Urinary retention after spinal anaesthesia with hyperbaric prilocaine 2% in an ambulatory setting

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Background. Hyperbaric prilocaine 2% is a medium long-acting spinal anaesthetic. There are few data on time to recovery and rate of urinary retention after spinal administration of hyperbaric prilocaine 2%. This prospective study was carried out to evaluate the time to spontaneous micturition, quantify the rate of necessary bladder catheterizations, and identify the risk factors for urinary retention after intrathecal prilocaine administration.

Methods. ASA I/II patients (16–80 yr) undergoing ambulatory lower limb surgery were enrolled and received spinal anaesthesia using hyperbaric prilocaine 2% (60 mg). Ringer’s lactate was administered for peroperative volume replacement. Bladder ultrasound was performed hourly until spontaneous micturition or catheterization, when bladder filling reached 600 ml, and they were unable to urinate spontaneously.

Results. Eighty-six patients completed the study (49 males and 37 females). Mean (SD) fluid administration was 1200 (499) ml until either micturition or catheterization; 37.8% of the women and 12.2% of the men required catheterization (P=0.009). Mean (SD) time between spinal anaesthesia and catheterization was 190 (88) min, and 260 (61) min to micturition (P<0.0001). Age <40 or >60 yr and female gender were predisposing factors for urinary retention.

Conclusions. After spinal anaesthesia with hyperbaric prilocaine 2% (60 mg) for ambulatory lower limb surgery, 23% of patients required postoperative urinary catheterization. Postoperative bladder ultrasound and early catheterization are essential to avoid bladder distension and facilitate discharge in patients after intrathecal prilocaine 2% administration in ambulatory surgery.

Br J Anaesth 2010; 104: 582–6

Keywords: anaesthetics local, prilocaine; analgesic techniques, subarachnoid; surgery, day-case; surgery, orthopaedic; urinary retention

Accepted for publication: February 1, 2010

The frequency of ambulatory surgical interventions is growing, partly as a consequence of increasing cost pressures in public health systems. Spinal anaesthesia is quick, cost-efficient, and safe,1 and seems ideal for lower limb orthopaedic operations and short general surgical procedures. Although bupivacaine and lidocaine are used widely,2 hyperbaric prilocaine 2% has gained popularity because of its fast onset, shorter duration of action, faster recovery of sensory and motor functions, and low incidence of transient neurological symptoms.3,4

Urinary retention after spinal anaesthesia has a reported incidence between 0% and 69%, which is why successful micturition is still an important discharge criterion in many centres.5,6 To date, there are few data on time to recovery and rate of urinary retention after spinal anaesthesia with hyperbaric prilocaine. Therefore, this prospective,
single-centre, observational pilot study was performed to measure the incidence of urinary retention and time to spontaneous postoperative micturition, and to identify predisposing factors leading to catheterization after spinal anaesthesia with hyperbaric prilocaine 2%.

**Methods**

After obtaining Institutional Review Board approval and informed patient consent, a prospective, single-centre, observational, pilot study was conducted between September 1, 2008, and January 31, 2009, at a primary care hospital in Switzerland. Inclusion criteria were patients aged 16–80 yr and ASA grade I–II, undergoing surgery of the lower limb lasting up to 90 min (knee and ankle arthroscopy, removal of osteosynthetic material), and informed consent for spinal anaesthesia. Exclusion criteria were prostate hyperplasia or urogenital pathologies (incontinence, cysto-ureteric reflux, known bladder retention), intraoperative blood loss >200 ml, pregnancy, alcohol or drug abuse, contraindications to or failure of spinal anaesthesia, or incomplete data records.

Patients were allowed to drink clear fluids up to 2 h before induction of anaesthesia. All patients voided before transfer to the operating area. After application of routine monitoring equipment (ECG, oscillometric arterial pressure cuff, pulse oximetry), an i.v. infusion with Ringer’s lactate was commenced and an initial bladder scan was performed to measure bladder content before spinal anaesthesia. In the lateral position, the subarachnoid space was punctured with a 27 G Whitacre needle at L3/4 or L4/5 using a median or paramedian approach until there was free backflow of cerebrospinal fluid, and 3 ml of hyperbaric (i.e. containing 6% glucose) prilocaine 2% (Sintetica S.A., Mendrisio, Switzerland) was administered without any adjuncts. After 10 min, patients were returned to the supine position. Perioperatively, ephedrine, midazolam, or atropine, were administered i.v. if required.

After surgery, patients were allowed to drink freely. Pain was measured on a numeric rating scale (0–10). All patients received acetaminophen (1000 mg) and diclofenac (75 mg) i.v. after the end of surgery. Additional analgesics were administered according to a standardized protocol if numeric pain score was >3. First-line rescue medication was metamizol (1000 mg) followed by opioids (e.g. morphine 1 mg i.v.) as required.

Ultrasound scans of the bladder (BladderScan BVI 3000®, Verathon, Bothell, WA, USA) were performed hourly after surgery until spontaneous micturition or catheterization occurred. It should be noted that ultrasound bladder scans used to diagnose urinary retention after spinal anaesthesia are part of daily clinical routine. Urinary retention was defined as a bladder volume >600 ml together with the inability to micturate. Patients were catheterized when these criteria were met.

Data were analysed using Student’s t-test and Fisher’s exact test to detect significant differences among the groups. Correlations among outcome parameters and potential factors influencing micturition were analysed using Pearson’s correlation test. Linear and logistic univariate and multivariate regression analyses were performed to detect influencing and risk factors for catheterization. A P-value of <0.01 was deemed to be statistically significant.

**Results**

Ninety-three consecutive patients met the inclusion criteria, gave informed consent, and were enrolled. Seven patients were excluded because of incomplete data, leaving 86 patients [49 males (57%) and 37 females (43%)] for analysis. Mean age was 46 yr (range 16–79 yr). Mean (sd) duration of surgery was 45 (18.6) min (range 5–90 min); patients received a mean (sd) of 546 (258) ml (range 100–1300 ml) of i.v. Ringer’s lactate before and during surgery and 447 (316) ml (range 30–1380 ml) after the operation until micturition or urinary catheterization (Fig. 1, Table 1). Mean (sd) postoperative oral fluid intake until micturition/catheterization was 280 (355) ml (range 0–1500 ml). Mean (sd) level of spinal anaesthesia was T8 (1.97) (range T 3–12). Eight patients required the administration of atropine because of vagal reactions. All surgical procedures were performed under the tourniquet, with the tourniquet time being almost identical to operation time. No failures of spinal anaesthesia occurred. Patients who micturated spontaneously and those who suffered urinary retention showed no difference with regard to mean duration of surgery, postoperative oral fluid intake, level of spinal anaesthesia, and administration of pain drugs, ephedrine, midazolam, or atropine. Total i.v. fluid administration was unexpectedly higher in patients who voided spontaneously in comparison with those who needed catheterization (Table 1).

Urinary retention leading to catheterization was required in 20 patients (23.3%). The incidence of urinary retention after spinal anaesthesia with prilocaine 2% was significantly higher in female (37.8%; 14 of 37 patients) than in male patients.

**Fig 1 Study population.**
male patients (12.2%; six of 49) (P<0.01, Table 2). The odds ratio (OR) for urinary retention in women was 4.36 (95% CI 1.48–12.87) in comparison with men. Statistical analysis of the effect of age revealed an OR of 6.125 for women aged <40 yr in comparison with women aged between 40 and 60 yr and an OR of 5.25 for men aged >60 yr in comparison with younger men (Table 2), indicating the increased risk for younger women and elderly men when compared with older women and younger men. Men and women aged between 40 and 60 yr had the lowest risk for urinary retention in comparison with younger and older men and women (OR 0.19–0.33).

Mean (SD) time between spinal puncture and bladder catheterization was 190 (88) min (range 90–480 min). Mean time between spinal puncture and spontaneous micturition was significantly longer [270 min (SD 61), range: 160–470, P<0.0001]. Mean bladder volume was lower in patients able to micturate compared with those who required catheterization (Fig. 2). Young patients and women required early postoperative catheterization, whereas men underwent catheterization significantly later (P<0.0001, Table 1, Fig. 3). Opioids were required in nine (10.5%) patients. None of the patients receiving atropine or ephedrine, but two (22.2%) of the patients receiving opioids, required catheterization. None of the study patients required hospitalization due to pain; all patients left the hospital a few hours after surgery.

Apart from female gender and age >60 yr, no other predisposing factors (spinal level, additional drug administration, pain, surgical procedure times, preoperative bladder filling, i.v. or per oral fluid administration) were identified. Patients who were able to micturate spontaneously received perioperatively more fluid volume than did those who needed catheterization (P=0.009; Table 1).

### Discussion

In this single-centre, prospective, observational pilot study, the overall incidence of urinary catheterization after spinal anaesthesia with hyperbaric prilocaine 2% (60 mg) in ambulatory lower limb surgery was 23.3%. Female gender and age >60 yr were risk factors for urinary catheterization.

The reported incidence of postoperative urinary retention varies widely, from <1% to >50%. Furthermore, the accuracy of the diagnosis of urinary retention is questionable since it does not always follow standardized criteria. The design of this study avoided these shortcomings by defining the surgical procedure and its duration, thus limiting the impact of surgical factors on urinary retention. The incidence of urinary retention appears to be relatively high in this cohort when considering the medium-to-long effect of prilocaine, the relatively low mean age of patients, the type of surgery (lower limb orthopaedic procedures), and the low postoperative pain level (data not shown). It may be that the dose of prilocaine used was excessive, especially for this kind of operation. Hendriks and colleagues, using a slightly lower dose of prilocaine (50 mg), found a lower incidence of urinary retention (8.3% vs 23.3% in this study). However, other investigations found similar incidences of retention to the present study, using even higher doses of prilocaine (80 mg) for the same kind of operation. Another explanation could be the early indication for catheterization based on accurate ultrasound bladder volume measurements. Nevertheless, other investigations also using the reliable ultrasound technique of bladder volume measurement found almost equal incidences of urinary retention. The current study parallels these observations as shown by a high correlation of 0.95 between

| Table 1 Mean (range) or mean (SD) characteristics of patients with spontaneous micturition vs catheterization. *P<0.01; **P<0.0001. Bladder content is the amount of urine measured by BladderScan before micturition or catheterization. Residual urine volume is the amount of urine measured by BladderScan after micturition or catheterization. Fluid administration is the amount of fluids overall (per oral or i.v.) from start of anaesthesia until micturition or catheterization |

<table>
<thead>
<tr>
<th>All patients</th>
<th>Micturition</th>
<th>Catheterization</th>
<th>Patients with micturition</th>
<th>Micturition</th>
<th>Catheterization</th>
<th>Patients with catheterization</th>
<th>Micturition</th>
<th>Catheterization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>45.8 (16–77)</td>
<td>48.6 (17–79)</td>
<td>45.1 (18–73)</td>
<td>47.1 (16–77)</td>
<td>46.8 (25–73)</td>
<td>49.4 (17–79)</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Time since spinal anaesthesia (min)</td>
<td>276 (59)</td>
<td>180** (86)</td>
<td>285 (61.9)</td>
<td>256 (53)</td>
<td>260 (109)</td>
<td>158* (41)</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Bladder content (ml)</td>
<td>514 (193)</td>
<td>787** (141)</td>
<td>465 (199)</td>
<td>560 (185)</td>
<td>815 (132)</td>
<td>780 (124)</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Residual urine volume (ml)</td>
<td>123 (190)</td>
<td>18 (39)</td>
<td>128 (183)</td>
<td>115 (215)</td>
<td>5 (10)</td>
<td>23 (52)</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Fluid administration (ml)</td>
<td>1291 (499)</td>
<td>960* (407)</td>
<td>1350 (555)</td>
<td>1170 (314)</td>
<td>975 (492)</td>
<td>956 (433)</td>
<td>Male</td>
<td>Female</td>
</tr>
</tbody>
</table>

| Table 2 Number and percentage of patients with spontaneous micturition vs catheterization as a function of age and gender |

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>16–40</th>
<th>41–60</th>
<th>61–80</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micturition</td>
<td>Catheterization</td>
<td>Micturition</td>
<td>Catheterization</td>
</tr>
<tr>
<td>Male patients</td>
<td>15 (93.7%)</td>
<td>1 (6.3%)</td>
<td>22 (95.6%)</td>
</tr>
<tr>
<td>Female patients</td>
<td>8 (47.1%)</td>
<td>9 (52.9%)</td>
<td>9 (100%)</td>
</tr>
</tbody>
</table>
ultrasound-measured bladder content and amount of measured urine after catheterization ($P<0.0001$, data not shown). Therefore, ultrasound bladder scanning appears to be a very sensitive detector of urinary retention after spinal anaesthesia. It has the potential to become the standard of care in the postoperative care unit.

Increased fluid administration has been reported to be associated with a higher incidence of urinary retention. In the current investigation, increased fluid intake (i.v. and oral) was not associated with an increased risk for urinary retention or catheterization. On the contrary, patients who spontaneously voided received accidentally overall significantly more fluid than did those who displayed urinary retention. They also had significantly less bladder filling at 4 h after operation. Nevertheless, it is possible that, in this study, patients who were able to micturate spontaneously could have had a higher fluid deficiency; it might also be possible that there are differences in the water balance of younger when compared with older patients; therefore, in patients who micturated spontaneously bladder filling did not reach the indication for catheterization until the motor and sensory effects of spinal anaesthesia had worn off. These data do not generally support the finding that fluids should be restricted in order to avoid catheterization.

The influence of gender on urinary retention is controversial. Some investigators have shown male gender to be a risk factor, one article reported female gender to be a risk factor, and others have found no difference. The present study found female gender to be an independent risk factor for catheterization with an OR of $>4$ in comparison with male patients. Whether this observation is limited to the administration of spinal anaesthesia with prilocaine for surgery of the lower extremities or can be generalized to other procedures remains to be investigated. Several explanations are possible for this observation: a supine position in bed, including immobilization with splints and dressings could prevent women from micturating; nurses might be more willing to catheterize women than men; men might have a greater desire to spontaneously micturate in order to avoid catheterization.

Age proved to be a further risk factor for urinary retention after spinal anaesthesia. In this study, women aged $<40$ yr and all patients aged $>60$ yr had a significantly higher incidence of urinary retention compared with other patients. The higher risk of postoperative urinary retention observed in older patients is in agreement with that reported by several authors and seems to be associated with degenerative processes of central, supraspinal somatic, and visceral neurones. Of course, it is possible that at least a certain percentage of men without known prostate hyperplasia had undetected prostate pathology affecting micturition.

Fig 2 Mean (sd) bladder volume (measured by BladderScan) before micturition or catheterization was significantly greater in patients who needed to be catheterized than in patients who voided spontaneously (*men $P=0.008$, **women $P=0.002$). This was independent of gender.

Fig 3 Women needed catheterization because of bladder filling $>600$ ml significantly earlier than men or women who voided spontaneously (compare Fig. 2). There was no significant difference between men who voided spontaneously and those who needed catheterization. *$P<0.0001$ for the time difference between spinal anaesthesia and urinary catheterization or spontaneous micturition in women. $P=0.009$ for time difference between spinal anaesthesia and urinary catheterization in men and women.

In conclusion, we found an incidence of postoperative urinary retention of 23.3% in patients undergoing lower limb orthopaedic surgery under spinal anaesthesia with
hyperbaric prilocaine 2% (60 mg). The incidence was higher in females aged <40 yr and in all patients aged >60 yr. Ultrasound bladder scans enabled reliable assessment of urinary volume and have the potential to become the standard of care in the postoperative care unit, but further prospective studies are required. Spontaneous mic-turition should remain a criterion for discharge after spinal anaesthesia with hyperbaric prilocaine 2% in the ambulatory setting.

Acknowledgements
The authors thank Dr Mihai A. Constantinescu, Consultant Plastic Surgeon, University Hospital, Berne, Switzerland, Dr Lukas Kirchmair, Department of Anaesthesiology and Intensive Care Medicine, Innsbruck Medical University, Innsbruck, Austria, and Ms Mary Heaney Margreiter, Court Interpreter, Innsbruck, Austria, for their critical review of the manuscript.

Conflict of interest
None declared.

Funding
This study was financially supported solely with departmental resources.

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