Original Article

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Comparative Study between General Anesthesia and Combined General Anesthesia with Spinal Anesthesia in Laparoscopic Cholecystectomy

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Abstract

Background: The goal of anesthetic management in patients undergoing laparoscopic surgical procedures include management of pneumoperitoneum. Regional anesthesia such as epidural and spinal can be used with general anesthesia (GA) for laparoscopic surgery with standard pressure pneumoperitoneum.

Materials and Methods: A total of 60 patients of American Society of Anaesthesiologist physical Grades I or II undergoing laparoscopic cholecystectomy surgeries with standard pressure pneumoperitoneum (intraabdominal pressure = 12-15 mmHg) were randomly divided into 2 groups with 30 patients in each group. Group A underwent the procedure under GA as per preset protocol. Group B underwent the procedure under combined spinal anesthesia (SA) followed by GA. In both the groups, systolic and diastolic blood pressure, heart rate, bradycardia, hypotension, oxygen saturation (SPO_2), and electrocardiography with ST segment analysis were recorded. Patients were enquired about nausea and vomiting, headache, sore throat, transient neurological symptoms, and pain in post-operative area. Carbon dioxide insufflation pressure was 12-15 mmHg.

Results: Group B, receiving combined spinal with GA, was more hemodynamically stable as compared to the Group A. All three hemodynamic parameters pulse rate, systolic blood pressure, diastolic blood pressure were elevated throughout the procedure in the GA group. Bradycardia was seen in 2 and hypotension in 5 cases in the Group B group. The surgeons did not find any significant difference in the operating conditions or muscle relaxation between the two groups. Patients in both the groups maintained adequate SPO_2. Post-operative nausea and vomiting was seen in 30% cases in the GA group and in 6.7% in Group B. Post-operative analgesia was better in the Group B for duration of 6-h, after which there was not much difference in both the groups.

Conclusion: GA if combined with SA is a feasible, safe and effective alternative to GA alone, providing stable hemodynamics, less neuroendocrine stress response, good surgical conditions, pain-free post-operative period, and minimal post-operative sequel.

Key words: Combined spinal anesthesia with general anesthesia, General anesthesia, Laparoscopic cholecystectomy

INTRODUCTION

From the advent of the surgical era of medicine, there has been a constant search for better surgical modalities, techniques, and tools. The 20th century found the dawn of a new surgical modality, which gained rapid acceptance from both the surgical fraternity and the patients. Minimally invasive surgery has virtually revolutionized the surgical therapy for a large variety of diseases, the most common used are endoscopic surgeries such as laparoscopic surgery. The first laparoscopic cholecystectomy, which might be regarded as the birth of minimally invasive surgery, was performed by Philippe Mouret in Lyons in March 1987.[1] The number of minimally invasive surgeries has increased exponentially worldwide over the past few decades as it provides less post-operative pain, decreased hospital stay, decreased cosmetic disfigurement and a quicker resumption of normal activities.[2] However, new surgical procedures translate to new anesthetic challenges demanding changes

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in anesthesia techniques. Although it has many benefits than conventional surgeries, it still causes stress hormone responses (cortisol, epinephrine, and norepinephrine) to some extent, especially when carbon dioxide (CO_2) pneumoperitoneum is concomitantly used in laparoscopic surgery. Increased peripheral vascular resistance, elevated serum catecholamine level, and decreased cardiac output (CO) in laparoscopic procedures might entail hemodynamic fluctuation which, in turn, compromises tissue perfusion. In addition, ventilatory impairment and diaphragmatic dysfunction also occur after laparoscopic surgery. Hence, laproscopy is only anatomically minimally invasive but physiologically it is otherwise. These insults if befall risky patients might sometimes court disaster, especially those with cardiopulmonary disease.

Increasing perioperative efficiency has become increasingly important in the modern day practice of anesthesiology. The role of the anesthesiologist has evolved from that of a physician primarily concerned with providing optimal surgical conditions and minimizing pain immediately after the operation, to that of a perioperative physician responsible for ensuring that patients with coexisting medical conditions are optimally managed before, during and after surgery.[3,4] The evaluation of clinically meaningful outcomes (e.g., quality of recovery, resumption of normal activities of daily living) has increasingly become a focal point of anesthesia-related clinical research involving new drugs and techniques.[5]

Even though there are several advantage of laparoscopic procedures, the adverse effects during the procedure are related to the cardiopulmonary effects of pneumoperitoneum, systemic CO_2 absorption, venous gas embolism. Although the changes in CO and preload are still matters of debate, many studies have found a marked increase in systemic vascular resistance.[6,7] These alterations in hemodynamic parameters need vigilant monitoring intra-operatively.

General anesthesia (GA) as the only suitable technique for laparoscopic procedures is a concept of the past. There is growing evidence suggesting that regional anesthesia has an important role to play in the care of patients undergoing laparoscopic procedures. Regional anesthesia such as epidural and spinal is can be used with GA for laparoscopic surgery with standard pressure pneumoperitoneum (intraabdominal pressure 12-15 mmHg). Key benefits of regional anesthesia if combined with GA include, decreased peritoneal stretch pain, decreased need for sedatives and narcotics and analgesics, better muscle relaxation and decreased surgical stress response and better hemodynamics, with post-operatives analgesia, improved bowel motility, and fast recovery.

Our study is designed to evaluate the feasibility of spinal anesthesia (SA) combined with GA in laparoscopic cholecystectomy and to compare the intra-operative surgical conditions, hemodynamic changes with GA and post-operative requirement of rescue analgesic and incidence of post-operative nausea and vomiting (PONV).

MATERIALS AND METHODS

The present study was carried out from June 2014 to May 2015, after taking the permission and approval from the departmental Ethical Committee and the written informed consent from the patients. It was a prospective, randomized, comparative clinical study. 60 American Society of Anaesthesiologist Physical status Grades I or II patients between 20 and 60 years, of either sex were posted for surgeries. A detailed pre-anesthetic evaluation was done to evaluate their basal heart rate (HR), blood pressure (BP). Patients were kept nil orally for 6-8 h prior to surgery and were randomly assigned to one of the two groups, either GA-Group A or combined SA with GA - Group B. On arrival in the operation theater, monitors were attached and baseline parameters such as HR, systemic arterial pressure, electrocardiograph (ECG), and peripheral oxygen saturation (SPO_2) were noted down. An appropriate sized intravenous cannula was placed *in situ*. Both the groups were preloaded with 10 ml/kg of ringer lactate.

In Group A patients, all patients underwent similar general anesthetic procedure. Patients were premedicated with ondensetron 4 mg, midazolam 0.05 mg/kg intravenously. Patients were induced with fentanyl 2 mcg/kg, thiopentone sodium 5 mg/kg, vecuronium bromide 0.1 mg/kg. Anesthesia was maintained with 40% oxygen in nitrous oxide and vecuronium bromide 0.05 mg/kg which was repeated every 20 min thereafter. Tidal volume and the ventilatory frequency was adjusted and intermittent positive pressure ventilation done to maintain end-tidal CO_2 between 32 and 36 mmHg. Pnemoperitoneum was created by insufflation of CO_2 and maintained at 12-15 mmHg. At the end of surgery, residual neuromuscular block was reversed by an appropriate dose of neostigmine 0.05 mg/kg and glycopyrrolate 0.01 mg/kg intravenously and after extubation patients transferred to the recovery room.

In Group B patients, same protocols followed except after premedication patient was put to left lateral position and under strict aseptic precaution lumbar puncture was performed using 27-gauge disposable Quincke type of spinal needle at L3-L4 spinal intervertebral space by midline approach. After the free flow of cerebrospinal fluid, 3 cc of heavy bupivacaine hydrochloride was injected intrathecally, the time and vital parameters noted after subarachnoid block (SAB). After the level of sensory blockade up to T4 was achieved, the patient was given GA as in Group A, vitals noted as preset proforma. During intra-operative period any hypotention, bradycardia were monitored during the surgical procedure. In both the groups, systemic blood pressure including the systolic blood pressure (SBP) and diastolic blood pressure (DBP), HR, SPO_2 and ECG with ST segment analysis were recorded at the following points of time: Prior to induction or pre-operative, at 1, 2, 3, 4, 5 min after intubation in Group A and after intubation of SA with GA in Group B, immediately after pneumoperitoneum and every 15 min thereafter. The intra-operative conditions and muscle relaxation was assessed by asking the surgeon to grade them as bad/good/excellent. In the post-anesthesia care unit, all the patients were monitored for any evidence of complications or adverse events. Patients were enquired about nausea and vomiting, headache, sore throat, transient neurological symptoms. Pain was analyzed using visual analog scale (VAS) and assessed at 1, 3, 6, 9, and 12 h. Intensity of pain was assessed by using 10-point VAS representing varying intensity of pain from 0 (no pain) to 10 (worst pain). Rescue analgesic diclofenac sodium 75 mg intramuscular was given when VAS was 6 or more. If any patient experienced nausea and/or vomiting, rescue antiemetic metaclopramide (0.1 mg/kg) intravenously was given. The results obtained in the study were presented in a tabulated manner.

RESULTS

The results obtained in the study were presented in the tabulated manner. A statistical analysis was done by sample "*t*" test. ANOVA and Chi-square test were performed for nonparametric values and corresponding *P* values was computed using SPSS for windows (statistical presenting system software version 17). $P < 0.05$ was considered statistically significant. 60 patients undergoing elective laparoscopic cholecystectomy over 1 year were randomly divided into two groups. Group A ($n = 30$) who underwent the procedure under GA and Group B ($n = 30$) who underwent the procedure under combined spinal with GA.

Age profiles were compared between the two groups of patients using Chi-square test, and no significant difference was found (Table 1).

Sex profiles were compared between the two groups of patients using Chi-square test, and no significant difference was found (Table 2).

Using 2 independent sample *t*-test $P > 0.05$, therefore, there was no significant difference between the two groups with respect to weight (kg) (Table 3).

Intra-operative comparison of mean pulse rate (PR) in Group A and Group B. Group B shows less tachycardia. The values at fixed intervals in both the Groups as shown in the observation table were observed. These values were compared using 2 independent sample *t*-tests. We found that there was a significant difference in PR values at post anesthesia intervals mentioned. Values were relatively lower in Group B and the difference was found to be statistically significant ($P < 0.05$) (Table 4).

Recorded the values at fixed intervals in both the Groups as shown in the observation table. These values were

Table 1: Age distribution

Age group (years)	n (%)	
	Group A	Group B
<30	15 (50)	16 (53.3)
31-45	13 (43.3)	12 (40)
45 and above	2 (6.7)	2 (6.7)
Total	30 (100)	30 (100)

χ^2=0.09, *P*=0.96 (NS), NS: Not significant

Table 2: Sex distribution

Gender	n (%)	
	Group A	Group B
Male	10 (33)	11 (36.6)
Female	20 (67)	19 (63.7)
Total	30 (100)	30 (100)

χ^2=0.0733, *P*=0.78 (NS), NS: Not significant

Table 3: Weight distribution

Group	Weight (kg) Mean±SD
Group A	58.56±5.16
Group B	57.72±5.25

t=0.57, *P*=0.58 (NS), NS: Not significant, SD: Standard deviation

Table 4: Changes in PR in two groups

Time interval (min)	Mean±SD		t value	P value	Significance
	Group A (PR)	Group B (PR)			
Pre-operative (PI)	80.5±9.2	74.6±8.5	2.37	0.02	S
1	105.7±10.5	77.8±10.4	9.42	0.00	S
2	103.5±10.1	76.0±7.1	11.16	0.00	S
3	104.1±9.9	73.5±7.0	12.62	0.00	S
4	103.4±9.0	72.2±6.9	13.79	0.00	S
5	101.4±9.5	74.4±8.0	10.88	0.00	S
At pneumo (PP)	114.7±11.4	81.4±5.9	13.01	0.00	S
15	112.4±8.3	75.0±10.3	14.14	0.00	S
30	105.9±10.3	71.4±10.2	11.91	0.00	S
45	105.0±11.6	71.7±6.2	10.34	0.00	S
60	100.7±6.7	72.9±6.5	11.35	0.00	S

NS: Not significant, S: Significant, PI: Post intubation, At pneumo: Pneumoperitoneum, PP: Post pneumoperitoneum, PR: Pulse rate, SD: Standard deviation compared using 2 independent sample *t*-tests. We found that there was no statistical significant difference between Groups A and B with respect to SBP values at baseline. However, there was a significant difference in SBP values after anesthesia at mentioned intervals between the two groups. Values were relatively lower in Group B, and the difference was found to be statistically significant ($P < 0.05$) (Table 5).

Recorded the values at fixed intervals in both the Groups as shown in the observation table. These values were compared using 2 independent sample *t*-test. We found that there was no significant difference between Groups A and B with respect to DBP values at baseline ($P > 0.05$). However, there was a significant difference in DBP values in post anesthesia at mentioned intervals between the two groups. Values were relatively lower in Group B, and the difference was found to be statistically significant ($P < 0.05$) (Table 6).

Group A had 30% of patients with PONV as compared to 6.7% in Group B. However, the incidence was not statistically significant (Table 7).

Recorded the values at fixed intervals in both the Groups as shown in the observation table. These values were compared using 2 independent sample *t*-test. There was a significant difference between the two groups with respect to VAS values during post-operative period until 6-h. Values were lower in Group B, and the difference was found to be statistically significant ($P < 0.05$). We also found that there was no statistically significant difference between Groups A and B with respect to VAS pain score post-operative 9 and 12 h ($P > 0.05$) (Table 8).

Table 5: Changes in SBP in two groups

Time interval (min)	Mean±SD		*t* value	*P* value	Significance
	Group A	Group B			
Pre-operative (PI)	121.8±11.2	121.3±7.4	0.18	0.86	NS
1	144.2±9.7	119.5±8.9	9.36	0.00	S
2	143.2±10.1	114.2±7.7	11.37	0.00	S
3	141.4±10.4	108.5±6.9	13.17	0.00	S
4	140.7±9.8	104.0±6.1	15.90	0.00	S
5	140.3±9.7	101.1±6.6	16.69	0.00	S
At pneumo (PP)	151.4±8.0	119.9±10.0	12.27	0.00	S
15	142.3±7.8	114.9±9.7	10.98	0.00	S
30	134.3±5.8	112.6±7.2	11.73	0.00	S
45	129.6±6.3	107.8±8.7	8.58	0.00	S
60	144.7±4.6	113.3±8.1	12.95	0.00	S

NS: Not significant, S: Significant, PI: Post intubation, At pneumo: Pneumoperitoneum, PP: Post Pneumoperitoneum, SD: Standard deviation

Table 6: Changes in DBP in two groups

Time interval (min)	Mean±SD		*t* value	*P* value	Significance
	Group A	Group B			
Pre-operative (PI)	74.8±7.0	79.0±3.3	2.70	0.01	NS
1	89.9±7.2	73.1±5.2	9.51	0.00	S
2	88.2±7.9	72.4±5.6	8.18	0.00	S
3	87.0±7.2	68.0±4.2	11.36	0.00	S
4	87.4±7.4	63.4±4.1	14.19	0.00	S
5	85.6±6.9	61.2±3.4	15.87	0.00	S
At pneumo (PP)	97.4±8.3	76.7±4.2	11.14	0.00	S
15	89.0±10.6	73.0±4.2	6.98	0.00	S
30	83.2±6.8	73.1±4.3	6.32	0.00	S
45	79.0±5.4	74.2±5.1	2.68	0.01	S
60	88.0±4.5	74.4±4.4	8.26	0.00	S

NS: Not significant, S: Significant, PI: Post intubation, At pneumo: Pneumoperitoneum, PP: Post Pneumoperitoneum, DBP: Diastolic blood pressure, SD: Standard deviation

Table 7: Post-operative nousea and vomiting

PONV	*n* (%)	
	Group A	Group B
Yes	9 (30)	2 (6.7)
No	21 (70)	28 (93.3)

χ^2=3.39, *P*=0.07, NS, NS: Not significant, PONV: Post-operative nausea and vomiting

Table 8: Mean pain score (VAS) in two groups

Time interval (h)	Mean±SD		*t* value	*P* value	Significance
	Group A	Group B			
1	7.1±0.8	0.1±0.3	40.11	0.01	S
3	5.6±0.7	2.0±0.8	17.59	0.00	S
6	4.7±1.5	4.5±1.1	0.54	0.59	NS
9	5.3±1.5	4.6±1.0	1.85	0.07	NS
12	4.9±1.0	4.1±1.9	1.83	0.07	NS

NS: Not significant, S: Significant, VAS: Visual analogue scale, SD: Standard deviation

DISCUSSION

GA has remained the most accepted modality of anesthesia for Laparoscopic cholecystectomy, while regional techniques have been shown to attenuate the metabolic and endocrine responses. However, the complications associated with GA has lead to the question whether the conventionally accepted sole modality of anesthesia, GA, is indeed a gold standard! The need for an additional modality of anesthesia with GA has led to studying various other options over the years. One of the most successfully used anesthesia with GA is spinal anesthesia. Various studies regarding its feasibility, patient comfort after the procedure, incidence of post-operative complications, recovery from anesthesia, ambulation, hospital stay and cost effectiveness due to decreased requirement of analgesia, have been conducted showing that it is indeed a good alternative to only GA, better than a sole, GA in various situations. All risks of SA are still present, and side effects such as hypotension, bradycardia, urinary retention, and others, should be expected in their usual rates.

Our study compared GA with combined spinal with GA. As there are incidences of conversion of SA to GA in some previous studies[8,9] due to intolerable pain after pneumoperineum with pressure of 12-15 mmHg, purpose of this study is to demonstrate that laparoscopic surgery done with standard pressure pneumoperitoneum can safely and effectively be performed with the patient under combined anesthesia, allowing the surgeon and anaesthesiologist a full complement of analgesia for the procedure.

In the present study, 60 patients undergoing laparoscopic cholecystectomy procedures were randomly assigned equally into GA Group (A) and combined spinal with GA Group (B). A statistical analysis of the age distribution ($x^2 = 0.09$, $P = 0.96$), sex distribution ($x^2 = 0.08$, $P = 0.78$), and weight distribution ($t = 0.57$, $P = 0.58$) all showed to be statistically insignificant. Hence, demographic characteristics are similar and comparable in both groups.

For each procedure, the surgeon was asked to opine regarding the surgical conditions and muscle relaxation as to whether it was bad/good/excellent. In all cases in the Group B, the surgeons did not find any difference in the operating conditions and muscle relaxation. Jesus de *et al.*,[10] and Pamela *et al.*,[11] assessed the surgical conditions in patients given SAB and concluded that SAB provided good intra-operative conditions with muscle relaxation as good as GA.

Group B patients unlike Group A patient showed less tachycardia intraoperatively. The mean HR preoperatively was statistically insignificant. The mean HR at different time intervals intraoperatively was higher in the GA group and was statistically significant at all time intervals. Bradycardia was found in 2 patients (8%) in the SA group which was managed with intravenous glycopyrrolate 0.2 mg uneventfully. Mehta *et al.*,[12] and Gautam[13] found no incidence of bradycardia in their studies, thus proving that bradycardia is not much of a threat.

Hypotension (i.e., >20% fall in BP) was noted in <20% cases, for which intravenous mephentermine 6 mg bolus was given in only 2 cases, and the rest were managed with intravenous fluids, while in group GA, hypotension was not seen in any patients. Sinha *et al.*,[14] reported hypotension in 18.21%, Mehta *et al.*,[12] in 30% of the cases, Hartmann *et al.*,[15] reported hypotension in 5.4% of their SA patients, Palachewa *et al.*,[16] had an incidence of 15.7%, Throngnumchai *et al.*,[17] 20.2%, and Hyderally[18] reported a 10-40% incidence. This then conclusively proves that the incidence of hypotension is no different whether laparoscopic surgery or open surgery is being done with SA.

Mean SBP and DBP was found to be higher in Group A compared to Group B at all time intervals during the procedure. Thus, indicating that SA if combined with GA provides an overall better hemodynamic picture as compared to only GA. An added cardiovascular advantage cited has been the decrease in surgical bed oozing because of hypotension, bradycardia and improved venous drainage associated with SA.[19]

In the post-operative period after SA with GA, there was no restlessness as is commonly seen after GA, and the patient is always receptive and more compliant to suggestions. A specific advantage of SA component, seems to be the decrease in the requirement of post-operative analgesia. The injectable analgesic was usually required early in post-operative period after extubation when only GA was used. The benefit of prolonged analgesia after SA has also been noted in other studies.[9,20,21] Intensity of pain was less in Group B as compared to Group A during early post-operative period until 6-h. There was no significant difference seen after this period.

Postural headache, one of the complications of SA was not seen in our study group B. The incidence of spinal headache has been variously quoted as 3.3%[22] 7.7%,[23] and 14%[24] after SA in open surgery.

There was no difference in occurrence of complications such as sore throat, relaxant-induced muscle pain, dizziness in both groups. But PONV was significantly low in Group B. It often create high morbidity after GA. In this context, PONV is, particularly, troublesome, and antiemetics may be required in as many as 50% of patients[22] and can delay discharge from the hospital in 7% of patients.[23] The problem with PONV was seen 8% in SA patients, but has been reported as high as 8.1% in another study of SA.[22] However, PONV is the highest after only GA, especially when high amounts of nitrous, opiate are used. In their presence, the rate can vary up to 60-70%.[24,25] Even with the newer agents like propofol and isoflurane, the incidence is as high as 30% and substantially increase the cost of anesthesia.[26] Our GA patients had an incidence of 20% of PONV, which was significantly higher compared with that in Group B patients. No significant difference was found in occurrence of sore throat in both the group.

Our initial experience with laparoscopic surgery under combined spinal with GA appears promising. We conclude that procedure is technically safe and feasible with excellent recovery and high degree of satisfaction in selected patients.

CONCLUSION

Our initial experience with laparoscopic surgery under combined spinal with GA appears promising. We conclude that procedure is technically safe and feasible with excellent recovery and high degree of satisfaction in selected patients. Large randomized control trials are needed before recommending this technique in larger population.

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