

Selective Spinal Anesthesia: A Comparison of Hyperbaric Bupivacaine 4 mg Versus 6 mg for Outpatient Knee Arthroscopy

Jukka V. Valanne, MD, PhD*, Anna-Maija Korhonen, MD*, Ritva M. Jokela, MD†, Pirjo Ravaska, MD*, and Kari K. Korttila, MD, PhD, FRCA†

*Department of Anaesthesia, Lapland Central Hospital, Rovaniemi, Finland; and †Department of Anaesthesia and Intensive Care, University of Helsinki, Helsinki, Finland

The use of spinal anesthesia may lead to the development of transient neurological symptoms (TNS) especially when short-acting anesthetics (e.g., lidocaine) are used (1–4). In ambulatory surgery, bupivacaine may delay the recovery of motor function and cause urinary retention, leading to delayed discharge (5,6). These concerns have increased interest in the use of small doses of bupivacaine (6,7) and techniques to produce unilateral spinal anesthesia (7–9), but the methods used so far may result in highly variable spinal anesthesia (10) or anesthesia of questionable reliability (6,11). Selective spinal anesthesia (SSA) is the practice of using minimal doses of intrathecal agents so that only the nerve roots supplying a specific area and only the modalities that require to be anesthetized are affected (5). We hypothesized that 4 mg spinal hyperbaric bupivacaine induces a reliable SSA with faster recovery compared with 6 mg for outpatient knee arthroscopy.

Methods

After the approval of the Ethics committee of Lapland Central Hospital, we obtained written, informed consent of 106 ambulatory adult ASA physical status I–III patients with body mass index <32, undergoing knee arthroscopy with tourniquet. The patients were prospectively randomized to receive either 4 mg = 0.8 mL (Group B4) or 6 mg = 1.2 mL (Group B6) of hyperbaric bupivacaine.

Dural puncture was performed with the patient in a lateral decubitus position at the L2–3 interspace, with the operative knee dependent. A 27-gauge lancet point

needle was used and the dose was injected over 2 min with the needle aperture directed laterally, towards the dependent side. The anesthesiologist who performed the subarachnoid injection was not involved in the patient evaluations. The lateral decubitus position was maintained for 10 min from the beginning of the injection. Intraoperatively, the patients were given midazolam up to 2 mg IV and/or alfentanil up to 1 mg IV if needed.

The dermatomal level of the sensory block was evaluated bilaterally at 7, 12, and 30 min after the beginning of bupivacaine injection, immediately postoperatively, and every 20 min thereafter until recovery to dermatome L2 level or discharge home. If one or more of dermatomes L1–4 were not blocked on the operative side, it was considered as a failed block, and the patient was excluded from further data analysis. The motor block on each side was assessed separately at 15 min after the injection, immediately postoperatively, and every 20 min thereafter until complete recovery using a modified Bromage scale (8,12).

The patient was transferred from the postanesthesia care unit (PACU) to the ambulatory surgery unit after complete recovery of motor block, sensory block not above T12, and stable vital functions. The home discharge criteria consisted of absence of nausea, vomiting, or bleeding, minimal or no pain, and the ability to walk and void. Four to six days after operation, the patients completed a telephone interview with a blinded investigator. They were asked about headache (positional headache was considered as postdural puncture headache), backache, pain, and other symptoms. TNS was defined as pain radiating to the buttocks or legs (13) and sensory disturbances on areas not related to the surgery.

The sample size of 52 patients per treatment group was calculated to detect a 25% difference in the recovery of motor block (120 min versus 90 min) with 45% SD using an α of 0.05 and a β of 0.2. The data were

Accepted for publication July 18, 2001.

Address correspondence and reprint requests to Jukka V. Valanne, MD, PhD, Department of Anaesthesia, Lapland Central Hospital, Ounasrinteentie 22, FIN-96400 Rovaniemi, Finland. Address e-mail to jukka.valanne@lshp.fi.

Table 1. Patient Characteristics and Recovery Times (min) From the Start of Spinal Anesthesia with Bupivacaine 4 or 6 mg

	Bupivacaine 4 mg (n = 48)	Bupivacaine 6 mg (n = 51)
Female	18 (37)	28 (55)
Male	30 (63)	23 (45)
Age (yr)	43.7 ± 15	46.4 ± 15
BMI	26.1 ± 3	25.3 ± 3
ASA physical status		
I	30 (63)	31 (61)
II	17 (35)	19 (37)
III	1 (2)	1 (2)
Duration of surgery (min)	27 ± 11	24 ± 11
To void	172 (115–319)*	203 (122–377)
To ambulate	166 (101–246)*	196 (139–367)
To home-readiness	181 (115–319)*	209 (147–377)

Values are n (%), mean ± sd, or median (range).

BMI = Body Mass Index.

* $P < 0.001$ versus Bupivacaine 6 mg.

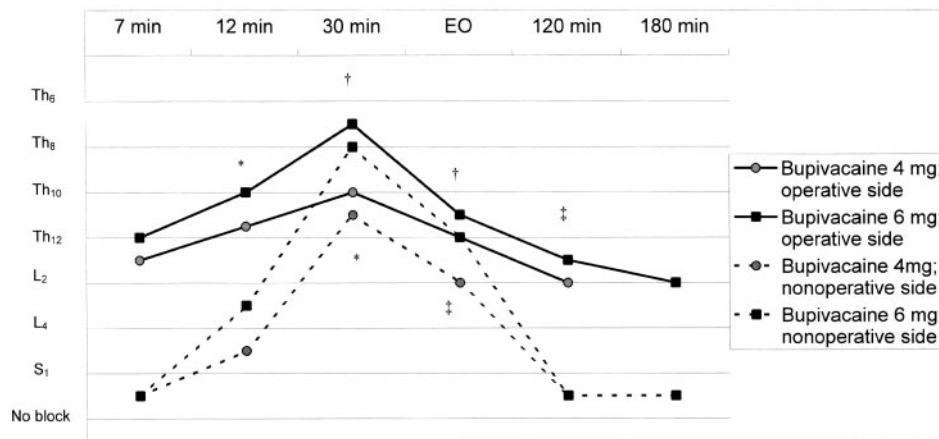


Figure 1. The median upper limit of sensory block on the operative and nonoperative side at times shown after spinal anesthesia with hyperbaric bupivacaine 4 mg or hyperbaric bupivacaine 6 mg. The bandage obstructed the evaluation of the sensory block on the operative side after the operation. * $P \leq 0.05$, † $P < 0.01$, ‡ $P < 0.001$ between the groups.

analyzed using the χ^2 test, Fisher's exact test, Student's t -test, or the Mann-Whitney U -test as appropriate. A P value < 0.05 was considered significant. SPSS for Windows (Version 9.0) statistical package (SPSS Inc., Chicago, IL) was used.

Results

The patient characteristics were comparable in the two groups (Table 1). In three patients it was impossible to make the dural puncture in the lumbar 2–3 interspace, and they were excluded. Four other patients (3 in Group B4 and 1 in Group B6) were excluded from the data analysis because of inadequate anesthesia.

The motor block on the operative side was equal in both groups at 15 min (median [range] 5 [1–5] versus 5 [0–5] in the B4 and the B6 groups, respectively, on a modified Bromage scale), but patients in the B4 Group more rapidly regained motor function of the operative leg: 83% versus 47% ($P < 0.001$) in the B6 Group at two hours after the spinal puncture. The sensory block on

the operative side was lower (but adequate) in the B4 group versus the B6 group (Fig. 1).

The B4 group was discharged to the ambulatory surgery unit after 65 ± 22 min (mean \pm sd) stay in the PACU compared with 98 ± 38 min stay of the B6 group ($P < 0.001$). The standard home discharge criteria were fulfilled significantly ($P < 0.001$) faster in the B4 group than in the B6 group (Table 1). The postoperative telephone interview showed no differences between the groups (Table 2).

Discussion

Small dose spinal anesthesia can lead to a high failure rate (6,11). According to Enk (14) a "low-dose, low-volume, low-flow" technique including maintenance of the lateral decubitus position for 5–30 min is the best means in producing unilateral spinal anesthesia.

In this study, spinal anesthesia failed to provide acceptable surgical anesthesia in four patients. This 4%

Table 2. Incidences of Postoperative Headache, Backache, Dysesthesia, and Dysuria After Spinal Anesthesia with Bupivacaine 4 or 6 mg

	Bupivacaine 4 mg	Bupivacaine 6 mg
Postdural puncture headache	2 (4.2)	2 (3.9)
Total incidence of transient neurological symptoms	1 (2.1)	2 (3.9)
Backache	0	0
Pain in legs	1 (2.1)	1 (2.0)
Dysesthesia	0	1 (2.0)
Dysuria	0	1 (2.0)
Patients' experience		
Equal to expectations	11 (23.4)	15 (30.0)
Superior to expectations	34 (72.3)	31 (62.0)
Worse than expectations	2 (4.3)	4 (8.0)
Patients' willingness to have same anesthesia	46 (97.9)	47 (95.9)

Values are n (%).

failure rate compares with the results of Pittoni et al. (15) with 5–12 mg of hyperbaric bupivacaine, who reported 2.5% failed blocks. The 3% incidence of TNS is nearly identical to the incidence reported by Ben-David et al. (16) using minidose lidocaine-fentanyl spinal anesthesia for knee arthroscopy.

The ideal SSA for knee arthroscopy would provide minimal or no motor blockade at the end of the surgical procedure, such that the patient can be fast tracked (5). In this study, the PACU stay of 65–98 min compares with a recent study by Mulroy et al. (17), whose patients stayed in the PACU for 146 min (spinal). It remains to be investigated whether, by further decreasing the anesthetic dose to 2–3 mg and adding a potent opioid, a subarachnoid block might facilitate fast tracking.

Using minidose of lidocaine-fentanyl (16) or hyperbaric bupivacaine (6) techniques, Ben-David et al. discharged their knee arthroscopy patients at 145 min or 202 min, respectively, whereas in this study, the B4 group achieved home readiness criteria at 181 min.

In conclusion, a unilateral, segmental spinal anesthesia for outpatient knee arthroscopy can reliably be produced with 4 or 6 mg of hyperbaric bupivacaine. The 4 mg dose appears superior to the 6 mg dose because it produces more SSA and allows discharge criteria to be fulfilled significantly faster.

We are grateful to Ms. Eija Ruoppa, RN, Ms. Arja Anttila, RN, and other nurses involved in this study for taking good care of the study patients.

References

- Freedman JM, Li D, Drasner K, et al. Transient neurologic symptoms after spinal anesthesia: an epidemiologic study of 1863 patients. *Anesthesiology* 1998;89:633–41.
- Keld DB, Hein L, Dalgaard M, et al. The incidence of transient neurologic symptoms (TNS) after spinal anaesthesia in patients undergoing surgery in the supine position: hyperbaric lidocaine 5% versus hyperbaric bupivacaine 0.5%. *Acta Anaesthesiol Scand* 2000;44:285–90.
- Hodgson PS, Liu SS, Batra MS, et al. Procaine compared with lidocaine for incidence of transient neurologic symptoms. *Reg Anesth Pain Med* 2000;25:218–22.
- Hiller A, Rosenberg PH. Transient neurological symptoms after spinal anesthesia with 4% mepivacaine and 0.5% bupivacaine. *Br J Anaesth* 1997;79:301–5.
- Vaghadia H. Spinal anaesthesia for outpatients: controversies and new techniques. *Can J Anaesth* 1998;45:R64–70.
- Ben-David B, Levin H, Solomon E, et al. Spinal bupivacaine in ambulatory surgery: the effect of saline dilution. *Anesth Analg* 1996;83:716–20.
- Tarkkila P, Huhtala J, Tuominen M. Home-readiness after spinal anaesthesia with small doses of hyperbaric 0.5% bupivacaine. *Anaesthesia* 1997;52:1157–60.
- Kuusniemi KS, Pihlajamäki KK, Pitkänen MT, et al. A low-dose hyperbaric bupivacaine spinal anesthesia for knee arthroscopies. *Reg Anesth* 1997;22:534–38.
- Casati A, Fanelli G, Cappelleri G, et al. Low dose hyperbaric bupivacaine for unilateral spinal anesthesia. *Can J Anaesth* 1998;45:850–4.
- Liu SS, Ware PD, Allen HW, et al. Dose-response characteristics of spinal bupivacaine in volunteers. *Anesthesiology* 1996;85:729–36.
- Biboulet P, Deschodt J, Aubas P, et al. Continuous spinal anesthesia: does low-dose plain or hyperbaric bupivacaine allow the performance of hip surgery in the elderly? *Reg Anesth* 1993;18:170–5.
- Cousins MJ, Bromage PR. Epidural neural blockade. In: Cousins MJ, Bridenbaugh PO, eds. *Neural blockade in clinical anesthesia and management of pain*. Philadelphia: JB Lippincott, 1988:253–360.
- Pollock JE, Liu SS, Neal JM, et al. Dilution of spinal lidocaine does not alter the incidence of transient neurologic symptoms. *Anesthesiology* 1999;90:445–50.
- Enk D. Unilateral spinal anaesthesia: gadget or tool? *Curr Opin Anaesthesiology* 1998;11:511–5.
- Pittoni G, Toffoletto F, Calcarella G, et al. Spinal anesthesia in outpatient knee surgery: 22-gauge versus 25-gauge Sprotte needle. *Anesth Analg* 1995;81:73–9.
- Ben-David B, Maryanovsky M, Gurevitch A, et al. A comparison of minidose lidocaine-fentanyl and conventional-dose lidocaine spinal anesthesia. *Anesth Analg* 2000;91:865–70.
- Mulroy MF, Larkin KL, Hodgson PS, et al. A comparison of spinal, epidural, and general anesthesia for outpatient knee arthroscopy. *Anesth Analg* 2000;91:860–4.