Laparoscopic appendicectomy under spinal anesthesia, a cost effective and efficient approach, a prospective study

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ABSTRACT

Background: Laparoscopic appendicectomy (LA) is widely accepted as the standard treatment for acute appendicitis and is conventionally performed under general anaesthesia. However, spinal anaesthesia (SA) has emerged as a potential alternative, particularly in resource-limited settings. This study aimed to assess the feasibility, safety, and cost-effectiveness of LA performed under spinal anaesthesia. **Methods & Materials:** This prospective study was conducted at Brahmanbaria Medical College Hospital from February 2022 to June 2024. A total of 188 patients (108 females, 80 males) aged 12-45 years with ASA grade I-II and clinically diagnosed acute appendicitis were included. All patients underwent laparoscopic appendicectomy under spinal anaesthesia. Patients with complicated appendicitis or contraindications to spinal anaesthesia were excluded. Data regarding operative time, intraoperative and postoperative events, pain scores, and hospital stay were analyzed. **Results:** The mean age was 25.5 ± 9.25 years, and the mean BMI was 22.55 ± 4.05 kg/m². The mean operative time was 22.8 ± 10.5 minutes, with a total procedure time of 52.1 ± 16.2 minutes. Median hospital stay was 2 days. Intraoperative events included shoulder pain (27.12%), abdominal discomfort (18.61%), anxiety (14.89%), nausea/vomiting (15.42%), and hypotension (9.57%), with no respiratory complications or bradycardia. Postoperative complications were mild, including nausea/vomiting (13.82%), shoulder pain (10.63%), and headache (6.38%), with no urinary retention or wound infections. Pain scores were minimal at 1 hour, peaked at 6 hours, and gradually declined thereafter. All patients reported good satisfaction and favourable cosmetic outcomes. **Conclusion:** Laparoscopic appendicectomy under spinal anaesthesia is a safe, effective, and economical alternative to general anaesthesia, offering low complication rates, rapid recovery, and significant cost savings.

Keywords: *Laparoscopic appendicectomy, Spinal Anaesthesia, Acute Appendicitis, Regional Anaesthesia*

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INTRODUCTION

Laparoscopic appendicectomy (LA) is the most commonly performed intra-abdominal operation. Sem first introduced the laparoscopic method for appendicectomy in the early 1980s [1]. Since then, laparoscopic appendicectomy was made popular by various surgeons and preferred over the open method due to its inherent advantages [2]. Acute appendicitis is one of the most common abdominal emergencies and therefore appendectomy is one of the most common operations [3,4]. With the recent progress in laparoscopic surgical techniques, today most appendectomies are performed laparoscopically [5]. Laparoscopic appendectomy (LA) has advantages over open appendectomy, like less postoperative pain, fewer surgical site infections, shorter hospital stays, shorter recovery periods for daily life activities, better cosmetic results, and fewer complications [6,7]. General anesthesia with positive pressure ventilation is the preferred mode of anesthesia in this technique. Regional anesthesia has not been used as the sole anesthetic procedure other than in the scenario of a patient at high risk to undergo laparoscopic appendicectomy with CO_2 pneumoperitoneum under general anesthesia. Various study already established the feasibility and safety of spinal anaesthesia for laparoscopic surgery [8,9]. Although many studies show the success of regional anesthesia in laparoscopic cholecystectomy and inguinal hernia repair operations, only a handful of studies examined the use of regional anesthesia in LA [10,11]. The aim of our study is to evaluate the feasibility and safety of spinal anesthesia for laparoscopic appendicectomy and also find out the cost-effectiveness which can help our marginalized population. The aim of this study is to evaluate the feasibility, safety, and cost-effectiveness of performing laparoscopic appendicectomy under spinal anesthesia.

METHODS & MATERIALS

The study was conducted at BrahmanBaria Medical College Hospital from February 2022 to June 2024. It was carried out

according to the approval of the Hospital Ethics Committee. We conducted a prospective study over a 28 months period where LA was performed on 188 patients (108 female and 80 male) of ASA grade I or II, who presented with acute appendicitis [12]. Inclusion criteria included - pain in the right iliac fossa, shifting of periumbilical pain to right iliac fossa, muscle guarding, tenderness at McBurney's point, vomiting, fever, leukocytosis, and age more than 12 years and clinical scores for diagnosing Acute Appendicitis by Alvarado score [13,14]. All the patients had a routine blood test, and a sonographic examination. Patients with generalized peritonitis, appendicular abscess or perforation, and a palpable mass, any cause of contraindication for spinal anesthesia or pneumoperitoneum, lack of cooperation, psychiatric disease, bleeding disorders, known sensibility to local or narcotic analgesics, being younger than 12 or older than 45 years of age, infection at spinal anesthesia injection site, spinal deformity or severe back pain, history of bradyarrhythmia, obesity (body mass index > 30 kg/m^2), other major systemic illness like uncontrolled diabetes or uncontrolled hypertension, history of allergy or hypersensitivity to local anesthetics, a history of abdominal surgery, or pregnancy. were excluded from the study. The patients who need to convert the procedure to open appendicectomy were excluded from the study. All patients were informed about spinal anesthesia in detail. Data were analyzed using SPSS version 26.

RESULTS

The study found that, the mean age of patients was 25.5 years ranging from 12 to 45 years, with a mean BMI of 22.55 kg/m2 ranging from 16.60 to 29.00 kg/m2 (Table I). The mean age of study population is 25.5±9.25 indicating a young adult population with moderate variability in age. The male female ratio 80:108. Mean body mass index was 22.55±4.05. Mean surgery time 22.80 minutes' ±10.50 seconds. Moreover, mean total surgery time 52.10 minutes' ±16.50 seconds. Mean hospital stay was 2±1 suggesting that the procedure required a short hospitalization. The distribution of maximal sensorial block (MSB) heights, presented as dermatomal levels, was, T2: 24 (12.76%) patients, T3: 143 (76.06) patients, T4: 21 (11.17%) patients (*Table I*).

Table I
Characteristics of the patients and procedure related times (*n* = 188).

Characteristic	Value
Age (year)	25.5±9.25
Sex, male: female	80:108
Body mass index (kg/m2)	22.55±4.05
Surgery time (min)	22.80±10.50
Total time (min)	52.10±16.20
Hospital stay (day)	2(1-3)
MSB, T2: T3: T4	24:143:21

Values are presented as mean ± standard deviation, number of patients, or median (range). MSB, maximal sensorial block height (dermatomal level)

Intraoperative adverse events included abdominal discomfort 35 (18.61%), 28 (14.89%), Shoulder pain 51 (27.12%) Nausea/vomiting 51 (29 15.42%), hypotension 18 (9.57%), with no cases of bradycardia or respiratory complications. There were no cases of urinary retention or wound infections. Cosmetic outcomes were highly satisfactory, and all patients reported a positive operational experience at the 1-month follow-up (*Table II*).

Table II
Intraoperative adverse events (*n* = 188).

Adverse event	No. (%)
Abdominal discomfort	35 (18.61)
Anxiety	28 (14.89)
Shoulder pain	51 (27.12)
Nausea/vomiting	29 15.42
Hypotension	18 (9.57)
Bradycardia	0 (0)
Respiratory discomfort/depression	0 (0)

The postoperative adverse events with the most common being affecting Headache 12 (6.38%), followed by shoulder pain in 20 (10.63%) patients, and Nausea/vomiting 26 (13.82%). Notably, no cases of urinary retention were reported (0%). These findings indicate that while most adverse events were mild, nausea/vomiting and shoulder pain were more frequent, highlighting areas for targeted preoperative counseling and management (*Table III*).

Table III
Postoperative adverse events (*n* = 188).

Adverse event	No. (%)
Headache	12 (6.38)
Shoulder pain	20 (10.63)
Urinary retention	0 (0)
Nausea/vomiting	26 (13.82)

Median VAS score of study population at 1 hour was 0. VAS scpre at 6th hour 29, 12 hours, 18 and further reduced to median 15 at 24 hours, demonstrating a gradual decline in pain over time. This highlights a peak in pain intensity around the 6th hour, followed by progressive relief (*Table IV*).

Table IV
Postoperative pain evaluation.

Measurement time	Median (range)
VAS 1 hour	0 (0)
VAS 6 hour	29 (15.42)
VAS 12 hour	18 (9.57)
VAS 24 hour	15 (7.97)

VAS, visual analogue scale.

No one patient developed wound infection or any other complication. All 188 patients were discharged after 24 hour and Hospital stay (day) 2(1-3). Almost all patients satisfied with their cosmetic results. All of the patients' answers to the questions regarding the comfort of operation were "GOOD" at the 1-month postoperative evaluation.

DISCUSSION

Laparoscopic appendicectomy is the gold standard for treatment of acute appendicitis in both complicated and uncomplicated cases. General anesthesia is regarded as safe, preferred and widely accepted anesthesia for laparoscopic surgery in most of the cases. Regional anesthesia has not been used as the sole anesthetic procedure other than in the scenario of a patient at high risk to undergo laparoscopic appendicectomy with CO2 pneumoperitoneum under general anesthesia. Single puncture spinal anesthesia can be an easier technique than general anesthesia [15]. Monitoring of patients under spinal anesthesia is easier than general anesthesia. Complication of endotracheal intubations like damage to oral cavity, teeth, sore throat, and aspirations, failure of intubations are absent in spinal anesthesia. Cost of spinal anesthesia is far less than general anesthesia. Nausea and vomiting are less with spinal anesthesia [16,17]. In the present study, 188 patients underwent LA under spinal anesthesia. Management of pain, discomfort, and anxiety during intra-abdominal carbon dioxide pneumoperitoneum is challenge during the use of spinal anesthesia for laparoscopic surgery. In particular, preventing and managing carbon dioxide pneumoperitoneum-induced shoulder pain is important during laparoscopic surgery under spinal anesthesia. Postoperative shoulder tip pain resulting from diaphragm irritation after general anesthesia can be easily reduced by removing intra-abdominal residual carbon dioxide gas, which can be accomplished by applying active aspiration via the trochars or the lung recruitment maneuver at the end of surgery [18,19]. In our study 51 (27.12%) patients experienced shoulder pain and for reduction we use preoperative NSAIDs and also Immediately after giving spinal anesthetics drugs head end of the table tilted down 10-15° that's pneumoperitoneal gas irritate less the diaphragm. However, intraoperative shoulder tip pain during regional anesthesia is a leading cause of conversion to general anesthesia. Per-op mild shoulder pain can be managed by finger massaging over right shoulder, using low-pressure pneumoperitoneum and clearing-out of smoke due to diathermy at the earliest. Lower rate of carbon-di-oxide inflow (1-2 L) during initial phase of inflation can avoid shoulder pain. Post-op shoulder pain can be avoided by near complete evacuation of pneumoperitoneum and by elevation of foot end of the table [20]. There are 2 studies on the incidence of shoulder pain in LA under spinal anesthesia that showed 25% and 30.8% of patients with shoulder pain, respectively, and the pain regressed with IV fentanyl treatment and our results None of the patients experienced shoulder pain that required conversion to general anesthesia [21,22]. Due to low intraabdominal pressure (8-10mmHg) during surgery intraperitoneal space become less compare to general anesthesia but that cause no problem during operation. Hypotension is a problem of spinal anesthesia, which can be overcome by preloading with fluids [23-25]. Hypotension is the most common and important complication of spinal anesthesia. Hypotension is caused by blockage of sympathetic efferent fibers, leading to decreased systemic vascular resistance and venous return to the heart [26-28]. The hypotension incidence in LA under regional anesthesia was determined by Mane et al and Jun et al as 11.5% and 12.5%, respectively; we observed fewer cardiovascular symptoms in our study [24,25,29,30]. In this study 18 (9.57%) patients developed transient hypotension. The sensorial block level is an independent risk factor for hypotension[31-34]. Even though the sensorial block reached the T2–T4 levels, the low incidence of hypotension in this study can be explained by the effects of prehydration and pneumoperitoneum. Abdominal discomfort and anxiety were the other adverse events after pneumoperitoneum. Abdominal discomfort was observed in 12.5%–23.1% of patients that underwent LA under spinal anesthesia [35,27]. 35 patients (18.61%) had abdominal discomfort and 28 patients (14.89) had anxiety. 1 to 2mg fentanyl effectively relieved these patients. Headache and urinary retention were adverse events that occurred postoperatively after spinal anesthesia (Table 3). Postoperative spinal anesthesia induced headache is reported in 0%–5.49% of patients after laparoscopic surgery and may cause longer hospital stays [28,29]. in our study 12 patients (6.38%) experienced postoperative headache. We considered all patients for urethral catheterization prior to surgery and we are out of postoperative urinary retention. Post-operative Nausea/vomiting 0%–12.5% is reported in LA cases under regional anesthesia [30,31]. In this study, 26 patients (13.82%) experienced post-operative nausea/vomiting which supports the findings of previous studies. There is ample evidence for shorter hospital stays with a laparoscopic procedure [22,33]. In this study average hospital is 2 (1-3) which is mirror of reference study. Teja et al have championed the need for more cost-effectiveness research in anesthesiology. They noted a paucity of cost-effectiveness data [34]. Imbelloni et al reported a savings in anesthesia cost of 54% when the spinal method was used compared to historical data [35]. Though our study is not a comparative study but we observed that in spinal anesthesia cost is less due to less drugs used, less prices of spinal anesthetics drugs, theater cost is low, no gaseous anesthetics drugs used, pain is less in post-operative time, post-operative nausea/vomiting is less which reduce the use drugs, anesthesiologist charge is less, no need of airway products like nasopharyngeal tube, endotracheal tube, VEIN circuit etc. In our study it observed that about 38% cost reduction is possible in spinal anesthesia which can help our marginalized population. In summary, the results of this case series provide a clear indication that spinal anesthesia has advantages to general anesthesia in laparoscopic appendectomy procedures. The data provided strong evidence for more rapid hospital discharges and substantial cost savings, without compromising the outcome of the procedure and postoperative comfort of the patient.

LIMITATIONS

The study has certain limitations, such as the single-site nature of the study, the absence of a control group, and the exclusion of difficult cases. This might

have affected the generalizability of the results. The age range of the participants was also limited to 18 to 65 years old, and they were generally healthy individuals.

CONCLUSION

Spinal/epidural anesthesia should be preferred because it is associated with less surgical field pain, longer postoperative pain-free period, and less nau sea and vomiting. Intraoperative adverse events related to pneumoperitoneum such as shoulder pain and anxiety can be managed easily in awake patients. What is important above all is that in a poor country like ours it would be worthwhile to operate at a low cost and serve the people of the country.

RECOMMENDATIONS

The study can be further improved by conducting multicenter randomized clinical trials that compare spinal anesthesia with general anesthesia to improve generalizability. Studies with heterogeneous patient populations, even those with complex cases, are encouraged. Long-term results and cost-benefit analysis need to be considered in future research. There is a need for standardized treatment plans for pain management during surgery to encourage the use of spinal anesthesia for laparoscopic appendicectomy.

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CONFLICT OF INTEREST

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