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Comparison of combined spinal and general anesthesia block and combined epidural and general anesthesia block in laparoscopic cholecystectomy

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ABSTRACT

Objective. Combined spinal and general anesthesia block (CSGAB) and combined epidural and general anesthesia block (CEGAB) in laparoscopic cholecystectomy were compared. **Material and methods.** Forty patients were randomly selected (ASA physical status I-II) to receive sevoflurane plus 10 to 15 mg of bupivacaine weighed at 0.5% and 20 µg of fentanyl (CSGAB) or sevoflurane plus 150 mg of ropivacaine and 1 µg/kg of fentanyl (CEGAB). Blood pressure, heart rate, oxygen and carbon dioxide saturation, drug doses and sevoflurane MAC (minimum alveolar concentration) were evaluated during surgery. Anesthesia recovery time and pain intensity and duration were evaluated during the first two postoperative hours. Frequency of incisional or referred pain, dyspnea, headache, cramping, nausea and vomiting were evaluated 24 hours after surgery. Statistical analysis was carried out using the Chi-square test and Student t test. Relative risk, absolute risk reduction and number needed to treat (NNT) for adverse reactions were determined. **Results.** Systolic and diastolic arterial pressures posterior to semi-Fowler's position were lower in the CSGAB group than in the CEGAB group. (94 ± 16 vs. 110 ± 18 mmHg; $p < 0.01$ and 59 ± 8 vs. 69 ± 12, mmHg; $p < 0.01$, respectively). Anesthesia recovery time (32 ± 17 vs. 61 ± 29 minutes; $p < 0.01$) and pain duration (26 ± 42 vs. 83 ± 46 minutes; $p < 0.01$) were shorter in the CSGAB group. NNT was 8 for postoperative pain, 8 for nausea, and 95 for vomiting. **Conclusions.** CSGAB was more efficacious for rapid anesthesia recovery and had a shorter post-operative pain duration than CEGAB.

Key words. Cholecystectomy. Laparoscopy. General anesthesia. Epidural anesthesia. Spinal anesthesia.

Comparación de la combinación de anestesia general y bloqueo espinal con anestesia general y bloqueo epidural en colecistectomía laparoscópica

RESUMEN

Objetivo. *Comparar la combinación de anestesia general y bloqueo espinal (CAGBE) con anestesia general y bloqueo epidural (CAGBEP) en colecistectomía laparoscópica.* ***Material y métodos.*** *40 pacientes fueron aleatoriamente seleccionados (condición física ASA I-II) para recibir sevoflurano, 10-15 mg de bupivacaina 0.5% y 20 µg de fentanil (CAGBE) o sevoflurano, 150 mg de ropivacaina y 1 µg/kg de fentanil (CAGBEP). Durante la cirugía se evaluaron: presión sanguínea, frecuencia cardiaca, saturación de oxígeno y dióxido de carbono, dosis de fármacos y concentración alveolar mínima de sevoflurano. Durante las primeras 2 h postoperatorias se evaluaron: tiempo de recuperación de anestesia e intensidad y duración del dolor. Veinticuatro horas después de la cirugía se evaluaron: frecuencia de dolor referido o incisional, disnea, cefalea, cólicos, nausea y vómito. Se utilizaron las pruebas de Ji cuadrada y t de Student. Para los efectos adversos se calcularon riesgo relativo, reducción absoluta del riesgo y número necesario a tratar (NNT).* ***Resultados.*** *Las presiones sistólica y diastólica después de la posición semi-Fowler fueron más bajas en el grupo CAGBE que en el grupo CAGBEP (94 ± 16 vs. 110 ± 18 mmHg; $p < 0.01$ y 59 ± 8 vs. 69 ± 12 mmHg; $p < 0.01$, respectivamente). El tiempo de recuperación de la anestesia (32 ± 17 vs. 61 ± 29 minutos; $p < 0.01$) y la duración del dolor (26 ± 42 vs. 83 ± 46 minutos; $p < 0.01$) fueron menores en el grupo CAGBE. El NNT fue 8 para el dolor postoperatorio, 8 para náusea y 95 para vómito.* ***Conclusiones.*** *La CAGBE presentó una pronta recuperación de la anestesia y una menor duración del dolor postoperatorio que la CAGBEP.*

Palabras clave. *Colecistectomía. Laparoscopía. Anestesia general. Bloqueo epidural. Bloqueo espinal.*

INTRODUCTION

Previous studies have demonstrated that regional anesthesia (epidural or spinal) reduces surgical stress, morbidity and postoperative mortality.[1-3]

In 1987 Yeager and colleagues showed there was a better postoperative evolution in patients who had been anesthetized with combined regional anesthesia than in those who had received only general anesthesia.[4] This finding sparked a series of studies in which diverse anesthetic techniques were compared in different surgical procedures. The majority of these studies have compared regional anesthesia with general anesthesia and very few studies have evaluated regional anesthesia combined with general anesthesia (RACGA). One of these studies was carried out by Davies and colleagues in patients undergoing aortic abdominal surgery. In this study, combined epidural and general anesthesia was compared with general anesthesia and postoperative morphine intravenous infusion, and both were found to be efficacious.[5] In relation to laparoscopic surgeries, regional anesthesia (RA) has been compared with general anesthesia (GA), specifically comparing spinal block and intravenous general anesthesia with propofol[6] or desflurane.[7] The first technique was found to be an effective alternative method.

These studies, however, were carried out in ambulatory gynecological laparoscopic procedures. Luchetti et al, carried out a study in laparoscopic cholecystectomy which compared the combination of general anesthesia and regional anesthesia with intravenous anesthesia, and demonstrated that the former procedure was safe and more effective in the control of postoperative pain.[8] Another study compared three anesthetic techniques in laparosopic cholecystectomy:

- Anesthesia with isoflurane.
- Anesthesia with isoflurane plus fentanyl.
- Anesthesia with isoflurane plus epidural anesthesia with lidocaine.

This study demonstrated that the hemodynamic changes were better in groups 2 and 3.[9] A more recent study evaluated the response to surgical stress comparing three anesthetic techniques:

- General anesthesia with sevoflurane.
- General anesthesia with sevoflurane plus fentanyl.
- General anesthesia with fentanyl plus epidural anesthesia with mepivacaine.

This study showed hormonal levels to be lower in the combined anesthetic techniques.[10] Motivated by demonstrations of the effectiveness of combined anesthesia, the present study was designed to compare, for the first time, according to our knowledge, two anesthetic techniques in patients undergoing laparoscopic cholecystectomy: combined spinal and general anesthesia block (CSGAB) and combined epidural and general anesthesia block (CEGAB). The principal objective of this study was to compare these two anesthetic techniques in terms of their transoperative (and immediate postoperative) hemodynamic changes, as well as the frequency of their immediate and 24-hour postoperative adverse symptoms.

MATERIAL AND METHODS

A controlled simple-blind clinical trial was carried out in patients programmed for laparascopic cholecystectomy at the General Surgery Service of the Zone General Hospital #1 IMSS, Colima, Colima, Mexico. Forty patients aged 20 to 60 years with ASA physical status I-II were studied. Patients with a history of allergy, coagulopathy, spinal surgery, heart disease and pregnancy were excluded from the study. The project was approved by the local ethics committee and participants gave their informed consent in writing. Patients were randomly assigned to one of two treatment groups: Group 1) Combined spinal and general anesthesia block (CSGAB) and Group 2) combined epidural and general anesthesia block (CEGAB).

All patients were infused with 1000-1500 mL Hartmann's solution warmed to 37 °C through a 16-gauge intravenous cannula over a period of 15 minutes. Diclofenac 75 mg IM, ranitidine 50 mg IV, ondansetron 8 mg IV, midazolam 50 µg/Kg IV and fentanyl 2 µg/kg IV were also administered.

Regional anesthesia

CSGAB patients were placed lying down on their left sides and spinal block was applied in the L2-L3 lumbar space. The dural perforation was performed with a number 27 Whitacre pencil-point needle. The correct placement of the needle in the lumbar subarachnoid space was confirmed by previous aspiration of the cerebrospinal fluid. Depending on the size of the patient, 10-15 mg of 5% bupivacaine plus 20 µg of fentanyl was administered in 30-45 seconds. To facilitate cephalic spread of the anesthesia, the patients were placed in the Trendelenburg position

for 5 to 8 minutes and then placed in a supine position. Sensory block level was determined bilaterally by needle prick. Sensorial block level was considered adequate when at the T4 level.

CEGAB patients were placed lying down on their left side and an epidural block was applied in the L2-L3 space. The lumbar perforation was performed with a 16 caliber Tuohy needle. Epidural solution was made up of the following mixture: 150 mg of 0.5% ropivacaine plus 1 µg/kg of fentanyl. After negative cerebrospinal fluid aspiration, 21-22 mL of the anesthetic solution mixture was administered through the epidural needle in a time frame of 120 to 180 seconds. After the Tuohy needle was removed, a 20 caliber epidural catheter was inserted and secured in place. Sensorial block level was determined by needle prick.

General anesthesia

Anesthesia was induced in both treatment groups with 5 mg/kg of thiopental infused in 60 seconds. Once there was no blink reflex, 70 µg/kg of vecuronium was administered to facilitate endotracheal intubation. The patient was intubated and the administration of sevoflurane mixed with oxygen at 100% was begun. Sevoflurane potency was quantified in each patient by minimum alveolar concentration (MAC).

Surgical procedure

Each patient was placed in a supine position. In order to produce pneumoperitoneum, a Veress needle was introduced in the supraumbilical region. The abdominal cavity was immediately insufflated with 2 to 4 liters of carbon dioxide until obtaining intra-abdominal pressure between 12-15 mmHg. The first umbilical trocar was then put into place and a laparoscopy of the abdominal cavity was performed. After this the patient was placed in the semi-Fowler's position with a right shoulder elevation of 45°. The rest of the trocars were then put into place and the surgical procedure was begun.

Before surgery (basal figures) and every 5 minutes thereafter until extubation, blood pressure, heart rate and oxygen saturation were determined with a monitor (General Electric Medical Systems® Mod Dash 4000. Milwaukee, WI 53223, USA) in all patients. However, for the present study we were only interested in these variables in the following periods: basal, post- general anesthesia, post- pneumoperitoneum, post- semi-Fowler's position and post-immediate extubation (first 5 minutes). Arterial hypotension was considered present when mean blood pressure diminished 30% from the base-line figures. Carbon dioxide determination was begun in the post-pneumoperitoneum, and the periods evaluated in the two groups were post-pneumoperitoneum and post-semi-Fowler's position.

Anesthesia recovery time was determined from the moment of extubation and it was quantified in minutes.

Once the patient had recovered from the anesthesia, the intensity and duration of pain was determined within the first two postoperative hours. Pain intensity in those first two hours was determined by the visual analogous pain scale on a scale of 0 to 10 (0 = absence of pain and 10 = maximum pain). The presence of adverse reactions such as incision pain, referred pain, nausea, vomiting, headache, dyspnea, odynophagia, tenesmus and abdominal cramping 24 hours after surgery were determined as present or absent.

Statistical analysis

Means, standard deviation and percentages were used. Qualitative variables such as presence or absence of hypotension, degree and intensity of pain, nausea, vomiting, headache, dyspnea, abdominal cramping and sevoflurane MAC (%) were determined in percentages and the comparison between both groups was carried out using the Chi-square test (χ^2) with the Yates correction or the Fisher exact test. The comparison of blood pressure, heart rate and oxygen and carbon dioxide saturation averages between both treatment groups was analyzed using the Student *t* test (equal variance) or Mann-Whitney *U* test (different variance). Quantitative variables such as amount of anesthetics, anesthesia recovery time and duration of pain were analyzed using the Student *t* test (equal variance) or Mann-Whitney *U* test (different variance).

Relative risk (RR), Absolute risk reduction (ARR), Reduced relative risk (RRR) and Number needed to treat (NNT) for each of the reactions were also determined for each of the adverse reactions.

A confidence interval of 95% was used in all statistical tests and significance was considered when $P < 0.05$.

RESULTS

Forty women patients with an average age of 39.3 ± 11.9 years (20 to 59 year interval), weight

of 70.2 ± 12.4 kg (41 to 107 kg interval) and height of 1.58 ± 0.05 m were studied. As shown in table 1, patient demographic characteristics were similar in both groups.

In relation to the amount of anesthetics administered, vecuronium means used in Groups 1 and 2 were similar (5.4 ± 1.2 mg *versus* 5.3 ± 1.2 mg, P = 0.7, Student t test). Fentanyl dose was less in Group 1 than in Group 2 (223 ± 40 µg *versus* 286 ± 55, P < 0.01, Mann-Whitney U test). Minimum alveolar concentration (MAC) for sevoflurane was as follows for both groups, respectively: MAC1, 90% (n = 18) *versus* 35% (n = 7), χ^2 = 10.6, P < 0.01; MAC 1.5, 10% (n = 2) *versus* 30% (n = 6), χ^2 = 1.4,

Table 1. Demographic characteristics of both treatment groups.

Characteristics	CSGAB n = 20	CEGAB n = 20	P
Age in years ± SD	39 ± 11	39 ± 12	0.9*
Weight in Kg ± SD	69 ± 10	70 ± 14	0.7
Height in meters ± SD	1.3 ± 0.4	1.4 ± 0.5	0.4
ASA physical status I%	65	55	0.5**
ASA physical status II%	35	45	0.5**

CSGAB: combined spinal general anesthesia block. CEGAB: combined epidural general anesthesia block. SD: standard deviation. P: statistical significance. * Student t test . ** *Chi-square* test.

Table 2. Mean and standard deviation, together with statistical significance of difference among groups.

Variables	CSGAB n = 20	CEGAB n = 20	P
Systolic arterial pressure (mm Hg)			
Base-line	124 ± 16.0	121.8 ± 15.5	0.6*
Post general anesthesia	115 ± 18.2	114.6 ± 13.6	0.9
Post pneumoperitoneum	105.4 ± 16.7	114.6 ± 18.2	0.1
Posterior to semi-Fowler's position	94 ± 16	110 ± 18	0.006*
Post extubation	126.5 ± 11.2	129.0 ± 11.2	0.4
Diastolic arterial pressure (mm Hg)			
Base-line	77.5 ± 9.6	78.1 ± 11.3	0.6
Post general anesthesia	70.6 ± 11.6	64.3 ± 8.7	0.06*
Post pneumoperitoneum	61.6 ± 9.7	72.3 ± 14.2	0.009**
Posterior to semi-Fowler's position	59 ± 8	69 ± 12	0.003**
Post extubation	74.5 ± 7.0	76 2 ± 11.0	0.5
Heart rate			
Base-line	77.9 ± 11.1	77.8 ± 11.3	0.1*
Post general anesthesia	75.7 ± 15.9	76.5 ± 8.0	0.8
Post pneumoperitoneum	69.1 ± 9.7	72 9 ± 14	0.3
Posterior to semi-Fowler's position	72.2 ± 10.7	72.5 ± 13.3	0.9
Post extubation	86.3 ± 13	86.7 ± 10.8	0.3
Oxygen saturation (%)			
Base-line	98.3 ± 1.4	98.5 ± 1.0	0.7**
Post general anesthesia	96.1 ± 3.1	97.0 ± 1.7	0.2
Post pneumoperitoneum	99.7 ± 0.5	99 9 ± 0.3	0.2
Posterior to semi-Fowler's position	99.7 ± 0.4	99.8 ± 0.4	0.7
Post extubation	98.4 ± 1.3	98.0 ± 2.1	0.3
Carbon dioxide saturation (%)			
Post pneumoperitoneum	28.4 ± 2.9	28.8 ± 2.4	0.6*
Posterior to change of posture	29.4 ± 2.7	29 2 ± 2.3	0.7

CSGAB: combined spinal general anesthesia block. CEGAB: combined epidural general anesthesia block. mmHg: millimeters of mercury. P: statistical significance. * Student t test. ** Mann-Whitney U test.

P = 0.2 and MAC 2, 0% *versus* 35% (n = 7), χ^2 = 6.2, P < 0.01.

As shown in table 2, CSGAB patients had lower figures for systolic and diastolic pressures after change of posture and pneumoperitoneum. There was hypotension in 47.5% (n = 19) of the patients, but percentage comparison between the two groups was not statistically different (CSGAB n = 9 [47.5%] *versus* CEGAB n = 10; [50%], χ^2 = 0.1; P = 0.7). The remaining parameters, such as oxygen saturation and heart rate, were similar in both groups during the basal, post-general anesthesia, post- position change, post-pneumoperitoneum and post-extubation periods (Table 2).

In relation to immediate postoperative pain (2 hours), the pain median was 0.9 (on a scale of 0 to 6). Twenty-two (55%) of the patients did not present pain and percentage comparison between both procedures showed no significant differences (CSGAB n = 13 [65%] versus CEGAB n = 9; [45%], χ^2 = 1.6; P = 0.2). Twelve point five percent (n = 5) of the patients presented a pain scale evaluation of 2 and there was no significant difference in the percentage comparison of the two groups (CSGAB n = 2 [10%] versus CEGAB n = 3; [15%], χ^2 = 0.2; P = 0.6). Thirty-two point five percent (n = 13) of the patients presented a pain scale evaluation of 3 or more, and no significant difference in the percentage comparison of the two groups (CSGAB n = 5 [25%] versus CEGAB n = 8; [40%], χ^2 = 1; P = 0.3) was found. However, pain duration was shorter in the CSGAB group than in the CEGAB group (26 ± 42 *versus* 83 ± 46 minutes, P < 0.001, Student t test). Anesthesia recovery time was statistically shorter in the CSGAB group than in the CEGAB group (32 ± 17 *versus* 61 ± 29 min, P = 0.002, Mann-Whitney U test).

There were adverse reactions in 87.5% (n = 35) of the patients, but there was no statistical difference in the percentage comparison of the two groups (CSGAB n = 15 [75%] *versus* CEGAB n = 17; [85%], χ^2 = 0.6; P = 0.4). Incision pain was the most frequent reaction and was found in 37.5% (n = 15) of the patients. Table 3 shows there was no significant difference in the reaction percentages of the two treatment groups.

Table 3. Adverse reaction percentage comparison between both treatment groups.

Adverse reactions	CSGAB n = 20	CEGAB n = 20	P
Total number of adverse reactions n = 35 (87.5%)	75 (15)	85 (17)	0.4
Incisional pain % (n)	50 (10)	25 (5)	0.1
Referred pain % (n)	5 (1)	25 (5)	0.1
Nausea % (n)	5 (1)	25 (5)	0.1
Vomiting % (n)	10 (2)	25 (5)	0.3
Headache % (n)	5 (1)	10 (2)	0.5
Dyspnea % (n)	0	5 (1)	-
Abdominal cramping % (n)	15 (3)	0	-

CSGAB: combined general spinal anesthesia block. CEGAB: combined general epidural anesthesia block. P: statistical significance.

Table 4. Postoperative clinical manifestations.

Symptom	RR 95% CI	ARR	RRR %	NNT
Pain (during the first hours after surgery)	0.5 (0.14-1.6)	–0.12	–0.7	8
Pain (24 hours after surgery)	0.2 (0.0 - 1.7)	– 0.1	– 4	9
Hypotension	0.8 (0.2 - 2.7)	– 0.03	– 0.1	9
Nausea	0.3 (0.05-1.2)	– 0.15	– 2	8
Vomiting	0.6 (0.08 - 3.1)	– 0.05	– 0.6	95
Headache	1 (0.01 - 80)	– 0.05	– 0.6	9
Dyspnea	0 (0.0 - 39)	– 0.02	0	9
Cramping	3 (0.2-170)	0.05	0.06	200

RR: Relative risk. ARR: Absolute risk reduction. RRR: Reduced relative risk. NNT: Number needed to treat.

Table 4 shows the absolute risk reduction (ARR), the relative risk (RR) and the number needed to treat (NNT). In accordance with postoperative clinical manifestations (at 2 and 24 hours), the NNT for spinal block to avoid pain was 8, while it was necessary to treat 200 patients to avoid cramping.

DISCUSSION

Our study showed that patients treated with CSGAB had a decrease in anesthetic requirements of fentanyl as well as sevoflurane MAC. Systolic and diastolic pressures and heart rate were similar in both groups. These variables have been studied previously in this type of surgery with epidural block and general anesthesia with isoflurane. Adequate stability was reported in the group treated with epidural block.[9] However, some differences were noted in our study, especially at key moments such as the change to the semi-Fowler's position during laparoscopy. At this moment the CSGAB group maintained the lowest systolic and diastolic pressures and greater stability. This could probably be explained by the inability of the epidural anesthesia to completely attenuate the stress response, especially by the cortisol pathway, due to incomplete block of the phrenic nerves that can transport noxious surgical stimuli to the central nervous system.[10]

Another controversial adverse effect in using spinal block is hypotension. This was found in both groups of the present study and with a frequency similar to that reported by other authors.[11]

A significant difference was found in various aspects of postoperative conditions, such as anesthesia recovery time, which was significantly shorter in the CSGAB group, in concordance with previous studies.[6,7] As is known, any type of anesthesia can be associated with adverse effects such as nausea and vomiting. In this study, nausea and vomiting were less frequent in the CSGAB group, which probably has to do directly with anesthetic requirements, since by using a lower dose of narcotics as well as halogenated agents, consciousness level is recovered more quickly and secondary effects such as nausea and vomiting diminish.

The only difference found in pain was its duration. It was shorter in the spinal block group and these results are similar to those found in previous studies.[7,12]

Our results were similar to those found in other studies in relation to type of pain. Incision pain was the most frequent.[13-15] Referred pain was more frequent in the CEGAB group and has been related to pneumoperitoneum pressure.[16]

Among the contributions of this work are the comparison of two anesthetic techniques which, according to our knowledge, had not been reported in laparoscopic cholecystectomy, the utilization of anesthetic medicaments, the evaluation of transoperative hemodynamic characteristics and postoperative adverse reactions to help the physician decide between one procedure and another.

CONCLUSION

The results of the present study show both combined techniques (CSGAB and CEGAB) to be safe and efficacious, but show CSGAB to have a faster recovery from anesthesia, less frequent nausea and vomiting and a shorter duration of postoperative pain.

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