PERIODICUM BIOLOGORUM
VOL. 115, No 2, 179–183, 2013

UDC 57:61
CODEN PDBIAD
ISSN 0031-5362

Original scientific paper

Intermittent spinal anesthesia – a viable alternative in hybrid vascular procedures?

IVANA TUDORIĆ ĐENO
ANA BRIŠKI
IVONA DRAGIĆ
DAVORKA ŽIDAK
JASMINKA PERŠEC
INO HUSEDŽINOVIĆ

University of Zagreb,
Dubrava University Hospital
Clinical Department of Anesthesiology
Reanimatology and Intensive Care Medicine,
Zagreb, Croatia

Correspondence:
Ivana Tudorić Đeno
University of Zagreb,
Dubrava University Hospital
Clinical Department of Anesthesiology,
Reanimatology and Intensive Care Medicine
Gojka Šuška 6, 10000 Zagreb, Croatia
E-mail: ivanatd@yahoo.com

Abbreviations:
ACT – activated clothing time
GA – general anethesia
ISAB – intermittent subarachnoidal block
LA – local anesthetic
NA – neuroaxial anesthesia
SS SAB – single-shot subarachnoidal block

Received May 15, 2013.

Abstract

In this prospective observational study we analysed anesthetic techniques used in high risk surgical patients who underwent hybrid peripheral revascularization. According to the anticipated duration of surgery, anesthesiologists chose general anesthesia (GA), single-shot or intermittent subarachnoid block (ISAB). The aim of this paper was to present the intraoperative conditions during single-shot subarachnoid block (SS SAB) compared to ISAB with spinal catheter placement. Spinal block distribution was assessed at the beginning and at the end of the surgery. This study has shown that ISAB is a viable alternative in prolonged hybrid vascular procedures, especially when general anesthesia carries great risk for the patient.

INTRODUCTION

The choice of anesthetic technique and hemodynamic monitoring during hybrid procedures for peripheral revascularization is greatly affected by patient comorbidities, duration of surgery and the assessment of risks and benefits of a certain anesthetic technique. The reduction in mortality by one third with the use of neuraxial anesthesia (NA) technique compared with general anesthesia (GA), not dependent on surgery subspecialty, provides basis for the application of NA technique in all procedures performed below the level of the umbilicus *(1)*. Development of postoperative cognitive dysfunction after GA further suggests the application of regional anesthesia whenever possible, especially in patients at risk of developing postoperative cognitive disorders or delirium *(2)*. Polyvascular patients planned for hybrid peripheral revascularization procedures as high risk patients can benefit from the application of NA. The length of procedure can be a limiting factor for the application of single-shot subarachnoid block (SS SAB). The aim of this paper is to present the intraoperative conditions during SS SAB compared to intermittent SAB with spinal catheter placement (ISAB).

METHODS

During the period between May 1, 2008 to December 31, 2011, we monitored the quality of intraoperative conditions, the absence of pain and unpleasant sensations in the surgical field during hybrid peripheral revascularization procedures of the lower extremities. Anesthesiologists were free to choose anesthetic technique based on the expected lenght of the procedure and comorbidities of patients. We analysed intraoperative analgesia in patients who received NA. All patients were

premedicated with midazolam 5 mg intramuscularly (Dormicum Roche®, Basel), and received 250 ml of Ringer's solution (Natrii chloridi infundibile compositum, Hrvatski zavod za transfuzijsku medicinu, Croatia) before the puncture. Puncture site was determined by palpation technique at the L2–3 or L3–4 intervertebral level. Puncture site was infiltrated by 100 mg of 2% lidocaine (5 ml Lidokain 2%, 20mg/ml, Belupo, Croatia). For puncture of subarachnoidal space in the SS SAB group an atraumatic Whitacre®, No 27 G (Vygon, France) spinal needle was used, and Spinocath® (B. Braun, Melsungen, Germany) catheter-over-the-needle technique in ISAB group. Basic monitoring included ECG, SpO2 and NIBP. Extended monitoring, which included IBP, was used if deemed necessary by the anesthesiologist. Block was considered adequate if the height of the sensory block was at Th10 level. In the ISAB group, the height of sensory block at Th12 level was determined every 60 minutes and if the sensation of coldness appeared, a bolus dose of local anesthetic (LA) solution of 1.6 mcg levobupivacaine (3,125 ml 0.5% Chirocaine®) and 16 mcg fentanyl (3,125 ml, 50 mcg/ml Fentanil®, Janssen) in 3.3% glucose solution was administered. In the SS SAB group when the patient signaled unpleasant sensations, sedatives and analgesics were applied to the point of deep sedation and complete analgesia. The intensity of motor block was determined at the beginning and at the end of surgical procedure and we assessed the achieved intensity according to the modified Bromage scale as used previously *(3, 4)*: 1-complete loss of movement in the lower extremities, 2-possibility of moving the feet, 3-partial flexion at the knee, 4-complete flexion at the knee, 5-flexion at the knee and hip, 6-proprioception test completed (positive). During surgery, partial heparinization with 5000 IU iv. was planned. The activated clothing time (ACT) was not measured in the SS SAB group, whereas in the ISAB group ACT was measured three minutes after heparin administration and before removing the catheter. If ACT value exceeded the baseline (110–160 seconds), conversion with protamine at a 1:1 ratio was performed, ACT measure repeated and the catheter removed. Since protamine was contraindicated in some patients, heparin conversion was not performed and the catheter was removed on the ward, after normal ACT laboratory values were obtained. Postoperative pain assessment was performed 30 minutes after surgery and then every 2 hours. Predicted analgesics for postoperative analgesia were Voltaren 150 mg iv. (6ml, 75mg/3ml Voltaren®, Pliva) for VAS 3–5 and Tramadol 100 mg iv. (2ml, 100mg/2ml Tramadol®, Farmal) for VAS over 5.

The gathered information is expressed as a mean value with a standard deviation for continuous variables and for categorical values with a measure of central tendency: median and range. Group comparability was determined with a t-test for independent samples and for establishing the difference in sensoric block height and motor block intensity between groups we used the Mann Whitey U test.

RESULTS

In the period from 2008 to 2011 there were 42 patients who underwent hybrid procedures. We have shown no difference between the groups when age and coexisting diseases are concerned (Table 1). The anticipated duration of surgery more than 180 minutes was planned in 22 patients. Technique of choice was GA in 14 patients, and ISAB in 8 patients. In patients with expected duration of surgery less than 180 minutes (N 20), prolongation of surgery occurred in 13 patients. Of all the patients who underwent hybrid peripheral revascularization procedure, the analysis included 21 patients (Figure 1).

TABLE 1

Demographic characteristics of the patients.

	SS SAB (13)	I SAB (8)	p
Age (years)	62±9	64±7	NS
ASA 1/2/3/4	0/1/11/2	0/0/5/3	NS
Comorbidity			
HA	10	6	
CAD with MI or CABG	7	5	
DM	4	3	
Gastritis, adipositas	3	3	
CVI	3	2	
COPD	1	0	
Dialysis	0	1	

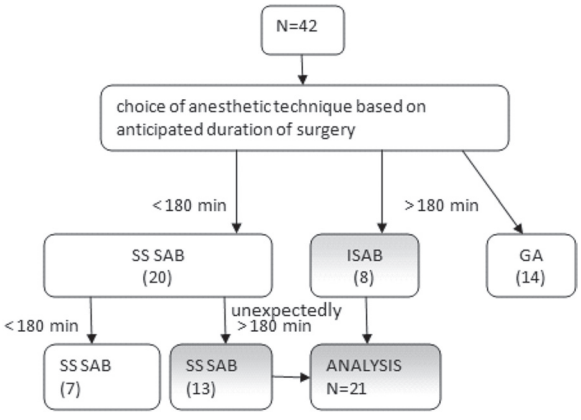

Figure 1. *Flowchart of inclusion and exclusion of patients.*

Characteristics of intraoperative anesthesia are presented in Table 2. The proportion of patients with inadequate intraoperative analgesia in SS SAB group in need of iv. sedation and analgesia is shown in Figure 2. Mean time for need of iv. analgesia and sedation in the SS SAB group was 164 minutes (Figure 3). In ISAB group median time for repeating an intrathecal bolus of LA solution was 117 minutes. The total dose of given levobupivacaine was significantly lower in ISAB then in SS SAB group, 12 mg and 16mg respectively (Table 2).

TABLE 2

Intraoperative analgesia duration and motor block intensity.

	SS SAB (13)	I SAB (8)	p
Duration of surgery (min)	200 (180–360)	210 (180–265)	0,2
Median time to heparinization (min)	55 (30–150)	61 (47–100)	0,4
Continuous heparinization surg (N)	2	2	
Duration of adequate analgesia (min)	164 ± 43	117±38	<0,01
Levobupivacaine dosage (mg)	16 (12,5 – 20)	12 (7,5–20)	<0,01
Bromage at the beginning of operation	12–1–0–0–0–0	0–0–5–3–0	<0,01
Bromage at the end of operation	0–0–0–0–3–10	0–0–0–0–0–8	=0,04

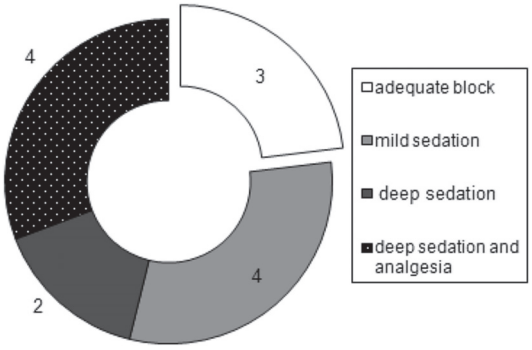

Figure 2. *The adequacy of intraoperative analgesia in SS SAB group in absolute values.*

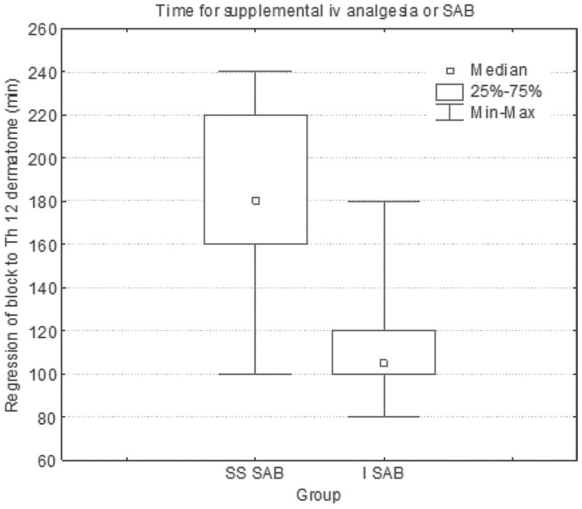

Figure 3. *Time for supplemental intravenous analgesia for SS SAB and bolus injection via catheter for ISAB.*

There was no statistically significant intergroup difference in time to systemic heparinization or in the number of patients on continuous postoperative heparinization. The catheter was removed at the end of surgery in 6 patients, and in 2 patients it was removed with a delay of 3 to 24 hours. In both cases the reason was prolonged ACT at the end of surgery and the catheter was removed when coagulation parameters returned to their reference range.

At the start of procedure motor block was more intense in the SS SAB group. Significant motor block regression was noted between the two points of measurement in both groups p< 0,01. In SS SAB group first point of measurement median (range) was 1 (1–2) and in the second point 5 (5–6) p<0.01. In the ISAB goup motor block intensity at first point of measurement was 3 (2–3) and at the end of the procedure a complete motor recovery was observed in all patients, p<0,01 (Table 2).

In both groups first postoperative analgesia was required 2 h after admission to the surgical ward and no difference in the required amount of nonsteroidal analgesics or opioids was recorded.

DISCUSSION

During this study we observed the occurrence of inadequate intraoperative analgesia due to unplanned prolongation of the surgery. Choice of anesthetic technique was based on the anticipated duration of surgery.

Conventional SAB (15–20 mg of 0.5% levobupivacaine solution) provides adequate sensory block in 90% of cases, with a maximum height of block Th8 (Th4-L3) *(5)*. Two-segment regression of block was described after 62 minutes, when using 12 mg of 0.5% levobupivacaine. Regression of block to L1 dermatome after the administration of levobupivacaine (12 mg) ocurred after 112 minutes *(6)*. Each additional milligram of levobupivacaine prolongs duration of sensory block for 10 minutes *(7)*. When administering 15–20 mg of levobupivacaine expected time of block regression to Th12/L1 was 140–190 minutes. Based on these data, we set a time limit during which intraoperative analgesia during SS SAB is maintained. This premise corresponds to the results of our study, where the time to Th12/L1 regression and need for additional analgesia totaled 165 minutes. Burning sensation and pain occurs during manipulation of Th 12/L1 dermatomes. Milder sedation with 5–7 mg midazolam iv. was sufficient to eliminate the negative sensations up to 220 minutes (N6), but with the prolong-

ation of surgery deep sedation with propofol (4ml/kg/min) and iv. analgesia with fentanyl (100–200 μg) i.e. conversion to GA were required (N4). These results show that for surgical procedures with proximal incision in the Th 12/L1 area, the duration of surgery is a limiting factor. In the group of patients (22) with an expected duration of surgery longer than 180 minutes, anesthesiologists have opted for catheter technique and intermittent spinal anesthesia in 8 cases only.

In the ISAB group the initial dose of 5–10 mg levobupivacaine in 3.3% glucose solution with fentanyl was used and the expected height of the block was Th10 (Th5-L1) *(8)*. The expected time for two-segment regression of block with hyperbaric levobupivacaine is 110 minutes, which is consistent with this research *(9)*. Time to repeat a bolus of an intrathecal LA solution was 117 minutes. Seven patients required one additional bolus and only one patient needed two**,** first in the 100th and second in 180th minute. Intraoperative analgesia was adequate regardless of duration of surgery. Regression of motor block at the end of surgery was complete. We performed proprioception test on unoperated limb, it was positive in all the patients. Careful titration of anestesia to achieve complete motor recovery at the end of surgery in I SAB group resulted in having an awake patient with recovered motor function thus being able to keep track of any eventual motor deficiency. In SS SAB group there was a minimal motor block, all patients were able to lift unoperated limb 10 cm from the ground, and proprioception test was negative in only 3 patients.

Reasons why anesthesiologists are reluctant to use microcatheter techniques for continuous or intermittent spinal anesthesia are previously reported serious neurological complications and cauda equina syndrome *(10, 11)*. Complications associated with catheter placement include paresthesia during catheter placement, catheter kinking during fixation or catheter dislocation during the extraction of metal needle *(12)*. Three patients experienced paresthesia during catheter placement, but no other complications were recorded. Neurologic complications associated with catheter techniques are post puncture headache and development of cauda equina syndrome. Incidence of post puncture headache when using Spinocath ® varies from 1.0 to 1.7% *(13, 14, 15)*, but was not recorded in our patients. A small number of patients with ISAB may be the reason why problems with catheter placement and neurologic complications were not recorded. Another risk associated with catheter neuraxial techniques is an epidural hematoma, especially in vascular surgery patients, where unfractionated heparin is used intraoperatively, and often continuously in postoperative period as well. According to studies the risk of bleeding in the epidural space with heparinization is not increased if the time from catheter placement to heparinization is longer than one hour, and if activated clotting time (ACT) is mantained two-fold higher than the base value *(16)*. In our patients, the mean time from puncture to heparinization was 56 minutes in the SS SAB group and 61 minutes in I SAB group, but the shortest interval was 30 min in SS SAB group and 47 min in ISAB group which is somewhat shorter than the recommended time of 1 hour. After heparinization with 5000 IU iv., the ACT value measured by HR-ACT kit (Medtronic, Minneapolis, USA), did not exceed twice the basal value 3 minutes after administration of heparin. The risk of an epidural hematoma after removing the catheter is no greater than the risk the general population is exposed to if current guidelines concerning time passed from puncture to heparinization and normal coagulation values are being followed *(17)*.

Benefits of catheter techniques are: bolus application of small amounts of LA, titration of analgesic effect according to the patients needs, greater hemodynamic stability, ability to prolong anesthesia depending on the duration of surgery and the quality of postoperative analgesia *(18)*. A spinal catheter technique is not commonly used in our hospital so we did not use catheter for postoperative analgesia, which certainly reduces the value of the technique itself. Careful titration of LA only for intraoperative analgesia produces relatively short postoperative analgesia. Both groups of patients had VAS over 5 as early as 2 hours after surgery and required non-steroidal antirheumatic drugs, and 6 hours after surgery VAS was higher than 7 and patients were given Tramadol 100 mg iv.

In patients with cardiac diseases such as aortic stenosis or pulmonary hypertension this technique is proven to provide greater hemodynamic stability when compared with other anesthetic techniques *(19, 20, 21)*. Given that the study focused on the quality of intraoperative analgesia we did not record mean arterial pressure so we can not compare the hemodynamic events between groups or with data from literature.

Disadvantage of this study is the lack of randomization process, freely selected doses of LA in the SS SAB group, as well as the initial dose in the I SAB group.

CONCLUSION

Catheter techniques have been reported as techniques with increased risk for development of neurological complications when compared with single-shot spinal anesthesia. Therefore, whenever the duration of the surgery allows it, the technique of choice is SS SAB. In the case of prolonged surgery or elderly patients with significant cardiovascular and respiratory comorbidities microcatheter techniques should be anesthesiologists first choice.

REFERENCES

1. RODGERS A, WALKER N, SCHUG S, MCKEE A, KEHLET H, VAN ZUNDERT A, SAGE D, FUTTER M, SAVILLE G, CLARK T, MACMAHON S 2000 Reduction of postoperative mortality and morbidity with epidural or spinal anaesthesia: results from overview of randomised trials. *BMJ 321 (7275):* 1493
2. MASON S E, NOEL-STORR A, RITCHIE C W 2010 The impact of general and regional anesthesia on the incidence of post-operative cognitive dysfunction and post-operative delirium: a systematic review with meta-analysis. *J Alzheimers Dis 22 (Suppl 3):* 67–79
3. BREEN T W, SHAPIRO T, GLASS B 1993 Epidural anesthesia for labor in an ambulatory patient. *Anesth Analg 77(5):* 919–24

4. MALDINI B, MIŠKULIN M, ANTOLIĆ S, GORANOVIĆ T, ZDRAVčEVIĆ-ŠAKIĆ K, GUDELJ G 2010 Local or spinal anesthesia in acute knee surgery. *Coll Antropol 34 (Suppl. 1):* 247–54
5. BURKE D, KENNEDY S, BANNISTER J 1999a. Spinal anesthesia with 0.5% S(–)-bupivacaine for elective lower limb surgery. *Reg Anesth Pain Med 24:* 519–23
6. ALLEY E A, KOPACZ D J, MCDONALD S B, SPENCER S L 2002 Hyperbaric spinal levobupivacaine: A comparison to racemic bupivacaine in volunteers. *Anesth Analg 94:* 188 –93.
7. LIU S S, WARE P D, ALLEN H W, NEAL J M, POLLOCK J E 1996 Dose-respons characteristics of spinala bupivacaine in volonteers. Clinical implications for ambulatory anesthesia. *Anesthesiology 85(4):* 729–736
8. DJENO I T, DUZEL V, AJDUK M, OREMUS Z S, ZUPCIĆ M, DUSPER S, JUKIĆ D, HUSEDZINOVIĆ I 2012 Increase in specific density of levobupivacaine and fentanyl solution ensures lower incidence of inadequate block. Coll Antropol *36(2):* 375–80
9. SANANSILP V, TRIVATE T, CHOMPUBAI, VISALYAPUTRA S, SUKSOPEE P, PERMPOLPRASERT L, VON BORMANN B 2012 Clinical characteristics of spinal levobupivacaine: hyperbaric compared with isobaric solution. *ScientificWorldJournal:* 69076
10. RIGLER M L, DRASNER K, KREJCIE T C, YELICH S J, SCHOLNICK F T, DEFONTES J, BOHNER D 1991 Cauda equina syndrome after continuous spinal anesthesia. *Anesth Analg 72(3):* 275–81
11. HORLOCKER T T, MCGREGOR D G, MATSUSHIGE D K, CHANTIGIAN R C, SCHROEDER D R, BESSE J A 1997 Neurologic complications of 603 consecutive continuous spinal anesthetics using macrocatheter and microcatheter techniques. Perioperative Outcomes Group. *Anesth Analg 84(5):* 1063–70
12. PEYTON P J 1992 Complications of continuous spinal anaesthesia. *Anaesth Intensive Care 20(4):* 417–25
13. POULAKKA R, HAASIO J, PITKÄNEN M T, KALLIO M, ROSENBERG P H 2000 Technical aspects and postoperative sequelae of spinal and epidural anaesthesia: a prospective study of 3230 orthopedic patients. *Reg Anesth Pain Med 25(5):* 488–497
14. STANDL T, ECKERT S, SCHULTE A M, ESCH J 1995 Microcatheter continuous spinal anaesthesia in the post-operative period: a prospective study of its effectiveness and complications. *Eur J Anesthesiol 12(3):* 273–279
15. IMBELLONI L E, GOUVEIA M A, CORDEIRO J A 2009 Continuous spinal anaesthesia versus combined spinal epidural block for major orthopedic surgery: prospective randomized study. *Sao Paulo Med J: 127(1):* 7–11
16. RAO T L, EL-ETR A A 1981 Anticoagulation following placement of epidural and subarachnoid catheters: an evaluation of neurologic sequelae. *Anesthesiology 55:* 618–620
17. GOGARTEN W, VANDERMEULEN E, VAN AKEN H, KOZEK S, JUAN V 2010 Llau and Charles M. Samama. Regional anaesthesia and antithrombotic agents: recommendations of the European Society of Anaesthesiology. *Eur J Anaesthesiol 27:* 999–1015
18. LUX E A 2012 Continuous spinal anesthesia for lower limb surgery: a retrospective analysis of 1212 cases. *Local Reg Anesth 5:* 63–67
19. BIBOULET P, JOURDAN A, VAN HAEVRE V, MORAU D, BERNARD N, BERNIQUIER S, CAPEDVILA X 2012 Hemodinamic profile of target-controlled general anesthesia techniques in elderly patients with cardiac comorbidities. *Reg Anest Pain Med: 37(4):* 433–440
20. COLLARD C D, EAPPEN S, LYNCH E P,CONCEPCION M 1995 Continuous spinal anesthesia with ivasive hemodinamic monitoring for surgical repair of the hip in two patients with severe aortic stenosis. *Anasth Analg 81(1):* 195–198
21. TURC J, LAMBLIN A, KLACK F, WEY P F, MARTINEZ J Y 2012 Pulmonary hypertension and femoral neck fracture: interest of continuous spinal anesthesia. *Ann Fr Anesth Reanimation 31(6):* 557–559