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# Safety and Feasibility of SAB in Otherwise Healthy Individuals Undergoing Laparoscopic Cholecystectomy

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## Abstract

***Background*:** The safety and feasibility of utilizing SAB as the sole anesthetic technique in otherwise healthy individuals undergoing laparoscopic cholecystectomy have been increasingly recognized. SAB offers potential advantages in terms of reduced complications, improved pain control, and avoidance of general anesthesia-related risks. ***Objective*:** To assess safety and feasibility of SAB in otherwise healthy individuals undergoing laparoscopic cholecystectomy. ***Method*:** The study included a cohort of 40 patients who underwent elective laparoscopic cholecystectomy and met specific inclusion criteria. All patients received a subarachnoid block (SAB) with 3 ml of 0.5% bupivacaine and 25 micrograms of fentanyl at the L2-L3 level. The laparoscopic cholecystectomy procedure was performed using a standard 4-port technique, while maintaining a low intra-abdominal pressure of 9-10 mm Hg through CO2 pneumoperitoneum. The patients were followed up at various time points, including 30 minutes, 4 hours, the time of discharge, and on the 7th day after the operation. Any voluntary or involuntary movements or exaggerated diaphragmatic excursions during the operation were carefully monitored. The study recorded parameters such as operation time, duration of operating room occupancy, length of hospital stay, post-operative pain levels, analgesic requirements, occurrences of nausea, vomiting, headache, right shoulder pain, wound-related complications, and patient satisfaction. ***Results*:** SAB demonstrated efficacy in all 40 patients undergoing surgery. Conversion to general anesthesia was required in two cases due to persisting low oxygen saturation. Hypotension occurred in 23.7% of patients, while 10.5% experienced right shoulder pain. The average operating time was 37.3 minutes, ranging from 21 to 77 minutes. Awkward movements and exaggerated respiratory excursions were observed in 23.7% and 18.4% of cases, respectively. Only two cases required conversion to general anesthesia. The mean hospital stay duration was 29.3 hours. No major complications were reported during the study. ***Conclusion*:** These findings suggest that SAB can be successfully and effectively used for laparoscopic cholecystectomy in healthy patients, providing a safe alternative to general anesthesia.

**Keywords:** SAB, Healthy Individuals, Laparoscopic Cholecystectomy.



## INTRODUCTION

Laparoscopic cholecystectomy, a minimally invasive surgical procedure for gallbladder removal, has become the preferred approach for managing gallbladder diseases. Traditionally performed under general anesthesia, laparoscopic cholecystectomy has shown excellent outcomes in terms of postoperative pain control, faster recovery, and shorter hospital stays. However, concerns regarding the potential risks associated with general anesthesia have led to a growing interest in exploring alternative anesthetic techniques for this procedure. One such technique is spinal anesthesia, also known as subarachnoid block (SAB). [1- 3].

Subarachnoid block involves the injection of anesthetic medication into the subarachnoid space, providing regional anesthesia and sensory blockade in the lower part of the body. In recent years, the safety and feasibility of utilizing SAB as the sole anesthetic technique in otherwise healthy individuals undergoing laparoscopic cholecystectomy have been investigated. This approach offers several potential advantages, including reduced systemic exposure to anesthetic drugs, avoidance of complications associated with general anesthesia, and improved postoperative pain control. [4- 7].

Several studies have examined the safety of SAB in laparoscopic cholecystectomy and have consistently reported positive outcomes. These studies have shown that SAB is associated with a lower incidence of complications compared to general anesthesia, such as fewer incidences of postoperative nausea and vomiting, reduced risk of airway-related complications, and decreased incidence of systemic drug-related side effects. Furthermore, the use of SAB allows patients to remain conscious during the procedure, enabling better communication with the surgical team and potentially reducing the risk of postoperative confusion or cognitive disturbances.

Feasibility is another crucial aspect to consider when evaluating the use of SAB in laparoscopic cholecystectomy. The procedure requires a specialized skill set and expertise from the anesthesiologist to ensure accurate needle placement, appropriate dosing of the anesthetic medication, and optimal pain control. However, with proper training and experience, SAB can be successfully performed, offering a viable alternative to general anesthesia for this specific surgical procedure. [8- 11]

In addition to safety and feasibility, postoperative pain control is a significant concern in laparoscopic cholecystectomy. Adequate pain management is crucial for patients' comfort and satisfaction, as well as for facilitating early mobilization and recovery. Several studies comparing SAB to general anesthesia have demonstrated superior pain control with SAB, both during the immediate postoperative period and throughout the hospital stay. This may be attributed to the direct blockade of pain signals at the spinal level, leading to better analgesia and reduced reliance on opioids.

While SAB in laparoscopic cholecystectomy appears promising, it is essential to consider individual patient factors, including comorbidities, anatomical considerations, and patient preferences, when determining the most appropriate anesthetic approach. Furthermore, the expertise and experience of the surgical and anesthesia teams play a crucial role in ensuring successful outcomes with SAB.

## OBJECTIVE

To assess safety and feasibility of SAB in otherwise healthy individuals undergoing laparoscopic cholecystectomy.

## METHODOLOGY

Forty patients were selected prospectively from the patients with gallstone disease who opted for laparoscopic cholecystectomy. After obtaining written informed consent, patients were enrolled in the study. The study was conducted in Tertiary Hospital, Dhaka from May 2017 to October 2018. Patient aged 20-65 years, having BMI <25kg/m2, normal coagulation profile and fulfilled the American Society of Anesthesiologists (ASA) physical status classification I and II were included in the study. Patients with recent history of jaundice, previous history suggestive of cholangitis or bile duct stone, acute cholecystitis, history of previous upper abdominal operations, ultrasonography features of edematous/thick 3+mm gallbladder wall and suspected gallbladder malignancy were excluded from the study. Patients having contraindication for SAB were exempted as well. All patients were kept overnight fasting and preloaded with intravenous (IV) fluid. Under full aseptic precaution standard spinal puncture was done with 25G spinal needle in L2-L3 intervertebral space in sitting position. Three milliliter of 0.5% bupivacaine + 25 microgram fentanyl was injected after confirming free flow of CSF. Head was tilted down to 10 degrees and was kept for 6 to 8 minutes to achieve desirable segmental block at T4–T5 level. Anesthesia level was checked with pin prick sensation. After adequate block the patient was sedated with 25 mg pethidine and 0.5 mg/kg ketamine in IV route. Standard pulse-oximeter was used for monitoring pulse and oxygen saturation. CO2 pneumoperitoneum was done and intra-abdominal pressure was kept at 9-10 mm Hg. The patient was positioned to reverse Trendelenburg position with left lateral tilt. Blood pressure was monitored manually at five minutes interval. Any hypotension was managed with extra IV fluid infusion. Injection ephedrine (5 mg), single dose, per-operatively, was given intravenously in patients with systolic blood pressure falling more than 20 mm of Hg from baseline value even after adequate intravenous fluid infusion. The surgeons were prepared to ask for general anesthesia if they felt that the anesthetic technique was causing technical difficulty of the procedure. Laparoscopic cholecystectomy was done by standard four port technique. After pericholecystic adhesiolysis (if any) Callot’s triangle was dissected and cystic duct and artery were identified and skeletonized. Both the structures were clipped separately and then divided. Gall bladder was then dissected free off the under surface of liver. Hemostasis was ensured and gall bladder delivered through umbilical port which was then closed in layers. Local anesthetic xylocaine 2% was injected in all port sites.

Any unwanted voluntary or involuntary movement or exaggerated diaphragmatic excursion from too rapid/ heightened respiration that impeded surgeon's work was monitored. Operation time, operating room (OR) occupancy time, hospital stay, post-operative pain and analgesic requirement, nausea and vomiting, headache, right shoulder pain, wound-related complications and patient satisfaction were noted. They were followed up at 30 minutes, 4 hours, at the time of discharge and on day 7 after operation. The patients were allowed to leave hospital once they passed urine, could comfortably move, had tolerated oral feeding and had been assessed by the surgeon as being free from any complications.

Pain perception was assessed by verbal rating score (VRS). Patient satisfaction level was determined based upon parameters like management of pain and postoperative nausea vomiting (PONV), quality of life and fulfillment of their expectation on quality of care by the health service providers.

## RESULTS

In table-1 shows base line characters of the patients. The mean age of the study population was 37.2 years while the range was from 20 to 65 years. Fourteen (35.0%) patients were male and 26 (65.0%) were female. Mean body mass index was 22.9 kg/ $m^2$ (range 19.3-24.7 kg/ $m^2$). Out of 40 cases, 13 (32.5%) had diabetes mellitus.

**Table-1: Baseline characteristics of the study population.**

| Parameter | Values |
|---|---|
| Total no of patients | 40 |
| Age in yrs (Mean, range) | 37.2 (20 - 65) |
| Sex (Male : Female) | 1 : 1.86 |
| BMI kg/$m^2$ (Mean, range) | 22.9, (19.3 - 24.7) |
| Number of cases having | |
| COPD | 3 (7.5%) |
| Hypertension | 7 (17.5%) |
| Diabetes mellitus | 13 (32.5%) |

Table-2 shows Details of SAB and clinical conditions of the cases during operation (n=38). Two patients had to undergo general anesthesia later due to persistent low oxygen saturation possibly due to adverse effect of sedative drugs. So ultimately, laparoscopic cholecystectomy under spinal anesthesia was completed in 38 patients. Blood pressure was maintained at normal range in 29 cases, but nine patients developed hypotensive episodes. Six patients were managed with additional IV fluid alone. Three patients needed injection ephedrine 5 mg, intravenously, single dose per-operatively along with IV fluid. Oxygen saturation was maintained in all cases around 98% with oxygen supplementation through nasal catheter if necessary. Operations were performed using low pressure pneumoperitoneum (9-10 mm Hg) to avoid excess stretching of the diaphragm and to lower the complications rate of hypercarbia. In spite of low-pressure pneumoperitoneum, we did not have any space constraint or any gastric distension as well. However, two conditions namely - awkward movement in 9 patients and exaggerated respiratory motion in 7 cases were encountered that made the operative field unsteady for a brief period of time.

**Table-2: Details of SAB and clinical conditions of the cases during operation (n=38).**

| Parameter | Values |
|---|---|
| Conversion from spinal to GA | 2 (5.0%) |
| Sensory loss (upper level)<br>T4 dermatome<br>T5 dermatome | <br>8 (21%)<br>30 (79%) |
| Intra-abdominal pressure | 9-10 mm of Hg |
| Oxygen saturation (Mean; range) | 97.6%; 96-97% |
| Respiratory rate/minute | |
| Before pneumoperitoneum (Mean; range) | 15.3; 14-17 |
| During pneumoperitoneum (mean; range) | 22.6; 16-34 |
| Cases with hypotension: SBP fall ≥ 20 mm Hg | 9 (23.7 %) |
| Number of cases managed by IV fluid only<br>IV fluid + inj. Ephedrine | 6 (15.8%)<br>3 (7.9%) |
| Number of cases with:<br>Awkward movement<br>Exaggerated respiratory movement | <br>9 (23.7%)<br>7 (18.4%) |

**Note:** *No cases had gastric distension requiring Ryle's tube or had inadequate intra-abdominal space/ access.*

Table-3 shows Operation details of cases by laparoscopic cholecystectomy under SAB (n=38). The duration of operations (skin incision to skin closure) was 21 to 77 minutes (mean 37.3 min). In three patients, wall of gallbladder was perforated during dissection. Saline irrigation and aspiration of the sub-hepatic space was done for bile spillage. In one case, stones were spilled out during dissection which was retrieved in an endobag.

**Table- 3: Operation details of Cases by laparoscopic cholecystectomy under SAB (n=38).**

| Parameters | Values |
|---|---|
| Cases converted to open cholecystectomy | 0 |
| Operating time (minutes) (mean and range)<br>OR occupancy (minutes) (mean and range) | 37.3; 21-77<br>45.6; 30-89 |
| Adhesions (gallbladder) | 10 (26.3%) |
| Gallbladder perforations during dissection | 3 (7.9%) |
| Gallstone spillage | 1 (2.6%) |
| Gut injuries | 0 |
| Bile duct injuries | 0 |

In table-4 shows Conditions of the patients observed during follow up at different time intervals (n=38). All patients were followed up at 30 minutes, at 4 hours, at the time of discharge and on the 7th day after operation. Almost all patients were hemodynamically stable and maintained full O2 saturation (98.2, 97-99%) in the early post-operative period. Incidence of nausea, vomiting and headache was very low. Only two patients complained of post-spinal headache, especially where first spinal puncture was unsuccessful. Only one patient developed nausea and vomiting. No patient required injectable analgesic for surgical site pain within 4 hours. Four patients complained of right shoulder tip pain which was severe in one case. Those patients were managed by continuous finger massaging by a nurse over the right shoulder area of the patients. All patients tolerated oral feeding at 6 hours and most of them were discharged from the hospital within 24 hours of operation after assessing them to be free from complication. Mild purulent discharge from umbilical wound was noted in two cases on first follow-up. The wounds healed up spontaneously on dressing. All the patients were satisfied with results of operations.

**Table-4: Conditions of the patients observed during follow up at different time intervals (n=38).**

| Conditions observed during follow up | Number (%) |
|---|---|
| **At 30 minutes** | |
| Hypotension | 2 (5.3%) |
| (SBP fall ≥ 20 mm of Hg) Nausea/ vomiting | 1 (2.6%) |
| Post-spinal headache Right Shoulder pain | 2 (5.3%) |
| Surgical site pain requiring injectable analgesic | 4 (10.5%) |
| **At 4 hours** | |
| Post-spinal headache Nausea/ vomiting | 01(2.6%) |
| Surgical site pain requiring injectable analgesic | 0 |
| Right shoulder pain | 0 |
| | 0 |
| **At discharge** | |
| Bile | 0 |
| leakage | 0 |
| Jaundice Peritonitis | 0 |
| Patient satisfaction | 25 (65.8%) |
| Highly satisfied Satisfied | 13 (34.2%) |
| Not satisfied | 0 |
| Hospital stay in hrs (mean; range) | 29.3; 21-53 |
| **At day 7 follow up** | |
| Port site infection (Umbilical) Bile | 2 (5.3%) |
| leakage | 0 |
| Jaundice | 0 |
| Peritonitis | 0 |

## DISCUSSION

Laparoscopic cholecystectomy is the gold standard for the treatment of uncomplicated symptomatic cholelithiasis. General anesthesia is regarded as safe and most widely practiced anesthesia for laparoscopic surgery in almost all of these cases. Regional anesthesia was seldom used in abdominal laparoscopic surgery except for diagnostic procedures [5]. The prime indication for using regional anesthesia in therapeutic laparoscopy is still limited. The preferred type of regional anesthesia is epidural anesthesia [1]. Thus, reports of laparoscopic cholecystectomy using subarachnoid block are limited [2- 6]. Single puncture SAB is an easier and more cost effective technique than general anesthesia [7]. Complication of endotracheal intubations such as damage to oral cavity, teeth, sore throat, aspirations, failure of intubations, gastric distension are absent in spinal anesthesia. Therefore, monitoring of patients under SAB is relatively easy compared to general anesthesia. Nausea and vomiting are less with SAB [8]. Laparoscopic cholecystectomy with low-pressure pneumoperitoneum under SAB is effective in patients with COPD, who are unsuitable for GA [9, 10].

Using low pressure (9-10 mm Hg) CO2 pneumoperitoneum during SAB for laparoscopic cholecystectomy have been reported to reduce the abdominal discomfort and chances of neck and right shoulder pain [11]. In our cases, operation was performed at an average pressure of 9-10 mm Hg using CO2 and no changes were necessary in port placement. Pursnani *et al.,* reported shoulder and neck pain in 2 out of 6 patients operated under SAB [10]. Surprisingly, right shoulder pain had never been a major problem in the present study. It occurred only in 10.5% patients and was managed by shoulder massage. In a study of 310 laparoscopic

cholecystectomy cases performed under spinal anesthesia, only one patient needed conversion to GA because of intolerable shoulder pain [2]. Reason for conversion in both the cases of our study was persistence of low SPO2 (below 90%) Hypotension is a problem of SAB, which can be overcome by preloading with fluids [12]. In addition to spinal anesthesia related hypotension, the pneumoperitoneum induced rise in intra-abdominal pressure could be another cause for persistence of hypotension. In spinal anesthesia, hypotension was reported in 5.4% to 20.2% cases [13-15] compared to 23.7% cases in the present study. Lowering of head end of table after Callots' triangle dissection, elevation of foot end of the table during repair of the ports and during postoperative period, as well as low pressure CO2 pneumoperitoneum prevent fall of blood pressure. An added advantage cited was the decrease in surgical bed oozing because of hypotension and Hypotension is a problem of SAB, which can be overcome by preloading with fluids [12]. In addition to spinal anesthesia related hypotension, the pneumoperitoneum induced rise in intra-abdominal pressure could be another cause for persistence of hypotension. In spinal anesthesia, hypotension was reported in 5.4% to 20.2% cases [13-15] compared to 23.7% cases in the present study. Lowering of head end of table after Callots' triangle dissection, elevation of foot end of the table during repair of the ports and during postoperative period, as well as low pressure CO2 pneumoperitoneum prevent fall of blood pressure. An added advantage cited was the decrease in surgical bed oozing because of hypotension and bradycardia associated with spinal aesthesia [16]. On the contrary, laparoscopic surgery under general anesthesia is associated with hypertensive episodes which may augment bleeding during dissection causing operation difficult and lengthy; but under spinal anesthesia, there were no such episodes of hypertension in any patient. The status of respiratory parameters during laparoscopic cholecystectomy done under SAB should be taken into consideration. In this context it can be stated that spontaneous physiological respiration during SAB would always be better than artificial respiration as in general anesthesia. Intubation related morbidity and mortality can be avoided and is one of the most beneficial effects of SAB particularly in patients with poor respiratory reserve [5]. Pulmonary function takes 24 hours to return to normal after laparoscopic surgery performed under general anesthesia [11].

A specific advantage of SAB is less requirement of analgesic during early post-operative period. In a comparative study between SAB versus GA for laparoscopic cholecystectomy, MM Islam *et al.*, [5] reported only 10% patients in the SAB group required injectable analgesic against 90% in the GA group. This was consistent with the findings in our study as none of our patients needed injectable analgesic during first 4 post-operative hours. The problem of PONV was much less (3.3% in SAB group vs 20% in GA group) in the same study which was also supported by our study (only 2.6% patients).

During the present study, two issues drew our attention from surgeon's point of view that was linked to technical aspect of laparoscopic cholecystectomy under SAB. The surgeon may have to pause for a while during any awkward movement of the patient's body involving upper extremity and/ or trunk that we came across in nine cases. Also, the surgeon may have to adjust for the heightened or faster diaphragmatic respiratory excursion that we encountered in seven patients. However, an experienced and competent surgeon can accommodate these events very well. Secure strapping of the patient and smooth, adequate sedation would help in this regard. Although intra-abdominal space was relatively less (9-10 mm Hg compared to standard 12 mm Hg), it did not hamper any aspects of surgical maneuver.

The time from application of anesthesia to wheeling the patient out of the operating room actually decreases when the patient is being operated under SAB as the time for intubation and extubation is saved [5]. SAB appears to be economical as it involves less medicine, decreased operation theater occupancy time, faster recovery and shorter hospital stay.

## CONCLUSION

These findings suggest that SAB can be successfully and effectively used for laparoscopic cholecystectomy in healthy patients, providing a safe alternative to general anesthesia.

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