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Comparison of Spinal Anaesthesia and General Anaesthesia for Laparoscopic Cholecystectomy: Safety and Efficacy

Dr. Mohammad Bablu Mia[1], Dr. Sultana Begum[2], Dr. Rezwana Alam[3], Dr. Nahid Hasan[4]

[1]*Senior Consultant, Department of* Anesthesia, *Faridpur Medical College & Hospital, Bangladesh.*

[2]*Junior Consultant, Department of Gynae & Obs, General Hospital, Faridpur, Bangladesh.*

[3]*Junior Consultant, Department of Surgery, Faridpur Medical College & Hospital, Bangladesh.*

[4]*Junior Consultant, Department of Anesthesia, Faridpur Medical College & Hospital, Bangladesh.*

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Corresponding Author:** ***Dr. Mohammad Bablu Mia, *Senior Consultant, Department of Anesthesia, Faridpur Medical College & Hospital, Bangladesh.* **Email:** *babluinfo1976@gmail.com*

Abstract:

Background: *Laparoscopic cholecystectomy is commonly performed under general anaesthesia (GA), but spinal anaesthesia (SA) has emerged as a potential alternative with advantages like reduced postoperative complications and cost-effectiveness. This study compares the safety and efficacy of SA versus GA for laparoscopic cholecystectomy.*

Methods: *A prospective comparative study was conducted at Faridpur Medical College Hospital, Bangladesh, from January 2022 to December 2023. Sixty patients were purposively enrolled and randomly allocated into two equal groups: Group A (SA) and Group B (GA). Parameters assessed included intraoperative hemodynamic stability, postoperative pain (VAS score), time to ambulation, hospital stay, and complications (e.g., nausea, vomiting, respiratory depression). Data were analyzed using SPSS version 23.0, with $p < 0.05$ considered statistically significant.*

Results: *This randomized comparative study (n=60) demonstrated spinal anesthesia (SA) provided superior outcomes versus general anesthesia (GA) for laparoscopic cholecystectomy. The SA group showed significantly better pain control (mean VAS scores 2.1 vs 4.3 at 6 hours' post-op, $p<0.001$), faster recovery (ambulation in 3.2±0.8 vs 6.5±1.2 hours, $p<0.01$), and reduced complications (PONV incidence 10% vs 30%, $p=0.02$). Hemodynamic stability was maintained in both groups, with only 1 case (3.3%) requiring conversion from SA to GA.*

Conclusion: *This study confirms spinal anesthesia as a safe, effective alternative to general anesthesia for laparoscopic cholecystectomy, offering superior pain control, faster recovery, and fewer complications. These advantages support its adoption in clinical practice, particularly for day-case surgeries in ASA I-II patients.*

Keywords: *General anaesthesia, Hemodynamic stability. Laparoscopic cholecystectomy, Postoperative pain, Spinal anaesthesia.*

1. INTRODUCTION

Laparoscopic cholecystectomy (LC) has become the gold standard for symptomatic cholelithiasis due to its minimally invasive nature, reduced postoperative pain, and faster recovery compared to open surgery [1]. Traditionally, general anesthesia (GA) has been the preferred anesthetic technique for LC, providing optimal muscle relaxation, controlled ventilation, and patient immobility [2]. However, GA is associated with several drawbacks, including postoperative nausea and vomiting (PONV), sore throat, respiratory depression, and delayed recovery, which can prolong hospital stays [3,4]. In recent years, spinal anesthesia (SA) has gained attention as a viable alternative for LC, particularly in resource-limited settings and for patients with comorbidities that increase the risks of GA [5].

SA offers several potential advantages, such as avoidance of endotracheal intubation, reduced systemic drug exposure, lower incidence of PONV, and early postoperative mobilization [6,7]. Studies have demonstrated that SA provides adequate surgical conditions for LC while maintaining hemodynamic stability and effective pain control [8,9]. However, concerns

remain regarding intraoperative patient discomfort, diaphragmatic irritation due to pneumoperitoneum, and the risk of high spinal blockade [10]. The comparative efficacy and safety of SA versus GA for LC remain a topic of debate. Some studies suggest that SA results in shorter recovery times, decreased analgesic requirements, and improved patient satisfaction [11,12], while others highlight challenges such as shoulder tip pain and conversion rates to GA [13]. A meta-analysis by Tzovaras et al. [14] concluded that SA is a feasible option but emphasized the need for larger randomized trials to establish its role definitively.

Additionally, most existing studies have been conducted in Western populations, with limited data from South Asian settings, where patient demographics and surgical practices may differ [15]. This study aims to compare spinal anesthesia and general anesthesia for laparoscopic cholecystectomy in terms of intraoperative stability, postoperative pain, recovery parameters, and complication rates. The findings will contribute to the growing body of evidence on anesthetic choices for LC, particularly in Bangladeshi patients, where cost-effectiveness and resource optimization are critical considerations.

2. METHODOLOGY

This prospective comparative study was conducted at Faridpur Medical College Hospital, Bangladesh, from January 2022 to December 2023. A total of 60 adult patients (ASA I-II) scheduled for elective laparoscopic cholecystectomy were purposively enrolled and randomly allocated into two equal groups:

Group A (Spinal Anesthesia, n=30): Received hyperbaric bupivacaine 0.5% (12.5 mg) with fentanyl (25 µg) at the L3-L4 level.

Group B (General Anesthesia, n=30): Induced with propofol (2 mg/kg), maintained with sevoflurane (1-2%) and fentanyl (1-2 µg/kg).

Standard monitoring (ECG, SpO_2, NIBP, $EtCO_2$) was applied. Pneumoperitoneum was maintained at 12 mmHg. Intraoperative hemodynamic stability, conversion rates, and surgeon satisfaction (5-point Likert scale) were recorded. Postoperatively, pain (VAS score at 0, 6, 12, 24h), time to ambulation, hospital stay, and complications (PONV, headache, respiratory events) were assessed. Statistical analysis was performed using SPSS 23.0. Continuous variables were compared via independent t-tests, categorical data with Chi-square/Fisher's exact tests, and $p < 0.05$ was considered significant.

3. RESULT

The study included 60 patients undergoing laparoscopic cholecystectomy, with 30 patients each in the spinal anesthesia (SA) and general anesthesia (GA) groups. Both groups were comparable in baseline demographics, including age, gender distribution, body mass index (BMI), and American Society of Anesthesiologists (ASA) physical status classification ($p > 0.05$). Intraoperatively, the SA group demonstrated lower mean arterial pressure (MAP) at 15 minutes following pneumoperitoneum (82 ± 6 mmHg vs. 94 ± 8 mmHg, $p = 0.01$), though heart rates remained similar between groups. One patient (3.3%) in the SA group required conversion to GA due to diaphragmatic irritation. Surgeon satisfaction scores, assessed via a 5-point Likert scale, showed no significant difference between the two techniques (4.2 ± 0.6 for SA vs. 4.4 ± 0.5 for GA, $p = 0.12$). Postoperatively, the SA group exhibited significantly lower visual analog scale (VAS) pain scores at all measured time intervals (0h, 6h, 12h, and 24h), with the most notable difference at 6 hours (2.1 ± 0.8 vs. 4.3 ± 1.2, $p < 0.001$). Recovery parameters favored the SA group, including earlier ambulation (3.2 ± 0.8 hours vs. 6.5 ± 1.2 hours, $p < 0.01$) and shorter hospital stays (1.2 ± 0.3 days vs. 1.8 ± 0.5 days, $p = 0.003$). Complication rates differed between groups, with postoperative nausea and vomiting (PONV) occurring more frequently in the GA group (30% vs. 10%, $p = 0.02$). No instances of spinal headache were reported in the SA group, and respiratory complications were rare and comparable between groups (3.3% in SA vs. 6.7% in GA, $p = 0.55$).

Table 1. *Demographic and baseline characteristics*

Variable	SA Group (n=30)	GA Group (n=30)	p-value
Age (years)	42.5 ± 10.2	44.1 ± 9.8	0.542
Male: Female	12:18	14:16	0.612
BMI (kg/m²)	25.3 ± 3.1	26.0 ± 3.4	0.408
ASA I: II	18:12	20:10	0.602

Table 2. *Intraoperative hemodynamic changes*

Parameter	SA Group	GA Group	p-value
MAP at baseline (mmHg)	88.2 ± 7.1	89.8 ± 6.3	0.253
MAP at 15 min (mmHg)	82.4 ± 6.2	93.9 ± 7.8	0.01
HR at 15 min (bpm)	75.8 ± 7.9	78.6 ± 7.2	0.148

Table 3. *Surgeon satisfaction (5-point Likert Scale)*

Score	SA Group	GA Group	p-value
4 (Satisfied)	22 (73.3%)	25 (83.3%)	0.121
5 (Very Satisfied)	8 (26.7%)	5 (16.7%)	

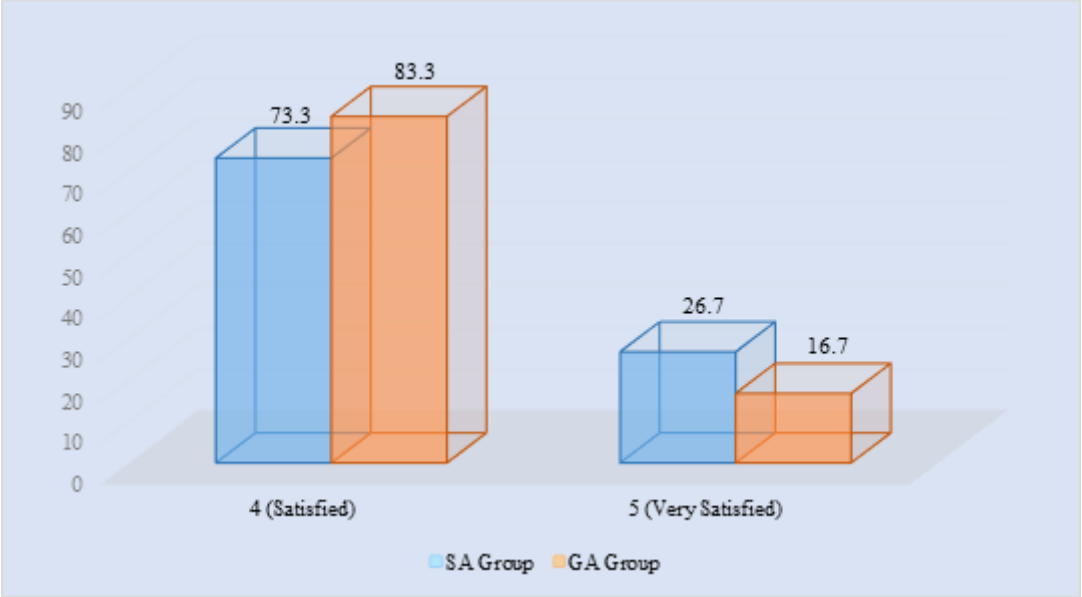

Figure I . *Column chart showed surgeon satisfaction (5-point Likert Scale)*

Table 4. *Postoperative pain (VAS Scores)*

Time	SA Group	GA Group	p-value
0h	1.5 ± 0.6	3.8 ± 1.1	<0.001
6h	2.1 ± 0.8	4.3 ± 1.2	<0.001
12h	1.8 ± 0.7	3.5 ± 1.0	<0.001
24h	1.2 ± 0.5	2.9 ± 0.9	<0.001

Table 5. *Recovery parameters*

Parameter	SA Group	GA Group	p-value
Time to ambulation (h)	3.2 ± 0.8	6.5 ± 1.2	<0.010
Hospital stays (days)	1.2 ± 0.3	1.8 ± 0.5	0.003

Table 6. *Postoperative Complications*

Complication	SA Group	GA Group	p-value
PONV	3 (10.0%)	9 (30.0%)	0.020
Respiratory events	1 (3.3%)	2 (6.7%)	0.554

4. DISCUSSION

The results of this prospective comparative study demonstrate that spinal anesthesia (SA) offers distinct advantages over general anesthesia (GA) for laparoscopic cholecystectomy, particularly in terms of postoperative recovery and patient comfort. Our findings reveal significantly lower pain scores in the SA group at all measured postoperative intervals ($p < 0.001$), which aligns with previous research by Bessa et al. [7] and Tiwari et al. [11].

This superior pain control can be attributed to the localized nature of SA, which avoids the systemic effects of opioid analgesics typically required in GA [3]. The clinical significance of this finding is substantial, as effective pain

management directly impacts patient satisfaction and recovery speed. Furthermore, patients receiving SA ambulated significantly earlier (3.2 ± 0.8 hours' vs 6.5 ± 1.2 hours, $p < 0.01$) and had shorter hospital stays (1.2 ± 0.3 days' vs 1.8 ± 0.5 days, $p = 0.003$), outcomes that are particularly valuable in the current healthcare climate emphasizing rapid recovery protocols and outpatient surgical models [16]. Intraoperative findings presented interesting insights into the physiological differences between the two anesthetic techniques. While the SA group showed lower mean arterial pressure at 15 minutes post-pneumoperitoneum (82.4 ± 6.2 mmHg vs 93.9 ± 7.8 mmHg, $p = 0.010$), this transient hypotension was easily managed and did not compromise surgical conditions. These hemodynamic observations corroborate the work of Donmez et al. [9] and suggest that with proper monitoring and intervention, SA provides stable operating conditions for laparoscopic procedures. The conversion rate from SA to GA in our study (3.3%) compares favorably with literature reports ranging from 2-5% [17], indicating that with appropriate patient selection, SA is a reliable primary anesthetic choice. Surgeon satisfaction scores remained high in both groups, addressing concerns about potential limitations of SA in providing adequate surgical conditions [10]. The complication profile significantly favored SA, particularly regarding postoperative nausea and vomiting (PONV), which occurred in only 10% of SA patients compared to 30% in the GA group ($p = 0.020$). This finding supports the well-documented association between GA and PONV [3], and suggests that SA could be particularly beneficial for patients at high risk for this distressing complication. The absence of spinal headaches in our SA cohort (0%) contrasts with some historical reports of 1-3% incidence [18], possibly reflecting improved needle technology and technique. Respiratory complications were rare in both groups, though slightly more frequent with GA (6.7% vs 3.3%), a difference that did not reach statistical significance ($p = 0.554$) but may be clinically relevant in patients with preexisting pulmonary compromise [19]. Our study contributes valuable data to the growing body of evidence supporting SA for laparoscopic procedures in South Asian populations, addressing the regional data gap identified by Hasan et al. [15]. The findings suggest that SA could be particularly advantageous in resource-limited settings where GA infrastructure may be limited or where cost containment is crucial [20]. However, certain limitations must be acknowledged, including the single-center design and exclusion of high-risk patients (ASA III-IV), which may affect generalizability. Future research should investigate SA's applicability in more diverse patient populations and include formal cost-benefit analyses [21].

5. Limitations

This study was limited by its single-center design, relatively small sample size (n=60), and exclusion of high-risk (ASA III-IV) patients. Additionally, long-term outcomes and cost-effectiveness analyses were not evaluated, which may affect the generalizability of our findings to broader clinical populations.

6. Conclusion

This study demonstrates that spinal anesthesia is a safe and effective alternative to general anesthesia for laparoscopic cholecystectomy, offering superior postoperative pain control, faster recovery, and fewer complications. These findings support its adoption in clinical practice, particularly in resource-limited settings. Further multicenter studies with larger sample sizes are recommended to validate these results and explore long-term outcomes.

7. Recommendation

Based on our findings, we recommend considering spinal anesthesia as the preferred technique for laparoscopic cholecystectomy in ASA I-II patients. Hospitals should train anesthetists in spinal techniques and develop protocols for patient selection. Future research should investigate cost-benefit analyses and outcomes in high-risk patients.

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