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Research Article

Combined general - spinal anesthesia versus combined general - epidural anesthesia for Laparoscopic Hysterectomy

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Abstract

Background: General anesthesia (GA) is the preferred anesthetic technique for laparoscopic hysterectomy(LH). However, laparoscopic surgery is accompanied with marked stress response, Adding regional techniques, to GA was used to overcome these significant hemodynamic effects .The aim of our study is to compare the effect of combined spinal-general anesthesia with that of combined epidural-general anesthesia on hemodynamic stress, Requirement of Isoflurane, analgesics and vasodilators, recovery profile ,VAS score at recovery, the time for first analgesic request, surgeon's satisfaction, and intraoperative and postoperative complications. **Methods:** This was a prospective randomized controlled study including 105 female patients, aged 45-65 years old, belonging to ASA I or II grade who underwent LH. They were randomly assigned to one of three equal groups. Group S-GA received spinal combined with general anesthesia; group E-GA received epidural along with GA; and group GA received only general anesthesia. Intraoperatively, cardiovascular parameters and SpO2 were recorded. operative field assessed by surgeons ,isoflurane, nitroglycrine and opoid consumption were recorded also post operative pain, intra and postoperative complication. **Results:** S-GA and E-GA groups showed stable hemodynamic parameters (MAP and HR) at pneumoperitoneum and during surgical manipulation. However, MAP decreased significantly at postinduction in groups S-GA and E-GA. Intraoperatively, consumption of isoflurane, opioid and nitroglycerine infusion was higher in group GA .groups S-GA and E-GA showed better operative field ,pain scores ,fast recovery and longer postoperative analgesia .Incidence of postoperative complications was low. **Conclusion:** spinal or epidural anesthesia, combined with general anesthesia was an effective for attenuation of the hemodynamic stress response associated with pneumoperitoneum without increasing side effects

Keywords: Laparoscopic hysterectomy, spinal, epidural, general anesthesia.

Introduction

GA has remained the most accepted anesthetic technique for laparoscopic surgeries. But under GA the hemodynamic derangements during pneumoperitoneum have to be managed by either deepening the anaesthesia or by administering vasodilators. There is growing evidence suggesting that regional anesthesia has a beneficial role in the anesthetic management of patients undergoing laparoscopic surgery [(1)]. Regional anesthesia such as epidural and spinal can be used with GA for laparoscopic surgery, to blunt the stress response associated with pneumoinsufflation, decrease the requirement for anesthetics and analgesics leading to faster awakening from anesthesia, and provide postoperative analgesia and enhanced bowel motility. Our study was conducted to compare the efficacy and safety of combined spinal-general anesthesia and those of combined epidural-general anesthesia in patients undergoing LH.

Patients and Methods

This prospective comparative study was conducted in Minia Maternity University Hospital after obtaining Institutional Ethical Committee approval and written informed

consent from all patients. A total of 105 female patients, belonging to ASA grade I and II, aged between 45-65 years, and scheduled to undergo Laparoscopic hysterectomy were included in the study. Patients who refused to participate in the study, presented with known allergy to any of the study drugs or with contraindications to neuraxial anesthesia, with severe cardiac, pulmonary, or neurological diseases, drug abuse or on analgesics for any reason, or patients in whom surgery had to be converted to open hysterectomy were excluded from the study.
The patients were divided into three groups by computer-generated random allocation, having 35 patients each.

- Group S-GA: received spinal anesthesia combined with general anesthesia.
- Group E-GA: received epidural anesthesia combined with general anesthesia.
- Group GA: received general anesthesia.

The attending anesthesiologist was not blinded to group assignment, because the anesthetic techniques were different from each other. However, the investigator who analysed the results was unaware of the type of anesthetic that was administered.

Sample size justification:
Our sample size was estimated using online epitools programme for **"Prospective, cohort, and randomized clinical trials studies".**
Using the following parameters:

1- Confidence interval: (95 %)
2- Desired power: (80%)
3- Alpha: (0.05)
4- Odds ratio between combined spinal – general and epidural – general group: (3.5)

Minimal required sample size was **105.** Randomly allocated cases were divided into 3 groups, each group contains (35) cases.

A careful medical history was taken from the patients. Then, general examination, including (heart rate, blood pressure, respiratory rate and O_2 saturation) and physical examination including (chest, heart and abdomen) were done preoperatively. In addition, routine and relevant investigations such as complete blood picture, coagulation profile (prothrombin concentration, INR), random blood sugar, renal and liver function tests were checked before the surgery.

Patients were surgically prepared for laparoscopic hysterectomy by the surgical team. Upon arrival in the operating theatre, standard monitoring of ECG, non-invasive blood pressure (NIBP), temperature and oxygen saturation were attached and the baseline values of HR, MAP and O_2 saturation were recorded. Then, an intravenous access was secured, and all patients were co-loaded with 10-15 ml /kg of Ringer's solution.

In S-GA group, spinal anesthesia was given in the sitting position, using 25G Quincke needle. Under complete aseptic technique, it was performed in the L2-L3 or L3-4 intervertebral space. After free flow of CSF, 2.5 ml of heavy bupivacaine 0.5% (12.5 mg) and 25 µg of fentanyl were injected intrathecally. Then, patients were made supine and the vital signs including HR, noninvasive BP and SpO2 was recorded at 5 min. intervals till induction of general anesthesia. Onset of adequate analgesia was confirmed by loss of sensation to pin prick at the 4^{th} thoracic segment. Any cases of failed spinal anesthesia were excluded from the study.

In E-GA group, all patients received lumbar epidural (L1-2 or L2-3) in the sitting position, under all aseptic precautions. It was performed using the midline approach and loss of resistance to saline to identify the epidural space. After getting the epidural space by 16G Tuohy needle, epidural catheter was fixed with 5 cm in epidural space. After negative aspiration of blood or CSF from the catheter, 8-12 ml of 0.375% bupivacaine and 50 µg of fentanyl were injected epidurally to obtain loss of sensation to pin prick at T4 level. As in S-GA group, patients in whom adequate analgesia was not obtained were excluded from the study. Intraoperatively, 6 ml of 0.375% bupivacaine was injected every 1 hr. till the end of surgery.

All patients were premedicated with midazolam 0.03 mg/kg. Then, they received general anaesthesia according to the same protocol. After preoxygenation for 3 min., anesthesia was induced with iv propofol 1% 2.5–3.5 mg/kg until loss of verbal response, fentanyl (1.5 µg/kg), followed by atracurium 0.5 mg/kg to facilitate tracheal intubation. Anesthesia was maintained with inhalational isoflurane 1–1.5%

in 100% oxygen to keep mean arterial pressure (MAP) and HR±20% of preinduction values.

Mechanical ventilation was maintained with a tidal volume of 6–8 ml/kg and ventilatory frequency was adjusted to maintain an end-tidal carbon dioxide concentration of 35–40 mmHg. Intraoperatively, heart rate, noninvasive arterial blood pressure and pulse oximetry were measured every 5 min until extubation. Hemodynamic parameters (including MAP and HR) and SpO_2 were recorded at various stages: post induction, postintubation, at creation of pneumoperitoneum and during surgical manipulation (every 5 min.), at release of CO_2 insufflation and at extubation

Pneumoperitoneum was created by insufflation of CO_2 to maintain intra-abdominal pressure between 12 and 15 mmHg throughout the surgical procedure. The hemodynamic changes associated with pneumoperitonium such as hypertension and/or tachycardia were managed by increasing anesthetic concentrations, and/or giving IV nalbuphine (0.1-0.2 mg/kg). If these measures failed, iv nitroglycerine infusion (GTN) was administered in titrated doses (0.5-3 µg/kg/min). The consumption of isoflurane, opioid and nitroglycerine during the surgery were recorded. The average total volume of isoflurane liquid was calculated and compared in the 3 groups. The average total doses of nalbuphine (mg) and GTN were also calculated in all the groups. Towards the end of surgery, IV ondansetron was given (100 µg/kg) for emetic prophylaxis.

Any incidence of hypotension, bradycardia, or hypertension was noted. Hypotension defined as SBP < 90mmHg or >20% reduction in preoperative MAP, bradycardia defined as pulse rate (PR) < 50/min. and hypertension defined as SBP > 160 mmHg or MAP > 20% than baseline level. Hypotension was treated with IV fluid boluses and incremental doses of IV ephedrine 5-10 mg.

Recovery was performed by discontinuation of inhalational anesthesia and reversal of neuromuscular blockade with neostigmine 0.05 mg/kg and atropine 0.01 mg/kg. Duration of surgery, duration of pneumoperitoneum, and recovery time (defined as time from discontinuation of anesthetic agents to tracheal extubation) were noted. Surgeon's opinion was taken regarding the operative field with respect to bowel contractility and need for head low. They were asked to grade the operative field as excellent, good or poor.

Postoperatively, haemodynamics (including HR and BP), SpO_2, and respiratory rate (RR) were monitored for all patients for one hour in the PACU. Postoperative pain was assessed using the visual analogue scale (VAS), ranging from 0 to 10. When VAS was > 4, analgesics were given using IV paracetamol (10- 15 mg/kg) qds, diclofenac 75 mg bd, and IV nalbuphine 0.1-0.2 mg/kg in groups S-GA and GA. In E-GA group, 10 ml of 0.25% bupivacaine with fentanyl 50 µg were injected epidurally for postoperative analgesia, together with systemic analgesics used for other 2 groups. The time for 1st analgesic request was recorded. Postoperative complications such as PONV, urinary retention, pruritus, shoulder pain, headache, emergence agitation or dizziness were reported.

Statistical analysis:

Data was entered and analyzed using SPSS version 22. Data was presented using descriptive statistics. Quantitative variables were presented using (mean; SD). Qualitative variables were represented by numbers and percentages.

ANOVA test was used to compare means of three groups. Chi-square test was used to compare qualitative variables. Post hoc test was used to show significance between each two groups. Figures were presented by excel 2010. P value< 0.05 was setted as cutoff point for statistical tests.

Results

A total of 105 patients undergoing laparoscopic hysterectomy were included in our study. They were randomly divided into three equal groups, 35 patients in each group, according to the type of anesthesia.

- Group S-GA: received combined spinal-general anesthesia.
- Group E-GA: received combined epidural-general anesthesia.
- Group GA: received general anesthesia.

The study groups were found to be comparable with respect to patient characteristics such as age, Body mass index (BMI), ASA grade and associated comorbidities. Regarding the duration of surgery and pneumoperitoneum, there was no significant difference among the three groups (Table: 1).

Haemodynamic data showed that the baseline values of mean arterial blood pressure (MAP) and heart rate (HR) (Table: 2, 3), (Fig.: 1, 2) were similar in the three groups. The HR did not show any significant difference among the 3 groups at postinduction or postintubation. However, at creation of pneumoperitoneum, it increased significantly in GA group, compared to other groups. This continued throughout the surgical manipulation till 40 min. later. After release of pneumoperitoneum, HR was similar in the 3 groups till the end of surgery, at extubation, at 5 and 10 min. after extubation. Compared to baseline readings, HR increased significantly at pneumoperitoneum in GA group, while it did not change in other two groups (Table: 2, Fig.: 1).

Regarding MAP changes, both S-GA and E-GA groups showed significant decrease in MAP at postinduction, compared to baseline values in the same group and compared to the corresponding readings in GA group. Then, MAP increased significantly in group GA compared to the readings in groups S-GA and E-GA at all measurement points from CO_2 insufflation till release of pneumoperitoneum. Afterwards, the MAP values were comparable in the 3 groups. In addition, GA group showed higher MAP readings at pneumoperitoneum, in comparison to baseline values.

Concerning oxygen saturation (SaO_2) (Fig.: 3), there were no significant changes in SaO_2 readings among the three groups or when compared to baseline values within each group during the study period.

The consumption of isoflurane (ml), intraoperative opioid (mg), and NTG infusion (µg/kg/min.) during surgery was significantly higher in group GA than that in other two groups. Although it was higher in E-GA group compared to S-GA group, this difference was statistically insignificant. Mean volume of isoflurane liquid used was 10.7±2.1, 12.5±2.7and 27±3.1 ml in S-GA, E-GA and GA groups respectively (Table: 4, Fig.: 4). None of the patients in S-GA and E-GA groups needed GTN infusion to adjust the MAP, while the average dose of GTN used in GA group was 2.3 ± 1.1 µg/kg/min. The average doses of IV nalbuphine used intraoperatively were 12.6 ± 1.2, 13.1±1.2, and 14.1±1.3 mg in groups S-GA, E-GA, and GA respectively.

The operative field assessed by surgeons was better in groups S-GA and E-GA than in GA group. It was “excellent” in 25 cases in each group i.e.71.4%, good in 8(22.9%) and in 5 cases (14.3%) in groups S-GA and E-GA respectively, while it was poor in 2(5.7%) and 5(14.3%) patients in groups S-GA and E-GA respectively. It was excellent in 5(14.3%), good in 21 (60%) and poor in 9 patients in GA group (Table: 4).

Recovery time was significantly longer in group GA (6.3 ± 0.9 min.) than in group S-GA (4.3 ± 0.8 min.) and group E-GA (4.5 ± 0.9 min.), with no significant difference between S-GA and E-GA groups (Table: 5). With respect to VAS score at recovery from anesthesia, both groups S-GA and E-GA exhibited better pain scores (2.0±0.6 and 2.2±0.6 in S-GA and E-GA groups respectively), when compared with group GA (5±0.6), with no significant difference between S-GA and E-GA groups (Table: 5). In addition, S-GA and E-GA groups showed prolonged similar postoperative analgesia, where the time for 1st analgesic request was significantly longer in these groups (70±9.1 and 67.6±8.2 min. in S-GA and E-GA groups respectively), in comparison with that in GA group (20.5±7.2 min.) (Table: 5).

Regarding intraoperative cardiovascular changes, hypotension occurred in 5 and 3 patients in groups S-GA and E-GA respectively, whereas none of the patients in GA group developed hypotension. Bradycardia occurred in 6, 4, and 7 patients in S-GA, E-GA, and GA groups respectively. Hypertension happened in 1, 1, and 8 patients in groups S-GA, E-GA, and GA respectively. Incidence of postoperative complications was low in the three groups, with no significant differences among the groups (Table: 6).

Table (1): Patient Characteristics and operative data (N = 105)

	Group S-GA (N = 35)	Group E-GA (N = 35)	Group GA (N = 35)
Age (years)	42.8 ± 7.6	41.8 ± 7.5	40.8 ± 7.7
BMI (kg/m^2)	24.7 ± 3.1	24.6 ± 3.2	24.6 ± 3.3
ASA (I/II)	25/10	23/12	27/8
Comorbidities			
Hypertension	5 (14.3%)	7 (20%)	3 (8.6%)
Diabetes mellitus	5 (14.3%)	7 (20%)	4 (11.4%)
Chronic kidney disease	2 (5.7%)	3 (8.6%)	3 (8.6%)
Bronchial asthma	4 (%11.4)	2 (5.7%)	2 (5.7%)
Duration of Surgery (min)	77.2 ± 9.6	77.9 ± 9.6	77.4 ± 9.6
Duration of Pneumoperitoneum (min)	70.9 ± 8.7	70.1 ± 8.7	70 ± 8.7

Data are expressed as mean±SD, numbers or percentage

Table (2): Heart rate (HR) changes in the study groups.

	Group S-GA (N = 35)	Group E-GA (N = 35)	Group GA (N = 35)
Baseline	81.33±7.6	81.23±6.8	81.27±8.8
Post induction	76.36±7.7	76.21±6.5	77.34±8.1
Post intubation	75.64±7.2	75.31±7.1	76.76±7.9
At pneumopertomium	73.54±7.1*	73.22±7.8#	86.76±5.8*# x
Surgical manipulation	73.54±7.1*	73.23±7.8#	85.62±6.7*#
5 minutes	69.53±7.3*	70.14±7.7#	84.54±7.8*#
10 minutes	65.79±7.5*	66.71±6.1#	83.52±8.5*#
15 minutes	76.21±7.3*	66.73±6.2#	82.52±8.5*#
20 minutes	76.2±7.4*	76.29±6.2#	86.54±7.5*#
25 minutes	77.49±7.1*	78.77±6.5#	87.92±7.1*#
30 minutes	79.22±7.6*	80.87±6.7#	91.56±7.9*#
35 minutes	79.29±7.2*	80.18±7.8#	89.78±6.8*#
40 minutes	75.79±7.8*	74.33±7.4#	87.21±8.3*#
45 minutes	79.53±7.9	78.71±7.8	79.34±6.9
50 minutes	77. 21±7.4	76. 89±7.3	78.54 ±7.9
55 minutes	76.96 ±7.2	74.68 ±7.7	75.32 ±7.5
60 minutes	77.26±7.1	76.39±7.9	77.72±7.3
65 minutes	77.2±7.4	76.29±6.2	77.54±7.5
At Desufflation	79.53±7.9	78.71±7.8	79.34±6.9
At extubation	80.13±5.9	81.34±6.8	83.84±6.3
5 minutes	81.16±7.7	82.58±6.4	81.72±7.7
10 minutes	79.61±7.2	78.44±6.7	80.14±7.3

Data are expressed as Mean±SD
* P < 0.05 Group S-GA vs Group GA
# p < 0.05 Group E-GA vs Group GA
† p < 0.05 Group S-GA vs Group E-GA
X p< 0.05 compared to baseline value in the same group

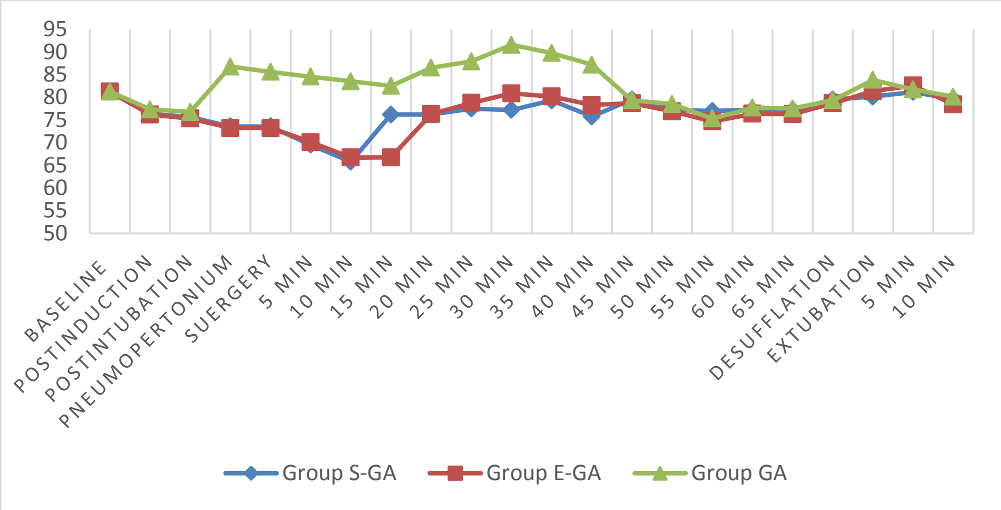

Fig. 1: Comparison of HR changes among the study groups

Table (3): Mean arterial pressure (MAP) changes in the study groups (N = 105)

	Group(S-GA) (N = 35)	Group (E-GA) (N = 35)	Group (GA) (N = 35)
Baseline	96±8.3	95±9.6	94±7.5
Post induction	86±9.4^{*x}	84±9.4$^{\#x}$	95±8.4$^{*\#}$
Post intubation	85±7.1	84±7.8	94±9.7
At pneumopertomium	91±8.5*	92±8.1$^{\#}$	98±7.3$^{*\#x}$
Surgical manipulation	91±7.4*	92±7.6$^{\#}$	95±7.4$^{*\#}$
5 minutes	90±7.5*	89±6.1$^{\#}$	97±7.6$^{*\#}$
10 minutes	91±8.1*	90±6.2$^{\#}$	99±8.1$^{*\#}$
15 minutes	93±7.6*	92±6.7$^{\#}$	102±7.9$^{*\#}$
20 minutes	93±6.6*	93±6.4$^{\#}$	103±8.9$^{*\#}$
25 minutes	94±6.7*	93±7.5$^{\#}$	104±9.1$^{*\#}$
30 minutes	93±7.5*	91±7.6$^{\#}$	103±9.2$^{*\#}$
35 minutes	92±7.8*	91±7.4$^{\#}$	100±8.3$^{*\#}$
40 minutes	91±7.4*	90±6.7$^{\#}$	99±8.8$^{*\#}$
45 minutes	95±6.5*	94±7.6$^{\#}$	105±9.6$^{*\#}$
50 minutes	96±9.4*	95±8.8$^{\#}$	105±9.3$^{*\#}$
55 minutes	93±7.8*	94±7.3$^{\#}$	102±8.1$^{*\#}$
60 minutes	91±6.9*	93±7.2$^{\#}$	99±7.1$^{*\#}$
65 minutes	92±7.3*	95±9.6$^{\#}$	104±7.5$^{*\#}$
At Desufflation	91±6.4	93±7.4	102±8.4
At extubation	92±7.5	94±6.2	96±6.6
5 minutes	93±7.1	95±7.2	94±7.3
10 minutes	91±8.6	93±8.7	94±8.9

Data are expressed as Mean±SD

* P < 0.05 Group S-GA vs Group GA

# p < 0.05 Group E-GA vs Group GA

† p < 0.05Group S-GA vs Group E-GA

X p< 0.05 compared to baseline value in the same group

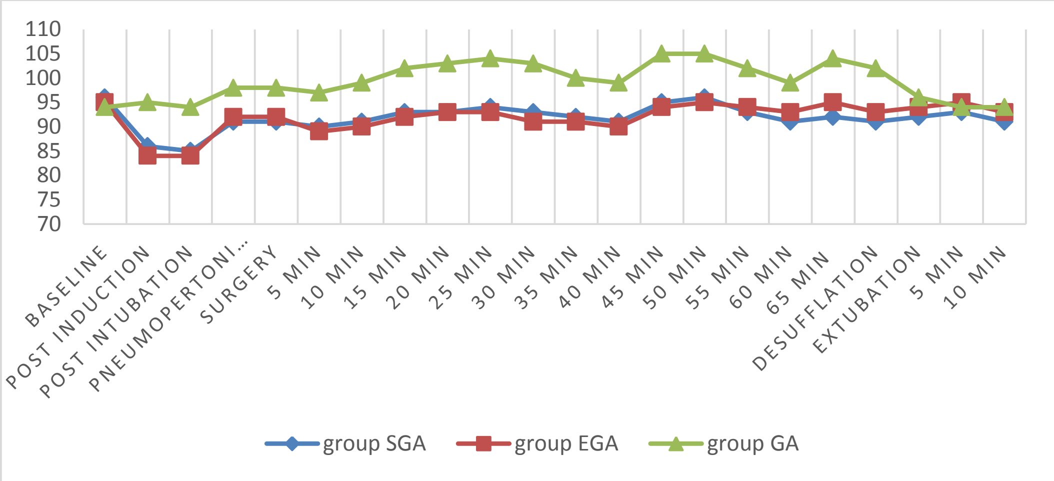

Fig. 2: Comparison of MAP changes among the study groups.

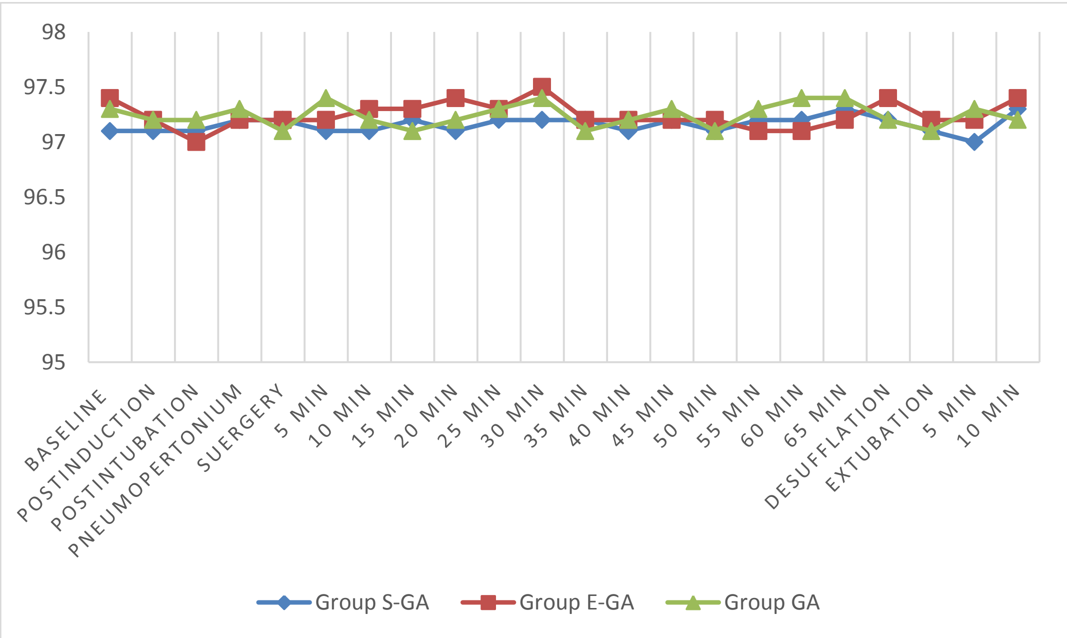

Fig. 3: Arterial oxygen saturation (SaO2) in the study groups.

Table (4): Anesthetic and operative data: (N = 105)

	Group S-GA (N = 35)	Group E-GA (N = 35)	Group GA (N = 35)
Isoflurane Consumption (ml)	10.7 ± 2.1 *	12.5 ± 2.7 #	27.3 ± 3.1 *#
Intraoperative Opioid Consumption (mg)	12.6±1.2 *	13.1 ± 1.2 #	14.1 ± 1.3 *#
Nitroglycerine Consumption(µg/kg/min)	0 *	0 #	2.3 ± 1.1 *#
The operative field assessed by surgeons			
Excellent	25 (71.4%) *	25 (71.4%) #	5 (14.3%) *#
Good	8 (22.9%) *	5 (14.3%) #	21 (60%) *#
Poor	2 (5.7%) *	5 (14.3%) #	9 (25.7%) *#

Data are expressed as Mean±SD, numbers and percentage.

* P < 0.05 Group S-GA vs Group GA

\# p < 0.05 Group E-GA vs Group GA

† p < 0.05 Group S-GA vs Group E-GA

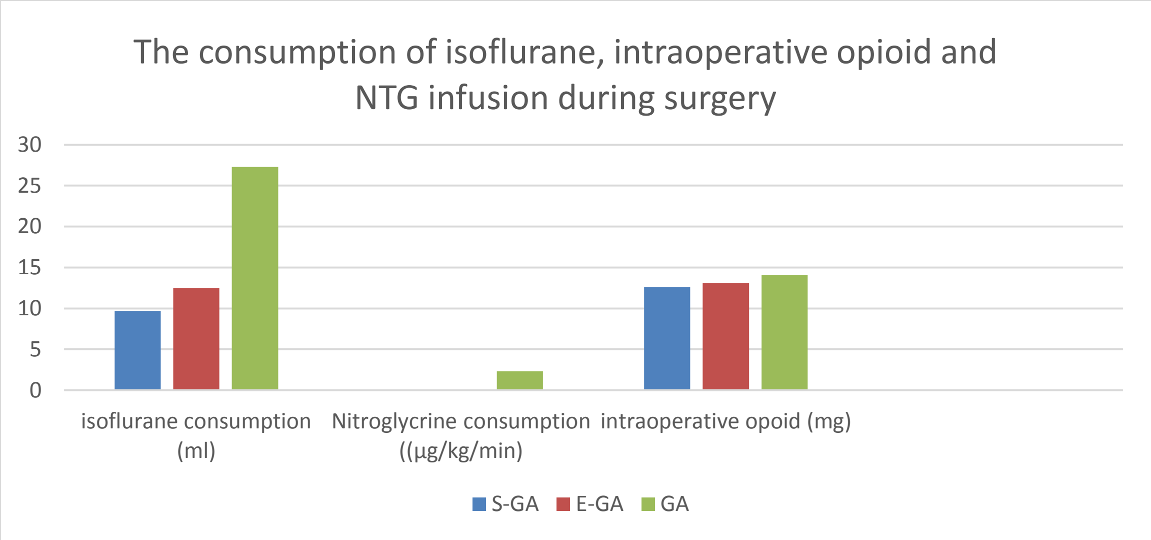

Fig: 4: The consumption of isoflurane, intraoperative opioid and NTG infusion during surgery

Table (5): Comparison among the study groups as regard to recovery time, VAS score at recovery and time for first analgesic request.

	Group S-GA (N = 35)	Group E-GA (N = 35)	Group GA (N = 35)
Recovery Time (min.)	4.3 ± 0.8*	4.5 ± 0.9#	6.3 ± 0.9*#
VAS score at recovery	2.0 ± 0.6*	2.2±0.6*	5±0.6*#
Time to First Analgesic request (min)	70 ± 9.1*	67.6 ± 8.2#	20.5 ± 7.2*#

Data are expressed as Mean±SD
* P < 0.05 Group S-GA vs Group GA
\# p < 0.05 Group E-GA vs Group GA
† *p < 0.05* Group S-GA vs Group E-GA

Table (6): Incidence of intraoperative and postoperative complications.

	Group S-GA (N = 35)	Group E-GA (N = 35)	Group GA (N = 35)
Intraoperative hypotension	5 (14.3%)*	3 (8.6%)	0 (0%)*
Intraoperative bradycardia	6 (17.1%)	4 (11.4%)	7 (20%)
Intraoperative hypertension	1 (2.8%)*	1 (2.8%)#	8 (22.8%)*#
Emergence agitation	4 (11.4%)	3 (8.6%)	9 (25.7%)
Urinary retention	5 (14.3%)	4 (11.4%)	0 (0%)
Postoperative nausea and vomiting	6 (17.1%)	7 (20%)	12(34.3%)
Dizziness	2(5.7%)	3(8.6%)	4(11.4%)
Pruritis	2 (5.7%)	2 (5.7%)	4 (11.4%)
Headache	3 (8.6%)	0 (0%)	2 (5.7%)
Shoulder pain	4 (11.4%)	3 (8.60%)	8 (22.9%)

Data are expressed as numbers and percentage
* P < 0.05 Group S-GA vs Group GA
\# p < 0.05 Group E-GA vs Group GA
† *p < 0.05* Group S-GA vs Group E-GA

Discussion

Laparoscopy is a minimally invasive procedure which was performed very commonly in gynecological as well as in general surgeries. Laparoscopic techniques offer major benefits to the patient such as minimized incision size and trauma with reduced intraoperative blood loss and postoperative pain. Also, laparoscopic surgeries are associated with shortened recovery rates and a lower incidence of postoperative wound infections and pulmonary complications [2, 3].

General anesthesia with endotracheal intubation is preferred for gynecologic laparoscopic surgery because it controls surgical pain and improves patient comfort with pneumoperitoneum and Trendelenburg position. It provides a secure airway and allows for control of minute ventilation to reduce hypercarbia[4]. Besides, it confers good muscle relaxation and a clear operative field [5,6]. However, laparoscopy itself is associated with significant stress response caused by pneumoperitoneum, causing increase in SVR and MAP[7]. This is managed by increasing anesthetic concentrations and/or administering vasodilators[4]. This eventually leads to unnecessary deepening of anesthesia, resulting in delayed awakening and recovery. Regional anesthesia in combination with GA, by blocking the sympathetic and spinal nerves, can attenuate the surgical stress response, improves intestinal blood flow and contractility, and provides analgesic effects [8].

The aim of our study was to evaluate the effect of administering spinal or epidural anesthesia combined with GA in maintaining stable hemodynamics in laparoscopic hysterectomy. The secondary outcomes were requirement of inhaled anesthetics, analgesics and vasodilators, and recovery profile. In addition, duration of effective analgesia, surgeon's satisfaction, and incidence of intraoperative and postoperative complications were noted.

Our work demonstrated that regional anesthesia, either spinal or epidural, combined with general anesthesia attenuated the hemodynamic changes associated with peumoperitoneum, where HR and MAP increased significantly in GA group at pnemoperitoneum and thereafter during surgery, compared with other groups. At CO_2 insufflation, HR and MAP were also higher than their baseline values in GA group only, while they were stable in other groups. However, using regional techniques combined with GA caused significant reduction in MAP at postinduction in S-GA and E-GA groups. This is due to the additive effect of sympathetic blockade of regional anesthesia and the vasodilatation and myocardial depression effect of GA. Regarding this desirable hemodynamic stability observed in S-GA and E-GA groups, this was similar to various studies which used combined spinal or epidural with general anesthesia for laparoscopic surgeries [1,9-14]. Both combined spinal-GA, administered for laparoscopic cholecystectomy (LC) [1, 9] and LH surgeries [10,14] and epidural-GA used for various laparoscopic surgeries [(in gynecological procedures [12], adrenalectomy[11], and LC [13]] were found to be more effective than GA in maintaining haemodynamic parameters and attenuating the stress response associated with pneumoinsufflation . For the best of our knowledge, this is the first study that compared the effect of combined spinal-GA with that of combined epidural-GA in patients undergoing LH. Intraoperatively, more patients in S-GA group developed episodes of hypotension (5 patients), compared to GA group ($P< 0.05$), while hypertensive events were more frequent in GA group ($P< 0.05$). Hypotension was more evident in S-GA group because spinal anesthesia tends to produce a greater degree of cardiovascular depression than epidural anesthesia. In addition, the cardiovascular effects of epidural anesthesia such as hypotension or bradycardia are gradual and less marked, in comparison with those of SA [15]. However, there are studies that used combined spinal-GA in patients undergoing LH [10,14] and LC[1] and they did not find significant hypotension in their patients, compared with GA group. This may be caused by using lower doses of bupivacaine 0.5% (10 mg) in their studies.

Contrary to our results, other studies did not show significant differences in hemodynamic parameters in groups having combined epidural-general anesthesia compared with those having only general anesthesia for laparoscopic surgeries [16,17]. Luchetti et al., compared the effectiveness of combined epidural general anesthesia versus TIVA for LC [16]. Intraoperative parameters were similar in both groups. This may be attributed to conducting their study in LC surgery and using TIVA for anesthetic maintenance in GA group. However, they showed better recovery and pain scores postoperatively in combined epidural general anesthesia group, which was in agreement with our results. Our research demonstrated faster recovery time (4.3±0.8 and 4.5±0.9 min. in S-GA and E-GA groups respectively) and longer duration of potoperative effective analgesia (70±9.1 and 67.6±8.2 min. in S-GA and E-GA groups respectively), compared with GA group. Nizamoglu et al.,, studied the effect of combined epidural-general anesthesia versus plain GA on hemodynamics and hormone levels in 32 patients, who had laparoscopic adrenalectomy for functional adrenal tumors [17]. Their different findings may be due to different laparoscopic procedure, small number of patients included in their study (i.e 16 in each group), and recording the hemodynamic variables at less frequent intervals (before anesthetic induction, after insufflation, before and after adrenalectomy).

Intraoperatively, there was significant reduction of the volume of liquid isoflurane used and the average doses of IV nalbuphine and GTN infusion in both S-GA and E-GA groups. This led to faster recovery and extubation in both groups at the end of the surgery. These results correlate with the observations of other studies which used combined spinal or epidural anesthesia with GA for laparoscopic surgeries [10, 13, 14].

The analgesic effect of regional anesthesia combined with GA was evident in our results, where VAS score at recovery was quite less in S-GA and E-GA groups, compared to GA group. The time for 1st analgesic request was also longer in S-GA and E-GA groups than in GA group. Similarly, Sale et al., reported lower VAS values in combined spinal-GA group, compared with GA group for 6 hr in LC surgery [1]. Also, Bandewar et al., found better pain scores postoperatively in epidural-GA group than in GA group in LC [13]. We considered neither the postoperative analgesic requirement nor the VAS values after recovery as the mode of analgesia was different between the groups.

Our research demonstrated better operative field in S-GA and E-GA groups, where the unopposed parasympathetic activity following regional anesthesia results in increased bowel contractility. This finding was supported by other studies which used regional anesthesia with GA for LH and other gynecological procedures. [10, 12, 14]. However, other studies did not find any differences in operating conditions [1]. It is well known that this parameter is subjectively assessed by the surgeons which may be dependent on the surgeon's experience.

Concerning the postoperative complications, their incidence was very low with no significant difference among the 3 groups. PDPH is a common problem following SA. Headache occurred infrequently and similarly in the 3 groups. The incidence of PDPH is directly related to the needle diameter that pierces the dura mater [18] and decreased in older age population [19]. We used small gauge spinal needle (25G) and the age range for our patients was between 45-65 years. No significant difference was found among the groups regarding the occurrence of PONV. Although laparoscopic surgery, use of volatile anesthesia and opioids, and female gender are important risk factors for PONV, the incidence of PONV was low in our research. This can be attributed to using combination therapy with drugs targeting different receptor classes, including metoclopramide, dexamethasone and ondansetron, producing an additive effect [20]. However, other researchers found that PONV was more common in patients who had only GA than in combined spinal-GA for laparoscopic surgeries [1, 10]. Other adverse events were infrequent and comparable among the three groups.

Conclusion

We conclude that both combined spinal-GA and epidural-GA were equally safe and effective for ameliorating the hemodynamic derangements caused by pneumoperitoneum, without significant adverse effects, in patients undergoing laparoscopic hysterectomy.

Although there was significant decrease of MAP at postinduction and more hypotensive episodes in S-GA group, this was managed promptly without any adverse sequelae. We can recommend administering both techniques in LH, but considering simplicity and cost-effectiveness of spinal anesthesia, combined spinal-GA would be more feasible than combined epidural-GA.

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