Spinal anaesthesia for laparoscopic cholecystectomy: A comparison with general anaesthesia regarding haemodynamic and respiratory stability

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Received: 28th February, 2019 **Accepted:** 19th March, 2019

Abstract
General anaesthesia has been technique of choice for laparoscopic surgeries. Given the advantages of spinal anaesthesia, we conducted a study to see feasibility of spinal anaesthesia in laparoscopic cholecystectomy in respect to cardiovascular and respiratory stability and post operative outcome. After obtaining institutional ethical committee approval, sixty consenting patients for laparoscopic cholecystectomy were randomized into two groups to receive spinal or general anaesthesia. Spinal anaesthesia was given with 0.5% bupivacaine heavy and 1µg/kg clonidine. General anaesthesia group received standard general anaesthesia with endotracheal intubation and positive pressure ventilation. Intraoperative haemodynamics, end tidal and arterial CO2, postoperative analgesia, satisfaction scores and complications were compared. As per Student t test and Chi square tests demographic, surgical duration, haemodynamic parameters were comparable. Perioperative PaCO2 was stable and comparable. 24 hr visual analog pain scores, tramadol consumption were significantly less in spinal group. Incidence of postoperative nausea and shoulder tip pain was less than 6% in spinal group. Both groups had good patient and surgeon acceptance.

Conclusion: Laparoscopic cholecystectomy can be safely performed under spinal anesthesia and provides good hemodynamic and respiratory stability, requires less postoperative analgesia and better patient and surgeon satisfaction.

Keywords: Clonidine, General anaesthesia Laparoscopic cholecystectomy, Spinal anaesthesia.

Introduction

Laparoscopic cholecystectomy is the gold standard for surgical treatment of symptomatic gallstones due to the minimally invasive nature of the procedure, less postoperative pain, reduced hospital stay and early return of daily activities.[1] Until recently the choice of anaesthetic technique for laparoscopic cholecystectomy had been limited to general anaesthesia with muscle relaxation, tracheal intubation and positive pressure ventilation.[2]

Spinal anaesthesia is a less invasive and has lower morbidity and mortality rates as compared to general anaesthesia. Under spinal anaesthesia patient is awake, there is no airway instrumentation, less postoperative pain and absence of nausea and vomiting.[3] Also the cost effectiveness of spinal anaesthesia makes it an attractive choice. The limiting factor for use of spinal anaesthesia in laparoscopic cholecystectomy was the patient discomfort because of respiratory embarrassment associated with pneumoperitoneum and the shoulder tip pain.[5]

Intrathecal clonidine along with bupivacaine in laparoscopic surgery has been shown to abolish shoulder tip pain and provides good sedation and analgesia in the peri-operative period without significant changes in the haemodynamics.[4] Spinal anaesthesia is shown to preserve diaphragmatic activity in laparoscopic surgery and gas exchange is maintained within physiologic limits without compromising ventilation.[6]

In this background, we designed a study to compare the spinal anaesthetic technique using clonidine as an adjunctive with conventional general anaesthesia for elective laparoscopic cholecystectomy in healthy adult patients.

Materials and Methods

Institutional ethical committee approval was obtained prior to the study (No. 532/L/11/12/Ethics/Estt.Vol III).

Written informed consent was taken from all the patients after explaining the procedure. Sixty patients of either gender scheduled for elective laparoscopic cholecystectomy aged 18-50 years of either gender with American Society of Anaesthesiologists (ASA) physical status I or II, BMI < 30kg/m^2, scheduled for elective laparoscopic cholecystectomy were included in the study. Patients with acute cholecystitis/cholangitis/ pancreatitis, known contradiction for pneumoperitoneum, spinal anaesthesia, and previous upper abdominal surgery were excluded from the study.

A thorough preoperative evaluation was done for all the patients on the previous day of surgery and were explained about the procedure. Patients posted under spinal anaesthesia were explained that any pain, discomfort or anxiety will be managed with appropriate medication or converted to general anaesthesia if required. Similarly surgeons were informed to ask for general anaesthesia if there was any technical difficulty during the procedure. All patients were kept nil per oral for 8 hrs for solid foods and 4 hrs for clear fluids and received tab alprazolam 0.5mg and tab ranitidine 150mg in the night prior to surgery as premedication.

Patients were randomly allocated into one of the two groups namely spinal anaesthesia (SA) group or general anaesthesia (GA) group by a numbered sealed envelopes. The sealed envelopes were placed in the operating room and opened on patient's arrival. On the day of surgery

intravenous access was obtained with 18G IV cannula on the left hand and 500ml of Ringer's lactate was infused over 15min. Monitoring included electrocardiogram, non-invasive blood pressure, pulse oximetry, heart rate and end-tidal carbon dioxide. 14Fr nasogastric tube was inserted and urinary bladder was catheterized in all the patients.

Patients in spinal anaesthesia group were positioned in right lateral position. Spinal anaesthesia was given with 25G Quincke spinal needle at L_2-L_3 intervertebral space. After confirming free and clear flow of CSF, 3ml of 0.5% bupivacaine heavy with 1µg/kg clonidine was injected intrathecally. Patients were positioned to supine position and table was tilted to 20 degree Trendelenberg position till the sensory block reached T4 dermatome. Pin prick test was performed to evaluate the sensory block level. Once the block level reached T4 dermatome level, the table position was normalized and the surgeons were allowed to proceed with the surgery. If mean blood pressure decreased to less than 60 mmHg, ephedrine 6mg bolus was administered and if heart rate decreased to less than 50 beats per minute atropine 0.6mg was administered. Patients who experienced intraoperative discomfort like right shoulder pain were initially reassured, when persisted, midazolam 1mg bolus doses were given intravenously. When the pain still persisted, surgeons were asked to spray the right dome of diaphragm with 10ml of 2% lignocaine. In spite of above measures if patient had discomfort and/or if surgeons were not comfortable, it was converted to general anaesthesia.

Patients in general anaesthesia group were induced with injection propofol 2mg/kg, paralysed with injection vecuronium 0.1 mg/kg and injection fentanyl 2µg/kg, paracetamol 1g intravenously were used for analgesia. After tracheal intubation and confirmation, anaesthesia was maintained with oxygen:nitrous-oxide (40:60) and sevoflurane 1-2% with positive pressure ventilation using closed circuit. Minute ventilation was adjusted to maintain end tidal CO_2 between 35 to 40 mmHg. At the end of surgery patients were reversed with neostigmine 0.05mg/kg and glycopyrrolate 0.01mg/kg and trachea was extubated when patients were awake and comfortable. Blood pressure, oxygen saturation, heart rate, respiratory rate were recorded every 5 minutes. Arterial partial pressure of carbon dioxide was determined in all patients before induction of anaesthesia, half an hour after pneumoperitoneum and in postoperative period.

Intraoperative cardiovascular and respiratory stability and post operative analgesic requirements were considered primary outcome and patient and surgeon satisfaction scores were considered secondary outcome. Uniform technique of laparoscopic cholecystectomy was used with a standard four trocar technique. Carbon dioxide pneumoperitoneum was established by the surgeon to a maximum pressure of 14mmHg and the surgery was proceeded. Any complication/side effects were noted and treated. Postoperatively pain was managed by intravenous injection tramadol 50mg as and when required and paracetamol 1g intravenous infusion 8th hourly. Other postoperative events related to surgery or anaesthesia such as discomfort, nausea, vomiting, shoulder pain were recorded. The ease and comfort of surgery was asked to be graded by surgeons on a scale of good, average and poor.[3] At the time of discharge patients were questioned about their degree of satisfaction with the anaesthesia technique on a scale of good, average and unsatisfied (Table 4 included in results).

Data was tabulated in Microsoft Excel and analysed using Minitab version 17. Continuous variables are presented as mean±SD, for parametric data and median and IQR, if the data was skewed. Student t test was applied for calculation of statistical significance whenever the data was normally distributed. Mann Whitney U test was applied whenever data was skewed. Categorical variables are expressed as frequencies and percentages. Nominal categorical data between the groups are compared using Chi-square test or Fisher's exact test as appropriate. p value <0.05 is taken to indicate a statistically significant difference.

Results

All the patients completed the study without any major complications or requiring change of anaesthetic or surgical technique. Student t test has been used for calculation of statistical significance whenever the data followed normative distribution. Mann Whitney test has been applied whenever data followed non-normative distribution. Categorical variables were expressed as frequencies and percentages. Nominal categorical data between the groups were compared using Chi-square test or Fisher's exact test as appropriate. p value <0.05 was taken to indicate a statistically significant difference. The demographic data (Table 1) was comparable between two groups with respect to age, gender, ASA physical status and body mass index.

Table 1: Demographic characteristics

Characteristics	Group GA (n=30)	Group SA (n=30)	p value
Age (mean ±SD)	38.7 ± 9.425	37.9 ± 9.166	0.74 *
Male Female	10 19	10 20	0.787**
Body Mass Index (mean ±SD)	23.67 ± 3.09	25 ± 2.71	0.082 *
ASA Physical Status I II	 22 8	 24 6	 0.542**
Mean duration of surgery (median)	75min	87.5	0.11

*****student t test **Chi Square test

The intraoperative haemodynamic parameters like heart rate, mean arterial pressure and respiratory rate remained stable and were comparable between both the groups.

The perioperative PaCO2 levels were comparable and within acceptable levels between both the groups. (Fig. 1).

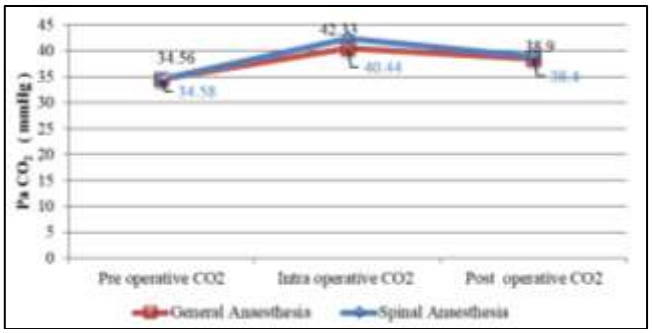

Fig. 1: Trend in the $PaCO_2$ levels between the two groups

The median duration of analgesia (request for first analgesic dose) for the subjects in general anaesthesia and spinal anaesthesia group was 90 and 285 minutes respectively. Patients in spinal anaesthesia group had a significant prolongation of the duration of analgesia. (p=0.001) (Table 3)

Table 3: Duration of analgesia (time for request of first analgesic dose)

Group	Duration (minutes) median	p value
GA (n=30)	90	0.001
SA (=30)	285	

The Visual Analogue pain score remained below 2 for patients in spinal anesthesia group for 24 hrs as compared to patients in general anesthesia group who had pain scores between 3 to 5 requiring rescue medications. (Fig. 2)

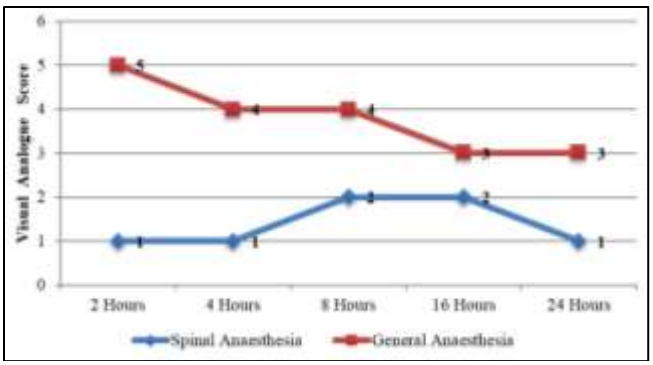

Fig. 2: Visual analogue score among study groups

19 and 11 patients responded as good and averae for spinal anaesthesia as compared to zero and 28 for general anaesthesia. (Table 4).

Table 4: Patient satisfation score

Satisfaction Levels	GA (n=30)	SA (n=30)	Total	P-Value
Good	0	19	19	0.00
Average	28	11	39	
Unsatisfied	2	0	2	
Total	30	30	60	

Discussion

We observed patients in spinal anaesthesia group maintained stable haemodynamic and respiratory parameters. Most of the studies have reported the feasibility of performing laparoscopic surgeries under spinal anaesthesia even though concerns like shoulder tip pain, stability of haemodynamic and respiratory parameters exist.[6,11,12,7] We used clonidine in a dose of 1µg/kg as an adjunctive for spinal anaesthesia. Even though we observed a statistically significant decrease in arterial pressure and heart rate in spinal group, out for 30 patients only one required intervention for hypotension and two required treatment for bradycardia. Contrary to the understanding, spinal anaesthesia with clonidine as adjunctive for laparoscopic cholecystectomy provided relatively stable haemodynamics. Ghodki et al documented similar observations in their study on clonidine at 30 µg as an adjunctive for spinal anaesthesia in laparoscopic cholecystectomy.[7]

Perioperative respiratory parameters and $PaCO_2$ levels in spinal anaesthesia group were clinically within normal range. In spinal group, even though we did not have control over the respiratory rate, there was no statistically significant difference between the two groups. Patients in spinal group maintained an average rate of 12 to 14 breaths/minute. The end tidal CO_2, and SpO_2 levels in both the groups were within normal clinical limits.

We monitored arterial partial pressure of CO_2 ($PaCO_2$) by blood gas analysis to see the effect of either of the anaesthetic techniques on the ability of respiratory system to eliminate CO_2. The base-line $PaCO_2$ levels in both groups were similar. Intra-operatively thirty minutes after creating pneumoperitoneum the rise in $PaCO_2$ levels were still within normal limits in both the groups. Intra-operatively, spinal group had a mean $PaCO_2$ level of 42.33±6.39 mmHg. In the postoperative period the mean $PaCO_2$ levels in both the groups were below 40 mmHg (38±3.3 in general anaesthesia group and 38.9±5.1 in spinal group). This observation confirms that even though the level of spinal block is at T4 level, patient can still compensate for the increased demand on ventilation by increasing the tidal volume as the rate remained unchanged. Pusapati R N et al observed similar results in their study on gynecologic laparoscopy under SA.[6]

The incidence of shoulder tip pain following SA has been reported to be around 25-48%.[8,13] Clonidine was tried with bupivacaine as an adjunctive for SA by Ghodki et al[7] to abolish the shoulder tip pain. We used a dose of 1µg/kg clonidine intrathecal for SA group and observed an incidence 6.6% which is similar to the observations by Ghodki. Two patients in SA group who complained intra-

operatively about shoulder tip received IV tramadol 50 mg, IV midazolam 2mg and sub-diaphragmatic instillation of 10 ml of 2% lignocaine through the port by the surgeon. Twelve patients in GA group had PONV which is about 40% incidence whereas only one patient in SA group had PONV. The observations were similar to findings in a study conducted by Mehta et al.[9] Also clonidine used as an adjunctive in SA does not have emetic properties unlike opioids.

The first 24 hr tramadol requirement for analgesia in general anaesthesia group was significantly higher. Patients in the spinal group consistently reported significantly less pain. Tiwari et al[10] and Bessa et al[11] in similar studies too confirmed that SA results in significantly less post operative pain, compared to that under GA for laparoscopic cholecystectomy. The median tramadol consumption in SA group was also less (150 mg) compared to GA group (200 mg). The median visual analogue score (VAS) in the SA group ranged between 1-2 score compared to 3-5 score in the GA group over first 24hr duration (accepatable clinical limit for VAS score is <3).

The surgeons were satisfied with both the techniques. Patient satisfaction score was also better in SA group due to extended duration of analgesia and less incidence of PONV.

We conclude that laparoscopic cholecystectomy can be safely performed under spinal anaesthesia using bupivacaine and clonidine as an adjuvant. Spinal anaesthesia provides stable intra-operative haemodynamic and respiratory parameters, requires less postoperative analgesics with extended duration of analgesia, with no major complications and has better patient satisfaction.

Conflict of Interest: None.

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How to cite this article: Swathi S, Nagaraj AV, Nataraj MS. Spinal anaesthesia for laparoscopic cholecystectomy: A comparison with general anaesthesia regarding haemodynamic and respiratory stability. *Indian J Clin Anaesth* 2019;6(2):254-7.