Plain articaine or prilocaine for spinal anaesthesia in day-case knee arthroscopy: a double-blind randomized trial

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Background. Both prilocaine and articaine are short-acting local anaesthetics suited for spinal anaesthesia for day-case knee arthroscopy. Articaine is thought to have a faster onset and shorter duration of action than prilocaine, although no comparative study has been published in the anaesthetic literature.

Methods. In this prospective randomized double-blind study, spinal anaesthesia was performed in 72 ASA I–II patients undergoing knee arthroscopy with 50 mg of either plain prilocaine or plain articaine. The primary outcome variable was duration of motor block. Secondary outcomes were onset of sensory and motor blocks, maximum spread of the sensory block, time to spontaneous voiding, and side-effects.

Results. Time to full motor function recovery was shorter after articaine than prilocaine [mean (SD) 140 (33) vs 184 (46) min, respectively, P<0.001]. Time to spontaneous voiding was shorter after articaine than prilocaine [mean (SD) 184 (39) vs 227 (45) min, respectively, P<0.001]. One patient in the articaine group reported mild transient neurological symptoms (TNS) limited to the first postoperative day, but there were no significant differences in adverse effects between the groups.

Conclusions. Spinal anaesthesia with plain articaine 50 mg resulted in a faster recovery of motor function and earlier spontaneous voiding compared with plain prilocaine 50 mg. Surgical anaesthesia was not different. The incidence of TNS was low.


Keywords: anaesthetic techniques, subarachnoid; anaesthetics local, articaine; anaesthetics local, prilocaine; surgery, day-case

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Spinal anaesthesia is commonly used for knee arthroscopy. In day-case patients, a short-acting local anaesthetic is preferred. Because a high incidence of transient neurological symptoms (TNS) after spinal anaesthesia with lidocaine is reported, alternative local anaesthetics have been investigated. Intrathecal prilocaine has a low incidence of TNS, but a longer duration of action than lidocaine. Articaine, commonly used in dentistry, is an amide local anaesthetic with a thiophene instead of a benzene ring within its structure. Its application for local, regional, and neuraxial anaesthesia has been reviewed previously. The use of articaine for spinal anaesthesia is mainly studied in Finland and The Netherlands. Intrathecal articaine appears to have a shorter duration of action than prilocaine and only one case of TNS has been reported, but articaine and prilocaine have not been compared directly in published studies. In this prospective, randomized, double-blind study, we compared the anaesthetic characteristics of intrathecal articaine and prilocaine.

Methods

The Medical Ethic Commission Arnhem-Nijmegen, The Netherlands, approved this study. After written informed
Hypotension (systolic pressure <30% of initial value) was treated with ephedrine 5 mg i.v. Bladder content was measured by means of ultrasound scanning on arrival and at departure of the post-anaesthesia care unit. Time to spontaneous voiding was noted. If the estimated bladder volume was 500 ml, a single catheterization of the bladder was performed. Twenty-four hours after surgery, patients were questioned by telephone for pain in the knee, the puncture site, headache, the use of analgesics, and for complaints of TNS which was defined as pain, dysesthesia, or both in the buttocks, lower extremities not related to the arthroscopy, or both. Localized pain at the puncture site was not considered as part of the definition. If any TNS were present, the patient was contacted again the next day.

The primary outcome measure was duration of motor block; secondary outcome measures were time to onset, time to spontaneous voiding, and adverse effects. On the basis of previous studies, we calculated that 28 patients per group would be sufficient to detect a 30 min difference in duration of the effect with 80% power ($\alpha=0.05$; two-tailed testing; $\sigma=40$). In anticipation of case failure, we included 36 patients in each group.

Statistical analysis was performed with SPSS version 14.0 for Windows. Categorical variables were analysed using the $\chi^2$ test or Fisher’s exact test. Normal distributed variables were compared using Student’s $t$-test. The Mann–Whitney $U$-test was performed when parametric assumptions were not met. Differences were considered significant with $P<0.05$.

## Results

All patients were included and treated in the period from March to May 2007. Between both groups, there were no differences in general or surgical characteristics (Table 1). In one patient, a paramedian approach was performed to enter the subarachnoid space. This patient and one other reported an episode of paraesthesia during puncture without postoperative sequelae.

Anaesthetic characteristics and time to spontaneous voiding are shown in Table 2 and Figure 1.

There was no difference in time to reach the sensory block to L1 or modified Bromage 2 score between articaine and prilocaine.

### Table 1 Patient characteristics and duration of surgery. Data are presented as number, mean (range) for age, mean (sd) or median (range)

<table>
<thead>
<tr>
<th>ASA III</th>
<th>Articaine ($n=36$)</th>
<th>Prilocaine ($n=36$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male/female</td>
<td>28/8</td>
<td>30/6</td>
</tr>
<tr>
<td>Age (yr)</td>
<td>47 (22−60)</td>
<td>46 (22−69)</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>81.3 (15.3)</td>
<td>79.1 (14.3)</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>177 (9.9)</td>
<td>178 (8.3)</td>
</tr>
<tr>
<td>BMII (kg m$^{-2}$)</td>
<td>26.0 (3.8)</td>
<td>24.9 (8.6)</td>
</tr>
<tr>
<td>Preoperative bladder content (ml)</td>
<td>51 (6−220)</td>
<td>38 (3−300)</td>
</tr>
<tr>
<td>Time from intrathecal injection to end of surgery (min)</td>
<td>25 (8)</td>
<td>25 (5)</td>
</tr>
</tbody>
</table>
and prilocaine (Table 2). Five minutes after intrathecal injection, surgical block was achieved in 29 of 36 patients treated with articaine and in 23 of 36 patients treated with prilocaine (P=NS). At introduction of the arthroscope, spinal anaesthesia was insufficient in four patients receiving prilocaine and one patient receiving articaine (Table 3). Three of these patients (two prilocaine and one articaine treated) reported feeling the incision but did not experience it as painful and therefore did not receive analgesic supplementation. Two patients who received prilocaine required analgesic supplementation because of a painful sensation at incision; one because of insufficient sensory block level (L1) and another patient experienced pain, although the sensory and motor blocks complied with our definition of sufficient anaesthesia. No reflex muscle movement that could cause a problem for the surgeons was apparent in any of the cases. There were no differences in clinically relevant hypotension or bradycardia.

Maximal level of the sensory block was not different between the groups nor was time to two-dermatome regression (Table 2). Mean times to full recovery of motor function (140 vs 184 min, \( P<0.001 \)) and time to spontaneous micturition (185 vs 230 min, \( P<0.001 \)) were shorter after spinal anaesthesia with articaine than with prilocaine.

Three patients in the prilocaine group and one in the articaine group required bladder catheterization (Table 3). Preoperative bladder contents of these patients were 127, 160, 271 ml (the prilocaine group) and 216 ml (the articaine group) and catheterization was performed at 130, 130, 153, and 92 min after intrathecal injection: well before the mean times to spontaneous voiding. One patient who received articaine reported TNS: mild pain in the buttock region limited to the first postoperative day. No post-dural puncture headaches occurred.

**Discussion**

In this randomized double-blind study, we found that spinal anaesthesia with either articaine 50 mg or prilocaine ‘plain’ was suitable for knee arthroscopy. However, after spinal anaesthesia with articaine 50 mg, recovery of motor function was faster and time to spontaneous voiding significantly shorter compared with prilocaine. No significant differences in time to onset, additional analgesics, maximum level of sensory block, time until two-dermatome regression were noted. TNS occurred in only one patient receiving articaine. Although five patients had insufficient analgesia at the operative site, only two patients experienced pain for which additional medication was required. In our opinion, this failure rate is acceptable. Our findings are similar to previous studies of spinal anaesthesia with articaine and prilocaine (Tables 4 and 5).

Kallio and colleagues and Dijkstra and colleagues, using hyperbaric articaine solutions and a higher quantity of local anaesthetic, reported a shorter duration of motor block compared with our results. However, in these studies, time to spontaneous voiding was shorter after plain solutions compared with hyperbaric solutions. Direct comparison in a randomized double-blind trial is indicated to confirm whether these apparent differences also occur with a 50 mg dose of hyperbaric articaine. In spite of preoperative bladder emptying, four patients required catheterization because of an estimated bladder volume of >500 ml. Apart from the preoperative post-voiding residue in these patients, differences in preoperative oral fluid intake might explain why their bladders were faster filled. In order to prevent catheterization, patients should be encouraged to void...
before surgery, if their bladder is not completely empty on bladder scanning examination, and the volume of i.v. fluids administered should be minimized.

Low-dose spinal bupivacaine with additional drugs has been suggested as an alternative to short-acting local anaesthetics in order to reduce the duration of bladder dysfunction after knee arthroscopy. After spinal anaesthesia in 24 patients with bupivacaine 5 mg and clonidine 15 μg, van Tuijl and colleagues10 reported an average time to complete motor block regression of 86 min, but a mean (SD) time to voiding of 194 (38) min. However, data from seven were missing because they had left the hospital before spontaneous voiding had occurred. After intrathecal injection, patients were placed in a lateral decubitus position with the operative side down for at least 5 min and kept in this position until just before the start of surgery (average 24 min). (In the present study, surgery was completed by an average of 25 min.) Three of their 24 patients received additional opioids or general anaesthesia. Some authors consider hospital discharge safe even before spontaneous voiding has occurred after spinal anaesthesia with short-acting local anaesthetics for low-risk surgical procedures in patients at low risk for urinary retention, provided that bladder content is measured with ultrasound scanning at discharge and clear instructions are given to the patient what to do in case no voiding occurs within the next few hours.11 From an economic viewpoint, this approach might seem appealing, though on grounds of patient safety, we prefer a patient to be capable of voiding before discharge from the hospital after spinal anaesthesia with a long-acting local anaesthetic. Recently, preservative-free 2-chloroprocaine has been shown to have an ultra short duration of effect after spinal injection and might be recommended for knee arthroscopy, but this agent is not available in The Netherlands.12 We conclude that for spinal anaesthesia for knee arthroscopy, articaine 50 mg ‘plain’ (20 mg ml−1) is preferable to prilocaine 50 mg. In our study, mean time to full motor function recovery was 44 min shorter and spontaneous micturition occurred 45 min earlier, which may result in an earlier discharge. The incidence of TNS was low. Comparing our data with previous studies suggests that hyperbaric articaine might be preferred to plain articaine, given the apparent shorter duration of the motor block, although time to spontaneous voiding is shorter with the plain solution. Direct comparison in a randomized double-blind trial is indicated to confirm this.

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References

1 Zaric D, Christiansen C, Pace NL, Punjasawadwong Y. Transient neurologic symptoms (TNS) following spinal anaesthesia with lidocaine versus other local anaesthetics. Cochrane Database Syst Rev 2005; CD003006


9 Dijkstra T, Reesink JA, Verdouw BC, Van der Pol WS, Feberwee T, Vulto AG. Spinal anaesthesia with articaine 5% vs bupivacaine 0.5% for day-case lower limb surgery: a double-blind randomized clinical trial. Br J Anaesth 2008; 100: 104–8


11 Mulroy MF, Salinas FV, Larkin KL, Polissar NL. Ambulatory surgery patients may be discharged before voiding after short-acting spinal and epidural anesthesia. Anesthesiology 2002; 97: 315–9