Section: Anaesthesia

Original Research Article

COMPARISON OF THE EFFECTS OF COMBINED GENERAL ANESTHESIA AND SPINAL ANESTHESIA VERSUS GENERAL ANESTHESIA ALONE ON HEMODYNAMIC PARAMETERS IN LAPAROSCOPIC GYNECOLOGICAL SURGERIES: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: General anesthesia (GA), by convention, remains the mainstay for all laparoscopic surgeries. The unopposed increase in systemic vascular resistance (SVR) are related to the cardiovascular effects of pneumoperitoneum, systemic CO2 absorption and venous gas embolism. When spinal anesthesia (SA) is used in conjunction with general anesthesia, the sympathectomy resulting from the former may limit the rise in SVR. This study was designed to compare the effects of combining spinal and general anesthesia with that of general anesthesia alone on hemodynamic stability in laparoscopic gynecological surgeries

Materials and Methods: 100 patients aged 18-65 years with BMI between 18- 30 kg/m2 belonging to American Society of Anesthesiologist (ASA) physical status I &II undergoing elective laparoscopic gynecological surgeries in Government Medical College Kozhikode were divided into two groups of 50 each. One group received Combined spinal and General Anesthesia (Group SGA) and other received General Anesthesia alone (Group GA). In both the groups, following parameters were compared: Changes in mean arterial pressure(MAP) and heart rate(HR) during the creation of pneumoperitoneum upto 30 min in 5 min interval and thereafter every 10 min till closure, Total dose of propofol required, Recovery time, Surgeon's satisfaction by numeric rating scale (NRS) from 1 to 10.Statistical analysis was done using SPSS software version 20.Qualitative data were compared using Chi-square test and quantitative data compared using independent 't' test. A p-value of less than 0.05 was taken as significant.

Results: Both groups were comparable with respect to demographic data like age, BMI. Baseline heart rate (HR) and mean arterial pressure (MAP) were comparable in both groups. There was significant reduction in MAP and HR in group SGA as compared to group GA. Total dose of propofol required intraoperatively in Group GA was 578.18+70.74mg and in group SGA was 486.14+51.54mg. This resulted in early awakening with less recovery time. Surgeon's satisfaction was 7.12+0.96 and 9.16+0.79 in group GA and SGA respectively. These differences were statistically significant. Combining two anesthesia techniques, added their advantages and limit the side effects.

Conclusion: Concomitant use of spinal and general anesthesia can effectively attenuate the hemodynamic repercussions during pneumoperitoneum in laparoscopic gynecological surgeries than general anesthesia alone. Overall quality of anesthesia is better in terms of reduced anesthetic requirement, shorter recovery time and satisfactory operative field in combined technique.

Keywords: Hemodynamics, Laparoscopy, Pneumoperitoneum, Spinal Anesthesia.

INTRODUCTION

The introduction of laparoscopy in the field of surgeries in the mid-1950s revolutionized surgical techniques due to reduction in overall morbidity related to reduced hospital stay, early recovery, less surgical complications like reduced bleeding, reduced overall cost and post-operative complications.[1] However, new surgical procedures translate to new anesthetic challenges demanding changes in anesthesia techniques.

Although laparoscopic surgeries have many benefits than conventional surgeries, it still causes stress hormone responses, especially when carbondioxide (CO2) pneumoperitoneum is concomitantly used. Increased peripheral vascular resistance, elevated serum catecholamine level and decreased cardiac output (CO) in laparoscopic surgeries cause hemodynamic fluctuations which in turn compromises tissue perfusion.[2] Hence laparoscopy is only anatomically minimally invasive, but physiologically otherwise.

The adverse effects during the procedure are related to the cardiovascular effects of pneumoperitoneum, systemic CO2 absorption and venous gas embolism. Many studies have found a marked increase in systemic vascular resistance which has to be maintained by increasing the depth of anesthesia.[3,4] This eventually leads to unnecessary deepening of anesthesia, delayed awakening & do not prove cost effective.[2]

GA as the only suitable technique for laparoscopic surgeries is a concept of the past. Under GA alone, the hemodynamic derangements during pneumoperitoneum have to be managed by either increasing the anesthetic concentration or by administering vasodilators.

There is growing evidence that regional anesthesia plays an important role in the care of patients undergoing laparoscopy. When spinal anesthesia is used in conjunction with general anesthesia, the sympathectomy resulting from the former may limit the rise in SVR, thus overcoming the increased MAP. Other benefits include decreased peritoneal stretch pain, decreased need for opiods, better muscle relaxation, improved surgical field by contraction of bowels and decreased surgical stress response with better hemodynamics and faster recovery.[2]

The present study was designed to compare the effects of combining spinal and general anesthesia with that of general anesthesia alone on hemodynamic stability in laparoscopic gynecological surgeries, with the hypothesis that the sympathectomy due to spinal anesthesia overcomes the hemodynamic response of pneumoperitoneum.

MATERIALS AND METHODS

Study Design: Prospective Observational Cohort study

Study Period: 2019 January to 2020 March.

Study setting: A tertiary care teaching hospital, Govt. Medical College, Kozhikode.

Study Population: 100 females of 18-65years, belonging to American Society of Anesthesiologist's (ASA) physical status I or II undergoing elective laparoscopic gynecological surgery.

Sample size:

$$n = \frac{2\,[Z\alpha + Z\beta]\,*\,SD}{d}\,2$$

where, Zα =1.96; Zβ=0.84; SD= Standard Deviation, d=effect size

To detect a difference between the study groups, sample size was calculated using above formula and obtained as 46 in each group. Considering the drop outs sample size was taken as 50 in each group.

Group SGA: n=50, for Combined spinal and general anesthesia Group GA: n=50, for General anesthesia only

Inclusion Criteria

- Patients with ASA status I or II undergoing elective laparoscopic gynecological surgery.
- Age 18 - 65 years
- BMI 18-30 kg/m2

Exclusion Criteria

- Patients with ASA status III or IV
- Contraindications to spinal anesthesia
- Patient refusal
- Patients with valvular heart diseases, coronary artery disease.
- Patients undergoing diagnostic laparoscopy.

Methods:

After obtaining institutional ethics committee approval, 100 patients scheduled for laparoscopic gynecological surgeries were selected on the basis of inclusion and exclusion criteria. A detailed pre-anesthetic evaluation was done for all patients.

On the day before surgery, procedure was explained to each patient and written informed consent was taken for participation to the study. The patients were grouped into two to receive either combined spinal and general anesthesia (group SGA) or general anesthesia alone (group GA).

All patients were kept nil per oral overnight and premedicated on the previous night of surgery with Tab. Alprazolam 0.50mg, Tab. Metoclopramide 10mg and Tab. Ranitidine 150mg. Also Tab. Metoclopramide 10mg and Tab. Ranitidine 150mg were given on the morning of surgery.

In the operating room, monitors were attached and baseline parameters such as electrocardiogram, heart rate, non-invasive blood pressure(systolic and diastolic BP, mean arterial pressure), respiratory rate, oxygen saturation (SpO2) and end tidal CO2 (EtCO2) were recorded.

An intravenous (IV) line was secured with No.18G cannula and all patients were coloaded with Normal saline 10ml/kg. Patients were premedicated with Midazolam 1mg intravenously.

Group SGA patients were put to left lateral position and under aseptic precautions, spinal anesthesia was given with 25G Quincke type spinal needle at L3- L4 intervertebral space. Free and clear flow of

cerebrospinal fluid was confirmed. 2ml of heavy bupivacaine hydrochloride was injected intrathecally. Onset of sensory blockade was checked by pin prick and motor block assessment was carried out with Modified Bromage scale. Sensory blockade upto T4 was achieved. A waiting period of 10 min was allowed before GA induction and a total of 20 min was taken before head down position.

Changes in HR and MAP was monitored after giving spinal anesthesia till induction. Any occurrence of hypotension (>20% fall in blood pressure) and bradycardia (HR <50/min) was managed by administering IV fluids and inj. ephedrine 6 mg boluses and inj. atropine 0.02mg/kg intravenously respectively. Any cases of failed SA was excluded from the study and was managed by GA alone.

Patients were given Ondansetron 4 mg, Glycopyrrolate 0.2mg, Fentanyl citrate 2mcg/kg intravenously and preoxygenated prior to induction. General anesthesia was induced with thiopentone sodium 2.5% in a dose sufficient to abolish eyelash reflex and neuromuscular blockade was achieved with Inj.vecuronium bromide 0.1mg/kg intravenously. Airway was secured with endotracheal tube of appropriate size. Anesthesia was maintained with Nitrous oxide and Oxygen mixture (60:40), Propofol infusion and muscle relaxation was maintained using intermittent doses of vecuronium bromide. Inj. Paracetamol 1 g was given intravenously before the start of skin incision.

During maintenance, rate of propofol infusion was started at the lowest dose of 3mg/kg/hr and thereafter incremental doses was adjusted to maintain HR and MAP within 20% of the baseline value to ensure adequate depth of anesthesia.

Tidal volume and ventilator frequency was adjusted to 5-8 ml/kg and

10-14/min respectively to obtain an end-tidal carbon dioxide (EtCO2) value between 25 and 35 mm Hg during pneumoperitoneum. Carbon dioxide was used for pneumoperitoneum and the pressure was kept between 12 to 15 mmHg for all patients. Time of creation of pneumoperitoneum was noted. Propofol infusion was stopped during skin closure.

When the procedure is over, residual neuromuscular block was reversed by Neostigmine 0.05mg/kg and Glycopyrrolate 0.01mg/kg. After reversal, nitrous oxide was cut off and tracheal extubation was performed when patients achieve a regular spontaneous breathing pattern and able to follow the commands. Thereafter patients were transferred to post anesthesia recovery room.

In Group GA patients, same protocols were followed except giving spinal anesthesia. In both the groups, following parameters were compared:

1. Changes in MAP and HR during the creation of pneumoperitoneum upto 30 min in 5 min interval and thereafter every 10 min till closure.
2. Total dose of propofol required (in mg/kg).
3. Recovery time (Time from stoppage of propofol infusion to tracheal extubation)
4. Surgeon's satisfaction by numeric rating scale from 1 to 10 (10 indicating the best possible field)

Statistical analysis: Statistical analysis was done using SPSS software version 20. Qualitative data were compared using Chi- square test and quantitative data compared using independent 't' test. A confidence interval of 95% was used in all statistical tests and p< 0.05 value was considered as statistically significant. All values are expressed as mean with standard deviation.

RESULTS

A total of 100 patients, 50 patients each in group GA and group SGA, belonging to ASA I and II were enrolled in the study. Both the groups were compared for demographic variables like ASA status, BMI and age distribution and they were similar.

Hemodynamic parameters:

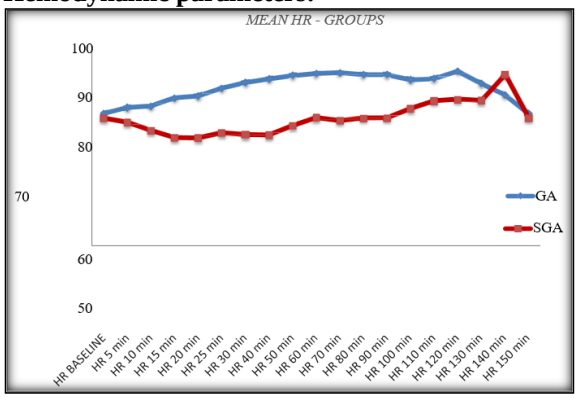

Figure 1: Comparison of Mean HR

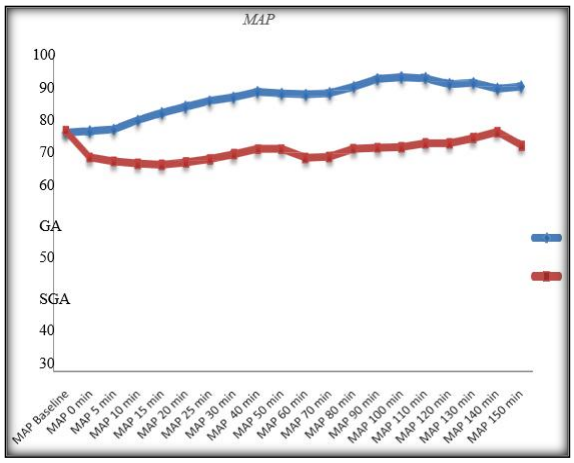

Figure 2: Comparison of Mean arterial pressure

Base line mean heart rates were comparable as p value was 0.646. There was no significant difference between these groups at 0 minutes during pneumoperitoneum with p value more than 0.05. There was significant difference between these groups at 5 min of pneumoperitoneum up to 150 min with all p - value < 0.05 with heart rate being less in group SGA.

Base line MAP was comparable as p- value was 0.789. Baseline MAP in Group SGA was 82.7800+8.80mmHg, whereas in Group GA it was

83.2400+8.31mmHg. There was significant rise in MAP throughout pneumoperitoneum in Group GA and was statistically significant with p value < 0.05 when compared to group SGA. No significant post spinal hypotension(<20 %) was observed in group SGA.

Table 1: Total dose of propofol used intraoperatively

	GROUP	N	Mean	SD	p- value	Inference
Total dose of propofol used intraoperatively	GA	50	578.1800	70.74666	<0.001	Significant Difference
	SGA	50	486.1400	51.54036		

During maintenance, rate of propofol infusion was started at the lowest dose of 3mg/kg /hr and adjusted to maintain HR and MAP within 20% of the baseline value.

Table 2: Recovery time (Time from stoppage of propofol infusion to tracheal extubation).

	Group	N	Mean	SD	p-value	Inference
Recovery Time(min)	GA	50	15.5600	2.89377	<0.001	Significant Difference
	SGA	50	9.7600	2.59953		

Recovery was early and rapid in group SGA compared to group GA.In Group GA, Mean recovery time was 15.56 +2.89min whereas it was 9.76+2.59min in SGA group.

Table 3: Surgeon's Satisfaction

	GRO UP	N	Mean	SD	p- value	Inference
Surgeon's Satisfaction (NRS)	GA	50	7.1200	0.96129	<0.001	Significant difference
	SGA	50	9.1600	0.79179		

Surgeons were asked to grade the operative field on the basis of bowel contractility and need for head low. Surgeon's satisfaction was quantified by numerical rating scale(NRS) from 1 to 10, with 1 meaning poor operative field and the need for maximum head low and 10 meaning best operative field with minimum head low. In our study, we found that NRS in SGA group was higher with that of GA group.

DISCUSSION

Laparoscopy is a minimally invasive procedure allowing endoscopic access to the peritoneal cavity after insufflation of a gas (CO2) to create space between the anterior abdominal wall and the viscera.[5] The three major forces that uniquely alter patient's physiology during laparoscopy are; the increase in intra-abdominal pressure and volume which are transmitted to the thorax, the effects of patient positioning Trendelenberg, reverse Trendelenberg and lateral position and carbon dioxide pneumoinsufflation which is not inert.[6,7]

Laparoscopic procedures have been traditionally performed under GA owing to pneumoperitoneum related respiratory changes associated with it.[1] Pneumoperitoneum during laparoscopic surgery leads to significant cardiovascular and respiratory changes often necessitating therapeutic interventions.[8,9] But under GA alone, the hemodynamic derangements during pneumoperitoneum have to be managed by either increasing the anesthetic concentration or by administering vasodilators. The need for an additional modality of anesthesia with GA has led to studying various other options over the years. However, recently the use of RA especially spinal anesthesia (SA) was introduced for the same. Evidences suggest the safety of the use of GA, SA and combined spinal and general anesthesia in laparoscopy without any significant side effects. Combining two anesthesia techniques added their advantage and limited the side effects of both.

One of the most successfully used anesthesia with GA is spinal anesthesia. Various studies regarding its feasibility, patient comfort after the procedure, incidence of postoperative 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.[11] The regional techniques have been shown to attenuate the metabolic and endocrine responses. Various pharmacological agents like betablockers, nitroglycerine, and alpha 2 agonists can be used to counteract these changes, but they have their own disadvantages.[11]

When SA was used in conjunction with GA, the sympathectomy resulting from SA may limit the rise in SVR, thus overcoming the increased blood pressure. This finding was confirmed in our study where the hemodynamic parameters in group SGA was well maintained during pneumoperitoneum, as against in group GA and results were consistent with previous study conducted by Ghodki P S et al.[12] Also it was demonstrated that the hemodynamic repercussions associated with pneumoperitoneum can be successfully managed with a combined spinal and general anesthesia than administering GA alone.

In the present study, the most significant feature was the rise in MAP in Group GA after induction of pneumoperitoneum and this response sustained during the entire pneumoperitoneum period in the control group (Group GA) as observed by the previous studies. This rise in MAP continued

throughout the pneumoperitoneum and was statistically significant when compared to the MAP changes in Group SGA. There was no spinal anesthesia related hypotension or bradycardia.

Post-pneumoperitoneum MAP until the completion of surgery, in Group SGA was lower as compared to Group GA, which was statistically significant. We found that MAP following pneumoperitoneum were significantly increased from 83.1±6.7mmHg at 0 min to 88.4±5.8 mmHg after 20 min in GA group as compared to 77.3 ± 7.4mmHg at 0 min to 76.2 ±8.4mmHg in SGA group, which was statistically significant (p - value<0.05).

It can be analyzed from our study that the requirement of propofol was markedly reduced in group SGA as compared to group GA ($p < 0.05$). This finding is in concordance with the previous study conducted by Ghodki PS et al analyzing that requirement of isoflurane was markedly reduced in group SGA as compared to group GA.[12] This finding is also supported by a study conducted by Lerou and Booij.[14] In our study, we found that only minimum dose was required for maintenance of anesthesia in group SGA. It was possible to titrate dose of propofol while maintaining adequate depth of anesthesia by monitoring hemodynamics like HR and MAP and maintaining within 20% of the baseline value.

Recovery time, however showed a significant variability in both groups, with Group GA requiring longer extubation time as compared to the other. This can be attributed to lesser requirement of total anesthestic agent (propofol) in SGA group. Agarwal A et al in their study found that the requirement of propofol for induction and maintenance of anesthesia in the combined epidural GA group was 1.3 +/- 0.3 mg/kg and 2.4 +/- 0.9 mg/kg/hr, respectively, compared with 2.4 +/- 0.6 mg/kg and 4.4 +/- 1.6 mg/kg/hr observed in the general anesthesia group (P <0.05).[15] Ghodki PS et al in their study also observed that the lower requirement of isoflurane resulted in early awakening and extubation in group SGA as compared to group GA.[12]

Luchetti et al, also compared recovery score in patients undergoing laparoscopic cholecystectomy and found that all patients had rapid recovery.[13]

Surgeon's satisfaction quantified by NRS was comparatively higher (9.16+0.79) owing to better operative field compared to group GA (7.12+ 0.96). That was statistically significant with p value < 0.05.This was coherent with the previous study by Ghodki PS et al where they found that NRS in SGA group was 7 (1.4) and that for GA group was 4.9 (0.9) which was statistically significant.[12]

It was noteworthy that duration of surgery was comparively lesser in Group SGA (149.500+11.47 min) with that of Group GA (157.320+8.40 min) owing to contracted bowel and better operative field. The unopposed parasympathetic outflow following SA causes increased bowel contractility, ultimately resulting in better operative field.[16] It also decreases the requirement of steep head low, often demanded for laparoscopic hysterectomy. This inference is based on NRS obtained from surgeons. All these contributed to a reduction in duration of surgery.

Limitations:

- Non-randomized study with possibility of selection bias
- Small sample size and single centre design
- Anesthetic requirement was not quantified in terms of Bispectoral Index (BIS) which can give accurate measurement of depth of anesthesia.

CONCLUSION

- It is concluded from this study that concomitant use of spinal and general anesthesia can effectively attenuate the hemodynamic repercussions during pneumoperitoneum in laparoscopic gynecological surgeries than general anesthesia alone.
- Overall quality of anesthesia is better in terms of reduced anesthetic requirement, shorter recovery time and satisfactory operative field in combined technique.

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