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Intrathecal morphine increases the incidence of urinary retention in orthopaedic patients under spinal anaesthesia

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Abstract

Background: Morphine injected into the subarachnoid space enhances the analgesic effects of spinal anaesthesia, improving the patient's comfort in the postoperative period. However, it is likely to be associated with adverse side effects that reduce patient satisfaction, e.g., urine retention. The aim of the present study was to evaluate the incidence of urine retention in patients receiving spinal anaesthesia combined with intrathecal morphine.

Methods: The postoperative course of 30 patients undergoing orthopaedic surgical procedures was analysed. Patients were divided into two groups: the control group (BSH; 16 individuals anaesthetised with a 0.5% hyperbaric solution of bupivacaine) and the experimental group (BSH + MP; 14 individuals anaesthetised with a 0.5% hyperbaric solution of bupivacaine with the addition of 0.2 mg morphine). The following parameters were analysed: duration of anaesthesia, time to miction, time to urgency and need to introduce a urinary catheter.

Results: There were no statistically significant differences in the duration of anaesthesia, incidence of hypogastric discomfort/difficulties in urination, time to hypogastric discomfort or duration of discomfort. Patients receiving intrathecal morphine were characterised by longer time to miction, higher incidence of urinary catheterisation and longer time between anaesthesia and urinary catheterisation.

Conclusions: Patients receiving spinal anaesthesia with a 0.5% hyperbaric solution of bupivacaine combined with intrathecal morphine were demonstrated to have a higher incidence of urinary catheterisation, longer time to urinary catheterisation and longer time to miction compared to patients receiving only local anaesthetics.

Key words: spinal anaesthesia, complications, urine retention; spinal anaesthesia, adjuvants, morphine

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Effective postoperative analgesia reduces the incidence of post-surgery complications, shortens hospitalisation and increases patient satisfaction. In subarachnoid (spinal) anaesthetic procedures, the pain-free postoperative period can be prolonged using adjuvants, e.g., morphine. This type of management decreases the degree of pain experienced by the patient according to the visual analogue scale (VAS), thereby permitting doses of analgesics administered enterally and parenterally to be reduced; in some cases, their supply can be abandoned [1]. The analgesic effects of intrathecal morphine can persist for 48 hours [2, 3]. However, there are some limitations resulting from the pharmacokinetic and pharmacodynamic properties of the opioid. Depression of the central nervous system can develop within 24 h after intrathecally administered morphine, which necessitates thorough, continuous monitoring of the patient during this period. Moreover, nausea, vomiting, pruritus and urine retention can occur [4]. The last of these adverse effects can significantly reduce the patient's comfort after surgery. Literature reports regarding the effects of intrathecal morphine on miction are scarce. The aim of the present study was to evaluate the incidence of urine retention in patients receiving intrathecal morphine combined with spinal anaesthesia and to verify the hypothesis assuming higher incidences of postoperative urine retention in patients anaesthetised for orthopaedic procedures.

METHODS

The study design was approved by the Bioethics Committee of the Military Medical Institute in Warsaw (no.

40/WIM/2010). The inclusion criteria were as follows: patient's informed consent, the possibility of surgery being performed under spinal anaesthesia, age < 40 years and no history of urologic diseases.

Prior to premedication, patients were familiarised with the questionnaire collecting the relevant data; possible patient concerns were explained. The questionnaire addressed: (1) the time to complete subsidence of spinal anaesthesia, including anaesthesia of sacral dermatomes; (2) time to miction; (3) volume of urine excreted; (4) time to occurrence of hypogastric complaints; (5) necessity to introduce a urinary catheter or otherwise; if possible, time to catheterisation and volume of urine; and (6) time to miction after removal of a urinary catheter. The questionnaires were collected on the day following surgery.

The patients were randomly allocated into two groups. Prior to their procedures, all patients voided the urinary bladder. There were no premedicated orally. All of the patients received spinal anaesthesia, which was routinely performed after sterile preparation of the puncture site at the level of L3-L4 or L4-L5 using Spinocan 27G or 29G needles (B. Braun Melsungen, Germany). Depending on the patient's height, 14–20 mg of bupivacaine as 0.5% hyperbaric solution was administered to the subarachnoid space to achieve a T10 level of anaesthesia.

The patients were divided into two groups: the control group (BSH; 16 individuals anaesthetised with a 0.5% hyperbaric solution of bupivacaine) and the experimental group (BSH + MF; 14 individuals anaesthetised with a 0.5% hyperbaric solution of bupivacaine combined with 0.2 mg morphine).

All patients had multi-electrolyte fluid transfused intraoperatively and received sedatives at doses ensuring an adequate level of sedation, not deeper than degree III according to the Ramsay scale. For this purpose, fractionated doses of midazolam were used; on average, the dose was 0.04 mg kg^{-1} (0.02–0.07 mg kg^{-1}). To achieve adequate sedation, some patients (4/16 in the BSH group and 5/14 in the BSH + MP group) also received propofol: the mean dose of propofol administered throughout anaesthesia was 0.02 mg kg^{-1} (0.32–5.23 mg kg^{-1} in the BSH group and 1.05–6.07 mg kg^{-1} in the BSH + MP group). The first dose of midazolam was administered prior to spinal anaesthesia with successive doses administered as required. Propofol was delivered in fractionated doses or in infusions, depending on the requirements and preferences of the anaesthetist, once the level of anaesthesia was determined.

Patients requiring an intraoperative supply of opioids, those requiring general anaesthesia due to insufficient level of regional anaesthesia or prolongation of surgery and those who did not return their questionnaires were excluded from further analysis.

The following were analysed:

— duration of anaesthesia, defined as the time (in minutes) from spinal anaesthesia to complete subsidence of motor and sensory block, including the sacral segments;
— time to miction, defined as the time (in minutes) from spinal anaesthesia to miction;
— inability to urinate, despite urgency (yes/no), assuming that occurrence of discomfort/hypogastric pain is tantamount to miction disorder;
— time to urgency, defined as the time (in minutes) from spinal anaesthesia to hypogastric complaints perceived by patients;
— duration of urgency, i.e., the time (in minutes) from discomfort to miction or urinary catheterisation;
— need to introduce a urinary catheter.

STATISTICAL ANALYSIS

Data were archived using Microsoft Office 2010 software. The statistical analysis was carried out using StatSoft Statistica 10 package (StatSoft, Tulsa, USA).

Inter-group differences in variables on a nominal scale were evaluated using a χ^2 test and a Fisher test. The remaining variables were evaluated using the Kolmogorov-Smirnov, Lilliefors and Shapiro-Wilk tests. When the distribution of variables was close to normal, the homogeneity of variance was analysed using Levene`s test or the Brown-Forsythe test. When homogeneity of variance was determined, intergroup differences were evaluated using Student's *t*-test. In cases where the variables were not normally distributed, the Mann-Whitney *U* test was applied. $P < 0.05$ was considered statistically significant.

The following were determined:

— risk of hypogastric discomfort;
— risk of required urinary catheterisation;
— absolute risk increase (ARI), i.e., absolute difference in the risk of hypogastric discomfort or urinary catheterisation between the control and experimental groups, defined as the difference between the control group event rate (CER) and the experimental group event rate (EER);
— relative risk increase (RRI), understood as part of the probability of hypogastric discomfort or urinary catheterisation resulting from intrathecal morphine administration, i.e., the quotient of absolute risk increase (ARI) and control group event rate: (CER)- CER-EER/CER;
— number needed to harm (NNH), i.e., the parameter determining the number of patients intrathecally administered morphine per one patient with adverse side effects; in this case, hypogastric discomfort or necessary urinary catheterisation calculated as the inverse of ARI, i.e., 1/(CER-EER).

Table 1. Compilation of data

Parameter	Group	Mean/median	95% CI for mean or median
Age (years)*	I	26.9	23.2–30.6
	II	29.9	26.5–33.2
Height (cm)*	I	175	170–180
	II	179	175–183
Body weight (kg)*	I	80	71–90
	II	85	77–92
LA dose (mg)*	I	17.2	16.3–18.1
	II	16.8	16.0–17.6
Range of anaesthesia (Th segment)*	I	10	10–12
	II	10	10–10
Duration of anaesthesia (min)*	I	336	290–383
	II	348	297–399
Intraoperative fluids (mL)**	I	2000	2000–2000
	II	2000	1750–2000
Postoperative fluids (mL)**	I	1500	1250– 2000
	II	1500	1500–1750
Time to discomfort (min)**	I	290	265–585
	II	445	240–845
Duration of discomfort (min)**	I	90	30–125
	II	120	60–330
Time to miction (min)*	I	403	320–500
	II	1070	670–1313
Time to catheterisation (min)*	I	125	dna
	II	814	425–1203
Duration of surgery (min)**	I	60	40–75
	II	93	70–118

*means (95% CI for means) or **medians (95% CI for medians); dna — does not apply

RESULTS

All of the patients returned completed questionnaires, which contained information about the time to miction, necessary urinary catheterisation and the time to miction after catheter removal if the bladder had been catheterised. For the majority of patients (12/16 in group BSH and 9/14 in group BSH + MP), the questionnaires did not include data about urine volume; therefore, this parameter was not analysed.

The BSH group consisted of 8 female and 8 male patients (50% each) whereas the BSH + MF group included 1 female (7.14%) and 14 male (92.86%) patients. The groups differed significantly in gender ($P = 0.01$); otherwise, there were no intergroup differences in age ($P = 0.77$), height ($P = 0.34$) and body weight ($P = 0.27$).

Moreover, there were no intergroup differences in doses of local anaesthetics administered to the subarachnoid space ($P = 0.26$), the extent of anaesthesia ($P = 0.28$), volumes of infusion fluids administered intraoperatively ($P = 0.73$) and volumes of infusion fluids recommended for the postoperative period ($P = 0.82$).

The mean duration of anaesthesia was 336 minutes in group BSH and 348 minutes in group BSH + MF ($P = 0.79$). The mean duration of surgery was 60 minutes in group BSH and 90 minutes in group BSH + MF. Procedures were significantly longer in the latter group ($P = 0.003$).

Table 2. Types of orthopaedic surgeries

Group	Surgery	n
BSH	Arthroscopy	8
	Knee ligament reconstruction	3
	Mosaicplasty	2
	Tibial tuberosity transfer	1
	Crus fracture stabilisation	1
	Removal of fusing material	1
BSH + MF	Knee ligament reconstruction	11
	Removal of fusing material	2
	Tibial crus fracture stabilisation	1

The results are listed in Table 1, and the types of orthopaedic procedures are presented in Table 2.

Five patients (31.25%) in group BSH and 7 patients (50.0%) in group BSH + MF experienced postoperative discomfort associated with urgency; the difference was not statistically significant ($P = 0.25$). In patients receiving intrathecal morphine, urgency-related discomfort occurred later (Fig. 1)

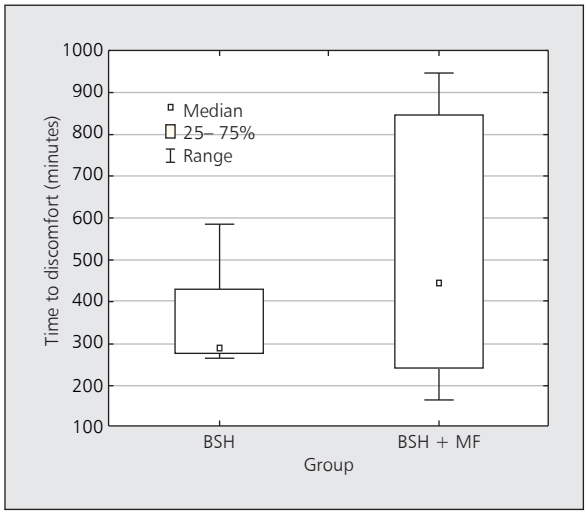

Figure 1. Comparison of times from spinal anaesthesia to hypogastric discomfort in groups BSH and BSH + MF

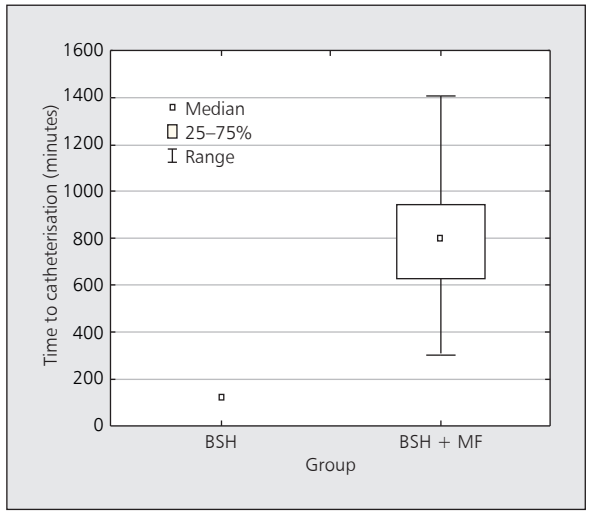

Figure 3. Comparison of times from spinal anaesthesia to urinary catheterisation in groups BSH and BSH + MF

Table 3. Events of urine retention in study groups

	Group BSH (n = 16)		Group BSH + MF (n = 14)	
	Hypogastric discomfort	Urinary catheter	Hypogastric discomfort	Urinary catheter
Event incidence n (%)	5 (31.25)	1 (6.25)	7 (50.0)	6 (42.86)
Absolute risk increase (%)			18.75	36.61
Relative risk increase (%)			60.00	587.70
NNH (n)			6	3

NNH — number needed to harm

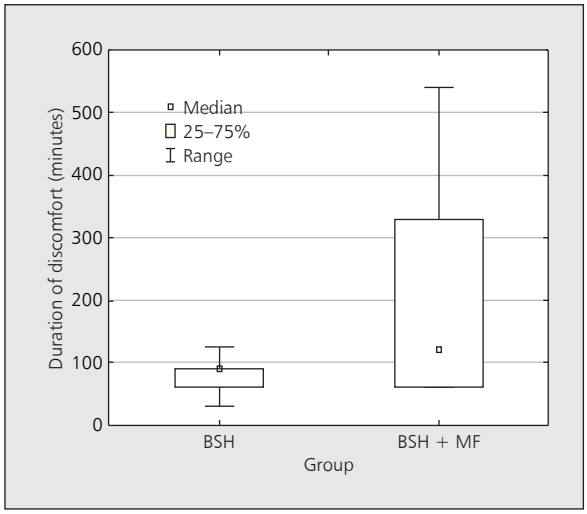

Figure 2. Comparison of hypogastric discomfort duration in groups BSH and BSH + MF

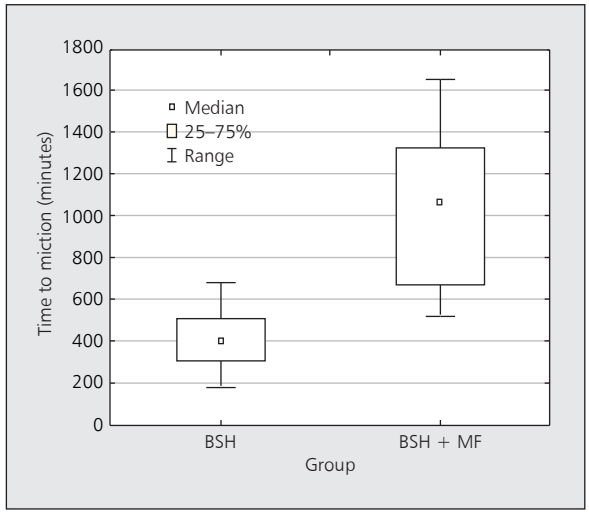

Figure 4. Comparison of times from spinal anaesthesia to miction in groups BSH and BSH + MF

and lasted longer (Fig. 2); intergroup differences were not statistically significant ($P = 0.53$ and 0.34, respectively). The patients in BSH + MF group required urinary catheterisation significantly more often (1/16 vs. 6/14; $P = 0.025$) (Table 3). Moreover, the duration of catheterisation was also longer in group BSH + MF (Fig. 3).

Patients in group BSH + MF urinated significantly later ($P < 0.0001$) (Fig. 4). Furthermore, a higher risk of hypogastric

discomfort and of absolute and relative risk of necessary urinary catheterisation were also observed in this group of patients (Table 3).

DISCUSSION

The analysis demonstrated that urinary catheterisation was required more often and later in patients receiving intrathecal morphine as an adjuvant to bupivacaine compared to patients who did not receive the opioid; the time to miction was also longer in these patients.

A study in an animal model revealed that inhibition of miction spasms occurred approximately 16 minutes after intrathecal morphine and lasted 250–350 minutes [5]. In humans, intrathecal opioids reduce the need to urinate, decrease detrusor contractions thereby increasing its capacity as well as the volume of retained urine and alter urethral sphincter activity, which results in impaired coordination between the detrusor contraction and relaxation of the internal urethral sphincter. In healthy volunteers, inhibition of bladder activity was observed one hour after administration of opioids and persisted for 24 hours [5]. According Kuipers et al. the mean times of restoration of lower urinary tract function in patients who received intrathecal morphine at doses of 0.1 and 0.3 mg were 14 and 20 hours, respectively [6]. Our observations show that the mean time from morphine administration to miction was 17.2, which is consistent with the literature data.

Many studies indicate that urine retention can be diagnosed when the patient cannot urinate at bladder volumes above 400 [7]–600 mL [8]. While planning our study, we assumed that the development of hypogastric discomfort is tantamount to urine retention; the volume of the urinary bladder was not determined ultrasonographically.

The NNH parameter that we determined for hypogastric discomfort is comparable with the results of a meta-analysis presented by Pöpping and colleagues [4]. Hence, it can be assumed that the clinically observed sensations of patients are equivalent to ultrasound results.

In our study, patients who received intrathecal morphine required urinary catheterisation later than did controls, which most likely results from the analgesic effects of morphine. No data on this phenomenon were found in the available literature.

Although some authors [9–11] did not demonstrate the correlation between intrathecal morphine and urine retention, we assumed that such a correlation exists. Nevertheless, limitations associated with intrathecal morphine should not result in its abandonment; a relevant argument is the efficacy of analgesia provided. Our data increase the knowledge on the issue discussed; therefore, we believe that they can be useful for clinical decision making.

CONCLUSION

Patients subarachnoidally administered a 0.5% hyperbaric solution of bupivacaine with morphine have a higher incidence of urinary catheterisation, later urinary catheterisation and later miction compared to those given only local anaesthetic.

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