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Comparison of general and spinal anaesthesia in patients undergoing open ventral hernia repair

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Abbreviations:
ASA – American Society of Anesthesiologist
SAP – systolic arterial pressure
DAP – diastolic arterial pressure
MAP – mean arterial pressure
HR – heart rate
GA – general anaesthesia
SA – spinal anaesthesia
TIVA – total intravenous anaesthesia
VAS – visaul analog scale
PONV – postoperative nausea and vomiting

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Abstract

Background and Purpose: *Ventral hernioplasty is common intervention that can be performed under general or regional anaesthesia. We compared TIVA and spinal anaesthesia in patients undergoing elective open ventral hernia repair.*

Materials and Methods: *Forty ASA I–II adults received either TIVA with propofol, midazolam, fentanyl and rocuronium (group GA, n=20) or spinal anaesthesia (L3–L4) with hyperbaric bupivacaine 0.5% 10mg+ sufentanil 10 μg (group SPA, n=20). Hemodynamic data, pain scores, time to first analgesic and side-effects were recorded.*

Results: *Ventral hernia was umbilical in 6, supraumbilical in 6 and infraumbilicall in 8 group GA and in 7, 6 nad 7 group SPA patients, respectively, P>0.05. Maximum decrease of systolic arterial pressure (SAP) was 10±6 in GA and 21±6% in SPA group, P<0.05 and of HR 11±5 and 17±7%, P>0.05, respectively. Pain scores at 0, 2, 4 and 8 h after surgery were 4 (2–6), 5 (2–7), 5 (1–6) and 4 (2–6) in GA and 0, 0, 0 (0–2) and 1 (0–3) in SPA group, respectively, P<0.05. Pain scores at 12 and 24 h were 4 (1–5) and 3 (0–4) in GA and 2 (0–4) and 1 (0–3) in SPA group, respectively, P>0.05. Time to first analgesic was 28±10 in GA and 580±138 min in SPA group, P<0.001. Postoperative nausea and vomiting (PONV) had 7 (35%) group GA and 1 (5%) group SPA patients, P<0.05.*

Conclusions: *General anaesthesia resulted in more stable hemodynamic profile but spinal anaesthesia provided better postoperative pain control and less PONV in patients undergoing open ventral hernia repair.*

INTRODUCTION

A ventral hernia is defined as a fascial defect located to the abdominal wall. Primary ventral hernias are clasiffied as umbilical, epigastric, Spigelian and lumbar hernias, whereas secondary (acquired) ventral hernias are incisional hernias which typically occur at the site of previous surgical incision *(1)*. Open ventral hernia repair is a common surgical procedure that is often peformed under general anaesthesia (GA). However, side-effects of GA, such as postoperative nausea and vomiting, short-term cognitive impairment, prolonged sedation and early postoperative pain may be undesirable in outpatients, elderly and cardiovascular compromised patients *(2–4)*. Spinal anaesthesia (SA) is a relatively simple technique that has been widely used for a various kind of surgeries, due to its easy reproducibility, rapid onset, effective sensory and motor blockade, prolonged postoperative analgesia and low incidence of major complications *(5–7)*.

In this prospective study we compared clinical profile of total intravenous anaesthesia (TIVA) and SA and tested the hypothesis that neuroaxial block would provide adequate anaesthesia, better postoperative pain control and less side-effects than GA in patients undergoing elective open ventral hernia reapir.

MATERIAL AND METHODS

After obtaining patients' informed consent, a total of 40 ASA physical status I–II adult patients undergoing elective open ventral hernia repair were included in study. Patients were randomly assigned to one of the two groups, the group GA (n=20) or the group SPA (n=20). Patients with history of allergy to anaesthetic drugs, body mass index > 35 or with neurologic or neuromuscular deseases were excluded. All patients were premedicated with peroral midazolam (7.5 mg) 45 minutes before surgery. A 20-gauge intravenous cannula was inserted on the forearm and intravenous infusion of 7 ml/kg of Ringer solution was started after arrival in the operating room. Standard intraoperative monitoring, including pulse oxymetry, heart rate and noninvasive blood pressure was used in all patients and BIS monitoring, additionally, in the group GA patients.

In the GA group, anaesthesia was induced with midazolam 0.05 mg/kg, fentanyl 3 μg/kg, propofol 2 mg/kg and rocuronium 0.6 mg/kg. Subsequently, the trachea was intubated and mechanical ventilation was peformed in a volume-controlled mode with fresh gas flow of 1.0 litre/min (air/O_2, FiO_2=0.4). Anaesthesia was maintained with continuos infusion of propofol 10–15 mg/kg/h and additional boluses of fentanyl (0.05 mg), rocuronium (10 mg) and propofol (30–50 mg) were administered as deemed necessary by attending anaesthesiologist. At the begining of the skin closure, propofol infusion was discontinued and tracheal extubation was performed following reversal of neuromuscular blockade with atropin (1.0 mg) and neostigmin (2.5 mg) when needed.

In the SPA group, SA was performed in the sitting position and dural puncture was performed at the L3–L4 intervertebral space, using a 22-gauge introducer and 27-gauge Whitacre spinal needle with the midline approach. After free flow of cerebrospinal fluid (CSF) was noted, 10 μg of sufentanil and 10 mg of hyperbaric bupivacaine 0.5% were intrathecally injected using separate syringes. Then, patients were placed in slight Trendelenburg position (15–20°) for the next 10 minutes in order to achieve adequate level of sensory block. The quality of SA was evaluated according to the need for supplementary iv analgesia. SA was considered as adequate when no analgesic was required, inadequate when 0.1mg of iv fentanyl was required and failed when GA had to be applied to complete the surgery.

In both groups, hemodynamic values like heart rate (HR), systolic (SAP), diastolic (DAP) and mean (MAP) arterial blood pressure were recorded intraoperatively every 10 min during the first 60 min after start of anaesthesia. Relative hypotension (fall in SAP ≥ 25% of baseline value) was treated with a rapid intravenous infusion of 250 ml of Ringer solution and absolute hypotension (fall in SAP < 90 mmHg) was treated with intravenous bolus of ephedrine 5–10 mg. Clinically relevant bradycardia (decrease in HR to less than 45 bpm) was treated with 0.5 mg of intravenous atropine.

Postoperative pain intensity was evaluated with a visual analog scale (VAS) from 0 = no pain to 10 = the worst pain imaginable at 0, 2, 4, 8, 12 and 24 hours after surgery. Rescue analgesic drug (tramadol 100 mg iv) was given on patient request or when VAS score was ≥3. All patients were given 1g of paracetamol i.v. every 6 hours, starting immediately after receiving first rescue analgesic drug. The time between end of surgery and first analgesic was recorded. Side-effects, such as pruritus, nausea, vomiting, headache or neurological complications were also documented.

Data were statistically analysed and expressed as mean ± standard deviation (SD) or median ± range for quantitative variables and percentege of patients for nominal variables. Avereges were comapred using unpaired two-sample t-test or Mann-Whitney U test when appropriated and proportiones were compared using Fisher's exact test. P value less than 0.05 was considered statistically significant.

RESULTS

There were no significant differences between the groups with respect to age, gender, weight, height, ASA physicial status and operation time (Table 1) and start values of SAP, DAP, MAP and HR, Table 2. Ventral hernia was umbilical in 6, supraumbilical in 6 and infraumbilical in 8 group GA and in 7, 6 and 7 group SPA patients, respectively, Table 3. Anaesthesia was adequate in 18 (90%) group SPA patients and inadequate in 2 (10%) patients who additionally required fentanyl supplementation to complete the surgery. No case of failed SA was documented.

TABLE 1

Patients caracteristics and operation time.

	Group GA (n=20)	Group SPA (n=20)	P
Age (years)	47 ± 16	46 ± 16	0.96
Gender			
Male (%)	8 (40)	6 (30)	0.74
Female (%)	12 (60)	14 (70)	
Weight (kg)	81 ± 7	79 ± 5	0.22
Height (cm)	171 ± 8	171 ± 9	0.83
ASA physical status			
I	7 (35)	9 (45)	0.75
II	13 (65)	11 (55)	
Operation time (min)	62 ± 18	63 ± 17	0.73

Values are mean ± standard deviation or number of patients (percenteges)
ASA: American Society of Anesthesiologist;

TABLE 2

Basal hemodynamic parameters.

	Group GA (n = 20)	Group SPA (n = 20)	P
SAP (mmHg)	129 ± 8	125 ± 9	0.15
DAP (mmHg)	76 ± 8	74 ± 9	0.33
MAP (mmHg)	92 ± 7	91 ± 8	0.52
HR (bpm)	73 ± 6	75 ± 6	0.22

Values are mean ± standard deviation. SAP: systolic arterial pressure; DAP: diastolic arterial pressure; MAP: mean arterial pressure; HR: heart rate

TABLE 3

Ventral hernia localisation.

	Group GA (n = 20)	Group SPA (n = 20)
Umbilical	6	7
Supraumbilical midline	4	3
Supraumbilical transverse	2	3
Infraumbilical midline	5	4
Infraumbilical transverse	3	3

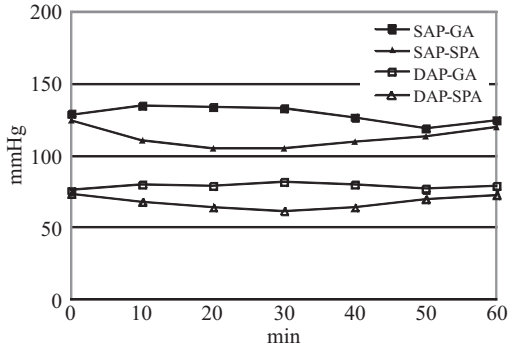

Figure 1. *The mean systolic arterial pressure (SAP) and diastolic arterial pressure (DAP) during the first 60 minutes after start of anaesthesia in the group GA and the group SPA; * P < 0.01(SAP-GA vs SAP-SPA and DAP-GA vs DAP-SPA)*

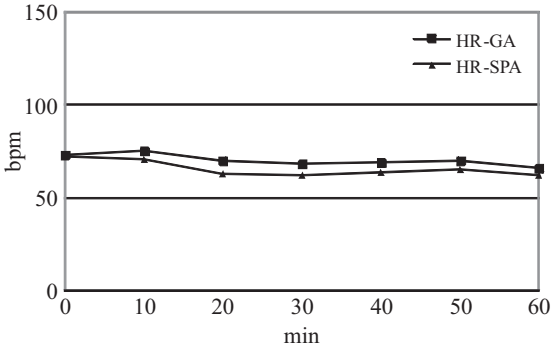

Figure 2. *The mean heart rate (HR) during the first 60 minutes after start of anaestheisa in the group GA and the group SPA.*

The mean values of SAP and DAP in the first 60 min after start of anaesthesia are shown in Figure 1 and of HR in Figure 2. The SAP and DAP were significantly lower in the SPA group at 10, 20, 30 and 40 min after start of anaesthesia, Figure 1. Maximum decrease of basal SAP was 10 ± 6 in GA and 21 ± 6% in SPA group, P < 0.05 and of HR 11 ± 5 and 17 ± 7%, P > 0.05, respectively. Relative hypotension was recorded in 2 (10%) GA and 4 (20%) SPA patients, P > 0.05 and absolute hypotension in 0% GA and in 4 (20%) SPA patients P=0.11. Decrease of HR < 45/min was recorded in 1 (5%) group GA and 4 (20%) group SPA patients, P = 0.34.

Postoperative VAS pain scores at 0, 2, 4 and 8 hours after surgery were higher in GA than in SPA group, P < 0.05, but did not differ significantly at 12 and 24 hours after surgery, Table 4. Time to first analgesic was 28 ± 10 in GA and 580 ± 138 min in SPA group, P < 0.001. Postoperative nausea and vomiting (PONV) had 7 (35%) GA and 1 (5%) SPA group patients, P = 0.04 and mild to moderate pruritus 14 (70%) the SPA group patients, P < 0.001. No case of headache or neurological complications were documented.

TABLE 4

Postoperative VAS pain scores at 0, 2, 4, 8, 12 and 24 hours after surgery in the group GA and the group SPA patients.

Time	group GA	group SPA	P
0 h	4 (2 – 6)	0	< 0.05
2 h	5 (2 – 7)	0	< 0.05
4 h	5 (1 – 6)	0 (0 – 2)	< 0.05
8 h	4 (2 – 6)	1 (0 – 3)	< 0.05
12 h	4 (1– 5)	2 (0 – 4)	> 0.05
24 h	3 (0 – 4)	1 (0 – 3)	> 0.05

DISCUSSION

General anaesthesia (GA) and spinal anaesthesia (SA) have proven to be effective anaesthetic methods for patients undergoing open ventral hernioplasty, but both of these techniques are associated with some complications and side-effects *(2–7)*. SA often results – with hypotension, urinary retention and prolonged motor recovery and all of that can limitate its routine use in ambulatory surgery and in geriatric population with limited cardiorespiratory reserve. On the other side, SA provides excellent sensory and motor blockade, prolonged postoperative analgesia and significantly lower drug and supply costs and teherefore, represents a more suitable and cost-effective alternative to GA *(4, 5)*.

In the present study we compared GA performed as TIVA and hyperbaric bupivacaine-sufentanil SA in inpatients undergoing elective open ventral hernioplasty. The study demonstrated that open ventral hernia repair can be successfully performed under SA because reliable

surgical anaesthesia was provided in all 20 group SPA patients. Although only 10 mg of hyperbaric bupivacaine was applied, the high success rate of spinal block can be explained as a result of intrathecal coadministration of 10 μg of sufentanil which strongly enhanced sensory without increasing motor and sympathetic blockade. It is well documented that intrathecal addition of opioid, due to its potent synergistic analgesic effect, greatly enhances subtherapeutic doses of local anaesthetic and previous studies reported successful SA produced with significantly reduced local anaesthetic dose when intrathecal opioids were coadministered *(8–12)*. Sufentanil is N-4 thienyl derivative of fentanyl and is more lipid soluble and has greater affinity for opioid receptors than fentanyl or morphine. When compared with fentanyl, sufentanil has a smaller volume of distribution and shorter elimination half-lif and is 7–10 times more potent than fentanyl and 100 times more potent than morphine *(13)*. In our study we decided to administer sufentanil because it has been shown to be better in attenuating hemodynamic and hormonal response to surgical stimuli as compared to fentanyl, and has a faster onset of action and lower risk for delayed respiratory depression as compared to morphine *(14–16)*.

In present study, GA provided more stable hemodynamic profile with minimal cardiovascular disturbance, which may be important benefit, especially in elderly and cardaic risk patients. The incidence of hypotension in patients with spinal anaesthesia depends on the level of sympathetic block, preoperative condition, age of patient, blood volume, type of surgery and amount of blood loss. In patients undergoing laparoscopic ventral hernioplasty under spinal anaesthesia, hypotension occured in 68% of patients and was easily resolved by fluid administration *(17)*. In our study in which open ventral hernioplasty was performed, clinically relevant hypotension (decrease of SAP < 90 mmHg) was observed in only 20% patients under SA and was easilly treated with 5–10 mg of iv ephedrin. Mean SAP decline from baseline was only 21% which can obviously be attributed to the fact that relatively low local anaesthetic dose was administered.

Heart rate during high neuraxial block typically decreases as a result of blockade of the cardio accelerator fibres arising from T1 to T4 but it may also decrease as a result of a fall in right atrial filling. In present study, mean decrease of HR from baseline during first 60 min of spinal anaesthesia was 17% and clinically relevant bradycardia (HR < 45/min) was observed in 20% group SPA patients.

Open ventral hernia repairs are often associated with substantial postoperative pain, frequently requiring narcotic analgesics. Early postoperative pain can decrease early ambulation, delay the return of bowel function and be a major problem in the acceptance of early discharge by patients *(18)*. In this study, SA provided excellent and prolonged postoperative analgesia and markedly better pain relief in the first 8 hours after surgery and time to first analgesic was more than 9 hours longer in SA than in GA group patients. Postoperative pain scores were lower at 12 and 24 h after surgery, too, but the differance was not found to be statistically significant. Previous studies also reported superiority of SA to GA in providing not only better postoperative analgesia after variuos tipes of surgery but also in reducing the need for blood transfusion, incidence of thromboembolic disease, pulmonary embolism, postoperative hypoxic episode and total drug and supply costs *(4, 19)*.

PONV is one of the main complaints in patients undergoing surgery under general anaesthesia and one of the most important factors that determines the length of hospital stay after ambulatory anesthesia (20). We reported PONV in 35% of the patients in GA group and in 5% of the patients in the SPA group and all were successfully treated with intravenous metoclopramid.

Administration of opioids into the subarachnoid space may produce significant, dose dependent side-effects, such as pruritus, nausea, vomiting, urinary retention and delayed respiratory depression. The incidence of pruritus in patients receiving intrathecal opioids is drug and dose-dependent and the reported rate is 23–75% *(11, 21, 22)*. In present study, the addition of intrathecal sufentanil resulted in mild to moderate pruritus in 70% of the patients and did not require any treatment. We did not report any case of urinary retention requiring bladder catheterization, headache or neurological complications in both groups.

In conclusion, results of this prospective study demonstrate that SA produced with hyperbaric bupivacaine 10 mg + sufentanil 10 μg provides safe and reliable surgical anaesthesia in adult patients undergoing elective open ventral hernioplasty. Although GA resulted in more stable hemodynamic profile, SA provided less PONV and better postoperative pain control.

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