Original article

Access this article online
Website: www.njisa.org
eISSN - 2456-9712

Spinal anesthesia for laparoscopic cholecystectomy: Is it a feasible alternative?

Puja Saxena, Richa Saroa, Sanjeev Palta, Esha Sethi Chaudhary
Department of Anaesthesia and Intensive Care, Government Medical College and Hospital, Sector – 32, Chandigarh, India

Address for correspondence:
Richa Saroa,
Associate Professor,
Department of Anaesthesia and Intensive Care, Government Medical College and Hospital, Sector – 32, Chandigarh
Email: richajayant@rediffmail.com

ABSTRACT

Background and Aims: Although mostly performed under general anesthesia, regional anesthesia has been sparingly employed in patients undergoing laparoscopic cholecystectomy. Recent evidence labels regional anesthetic techniques to be safe and highly acceptable for laparoscopic cholecystectomy. The present study was undertaken to evaluate and compare the effects of general or regional anaesthesia on haemodynamics, blood gases, postoperative pain and recovery scores, rescue analgesic consumption, and side effects in patients undergoing elective laparoscopic cholecystectomy. **Methods:** 80 patients were randomized in two groups of 40 each to receive either general or spinal anaesthesia for pain, hemodynamic variables, respiratory rate and cumulative rescue analgesic consumption. Intraoperative shoulder pain, oxygen saturation and arterial blood gas parameters were compared in both the groups. Intraoperative consumption of vasopressors was also observed. Modified Aldrete scoring was used to evaluate the recovery characteristics of both the techniques. Patient and surgeon feedback was assessed by the use of preformed questionnaire. At the end of study, data was compiled and analysed with appropriate statistical tests. **Results:** Spinal anaesthesia provided better postoperative analgesia in patients undergoing laparoscopic cholecystectomy as evident by lower VAS scores and lesser total analgesic consumption. There were more incidences of bradycardia, hypotension, and significant arterial blood gas changes under spinal anaesthesia. Patients in spinal anaesthesia group demonstrated better recovery score as well as lesser incidence of PONV IN PACU. **Conclusion:** Spinal anesthesia can be used as sole anesthetic technique in patients undergoing elective laparoscopic cholecystectomy especially in patients where general anesthesia carries its own inherent risks.

Key words: Laparoscopic cholecystectomy, general anaesthesia, spinal anaesthesia

INTRODUCTION

General anesthesia remains widely acceptable technique for conduct of laparoscopic cholecystectomy, the gold standard treatment for symptomatic gall stones disease. However whereas the surgical technique in laparoscopy is minimally invasive, the anaesthetic technique is fraught with hazards of general anesthesia in the perioperative period. Also, while co administration of regional anesthesia and general anesthesia has been found to be acceptable with beneficial results in post operative period, sole regional anesthetic technique have not gained much popularity for surgical anesthesia in patients undergoing laparoscopic surgery. There is lack of sufficient data to predict the patient behaviour, hemodynamic and respiratory changes during pneumoperitoneum with neuraxial blockade as high as T4 level that is required for laparoscopic surgery. Although hypotension and bradycardia are the predictable accompaniments of spinal anaesthesia which are easily manageable, still CO_2 pneumoperitoneum may cause an exaggerated effect on hemodynamic stability as well as by its propensity to cause diaphragmatic irritation, may lead to shoulder pain and discomfort. The assumption that pneumoperitoneum may not be well tolerated by a patient

How to cite this article: Saxena P, Saroa R, Palta S, Chaudhary ES. Spinal anesthesia for laparoscopic cholecystectomy: Is it a feasible alternative? Northern Journal of ISA. 2017;2:21-28.

who is awake has disregarded the regional anesthetic techniques from use in laparoscopic procedures[1].

While sporadic studies of laparoscopic surgery being performed in select patients solely under spinal or epidural anaesthesia have been published in patients with compromised respiratory function or ASA Grade 3 or more, the recent feasibility studies also suggest that regional anaesthesia for laparoscopic cholecystectomy is safe and highly acceptable[2–10].

Therefore the present study was a prospective, randomized, single observer trial to compare and assess the effect of two anesthetic techniques i.e., general anesthesia and spinal anesthesia primarily on intraoperative haemodynamics, arterial blood gas exchanges and postoperative recovery profile while observing the side effects and postoperative pain as secondary outcomes in patients scheduled to undergo elective laparoscopic cholecystectomy.

METHODS

After obtaining institutional ethical committee approval and written informed consent, 80 patients of either sex in the age group of 18-65 years of American Society of Anesthesiologists Physical status (ASA) status I/II scheduled to undergo laparoscopic cholecystectomy were enrolled for the study. Patients with contraindications for spinal or epidural anaesthesia, with history of previous upper abdominal or spine surgery, patients with conversion of surgery from laparoscopic to open, morbidly obese, severe cardiovascular/respiratory disease, seizure disorder, pregnancy, present history of beta blockers intake were excluded from the study. The patients were randomized using coded sealed envelopes to receive either Spinal Anaesthesia (Group S) or General Anaesthesia (Group G). Randomization was done using computer generated random number table. Since the techniques were so different, the patient, the surgeon and the anaesthesiologist could not be blinded. Single investigator performed all the procedures and assessments to avoid inter observer variability.

For standard deviation of 15, the required sample size was found to be thirty-participants in each group along with a confidence interval of 95% and power of eighty-percent. Therefore patients were randomized to receive either general or spinal anaesthesia with 40 patients in each group. After thorough pre anesthetic check up and relevant investigations, all patients were explained about linear visual analogue score (VAS). Patients were kept fasting for 8 hours and premedicated with tablet ranitidine (150 mg) and alprazolam (0.25 mg) a night prior and the morning of surgery. All the patients were cannulated with 18 G cannula for fluid administration and were connected to multichannel monitor (S/5™ critical care monitor, Datex Ohmeda, Helinski, Finland) in the operating room for Electrocardiogram (ECG), Non-Invasive Blood Pressure (NIBP), arterial oxygen saturation (SpO_2) respiratory rate, and end tidal carbon dioxide ($EtCO_2$) monitoring.

In the Group1S, spinal anaesthesia was performed in L2-L3 intervertebral space with a 26 G Quincke's needle and 0.5% hyperbaric Bupivacaine (3-3.5 ml) with fentanyl (20 mcg) in right lateral position. Patient was turned supine after the subarachnoid block. Sensory blockade up to T4-T5 level was achieved with head down tilt of the table by 15-20^0. The level of sensory block was assessed by pin prick sensation every 1 minute for 10 minutes, subsequent to which surgery was allowed to commence. After introduction of trocar, local anaesthetic irrigation (20 ml of 1% lignocaine) was performed over diaphragm and liver bed in anticipation of right shoulder pain. Any fall in heart rate less than 50 per minute was treated with intraveous atropine 0.6 mg. Any fall in systolic blood pressure to more than 20 % of the baseline was treated with intravenous fluids, oxygen administration and use of intermittent vasopressors (intravenous mephenteramine 3 mg), if necessary.

The patients randomized to receive general anaesthesia (Group 2G) were induced with standardized anaesthesia using morphine 0.1mg/kg as analgesic, propofol 1.5-2.5mg/kg as induction agent, and glycopyrrolate 0.2 mg as antisialagogue. Muscle relaxation was achieved with intravenous vecuronium 0.1mg/kg after confirming adequate mask ventilation. This was followed by tracheal intubation and mechanical ventilation and maintenance of anesthesia was achieved through administration of inhalational agent isoflurane with N2O and O2 in 60:40 ratios.

Laparoscopic cholecystectomy was performed by experienced surgeons. The intraabdominal pressure was limited to 12 mmHg and a low rate of CO_2 insufflation (1L/mt) was used to avoid vagal stimulation.

Intraoperative shoulder pain, oxygen saturation, haemodynamic and arterial blood gas parameters were recorded every 2 minutes for the first 10 minutes after anaesthesia, and every 5 minutes thereafter. Arterial blood gas analysis was performed before administering anaesthesia, 15 minutes after creating pneumoperitoneum and 30 minutes after desufflation. The results were compared in both the groups. Intraoperative consumption of atropine and mephentermine to maintain stable haemodynamics was also noted. At the end of surgery, patients were shifted to Post Anaesthesia Care Unit (PACU) and Modified Aldrete scoring was used to evaluate the recovery characteristics of both the techniques. Postoperatively, patients were assessed at regular intervals at 0, 1, 3, 6, 12 and 24 hours for pain (VAS scores), heart rate, blood pressure and respiratory rate. Rescue analgesia was provided with intramuscular diclofenac Sodiumif VAS >40. Intravenous tramadol (1-2 mg/kg) was administered if VAS was still > 40 at the end of one hour of administration of diclofenac sodium. Total supplementary analgesic consumption during study period was recorded in both the groups. In addition, all the patients were observed for the side effects of either procedure like nausea, vomiting, headache, abdominal pain, pruritis and urinary retention during the entire post operative period. Postoperative questionnaire consisting of patients' satisfaction during anaesthetic technique and surgeon's rating in terms of surgical field was also taken in account. All the observations were recorded in the prescribed proforma that were subjected to statistical analysis at the end of the study.

All quantitative variables were estimated using measures of central location (mean, median) and measures of dispersion (standard deviation). All the descriptive data were expressed as mean ± SD. All data was tested for normal distribution. Student's t test was used for comparison of means of continuous variables and normally distributed data. The student t test and chi square test was used to analyze demographic data. Recovery scores, pain scores and hemodynamic variables were compared using the non parametric Mann Whitney U test and student t test. Incidence of adverse events was compared using chi-square test. The p value of $p<0.05$ was taken to be statistically significant.

RESULTS

A total of 80 patients were enrolled with 40 in either group after the randomization. All the patients were subject to the statistical analysis with no drop out from the study (Figure 1). The demographic and the preoperative hemodynamic and respiratory parameters were comparable in both the groups (Table 1). The mean duration of surgery in group 1S was 56.81±9.15 minutes (Mean ± SD) found to be more than that in Group 2G 49.13±9.241 minutes and was statistically significant ($p<0.05$).

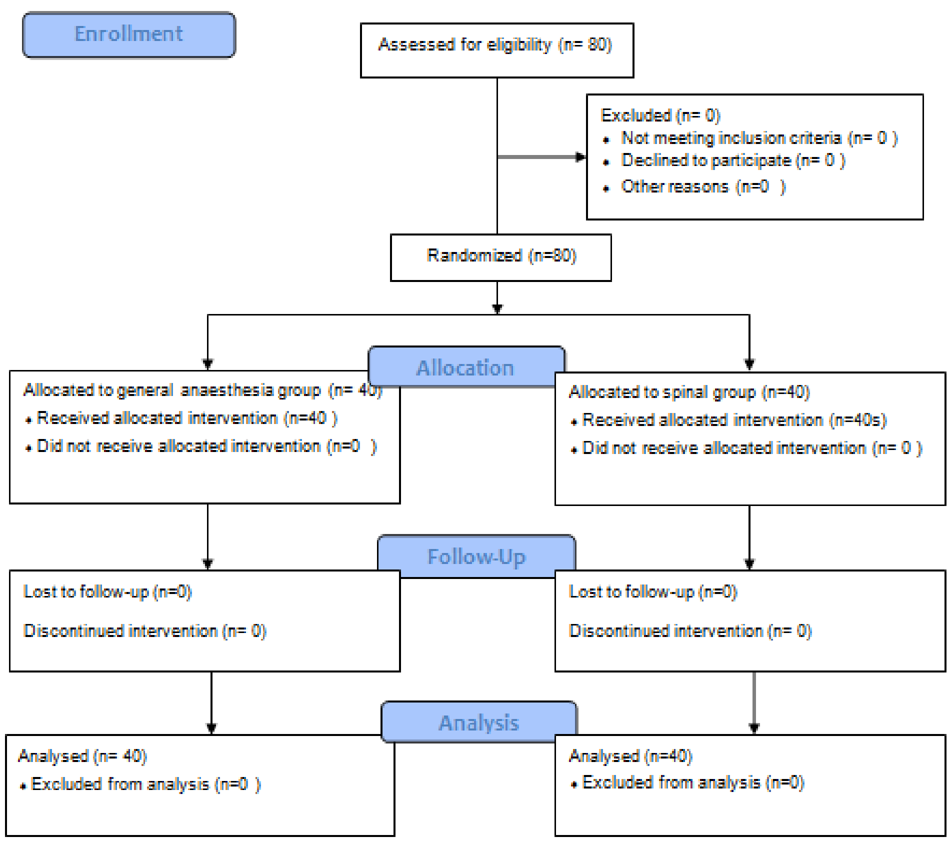

Figure 1. Consort diagram.

Table 1: Demographic data (MEAN + S.D.)		
	Group S (Spinal Anaesthesia)	Group G (General Anaesthesia)
AGE (Years)	40.11 ±10.231	43.25 ± 9.325
WEIGHT (Kilograms)	62.5 ±7.572	60.58 ± 9.753
HEIGHT (cm)	155.17± 5.695	155.35 ± 4.638
BMI	25.94 ±2.61	25.02 ± 3.35
SEX (M/F)	11/25	9/13
ASA (I/II)	23/13	27/13

Intraoperative haemodynamic parameters that included heart rate (Table 2) , systolic blood pressure and diastolic blood pressure, were found to be significantly low in group 1S at 5 minutes to 70 minutes.

While respiratory rate was adjusted in group 2G to maintain eucapnia, patients in group 1S exhibited significantly high respiratory rate in comparison to group 2G at 1 minute till 60 minutes after which results were statistically insignificant.

No difference was observed in the oxygen saturation in either group. While 17 patients in group 1S (47.22%) were administered atropine for symptomatic bradycardia, only 2 (5%) patients in group 2G required atropine that was statistically significant . Requirement of mephentermine was observed to be higher in group 1S (66.66%) than in group 2G 1S as compared to 2(5%).

Intraoperative shoulder pain was significant in patients receiving sub arachanoid block. While pain was relieved with local anaesthetic spray and intravenous analgesics in 36 (77.77%) patients, 4 (10%) patients had to be administered general anesthesia to relieve the same.

The preoperative pH values were comparable in both the groups. However, post insufflation, pH values were 7.32±0.042 (Mean± SD) and were statistically lower in Group 1S than group 2G with values of 7.34±0.041. Post desufflation values among both groups were comparable and statistically non significant. The mean post insufflation PaO_2 values significantly were lower in group 1S (155.58 ±36.95) than group 2G (193.36± 43.77) while mean post desufflation PaO_2 values were comparable in both the groups. However the post desufflation PaO_2 values were statistically higher in both the groups when compared to the preoperative values. The intraoperative mean postinsufflation and postdesufflation $PaCO_2$ values were significantly higher in group 1S (Table 3). The mean postoperative recovery scores for respiration, circulation, consciousness and O_2 saturation as judged by modified

Table 2: Intraoperative heart rate (Per Minute)

Group	Baseline	1 MIN	3 MIN	5 MIN	7 MIN	10 MIN	15 MIN	20 MIN	25 MIN	30 MIN	35 MIN	40 MIN	45 MIN	50 MIN	55 MIN	60 MIN	65 MIN	70 MIN
1S	84.31 ± 12.24	88.58 ± 16.96	88.86 ± 21.09	80.47 ± 18.30	73.56 ± 14.40	67.00 ± 11.47	64.39 ± 11.25	62.36 ± 14.15	62.39 ± 13.51	64.42 ± 12.69	67.7 ± 11.43	69.75 ± 10.88	68.94 ± 7.01	68.94 ± 7.39	69.35 ± 6.13	70.67 ± 6.06	70.53 ± 7.29	68.7 ± 8.38
2G	85.60 ± 11.33	94.35 ± 15.58	91.93 ± 12.73	*89.53 ± 15.71	*84.55 ± 15.16	*81.08 ± 14.40	*78.33 ± 13.61	*77.55 ± 15.73	*77.00 ± 18.31	*75.23 ± 19.58	*77.70 ± 18.82	*79.18 ± 17.33	*82.66 ± 16.46	*81.70 ± 16.76	*87.93 ± 17.57	*88.55 ± 15.37	*91.75 ± 16.78	*10.00 ± 16.97

*$p<0.05$

Aldretescore, were significantly lower on arrival in PACU till one hour in group 2G except for the muscle strength in lower extremity which was lower in group 1S. Recovery scores were comparable in both groups at 60 minutes (Table 4).

Table 3: ABG analysis

		GROUP 1S	GROUP 2G
PH	PREOPERATIVE	7.37+0.042	7.39+0.037
	POST INSUFFLATION	7.32+0.042	*7.34+0.041
	POST DESSUFLATION	7.34+0.036	7.35+0.048

		PREOPERATIVE	POST DESSUFLATION
pH	GROUP 1S	7.32 + 0.042	*7.34 + 0.036
	GROUP 2G	7.39 + 0.037	*7.35 + 0.048

*p<0.05

		GROUP 1S	GROUP 2G
$PaCO_2$	PREOPERATIVE	38.700 + 2.9068	37.460 + 2.631
	POST INSUFFLATION	44.000 + 2.8563	*38.593+ 3.8507
	POST DESSUFLATION	42.844 + 3.2512	*39.805 +3.6085

		PREOPERATIVE	POST DESSUFLATION
$PaCO_2$	GROUP 1S	38.700+2.9068	*42.844+3.2512
	GROUP 2G	37.460+2.6311	*39.805+3.6085

*p<0.05

		GROUP 1S	GROUP 2G
PaO_2	PREOPERATIVE	100.48 + 14.443	97.14 + 13.235
	POST INSUFFLATION	155.583 + 36.9589	*193.363+ 43.7793
	POST DESSUFLATION	110.008 + 16.0179	*113.530 +33.7496

		PREOPERATIVE	POST DESSUFLATION
PaO_2	GROUP 1S	100.48 +14.443	*110.008 + 16.0179
	GROUP 2G	97.14 + 13.235	*113.530 + 33.7496

*p<0.05

		GROUP 1S	GROUP 2G
bicarbonate	PREOPERATIVE	21.953 + 4.3073	21.540 + 1.9525
	POST INSUFFLATION	22.733 + 1.7905	*20.961+ 2.0903
	POST DESSUFLATION	23.032 + 1.3001	*21.251 +2.2852

		PREOPERATIVE	POST DESSUFLATION
bicarbonate	GROUP 1S	21.953 + 4.3073	*23.032 + 1.3001
	GROUP 2G	21.540 + 1.9525	*21.251 + 2.2852

*p<0.05

		GROUP 1S	GROUP 2G
Base excess	PREOPERATIVE	21.953 + 4.3073	21.540 + 1.9525
	POST INSUFFLATION	22.733 + 1.7905	*20.961+ 2.0903
	POST DESSUFLATION	23.032 + 1.3001	*21.251 +2.2852

		PREOPERATIVE	POST DESSUFLATION
Base excess	GROUP 1S	-1.959 +2.2294	-2.442 + 2.2433
	GROUP 2G	-1.835 + 2.3137	*-3.387 + 3.2580

*p<0.05

		GROUP 1S	GROUP 2G
SPO_2	PREOPERATIVE	97.775 + 1.3952	97.198 + 1.8267
	POST INSUFFLATION	98.739 + .9299	98.882+ 1.3690
	POST DESSUFLATION	98.144 + .9820	97.553 +1.5637

		PREOPERATIVE	POST DESSUFLATION
SPO_2	GROUP 1S	97.775+1.3952	98.144+.9820
	GROUP 2G	97.198+1.8267	97.553+1.5637

*p<0.05

Acidosis and alkalosis

	Group 1S	Group 2G
Post insufflation acidosis	26(72.22%)	22 (55%)
Post insufflation alkalosis	0	0
Post desufflation acidosis	21 (58.33%)	15 (37.5%)
Post desufflation alkalosis	0	0

*p<0.05

Table 4: Mean (Mean + S.D.) post operative diclofenac and ondanseteron consumption

	Diclofenac (mg)	Ondansetron (mg)
Group 1S	108.33 + 45.513	2.08 + 3.166
Group 2G	*155.63+ 46.163	*7.68 + 2.654

Post operative mean VAS scores were lower in patients who received spinal anesthesia at 0, 1, 3 and 6 hours and they also demonstrated lower rescue analgesic consumption in first 24 hours. The mean total analgesic consumption (mgs) was significantly higher in group 2G (155.63± 46.51) as compared to group 1S (108.33±45.51) (Table 5, 6).

Table 5: Adverse effects

	Group 1S	Group 2G
Nausea	5	*16
Vomiting	2	5
Headache	1	1
Urinary retention	0	1
Pruritus	5	*0
Backache	2	0

*p<0.05

Table 6: Mean (mean + sd) (mean post operative abdominal pain vas scores)

	0 hour	1 hour	3 hour	6 hour	12 hour	24 hour
Group 1S	0.00	0.00	23.03	41.58 ± 18.94	33.89 ± 17.20	23.56 ± 16.07
Group 2G	*62.25 ± 14.40	*31.75 ± 9.64	*33.95 ± 12.77	*51.83 ± 15.79	39.38 ± 18.54	16.63 ± 10.02

*p<0.05

Post operative mean heart rate, Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) were significantly lower in group 1S upto 1 hour for SBP and DBP and 3 hours for heart rate. Beyond these time intervals the values were comparable in both the groups. Mean respiratory rate was significantly higher in group 1S till one hour in the post operative period beyond which the values were comparable in both the groups. Post operative shoulder pain was comparable in both the groups upto 24 hours.

Post operative nausea and subsequent anti emetic consumption over 24 hours was significantly higher in group 2G (Table 7). Pruritis was reported (5 out of 40) to be more in group 1S.

Table 7: Mean (mean + SD) recovery score (modified aldrete score) excluding muscle strength

	On arrival in PACU	At 30 mins in PACU	At 1 hr in PACU
Group 1S	7.97 ± 0.29	8.00 ± 0.0	8.00 ± 0.0
Group 2G	*7.52 ± 0.67	*7.85± 0.42	8.00 ± 0.0

*p<0.05

25 Patients in group 1S rated the comfort during the anesthetic technique to be moderate to poor in the post operative questionnaire. Only 80.5% patients in group 1S recommended spinal anesthesia as an alternative technique for their acquaintances vis a vis to 95% in group 2G who recommended general anaesthesia for laparoscopic cholecystectomy.

In post operative questionnaire, 27.2% surgeons rated the condition of surgical field as very easy in group 1S as compared to 42.4% in group 2G. The surgeons were of the opinion that muscle relaxation could have been better in patients receiving spinal anesthesia.

DISCUSSION

Regional anesthetic techniques have not gained much popularity over general anesthesia for laparoscopic cholecystectomy. This is mainly due to the notion of increased pulmonary complications mainly pulmonary aspiration secondary to creation of pneumoperitoneum that may not be well tolerated by an awake patient thus making tracheal intubation an apparent choice during the procedure[11]. Also the paucity of data to predict the patient behaviour, hemodynamic and respiratory changes during pneumoperitoneum with neuraxial blockade as high as T4 level makes it a less tangible alternative.

Over the last decade, the utility of regional anesthesia as a sole anesthetic technique or in combination with general anesthesia has been demonstrated especially in high risk patients for laparoscopic procedures. Many recent studies have also demonstrated the benefits of regional anaesthesia in patients undergoing laparoscopic cholecystectomy which include reduction of stress response to surgery, avoidance of airway instrumentation, good muscle relaxation, excellent intraoperative and postoperative analgesic efficacy and lower incidence of deep vein thrombosis[12].

The present study was conducted in ASA I and II patients scheduled to undergo laparopscopic cholecystectomy and it was found that spinal anesthesia can be safely used as an alternate anesthetic technique to general anesthesia provided we foresee the problems that can be encountered and devise the strategy to tackle them pre-emptively.

In the present study, the reported mean operating time for surgery under spinal anesthesia was more as compared to the literature. This could be due to slightly modified technique of low pressure pneumoperitoneum (12 mmHg instead of 14-15 mmHg) along with lower rate of CO_2 insufflation[12,14] and local anaesthetic irrigation in abdominal cavity before start of procedure which led to an increase in the operative time in this group.

It has been suggested that incidence of intraoperative right shoulder pain requiring more intravenous analgesia and/ or necessitating anaesthetic conversion increases significantly with the increase in the intraabdominal pressure. We tried to circumvent this factor by the use of low pressure pneumoperitoneum as well as by slow rate of initial insufflation[15].

In the present study, spinal anesthesia had to be converted to general anesthesia in 4 patients. Similar conversions have been reported by Hamad and Ibrahim El-Khattary (10%)[16], Yuksek et al.,[2] and Sinha et al[7] where reverse Trendelenburg position and right shoulder elevation were used in spinal anaesthesia group. However Tzovaras et al.,[1] reported no anaesthetic conversions when minimal position changes were employed. This observation suggests that use of a minimal reverse-Trendelenburg and a minimal right shoulder elevation may assist in lowering anaesthetic conversion to general anaesthesia. Gautam[10] cited adequate explanation of the procedure to the patient and reassurance vital for the success of laparoscopic cholecystectomy under spinal anaesthesia.

In the present study, intraperitoneal irrigation with local anaesthetic solution before the start of procedure was found to be effective in significantly reducing intraoperative right shoulder pain in many patients. Our results are similar to the observations made by Yuksek et al.,[1] who too reported relief of shoulder pain with local anaesthetic solution.

The results of the present study in relation to relief of pain in the intraoperative and immediate period are in line with those of Bessa et al.,[8] and Tzovaras et al.,[1] that reaffirms the superiority of spinal anesthesia in the control of pain in intraoperative and immediate postoperative period when compared to general anesthesia leading to better acceptance as a day care procedure, besides having a lower cost. There is a likely possibility that local anaesthetic spraying in the spinal anaesthesia group might have contributed to lower VAS pain scores as compared to 2G group.

Shoulder pain has been reported after both general (35%-63%) as well as regional anesthesia[1,7,17,18]. In the present study too the post operative shoulder pain was comparable in both the groups. Unseen factors need to be explored which can accurately predict whether pain can be abolished by measures adopted in the present study or not. With an observation that symptomatic pain relief in post operative period is better in patients receiving spinal anesthesia makes it an appropriate choice to decrease the development of chronic pain[19].

As far as hemodynamic parameters are concerned, hypotension that was observed in patients receiving spinal anesthesia was easily managed with intravenous fluids and intermittent vasopressors with no continuous pharmacological hemodynamic support. The results are similar to those of Bessa et al.,[8] and Tzovaras et al.,[1] who reported hypotension in 30% and 59% of the patients receiving spinal anesthesia respectively in their studies. However, the incidence of bradycardia in the present study (47.22%) is higher than the that reported by Gautam[10] (0%) and Jimenez et al.,[20] (33%) which may be attributed to lower (8-10 mm) intra-abdominal pressure employed and minimal tilting of operating table that was employed in their studies.

In the present study, although creation of pneumoperitoneum produced significant acid base alterations such as decrease in pH and bicarbonate and an increase in PaCO2 in both the study groups with incidence of post desufflation acidosis being 58.33% and 37.5% in spinal and general anaesthesia group respectively, no impact on oxygenation was observed in both groups.

CONCLUSION

Spinal anesthesia can be used as sole anesthetic technique in patients undergoing elective laparoscopic cholecystectomy especially in patients where general anesthesia carries its own inherent risks. However adequate preparation and readiness is mandatory to manage the hemodynamic events and conversion to general anesthesia, if required in patients having considerable intraoperative discomfort not amnenable to corrective measures.

FOOTNOTES

Source of Support: Nil

Conflicts of Interest: Nil

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