pain along the phrenic nerve, was noted in 2 patients (6.3%) in Group I and none in Group II; however, this was not statistically significant (p=0.24). This finding is consistent with previous studies and is an inherent limitation of performing laparoscopy under SA, where the diaphragm is not anaesthetised.

Abdominal discomfort—perceived as a sensation of bloating or pressure during insufflation—occurred in 5 patients (15.6%) in Group I versus 1 patient (3.2%) in Group II (p=0.09). This did not reach significance, but the trend is clinically noteworthy. Anxiety was the only intra-operative adverse event to achieve statistical significance: 4 patients (12.5%) in Group I experienced moderate to severe anxiety versus none in Group II (p=0.04). This is expected, as conscious patients undergoing intra-abdominal surgery under regional anaesthesia may develop anxiety due to awareness of surroundings, conversation, or procedural sounds. All were managed with IV midazolam 1–2 mg.

Hypotension (systolic BP < 90 mmHg or a > 20% drop from baseline) occurred more frequently in the SA group (18.8% vs 9.7%, p=0.31), attributable to the sympathectomy-induced vasodilation of the spinal block. All episodes were transient and managed with IV fluids and ephedrine. Nausea/vomiting and bradycardia rates were similar between groups. Respiratory discomfort was rare and only occurred in one SA group patient, likely related to high block level; this was managed with supplemental oxygen and positioning adjustment. No patient required intubation.

**3. Postoperative Adverse Events**

**Table 3: Comparison of Post-Operative Adverse Events between Group I (SA) and Group II (GA)**

| Post-operative Adverse Event | Group I (SA) n=32 | Group II (GA) n=31 | P value |
|---|---|---|---|
| **Shoulder pain** | 3 (9.4%) | 0 (0%) | 0.08 |
| **Headache** | 4 (12.5%) | 2 (6.5%) | 0.42 |
| **Urinary retention** | 3 (9.4%) | 1 (3.2%) | 0.30 |
| **Nausea / Vomiting** | 4 (12.5%) | 6 (19.4%) | 0.44 |

*Values expressed as n (%). No statistically significant difference observed.*

**Table 3 – Detailed Explanation**

Postoperative adverse events were monitored from the time of recovery room admission until discharge. Shoulder pain in the postoperative period was noted in 3 patients (9.4%) in Group I and none in Group II (p=0.08). This is characteristically described as a dull aching in the right shoulder tip and is caused by residual $CO_2$ in the peritoneal cavity causing diaphragmatic irritation. It resolved spontaneously within 12–24 hours in all cases and responded to NSAIDs.

Post-dural puncture headache (PDPH) was observed in 4 patients (12.5%) in the SA group versus 2 patients (6.5%) in the GA group (p=0.42). PDPH is a recognised complication of spinal anaesthesia characterised by bilateral fronto-occipital headache that is positional in nature (worse on standing, relieved by lying flat). All cases were mild to moderate and managed conservatively with bed rest, oral hydration, caffeine, and analgesics; none required epidural blood patch.

Urinary retention—difficulty voiding requiring catheterisation—was seen in 3 patients (9.4%) in Group I versus 1 patient (3.2%) in Group II (p=0.30). This is a known complication of spinal anaesthesia related to sacral nerve block affecting bladder tone. Postoperative nausea and vomiting (PONV) was paradoxically higher in the GA group (6 patients, 19.4%) compared to the SA group (4 patients, 12.5%), though not statistically significant (p=0.44). This is consistent with literature showing that GA with volatile anaesthetic agents and opioids is a major risk factor for PONV.

**4. Postoperative Pain Evaluation (VAS Scores)**

**Table 4: Postoperative Pain Evaluation – VAS Scores at 0, 6, 12, and 24 Hours**

| Measurement Time | Group I (SA) n=32 | Group II (GA) n=31 | P value |
|---|---|---|---|
| **VAS at 0 hours** | 1.8 ± 0.7 | 2.9 ± 1.1 | 0.001* |
| **VAS at 6 hours** | 2.4 ± 0.9 | 3.6 ± 1.2 | <0.001* |
| **VAS at 12 hours** | 2.1 ± 0.8 | 2.8 ± 1.0 | 0.003* |
| **VAS at 24 hours** | 1.5 ± 0.6 | 1.9 ± 0.8 | 0.02* |

** Statistically significant (p<0.05). Values expressed as mean ± SD. VAS = Visual Analogue Scale (0 = no pain, 10 = worst pain imaginable).*

**Table 4 – Detailed Explanation**

The Visual Analogue Scale (VAS) is a validated 10-cm linear scale used to quantify subjective pain intensity, where 0 denotes complete absence of pain and 10 represents the most severe pain imaginable. VAS scores were recorded at four time points: immediately after surgery (0 hours), 6 hours, 12 hours, and 24 hours postoperatively.

At 0 hours (immediately postoperative), VAS scores were significantly lower in the SA group (1.8 ± 0.7 vs 2.9 ± 1.1, p=0.001). This striking difference is explained by the residual intrathecal analgesia of hyperbaric bupivacaine combined with fentanyl, which provides dense sensory blockade well into the immediate postoperative period. GA patients, in contrast, awaken with no residual analgesic from their anaesthetic agents and experience peak postoperative pain coinciding with the end of surgery.

At 6 hours, the VAS scores remained significantly lower in Group I (2.4 ± 0.9 vs 3.6 ± 1.2, p<0.001). Though the spinal block has typically receded by this time, the intrathecal fentanyl component continues to provide analgesia through spinal cord opioid receptors, and the systemic opioid-sparing effect of the block reduces breakthrough pain. At 12 hours, Group I continued to exhibit significantly lower pain (2.1 ± 0.8 vs 2.8 ± 1.0, p=0.003).

At 24 hours, the pain scores converged but remained significantly different (1.5 ± 0.6 vs 1.9 ± 0.8, p=0.02). By this time, both groups were on a standardised oral analgesia regimen (paracetamol + ibuprofen). The sustained analgesic advantage of SA at 24 hours likely reflects reduced central sensitisation and opioid requirements during the first 12–18 postoperative hours, preventing the windup phenomenon. Overall, the VAS data strongly support the superior analgesic profile of spinal anaesthesia for laparoscopic appendicectomy across all measured time points.

**DISCUSSION**

This prospective randomised comparative study evaluates, for the first time in a North Bengal tertiary care setting, the clinical efficacy, feasibility, and safety of laparoscopic appendicectomy performed under spinal anaesthesia versus general anaesthesia in 63 patients. The results provide compelling evidence that SA is a viable and potentially superior anaesthetic choice in select patient populations [5].

The concern that laparoscopy requires GA is rooted in the physiological effects of pneumoperitoneum: $CO_2$-induced peritoneal irritation, diaphragmatic elevation, ventilation-perfusion mismatch, and decreased cardiac output due to elevated intra-abdominal pressure. However, with low-pressure $CO_2$ insufflation (10–12 mmHg), Trendelenburg positioning (which helps shift $CO_2$ away from the diaphragm in SA patients), and careful patient selection, many of these concerns are mitigated [6].

Our finding that surgery time did not significantly differ between groups (48.3 vs 46.1 min, p=0.29) is reassuring and suggests that the SA technique does not adversely affect the quality of the operative field or surgical performance. This

aligns with the findings of Tiwari et al. (2013), Hamad and El-Khattary (2003), and Karbhari et al. (2019) in similar comparative studies. The significantly longer total procedure time in Group I (68.7 vs 62.4 min, p=0.01) is attributable to pre-operative SA administration time and confirming block height—an expected trade-off[7].

The significantly shorter hospital stay in Group I (2.1 vs 2.8 days, p=0.001) is clinically important. Reduced hospital stay correlates with faster recovery of mobility, early oral intake, and lesser need for parenteral analgesics. This finding is consistent with Turan et al. (2010) and Savasli et al. (2021), who also reported shorter hospital stays after laparoscopic procedures under SA[8].

The significantly lower VAS pain scores in Group I at all time points (0h, 6h, 12h, 24h) is one of the most important findings of this study. The sustained analgesic effect of intrathecal bupivacaine plus fentanyl is well-established in the neuraxial anaesthesia literature. In the context of laparoscopic appendicectomy, this translates to reduced analgesic consumption, reduced opioid-related side effects, and faster mobilisation [9].

Anxiety was the only intra-operative adverse event to reach statistical significance (12.5% in Group I vs 0%, p=0.04). This is a recognised and inherent limitation of performing conscious laparoscopic surgery under regional anaesthesia. Pre-operative counselling, establishing rapport, judicious use of benzodiazepines, and maintaining a calm operating environment are critical in managing this. As surgical teams gain experience with SA laparoscopy, patient selection improves and anxiety rates typically decrease[10].

Hypotension was observed more frequently in SA patients (18.8% vs 9.7%) but was not statistically significant and responded well to fluid and vasopressor support. This is a well-documented pharmacological consequence of the sympatholytic effect of spinal block. With vigilant monitoring and proactive haemodynamic management, this adverse event is manageable and does not constitute a contraindication to SA for laparoscopy.

Postoperative nausea and vomiting was paradoxically higher in the GA group (19.4% vs 12.5%), reinforcing the known emetogenic effects of volatile anaesthetic agents, opioids used in GA induction, and nitrous oxide[11]. This is an important advantage of SA that is frequently underappreciated.

The higher (though not statistically significant) patient satisfaction in Group I (90.6% vs 74.2%, p=0.08) may reflect the cumulative effect of superior analgesia, shorter hospital stay, faster recovery, lower PONV rates, and the psychological reassurance of being awake during the procedure. The study may have been underpowered to detect a significant difference in this outcome; a larger sample size may reveal statistical significance [12-14].

From a resource utilisation perspective, SA offers cost advantages over GA in terms of reduced drug costs, lower requirement for ventilator support, shorter ICU observation time, and faster turnover. In tertiary care centres in North Bengal serving socioeconomically disadvantaged populations, these cost savings have direct implications for healthcare access and equity [15-17].

The limitations of this study include its single-centre design, relatively small sample size, and short follow-up period. The subjective nature of the VAS score introduces potential measurement bias. Furthermore, the conversion rate from SA to GA (3.1%) suggests that patient selection criteria need further refinement. Future multi-centre randomised controlled trials with larger sample sizes are warranted to validate these findings [18-21].

## CONCLUSION

This prospective randomised comparative study conducted at a tertiary care centre in South Bengal demonstrates that laparoscopic appendicectomy performed under spinal anaesthesia is clinically efficacious, technically feasible, and safe, with an acceptable adverse event profile. Compared to general anaesthesia, spinal anaesthesia offers significantly superior postoperative analgesia across all VAS measurement time points, significantly shorter hospital stays, comparable surgical complication rates, lower postoperative nausea and vomiting, and high patient satisfaction. Only statistically significant intra-operative adverse event in the SA group was anxiety, which is manageable with appropriate patient counselling and judicious sedation. The total procedure time was marginally longer in the SA group, reflecting the time required for block placement, but this did not translate into any clinical disadvantage. In the context of South Bengal's tertiary care setting, where resource optimisation is paramount, SA for laparoscopic appendicectomy represents a cost-effective, reproducible, and patient-friendly alternative to GA. We recommend its adoption as a primary anaesthetic strategy for appropriately selected patients (ASA I–II, BMI $\leq$ 30, cooperative and well-counselled), particularly in centres where GA resources are limited or where enhanced recovery protocols are being implemented.

Further large-scale, multi-centre randomised controlled trials are needed to definitively establish evidence-based guidelines for the routine use of spinal anaesthesia in laparoscopic appendicectomy.

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