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The Effect of Spinal *versus* General Anesthesia on Postoperative Pain and Analgesic Requirements in Patients Undergoing Peripheral Vascular Surgery

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A B S T R A C T

The optimal anesthetic technique for peripheral vascular surgery remains controversial. The purpose of this study was to evaluate the effect of spinal versus general anesthesia on postoperative pain, analgesic requirements and postoperative comfort in patients undergoing peripheral vascular surgery. A total of 40 patients scheduled for peripheral vascular surgery were randomly assigned to two groups of 20 patients each to receive general anesthesia (GA) or spinal anesthesia (SA). In GA group, anesthesia was induced using thiopental and fentanyl. Vecuronium was used for muscle relaxation. Anaesthesia was maintained with isoflurane and nitrous oxide. In the SA group, hyperbaric 0.5% bupivacaine was injected into the subarachnoid space. Postoperative pain was assessed for 24 hours by a visual analog scale during three assessment periods: 0–4, 4–12 and 12–24 h as well as analgesic requirements. Patients were also asked to assess their postoperative state as satisfactory or unsatisfactory with regard to the pain, side effects and postoperative nausea and vomiting. Visual analogue scale (VAS) pain score was significantly lower in the group SA compared with group GA. This effect was mainly due to the lower pain score during the first study period. The patients received general anesthesia also reported a significantly higher rate of unsatisfactory postoperative comfort than those receiving spinal anesthesia. We conclude that spinal anesthesia is superior to general anesthesia when considering patients' satisfaction, side effects and early postoperative analgesic management.

Key words*: peripheral vascular surgery, spinal anesthesia, general anesthesia, postoperative analgesia, side effects*

Introduction

Different anaesthetic techniques have been used for peripheral vascular surgery but the optimal technique remains controversial. In this group of patients all undergoing surgery requiring less than 2 hours of anaesthesia, the type of anaesthesia employed has traditionally been left to the individual preference of the anaesthetist. Much of the literature supporting regional anesthesia concentrates on epidural anesthesia, with less consideration given to subarachnoidal anesthesia and peripheral nerve blocks[1,2]. Several studies have claimed improvements in outcome following regional anesthesia in patients undergoing peripheral vascular procedures. The reported beneficial effects have included improvement of the neuroendocrine stress response to surgery[3], significantly less blood loss[4], improvement in pulmonary function by blunting the reduction in functional residual capacity[5], cardiovascular stability, enhancement of lower limb blood flow, reduction in the incidence of graft thrombosis, and a reduction in the thrombotic response to surgery[6].

On the other hand, a large multicenter study including 423 patients compared general to epidural analgesia and anesthesia and spinal anaesthesia, failed to demonstrate any difference in cardiac morbidity[7]. Whilst either general or regional anesthesia can be safely administered, it is assumed that a good anesthetic should have a rapid onset and reversal of effects while providing desir-

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able intraoperative hemodynamic conditions and contributing to a reduced need for blood transfusion. It should also permit the earliest possible discharge from the postanesthesia unit (PACU) and minimize common postoperative issues such as pain, need for analgesics, nausea, vomiting and drowsiness. Our study concentrates on the latter and aims to evaluate the effect of spinal *versus* general anesthesia on postoperative pain, analgesic requirements and postoperative state in patients undergoing peripheral vascular surgery.

Material and Methods

After approval of the study by the Institutional Ethics Committee and the written informed consent of each patient, we enrolled 40 patients scheduled for peripheral vascular surgery and presenting an ASA physical status II/III. Exclusion criteria included the patient's refusal, allergy to local anesthetics, severe spinal deformity, coagulopathy, failed or inadequate spinal anesthesia, history of abuse of alcohol or narcotic substances and psychiatric history. Patients were randomly allocated to one of two groups to receive either general anesthesia (GA group n=20) or spinal anesthesia (SA group, n=20).

Patients were premedicated with midazolam a 7.5 mg po. Both groups received volume expansion with 10 mL/kg Ringers lactate solution prior and 2 mL/ kg/h during and after anesthesia until patients tolerated oral fluids. General anesthesia was induced using thiopental 3–5 mg/kg and fentanyl 1–2 μg/kg. Tracheal intubation was facilitated by vecuronium 0.1 mg/kg. Anaesthesia was maintained with isoflurane and 50% nitrous oxide in oxygen. Additional fentanyl and vecuronium were used if necessary. At the completion of the surgical procedure, neuromuscular blockade was reversed by administering neostigmine 2.5 mg and atropine 1 mg. The patients were awakened, extubated in the operating room and afterwards transported to the PACU for recovery where supplemental oxygen via a mask was administered for 2 h postoperatively. In the SA group, 15 mg 0.5 % bupivacaine (Marcain® Spinal, AstraZeneca) was injected into the subarachnoid space through L_2–L_3 or L_3–L_4 lumbar interspaces with the patient in the sitting or lateral decubitus position. Dural puncture was performed using a 25-gauge Quincke needle and the patient was afterwards immediately returned to the supine position. Midazolam 3–5 mg boluses were administrated for sedation as needed. Bradycardia (<50/min) was treated by IV. application of atropine 0.5–1.0 mg, hypotension (mean arterial blood pressure 30% bellow baseline) was treated by IV. application of ephedrine 5 mg, and oxygen was administered via a mask at 2–4L during the surgery and for 2 h postoperatively. Noninvasive measurements of blood pressure, heart rate (EKG), hemoglobin oxygen saturation (SpO_2) and respiratory rate were recorded throughout anesthesia and 24 h postoperatively in the PACU. Postoperative pain was noted using visual analog scale (VAS) from 0 = no pain to 10 = the worst pain imaginable. Postoperative analgesia was provided with combination of metamizol and tramadol hydrochloride. Analgesia was given on request or when patients experienced pain of VAS >3. Mild pain (VAS <5) was treated with combination of metamizol 1.25 g and tramadol hydrochloride 50 mg in 100 mL 0.9% NaCl iv. and moderate pain (VAS >5) was treated with the combination of metamizol 2.5 g and tramadol hydrochloride 100 mg in 100 mL 0.9% NaCl over 20 min iv. If no relief was obtained an additional dose of tramadol hydrochloride 25 mg was administered i.v. Postoperative pain was recorded by nursing staff during three assessment periods: 0–4, 4–12 and 12–24 h. Time interval to the first administration of the combination of tramadol hydrochloride and metamizol, and number of patients who needed analgesic were recorded. Anesthesia induction time, end of surgery to transfer to PACU and side effects such as postoperative nausea or headache requiring treatment were recorded. Patients were asked to indicate nausea or vomiting, by saying »yes« or »no«. If patients experienced nausea for 30 min, more than one emetic episode in 15 min, or if specifically demanded antiemetic, they received metoclopramide 10 mg every 8 hrs. Patients were also asked to assess their postoperative state as satisfactory or unsatisfactory with regard to the pain and side effects.

The results are expressed as means ± SD. The primary endpoint of the study was time to first administration of the combination of tramadol hydrochloride and metamizol. Before the study, the number of patients required in each group was determined using a power calculation with data obtained from previous studies. A pre-study power analysis indicated that a sample size of 18 would be required in each group in order to detect a 40% difference between the groups with $\alpha = 0.05$ and $\beta = 0.2$ and a standard deviation of 40% in this population. To exclude any dropouts, we included 20 patients in each group. Demographic data, duration of surgery, induction of anesthesia, end of surgery, pain scores, and tramadol and metamizol consumption were analyzed using Mann-Whitney U-test or Student's t-test as appropriate. Differences in nominal data such as sex and number of patients requiring postoperative analgesics were analyzed by the χ^2-test The level of significance was set at $p<0.05$.

Results

Forty patients were enrolled in the study: 20 patients received spinal anesthesia and 20 patients received general anesthesia. There were no intraoperative complications in either group. In the spinal group, failed spinal occurred once and general anaesthesia was given, and according to the study protocol, this case was excluded and replaced according to its randomization and group assignment.

The surgery had a mean duration of 120 minutes that was similar in both groups. There were no significant differences among the groups regarding demographic data as shown in Table 1. The anesthesia induction time observed between groups was significantly shorter (p<

TABLE 1
COMPARISON OF PATIENTS DEMOGRAPHICS

Demographics data	GA group	SA group
Number of patients	20	20
ASA II/III	16/4	17/3
Sex (M/F)	5/15	4/16
Age (yr)	61.2±10.5	60.6±9.7
Weight (kg)	67.3±7.2	68.3±7.8

GA group – general anesthesia; SA group – spinal anesthesia; Data presented as mean±standard deviation (SD) or number; no significant between-group differences

0.001) in GA group than SA group. However, the time from the end of surgery to readiness to leave the operating room was significantly faster ($p<0.001$) in SA group than GA group. In SA group this time was zero. The mean duration of analgesia (from end of surgery to first request for analgesic) varied amongst two group, being significantly longer in SA group than in GA group ($p<0.001$). Total analgesic consumption were also significantly lower in SA group compared to GA group (Table 2). Pain score was significantly lower ($p<0.001$) in the SA group compared with GA group during the first study period (0–4 h) after which no significant differences were noted among the groups. Mean overall VAS score of 24 hrs after surgery was statistically significantly lower in SA group compared with GA group. ($p=0.002$, Table 3) The patients who received general anesthesia also reported a significantly higher rate of PONV, dizziness, drowsiness and sore throat. There were no significant differences among the groups regarding headache and urinary retentions. Overall satisfaction rate was better in SA group than GA group ($p=0.028$, Table 4).

Discussion

GA and SA have proven to be effective anesthetic methods for patients undergoing peripheal vascular surgery. However, some anesthesiologist believe that regional anesthesia is better for peripheral vascular surgery, whereas others prefer general anesthesia Still, the optimal anesthetic technique for these procedures remains controversial and it has not been determined whether either of these techniques is superior to the other.

Effective postoperative pain control is an essential component of the care for the surgical patient. Inadequate pain control, apart from being inhumane, may result in increased morbidity or mortality[8,9]. The advantages of effective postoperative pain management include patient comfort and therefore satisfaction, earlier mobilization, fewer pulmonary and cardiac complications, a reduced risk of deep vein thrombosis, faster recovery

TABLE 2
ANESTHESIA CHARACTERISTIC AND POSTOPERATIVE DATA

	GA group	SA group	p
Number of patients	20	20	
Duration of surgery (min)	116.3±23.8	119.0±34.3	0.774
Anesthesia induction time (min)	7.2±1.7	12.3±2.5	<0.001
End of surgery – readiness to leave (min)	6.6±1.3	0±0	<0.001
Time to first analgesic (min)	94.7±156.6 (20–725)	364.2±224.7 (60–845)	<0.001
Total analgesic consumption (dose per patient – mg)			
Tramadol	152.5±71.5	100.0±72.5	0.026
Metamizol	3.7±1.8	2.3±1.6	0.013

GA group – general anesthesia; SA group – spinal anesthesia; Data presented as mean±standard deviation (SD); $p<0.05$ was considered statistically significant

TABLE 3
POSTOPERATIVE PAIN SCORE VAS

	GA group		SA group	
	VAS Mean (range)	A N(%)	VAS Mean (range)	A N(%)
0–4	3.6±1.4 (2–7)	14 (70)	1.1±1.8 (0–6)*	6 (30)*
4–12	3.7±1.3 (2–7)	4 (20)	3.3±1.3 (2–7)	8 (40)
12–24	1.8±1.2 (0–4)	1 (5)	1.7±1.3 (2–7)	2 (10)
Overall pain score	3.0±1.1 (0–7)	19 (95)	2.7±1.7(0–7)	16 (80)

GA group – general anesthesia; SA group – spinal anesthesia; Data presented as mean±standard deviation (SD) as median (range), * $p<0.05$ was considered statistically significant

TABLE 4
POSTOPERTIVE SIDE EFFECTS

Side effects	GA group N (%)	SA group N (%)	p
Sore throat	4 (20)	0 (0)	0.035
Nausea/vomiting	8 (40)	1 (5)	0.008
Dizziness	4 (25)	0 (0)	0.035
Drowsiness	5 (25)	0 (0)	0.016
Headache	2 (10)	6 (30)	0.113
Urinary retention	2 (10)	7 (35)	0.058
Overall satisfaction rate	12 (60)	18 (90)	0.028

GA group – general anesthesia; SA group – spinal anesthesia; Data presented as number N (%), $p<0.05$ was considered statistically significant

with less likelihood of the development of neuropathic pain, and reduced cost of care[10]. In our study pain level reported by GA patients was higher than SA patients and the difference was especially significant during the first study period. This result are in agreement with the many other studies in which patients received spinal anesthesia experience less pain in the early postoperative period compared with those who received general anesthesia[11,12].

The significantly lower VAS pain score in the early period could be a result of two mechanisms. There may be a preemptive effect in which SA attenuates the pain response by inhibiting afferent nociceptive pathways[13,14]. On the other hand, sensory recovery remains somewhat longer after motor recovery after spinal blockade, meaning that the SA group probably had some residual sensory blockade although complete motor recovery was observed in all patients[15]. Data available indicate that afferent neural blockade with local anesthetics is the most effective analgesic technique, with high-dose opioids, epidural opioids and clonidine, patient controlled opioid therapy, and nonsteroidal anti-inflammatory agents being next in order[10].

The results of the current study also demonstrate that patients undergoing peripheral vascular surgery under spinal anesthesia reguired less postoperative analgesics than patients received general anesthesia. The time to first request for analgesia was also significantly longer in the spinal anesthesia patients, and more GA patients needed analgesic comapared with SA patients. The decreased postoperative analgesic requirements and increased duration of analgesia in patients received SA may be intepreted as decreased pain perception in these ptients. SA prevents pain by directly delivering local anesthetics to nerves and therefore reduce pain intensity and decrease analgesic requirements.

Our trial confirms known advantages of spinal anesthesia in regards to the incidence of nausea, vomiting, and adverse events. Patients receiving spinal anesthesia were significantly more satisfied with their postoperative state compared with general anesthesia patients. Contributing factor to this satisfaction may have been the overall reduced incidence of postoperative pain, nausea/vomiting, sore throat, dizziness and drowsiness in spinal anesthesia patients. It is very important to emphasize that, the increased incidence of nausea and vomiting in the GA group could have been the result of the anesthetic method itself, associated primarily with the use of nitrous oxide and narcotic analgesic agents, as well as with the impairment of gastric emptying which is not noted with the use of spinal anesthetic agents.[16] Improved postanesthetic comfort also contributes to a high level of patient satisfaction in SA group, as documented in the literature[17].

Finally, the relatively low overall 24 hrs VAS pain score in both groups (GA 3.0 *vs*. SA 2.7), together with the lack of any serious side effects, indicates also, that the combination of metamizol and tramadol hydrochloride, which is a standard analgesic regimen very frequently used in our surgical department, is an efficient and reliable method for postoperative pain control.

Our study has a few limitations that should be addressed before the final conclusion. A major limitation of this pilot study was its small sample size (n=20) and short-term follow-up. The sample size may have contributed to the low statistical power and limited any type of subanalysis. One of the limitations of our study is the use of thiopental and isoflurane in the GA. The use of a shorter acting intravenous and inhalational agent such as propofol and sevoflurane may have resulted in faster emergence and recovery from GA. Another limitation was the use of diphenhydramine for nausea, which may result in sedation and delayed recovery.

Conclusion

Spinal anesthesia is superior to general anesthesia for peripheral vascular surgery when considering patients' satisfaction, side effects and early postoperative analgesic management.

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UČINAK SPINALNE I OPĆE ANESTEZIJE NA JAČINU POSLIJEOPERACIJSKE BOLI I ANALGETSKA POTRAŽIVANJA KOD BOLESNIKA PODVRGNUTIH PERIFERNIM VASKULARNIM OPERACIJAMA

S A Ž E T A K

Primjena odgovarajuće anesteziološke tehnike kod perifernih vaskularnih operacija ostaje još uvijek kontroverzna. Svrha ovog istraživanja je procijeniti učinak spinalne i opće endotrahealne anestezije na jačinu poslijeoperacijske boli, analgetska potraživanja te poslijeoperacijsko zadovoljstvo bolesnika podvrgnutih perifernim vaskularnim operacijskim zahvatima. U studiju je bilo uključeno 40 bolesnika podvrgnutih perifernim vaskularnim operacijskim zahvatima koji su nasumce podijeljeni u dvije skupine od 20 bolesnika te su podvrgnuti spinalnoj (SA) ili općoj anesteziji (OA). U OA skupini bolesnici su anestezirani tiopentalom i fentanilom. Vekuronij je korišten za mišičnu relaksaciju. Anestezija je održavana kombinacijom izoflurana i dušikovog oksidula. U SA skupini korišten je hiperbarični 0.5% bupivakain apliciran u subarahnoidalni prostor. Poslijeoperacijska bol kao i potreba za analgezijom procijenjivana je tijekom 24 sata uz pomoć vizualno analogne skale tijekom tri promatrana perioda: 0–4, 4–12, 12–24. Bolesnici su također zamoljeni da procijene svoje poslijeoperacijsko stanje kao zadovoljavajuće ili nezadovoljavajuće glede jačine boli, popratnih učinaka i poslijeoperacijske mučnine i povraćanja. Jačina poslijoperacijske boli bila je značajno niža u SA skupini u odnosu na OA skupinu. Taj učinak je posljedica manje boli tijekom prvog promatranog vremena. Bolesnici koji su podvrgnuti općoj anesteziji bili su više nezadovoljni svojim poslijeoperacijskim stanjem u odnosu na bolesnike u spinalnoj anesteziji. Zaključili smo da je spinalna anestezija superiornija u odnosu na opću anesteziju glede bolesnikovog zadovoljstva, popratnih učinaka te rane poslijeoperaijske boli.