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Comparative Study between General and Spinal Anaesthesia in Laparoscopic Appendectomy

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Abstract

Background: Laparoscopic appendectomy is rapidly increasing in the treatment of acute appendicitis. Spinal anesthesia has some advantages over general anesthesia in providing analgesia and muscle relaxation while avoiding some of the complications of general anesthesia.

Methods: This comparative study was conducted on 80 patients undergoing laparoscopic appendectomy. Surgeries were randomized into two groups. Group (G) was done under General Anesthesia (40 patients) and group (S) Subarachnoid block group (40 patients).

Results: From 1 min to 12 h post-operative there was significant increase in mean heart rate and mean arterial blood pressure in group G than group S. In group (S) 2.5% was converted to open due to shoulder pain and inappropriate level of anesthesia. The operative time between both groups was insignificant. Shoulder pain was found in 5% of group (S). Mean VAS score was significantly lower at 1, 2, 4 and 12 h with significantly less analgesic requirements in group (S).

Nausea was found in 5% of group (G) had and vomiting in 2.5%. No patients of group (S) had back pain. 5% in group (S) had retention and needed urinary catheterization. Early postoperative mobilization was noticed in group (S).

Conclusion: spinal anesthesia using a combination of 0.5% hyperbaric bupivacaine and a fentanyl provided effective anaesthesia for laparoscopic appendectomy with low-pressure CO_2 pneumoperitoneum.

Keywords: Laparoscopy; Laparoscopic appendicitis; Spinal anesthesia; Acute appendicitis

Introduction

Acute appendicitis is one of the most common causes of acute abdominal pain worldwide [1]. The reported lifetime cumulative incidence of acute appendicitis in Western countries is approximately 9%, and some recent reports have suggested that the incidence of acute appendicitis has been increasing in both developed and developing countries [2].

Open appendectomy (OA) was the standard treatment for acute appendicitis and was gradually replaced by laparoscopic appendectomy (LA) after its introduction by Semm in 1983 [3].

Over the last two decades, the laparoscopic approach has rapidly increased in popularity, particularly as published reports have associated laparoscopic appendectomy with earlier recovery, shortened length of hospital stay and decreased infectious complications [4].

Recent evidence suggests that regional anesthesia has a significant role in the care of patients undergoing laparoscopy [5].

Spinal anesthesia is a less invasive anesthetic technique that has lower morbidity and mortality rates, compared with general anesthesia [6].

Spinal anesthesia (SA) has the advantage of providing analgesia and total muscle relaxation in a conscious and compliant patient and an uneventful postoperative recovery. At the same time, it also protects against the potential complications of general anesthesia (GA). Despite these advantages, regional anesthesia is still preferred only for patients who are at high risk for general anesthesia, and the majority of surgeons still prefer doing both open and laparoscopic procedures under GA. Thus, most of the publications and textbooks on laparoscopic surgery cite GA as the only anesthetic option for abdominal laparoscopic surgery. But, lately, occasional reports of laparoscopic surgery being performed under regional anesthesia (spinal or epidural) in selected patients have started coming in [7].

Of the advantages of spinal anesthesia over general anesthesia is that the patient is awake and oriented at the end of the procedure. Second, the absence of general anesthetic side effects (e.g., nausea and vomiting) and less pain experienced due to the effect of neuraxial analgesia. Third, patients that have received spinal anesthesia tend to ambulate earlier than patients receiving general anesthesia. Finally, complications related to intubation and/or extubation is avoided in spinal anesthesia for patients undergoing laparoscopic interventions.

Combining a minimally invasive surgical procedure with a less invasive anesthetic technique appears, theoretically, to further enhance the advantages of the operation [8].

Although many reports of laparoscopic inguinal hernia repair and cholecystectomy under regional anesthesia have been published, few studies have involved regional anesthesia for laparoscopic appendectomy [9].

General anesthesia being the only suitable technique for laparoscopic surgeries needs a relook. Some complications as pressor response to endotracheal intubation, increased release of stress hormones, sore throat, post-operative pain, post-operative nausea and vomiting (PONV) are from the disadvantages of using GA [10].

Patients and Method

This comparative study was conducted in As-Salama hospital in AlKhobar, Saudi Arabia in the period between 1-1-2015 till 1-5-2016. 80 patients in age group ranging from 18-40 years, body mass index<30 kgm/m^2 and ASA physical status I/II were posted for laparoscopic appendectomy after a written informed consent was obtained.

Before the surgical procedures, both anesthetic techniques either general anesthesia or spinal anesthesia were considered for each patient with and patients were randomized by sealed envelopes to receive either general (group G) (40 patients) or spinal anesthesia (group S) (40 patients). Numbered and sealed envelopes were placed in the operating room and only opened at the patients' arrival there.

Patients' preoperative evaluation and preparation were standardized. All patients, who were in spinal anesthesia group, were informed about spinal anesthesia in detail about the possibility of general anesthesia if pain or un-satisfaction from spinal anesthesia during the procedure or discomfort despite administration of intravenous analgesics or sedatives. Patients who failed intraoperative spinal anesthesia or couldn't tolerate shoulder pain were converted to general anesthesia and categorized as cases of spinal anesthesia.

All patients with acute appendicitis undergoing laparoscopic appendectomy were included in this study. Patients with contraindication to laparoscopic appendectomy or converted to open were excluded from this study.

After obtaining baseline vital signs, both groups were preloaded with 10 ml/kg of Ringer lactate *via* a peripheral vein with an 18-gauge intravenous catheter. The patients under both the groups were premedicated 2 mg of midazolam hydrochloride, 4 mg ondanosetron, and 8 mg dexamethasone before the induction of anesthesia.

GA patients

Were induced with iv Propofol 2.5 mg/kg, fentanyl 1 μg/kg and succinyl chlorine 1.5 mg/kg, and intubated with suitable sized cuffed endotracheal tube. Anesthesia was maintained using 2-3% sevoflurane and 50% nitrous oxide in Oxygen and atracurium besylate (0.5 mg/kg) for neuromuscular blocking. Ventilation was controlled with a tidal volume of 6-8 ml/kg, and the ventilatory rate was adjusted to maintain a $PaCO_2$ value of 35-40 mmHg Noninvasive arterial blood pressure, electrocardiography, pulse oximetry and end tidal carbon dioxide ($ETCO_2$) were monitored continuously. Lactated Ringer's solution (3-6 ml/kg/h) was infused throughout surgery. No additional intravenous opioids were injected. At the end of surgery residual neuromuscular block was reversed by neostigmine 0.05 m/kg and atropine sulphate 0.01 mg/kg intravenously and patient was extubated and transferred to PACU.

SA patients

Patient in a sitting position, under complete aseptic technique at the level of L4-3 or L4-5 lumber interspace vertebrae in the midline approach lumbar puncture was performed using 27 gauge pencil point spinal needle, once flow of clear CSF, 15 mg hyperbaric bupivacian with 25 μg fentanyl in a total volume 3.5 ml injected intrathecally then the patient asked to lie in a supine position and the level of anesthesia was checked to a sensory blockade up to T4. The sensory block level was assessed by the pinprick test using a 24-gauge hypodermic needle, while the motor block level was assessed by the modified Bromage scale. Lactated Ringer's solution (3-6 ml/kg/h) was infused throughout surgery, Oxygen supplementation was given to all the patients at 3 l/min through the nasal cannula. Non-invasive arterial blood pressure, electrocardiography, and pulse oximetry were monitored continuously. Intraoperative incidents (e.g., right shoulder pain, headache, and abdominal discomfort, hypotension, nausea, and/or vomiting) were documented

Intraoperative hypotention more than 20% of the basal measure was managed by intravenous ephedrine sulphate 5 mg increment every 5 min. If any patient experienced pain or discomfort, fentanyl (30-50 μg) can be given and anxiety treated with i.v midazolam 2 mg. At the end of surgery patients transferred to PACU.

All Patients were monitored in the PACU for 30 min by nursing staff for evidence of complications or adverse events.

Surgical technique

Same technique was used for both groups. Patients were positioned supine.

All patients had 3 port technique, one port supraumblical 12 mm, one 5 mm port in infraumblical and one 5 mm port in the supra pubic region. Pneumoperitoneum was established by using closed versus needle technique with carbon dioxide at a maximum intra-abdominal pressure of 12 mmHg to minimize the incidence of shoulder pain. Another modification of the technique was the minimal-if any-tilting of the operating table, i.e., minimal head down and left tilt to minimize diaphragmatic irritation.

Diagnostic laparoscopy was carried out. Then dissection of the meso-appendix did by the use of bipolar cautery (Enseal). Double ligation of the appendix at its base by end loop and cutting the appendix by the help of Enseal. Retrieval of the appendix *via* the 12 mm port with the use of 5 mm lens.

In both the groups, mean ABP, heart rate, SPO_2 were recorded at the following points of times,

- Prior to induction.
- After induction in GA group and after subarachnoid block in SA group
- Immediately after pneumoperitoneum
- Every 15 minutes thereafter in both groups
- 1, 2, 4, 8 and 12 h postoperatively

Post-operative pain was analyzed using visual analogue scale (VAS) and assessed at 1, 2, 4 and 12 h. Intensity of pain was assessed by using

10 point VAS representing various intensity of pain from '0' to 10. Diclofenac sodium 75 mg i.v was given when VAS was >4 and the number of ampules administered to each patient during the first 8 h postoperatively was recorded If any patient experienced nausea/vomiting, ondensetron 4 mg was intravenously given. Headache, sore throat, pruritus, or any other neurologic complaint, and urinary retention were monitored.

Post-operative data were recorded including mobilization, and return of bowel sounds. Days of hospital stay were recorded, and the overall cost of both the operations was calculated.

Statistical analysis

Data were collected, revised, coded and entered to the Statistical Package for Social Science (IBM SPSS) version 20. The qualitative data were presented as number and percentages while quantitative data were presented as mean and standard deviations. The comparison between two independent groups with quantitative data and parametric distribution was done by using Independent t-test. The confidence interval was set to 95% and the margin of error accepted was set to 5%. So, the p-value was considered significant as the following: P>0.05: Non significant, P<0.05: Significant and P<0.01: Highly significant.

Results

This study included 80 patients in the age group from (18-40) with mean age 34. Seventy-four patients (92.5%) were males and 6 female (7.5%) patient. There was no statistically significant difference between both studied groups regarding age, sex distribution, mean body mass index (BMI), and the incidence of associated comorbidities (Table 1).

Mean HR	Group (G)	Group (S)	Independent t-test	
	Mean ± SD	Mean ± SD	t	P value
Basal	86 ± 1.77	85 ± 2.57	1.433	0.160
After induction	90 ± 1.05	75 ± 1.75	32.870	<0.001
Pneumo-peritoneum	100 ± 1.25	77 ± 2.05	42839	<0.001
Intra op 15	99 ± 2.47	80 3.17	21.144	<0.001
Intra op 30	95 ± 2.83	85 ± 1.19	14.567	<0.001
Intra op 45	91 ± 2.05	83 ± 2.55	10.935	<0.001
Intra op 60	90 ± 1.27	79 ± 2.07	20.256	<0.001
Post op 1 h	93 ± 3.77	84 ± 1.58	9.846	<0.001
Post op 2 h	94 ± 3.09	85 ± 3.69	8.363	<0.001
Post op 4 h	96 ± 2.33	80 ± 2.83	19.520	<0.001
Post op 8 h	92 ± 1.25	81 ± 2.67	16.686	<0.001
Post op 12 h	89 ± 2.82	83 ± 3.62	5.487	<0.001

Table 1: Comparison between group G and group S regarding mean heart rate at different measuring times.

The previous table shows that there was no statistically significant difference found between group G and group S at basal time but from induction to 12 h post-operative the table shows that there was highly statistically significant increase in mean heart rate in group G than group S with p-value <0.001 (Figure 1).

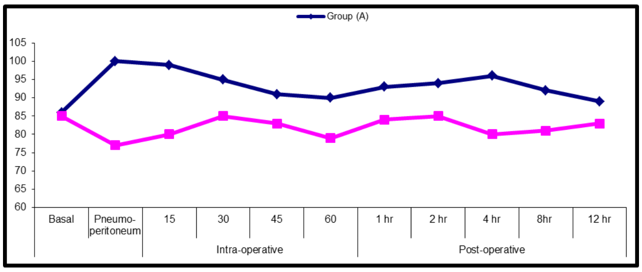

Figure 1: Mean heart rate in the two studied groups.

In both groups, all the cases were completed laparoscopically with no surgical conversion. In the spinal anesthesia group (S) one case (2.5%) was converted to open due to shoulder pain and inappropriate level of anesthesia. The operative time between both groups was statistically insignificant with mean operative time in group (G) 42.36 minutes and in group (S) 44.71 minutes. Intra and post-operative vital data were recorded in Table 2.

Mean ABP	Group (G)	Group (S)	Independent t-test	
	Mean ± SD	Mean ± SD	t	p-value
Basal	100.23 ± 1.25	100.11 ± 2.08	0.221	0.826
Pneumo-peritoneum	95.92 ± 3.18	85.34 ± 3.92	9.374	<0.001
Intra op 15	93.42 ± 2.87	84.7 ± 3.61	8.456	<0.001
Intra op 30	92.22 ± 2.95	86.9 ± 3.69	5.036	<0.001
Intra op 45	91.04 ± 3.45	85.52 ± 4.14	4.581	<0.001
Intra op 60	91.86 ± 4.17	86.21 ± 5.86	3.513	0.002
Post op 1 h	107.76 ± 2.37	92.3 ± 2.8	18.847	<0.001
Post op 2 h	109.65 ± 2.88	94.01 ± 3.31	15.942	<0.001
Post op 4 h	105.22 ± 2.29	96.35 ± 2.72	11.156	<0.001
Post op 8 h	103 ± 2.78	97 ± 2.65	6.986	<0.001
Post op 12 h	101.38 ± 3.38	98.05 ± 3.81	2.924	0.006

Table 2: Comparison between group G and group S regarding mean arterial blood pressure at different measuring times.

The previous table shows that there was no statistically significant difference found between group G and group S at basal time but from induction to 12 h post-operative the table shows that there was highly statistically significant increase in mean arterial blood pressure in group G than group S with p-value <0.01 (Figure 2).

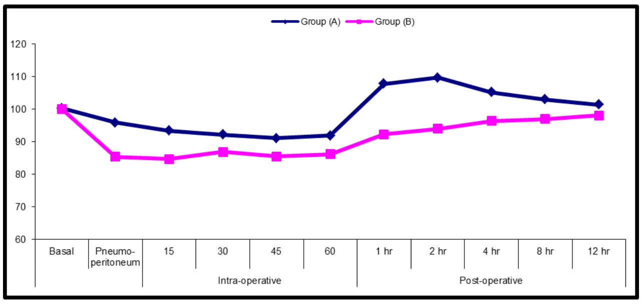

Figure 2: Mean arterial blood pressure in the two studied groups.

As for the pain, we found intra-operative shoulder pain in 2 patients (5%) in group (S), 1 of which was relieved by administration of fentanyl and midazolam injection and the other had to be converted to general anesthesia due to intolerable intraoperative shoulder pain.

As for post-operative pain, VAS score was recorded for both groups with mean score 3.0 ± 0.9 in group (G) and 1.5 ± 0.35 in group (S) at 1 hour post-operative with p-value<0.001. At 2 h postoperative mean score was found 3.2 ± 1.1 in group (G) and 1.9 ± 0.8 in group (S) with p-value<0.001. While it was 3.5 ± 0.88 in group (G) and 2.7 ± 0.95 in group (S) at 4 h with p-value=0.001. At 12 h post-operative the mean score was 2.8 ± 0.75 in group (G) and 2.1 ± 0.36 in group (S) with p-value<0.001. Group (G) needed analgesics ranging from 1 to 3 ampoules diclophenac Na (75 mg) with mean 1.6 ± 0.5 ampoule per patient, while group (S) the need for analgesics was ranging from 0 to 3 ampoules with mean was 0.6 ± 0.29 ampoule per patient with p-value=<0.001.

Two patients (5%) of group (G) had nausea and 1 patient (2.5%) had vomiting. No patients of group (S) had back pain due to the use of small spinal needle. Two patients (5%) in group (S) had retention and needed catheterization by nelaton catheter to evacuate the bladder but none needed further catheterization. Early postoperative mobilization was noticed in group (S) at 11.0 ± 1.3 h as compared to 16.0 ± 2.5 h for group (G) with p-value<0.001. As for the return of bowel sounds, they were heard after mean of 7.3 ± 2.1 h in group (G) and 6.8 ± 1.3 h in group (S) with p-value=0.371. Group (G) had a higher mean cost of the operation and hospital stay due to the use of anesthetic drugs and more pain killers but it was statistically non-significant.

Discussion

General anesthesia is the most commonly used and the most acceptable form of anesthesia for laparoscopic procedures. Some patients are more prone to the risks of general anesthesia than others (smokers, asthmatic patients etc.). Basal atelectasis, rise in the airway pressure, hypercapnia and post-operative nausea and vomiting are from the risks of general anesthesia. Spinal anesthesia offers a safer alternative to general anesthesia with some advantages over the general anesthesia group in pain management and hence in the recovery of the patients and their return to work.

Although not enough is written about the comparison between general and spinal anesthesia in laparoscopic appendectomy, some papers were discussing this comparison in laparoscopic cholecystectomy so the comparison with them might not be as effective in some items like shoulder pain due to the difference in the operative fields.

In our study 7.5% of the spinal group (S) of patients showed bradycardia, which was similar to Gurudatta and Arif in their study of spinal anesthesia in lower abdominal surgeries found that 12% of the patients had bradycardia [10], while Mehta et al. compared general and spinal anesthesia in laparoscopic cholecystectomy and found no evidence of bradycardia [11]. 5% of group (S) patients had hypotension (>20% fall in BP) in our study, while it was 24% in Gurudatta and Arif paper [10], 30% in Mehta et al. (>30% fall in BP) [11], 18.21% in Sinha et al. study discussing laparoscopic surgeries under spinal anesthesia [12].

Post-operative pain as measured by the VAS score was in favor of group (S) throughout the post-operative period (1, 2, 4, 12 h) with p-value= <0.001, while Gurudatta and Arif's study [10], and Bessa et al. study found that the difference was non-significant after 6 h 8 but Imbelloni et al. showed significant difference at 2, 4, 6 h but non-significant difference at 12 h in his study comparing general and spinal anesthesia in laparoscopic cholecystectomy [13].

The mean number of analgesic ampoules needed was significantly lower in the spinal anesthesia group 0.6 ± 0.29 ampoules/patient as compared to 1.6 ± 0.5 ampoules /patient the general anesthesia group. Bessa et al. did a study and compared general and spinal anesthesia in laparoscopic cholecystectomy and also found significantly lower values being 0.5 to 1.1 [8].

Shoulder pain was recorded in 2 cases (5%) of group (S) which was less than that reported by Gurudatta and Arif 24% [10], and Van Zandart et al. 25% in a study of laparoscopic cholecystectomy under spinal anesthesia [14], and this pain was relieved by sedation administration in 1 patient and the other was converted to GA. In postoperative period shoulder pain was found in 2 cases in both groups (2.5%) and resolved after 5-6 h with the aid of analgesia.

Other complications as PONV were in 3 cases (7.5%) of group (G) and none of group (S) compared to 32% and 8% respectively in Gurudatta and Arif study [10]. As for urinary retention, 2 patients (5%) of group (S) suffered from it and needed catheterization although Imbelloni et al. showed no cases of retention [13].

Early post-operative mobilization and the return of bowel sounds were in favor of the spinal anesthesia group over the general anesthesia group mostly due to better pain control outcome. The mean h for postoperative mobilization was 16.0 ± 2.5 h for group (G) and was 11.0 ± 1.3 h for group (S) which was significant on statistical level p-value <0.001. On the other hand, bowel sounds were heard earlier in group (S) after mean of 6.8 ± 1.3 h as compared to 7.3 ± 2.1 h in group (G) but it was non-significant statistically.

Conclusion

Using a combination of 0.5% hyperbaric bupivacaine and a fentanyl provided effective anaesthesia for laparoscopic appendectomy with low-pressure CO_2 pneumoperitoneum. It offers better pain management for the patients, earlier recovery and less operating room costs. We recommend an increasing use of spinal anaesthesia for laparoscopic appendectomy especially in patients with risks for general anesthesia.

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