Role of patient during puncture on successful unilateral spinal anesthesia in outpatient lower abdominal surgery.

European Journal of Anaesthesiology 2006; **23:** 491–495

doi: 10.1017/S0265021506000020

Original Article

Role of patient posture during puncture on successful unilateral spinal anaesthesia in outpatient lower abdominal surgery

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Summary
Background and objective: Unilateral spinal anaesthesia is a useful anaesthesia technique in lower abdominal surgery, especially in an outpatient setting. Patient posture is pivotal in the achievement of unilateral anaesthesia. Nevertheless, no studies have elucidated the influence of patient posture during the anaesthetic injection on unilaterality. Thus, the aim was to compare the effect of patient posture, during the induction phase of spinal anaesthesia, on block characteristics. *Methods:* Eighty patients, ASA I–II, scheduled for unilateral hernioplasty were randomized into two groups. Anaesthesia was performed in lateral position in Group 1 (G1) with operative side down and in sitting position in Group 2 (G2) whose patients were then immediately turned on their lateral side. All patients were maintained for 20 min in lateral position with their operative side down. Hyperbaric bupivacaine 1% 10 mg were used. *Results:* Unilateral anaesthesia was seen in 80% (32/40) and 12.5% (5/40) of G1 and G2, respectively. The readiness for surgery was faster in G1 ($P < 0.0001$). The motor block in the non-operative side was stronger in G2 ($P < 0.0001$). The offset of sensory block was faster in G1 ($P = 0.0001$). The offset of motor block was slower in G1 ($P = 0.0008$). The time for voiding was shorter in G1, although not significant. *Conclusions:* Lateral posture during the induction of spinal anaesthesia is pivotal for a higher success of unilateral block, a fast readiness to surgery, and a fast recovery. Therefore, this technique can be considered feasible and time-saving for lower abdominal surgery.

Keywords: ANAESTHETIC TECHNIQUES, spinal; ANAESTHESIA SPINAL, unilateral; ANAESTHETICS LOCAL, bupivacaine, hyperbaric; AMBULATORY SURGICAL PROCEDURES; POSTURE, lateral, sitting.

Introduction

Unilateral spinal anaesthesia is frequently used in lower limb surgery. However, it can be also useful in lower abdominal surgery like unilateral inguinal hernioplasty especially in an outpatient setting [1,2]. Several advantages are claimed for this anaesthesia technique, like limited cardiovascular effects [3], lower incidence of postoperative urine retention, rapid recovery [4], as well as good patient satisfaction [5]. To achieve a successful unilateral anaesthesia, several factors need to be considered, like needle shape and bevel direction, site and speed of injection of anaesthetics, amount, baricity and concentration of the anaesthetic solution, as well as degree of operating table inclination [6,7]. Moreover, patient posture is thought to be fundamental in determining the level of anaesthesia spread, particularly when a hyperbaric anaesthetic solution is used [8–12]. Interestingly, although patient posture in spinal anaesthesia is being exploited in clinical practice to obtain different block characteristics in particular during the induction phase (puncture), for instance in saddle anaesthesia, however the role of patient posture during puncture has not been specifically investigated yet.

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Accepted for publication 3 January 2006 EJA 3309
First published online 1 March 2006

The objective of the current article, thus, is to study the influence of patient posture (lateral decubitus vs. sitting) during the injection of the anaesthetic, followed by maintenance of lateral position during the establishment of the block, on the production of unilateral spinal anaesthesia in patients undergoing hernioplasty in an outpatient setting.

Methods

After obtaining the Local Medical Ethics Committee approval of Florence University Hospital and written informed consent, 80 patients scheduled for outpatient unilateral hernioplasty were consecutively recruited in the period between March 2003 and March 2004. Patients included (aged from 18 to 80 yr) were ASA physical status I–II. Patients with neurological or neuromuscular diseases, abnormal anatomy of the spine, high intra-abdominal pressure, diabetes, body mass index more than 30, height more than 180 cm and less than 155 cm, and patients on chronic analgesic therapy or anticoagulation therapy were excluded. The study has been carried out according to the Helsinki Declaration principles [13].

Study design

All patients received midazolam intramuscularly at a dose of 0.05 mg kg^{-1} 15 min preoperatively. Before anaesthesia, the operating table was adjusted to achieve a horizontal alignment of the spine. A peripheral venous catheter was inserted to each patient under local anaesthesia and 10 mL kg^{-1} of Ringer acetate were infused before the induction of anaesthesia. Patient's heart rate and oxygen saturation were continuously monitored. Blood pressure (BP) was measured every 2 min until the end of surgery and then hourly until full recovery. Intravenous (i.v.) ephedrine 3–6 mg increments were used to treat any drop in BP by 30% from the baseline. According to a computer-generated randomization sequence table, patients were randomly allocated to receive spinal anaesthesia in lateral decubitus position with operative limb side down (G1, $n = 40$), or in sitting position and after anaesthetic injection, they were immediately turned to lateral decubitus with operative limb side down (G2, $n = 40$). The same operator performed the anaesthesia in all patients. Whitacre needle 27-G (Becton-Dickinson, Franklin Lakes, NJ, USA) with an introducer of 20-G was used. Dural punctures were done at intervertebral space L2–L3 and once a free flow of cerebrospinal fluid was obtained, needle's orifice was turned toward the operative side, and a luer-lock syringe containing bupivacaine was connected and the anaesthetic was injected at a rate of 0.05 mL s^{-1} without barbotage. Every patient received hyperbaric bupivacaine 1% (10 mg) 1 mL (Marcaina® hyperbaric 1%; Astra Zeneca, Italy) at room temperature. After performing anaesthesia, all patients of both groups remained for 20 min in lateral decubitus position with operative side down before they were turned supine for surgery.

The hypothesis to be tested by the study was that spinal anaesthesia, carried out in lateral position, provides a higher number of blocks limited to the operated side than in sitting position, a difference in time to surgery readiness and a difference in the offset of sensory and motor block.

The assessment of sensory and motor block level bilaterally was carried out by an anaesthesiologist blinded to the patient's study group at the first and fifth minute after the anaesthetic injection, and every 5 min thereafter, until the start of surgery. The assessment was repeated immediately at the end of surgery and then hourly until full recovery. The level of sensory block was defined as the inability of patient to feel pinpricks evoked by a 20-G hypodermic needle. The response to the pinprick was compared with the sensation tested over an unanaesthetized area and was assessed by a scale ranging from 0 to 3 as (0: when the sharpness of needle prick was felt the same; 1: when it was felt as a blunt puncture; 2: when it was felt as touching; 3: when it was completely lost). The motor block was evaluated using a modified Bromage scale (0–3) where 0: no paralysis, able to flex knee and ankle, 1: unable to raise extended leg but able to flex knee, 2: unable to flex knee but able to flex ankle, and 3: unable to move lower limb [14]. Patients who obtained complete loss of sensation to pinprick at a level of T10 on the operative side were considered ready for surgery and time needed to achieve this level of sensory block is defined as time to readiness for surgery. A successful unilateral anaesthesia was defined as a block limited to only the operative side. The onset and the offset of the sensory and motor block were evaluated on both operative and non-operative sides. All patients received 1 g of i.v. paracetamol for pain. The duration of surgery and the time of bladder voiding were recorded. Patient who showed no signs of bleeding, pain, nausea or vomiting [15,16], who was fully oriented, able to drink, void and walk, and whose vital signs were stable for 1 h, was discharged with an escort.

Statistical analysis

All continuous variables are expressed as median and interquartile range (25th and 75th percentiles); discrete variables are expressed as frequencies. Kruskal–Wallis test was used for the analysis of demographic parameters. Collected data were analysed by Kruskal–Wallis test followed by the *post hoc t*-test with Bonferroni's test correction for inter-group comparison. The percentage of patients with successful unilateral spinal anaesthesia was analysed by Fisher's exact test. The level of confidence interval was 95% and a value of $P < 0.05$ was considered statistically significant. STATA software 8.0 for Windows (Stata Corporation, College Station, USA) was used for the statistical analysis.

Results

No differences between groups in terms of age, height, weight and gender were found (Table 1). The mean duration of surgery was 40 ± 12.7 min and 45 ± 10.3 min in G1 and G2 respectively. Sensory block was adequate for the planned surgery in all patients. Neural block characteristics are summarized in Table 2. Strict unilateral anaesthesia was seen in 80% of G1 and in 12.5% of G2 at the beginning of surgery; however, at the end of surgery it became 92.5% in G1 and 0% in G2. There was no difference in the height of sensory block on the operative side between groups. Nevertheless, the readiness for surgery was faster in G1 ($P < 0.0001$). The degree of motor block in the non-operative side was significantly stronger in G2 than in G1 at the start of surgery ($P < 0.0001$), whereas it became even stronger at end of surgery (Fig. 1). The offset of sensory block was significantly faster in G1 than in G2 ($P = 0.0001$) in both operative and non-operative side (Fig. 2). The offset of motor block was slower in G1 than in G2 ($P = 0.0008$). The time needed to regain voiding capacity was shorter in G1 than in G2, although the difference was not statistically significant (Table 2). No patient in either group showed bradycardia, nausea, vomiting; however, two patients in G2 have developed hypotension which was treated appropriately.

Table 1. Patient characteristics.

	G1: lateral position ($n = 40$)	G2: sitting position ($n = 40$)
Age (yr)	53.1 ± 9.8	53.7 ± 11.6
Height (cm)	167 ± 9	170 ± 7
Weight (kg)	73.2 ± 13.4	71.4 ± 11.2
Gender (male/female)	31/9	29/11

Data are expressed as mean ± SD or ratio; *n*: number of patients.

Discussion

In this study, the effect of patient posture on the production of a unilateral block has been investigated during the induction of spinal anaesthesia, after standardization of all variables known to affect the spread of anaesthetic solutions in the subarachnoid space [6,7]. Indeed, different studies have addressed the influence of patient posture on obtaining a successful unilateral spinal block [8–10,17,18]. However, to our knowledge, this is the only study that looked specifically to the influence of patient posture during the performance of spinal anaesthesia on the unilaterality. The study demonstrates that injecting a

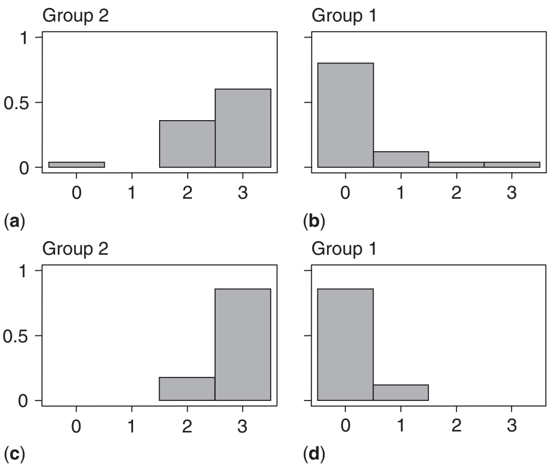

Figure 1.
*Frequency distributions of motor block expressed as Bromage score in the non-operative side after 20 min from dural puncture (**a**, **b**) (P < 0.0001) and after the end of surgery (**c**, **d**) (P < 0.0001).*

Table 2. Neural block characteristics.

	G1: lateral position ($n = 40$)	G2: sitting position ($n = 40$)	***P*-value**
Sensory block height on operative side	T10 (T10–T10)	T10 (T10–T11)	0.6
Sensory block height on non-operative side	L5 (L5–S2)	T12 (T11–T12)	<0.0001
Time to readiness for surgery on operative side (min)	10 (5–10)	15 (15–15)	<0.0001
Offset of sensory block on operative side (min)	185 (175–200)	250 (225–320)	<0.0001
Offset of sensory block on non-operative side (min)	0 (0–85)	220 (180–275)	<0.0001
Offset of motor block (min)	190 (165–205)	130 (105–150)	0.0008
Time to first voiding (min)	240 (205–275)	270 (215–320)	0.09

Data are expressed as median (25–75% quartiles); *n*: number of patients.

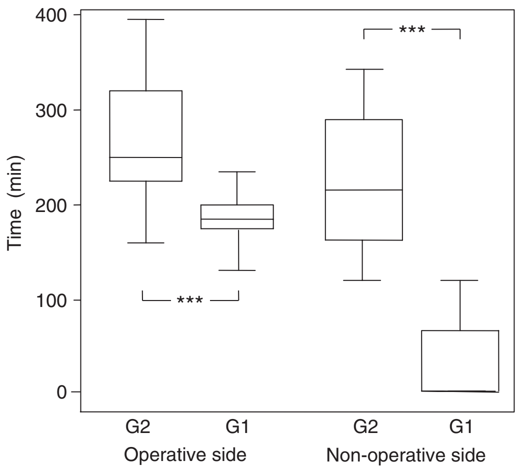

Figure 2.
Offset of sensory block in operative and non-operative side. The boxes represent the 25th–75th percentiles. The solid line represents the median. Error bars above and below the box mark the 1st and the 99th percentiles. ***P = *0.0001.*

hyperbaric anaesthetic to patients in different posture results in a difference in unilaterality. In fact, 32 patients in G1 (80%) obtained strict unilateral block in comparison to five patients in G2 (12.5%). The high unilaterality rate in G1 is consistent with other reports [19]. The lower rate of G2 is due to the spread of a substantial amount of anaesthetic to the counterlateral side, while patients are in sitting position. In an attempt to enhance fixation of local anaesthetic to the neurons on the operative side, in order to increase the success of unilaterality, it has been suggested to maintain patients in lateral position for a time of 15–20 min after the administration of the local anaesthetic [20]. However, in our study keeping patients in lateral position for 20 min did not result in an equivalent success of unilateral anaesthesia between the groups. This strongly indicates that patient posture during the injection of a hyperbaric anaesthetic is crucial in determining the block characteristics.

The difference in unilaterality between study groups became more evident after surgery. The percentage of unilateral block in G1 approached the 92.5% (37/40), whereas none of G2 has unilateral block anymore. Variations of block characteristics in relation to late changes in patient posture over time have been reported [9,21]. This, however, cannot explain the higher percentage of unilaterality obtained in G1 at the end of surgery, which can be explained, instead, by the disappearance of the block on non-operative side during surgery time in patients who attained bilateral block at the onset of surgery.

The height of sensory block on the operative side was almost equal in both groups, however, the time needed to reach a block level adequate for surgery was faster in G1 than in G2 (10 min vs. 15 min) ($P < 0.0001$). This probably because the settlement of the injected anaesthetic on both sides of subarachnoid space in sitting position causes that the effective volume and dose of the anaesthetic in the dependent side became less. In turn, patients in G2 have needed more time to achieve an equivalent spread. This result could raise a question about keeping patients for 20 min in lateral position, in order to reach acceptable level of sensory block when using hyperbaric anaesthetic solution. In fact, results by Esmaoglou and colleagues have also questioned the usefulness of maintaining patients in lateral position beyond 10 min after anaesthetic injection [22]. So far, no studies have been dedicated directly to investigate the time for surgical readiness and the time necessary for obtaining adequate unilateral block still needs to be defined.

The time for offset of sensory block on the operative side was shorter in G1 than in G2 ($P = 0.0001$). This is probably attributed to the difference in the speed of elimination of the local anaesthetic in relation to its distribution in the subarachnoid space. Local anaesthetics in subarachnoid space are eliminated by vascular absorption and diffusion across arachnoidal membranes. The concentration gradient of local anaesthetics toward the epidural space is the regulating driver of the elimination process [23]. So, probably the higher concentration gradient of local anaesthetic in the subarachnoid space of G1 patients, where almost all the drug has been distributed on one side, has created a major driving force for the faster elimination, and hence for a faster sensory offset.

Given that recovery from motor block usually precedes recovery from sensory block, it should be expected that motor block offset has occurred earlier in G1. Nevertheless, this was not the case. In fact, the time for motor block to offset was longer in G1 in comparison with G2 ($P = 0.0008$). This could be attributed, at least in part, to the availability of a higher volume of a highly concentrated anaesthetic solution on the dependent side. It is known that using a concentrated anaesthetic solution leads to a longer motor block [24]. In addition, the availability of a higher amount of the anaesthetic to nerve roots on the dependent side in G1 could explain the simultaneous offset of sensory and motor block in G1 (Table 2).

This study demonstrates also that the degree of motor block in G2 on the non-operative side was significantly stronger than in G1 at the beginning of surgery ($P < 0.0001$), whereas it became even stronger at the end of surgery (Fig. 1). This is simply because a higher number of patients in G2 have developed motor block on the non-operative side at the beginning of surgery, and at the end of surgery this number was increased. More patients in G1 got free of motor block in the non-operative side, as well.

The time needed to regain voiding capacity was longer in G2 than in G1, although the difference was not statistically significant ($P = 0.09$). This is in line with the longer time for sensory block to fade out observed in G2. For voiding to occur, regression of sensory block to at least a dermatomal level of S3 is needed. This regression can be reflected in regaining a normal peri-anal sensation and a normal proprioception of the big toe [25]. In addition, the unilateral blockade of parasympathetic efferent detrusor muscle may have helped the bladder to regain its function in a shorter time in G1.

In conclusion, this study shows that the lateral posture during the induction phase of spinal anaesthesia is determinant in providing a higher success rate of unilateral block, a faster readiness to surgery, and a faster recovery with few side-effects and complications, all particularly appreciable in an outpatient surgery.

Acknowledgement

The authors wish to thank the staff of day-surgery unit of Florence University for their collaboration and support. Preliminary data of this work have been presented at the Euro-anaesthesia 2004 meeting.

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