Psoas compartment block for lower extremity surgery: a meta-analysis

S. T. Touray1, M. A. de Leeuw2*, W. W. A. Zuurmond1 and R. S. G. M. Perez1,3

1Department of Anaesthesia and Pain Medicine, VU University Medical Centre, PO Box 7057, 1007 MB Amsterdam, The Netherlands. 2Department of Anaesthesia and Intensive Care, Zaans Medical Centre, PO Box 210, 1500 EE Zaandam, The Netherlands. 3Institute for Research in Extramural Medicine (EMGO), PO Box 7057, 1007 MB Amsterdam, The Netherlands
*Corresponding author. E-mail: ma.deleeuw@planet.nl

Psoas compartment block (PCB) is a potentially useful but controversial technique for lower limb surgery. We have conducted a systematic review of the efficacy and safety of PCB for anaesthesia and postoperative analgesia for hip and knee surgery. Relevant studies were identified within PubMed, EMBASE, and the Cochrane Library. The main outcome measure for anaesthesia was anaesthetic efficacy. For postoperative analgesia, the severity of postoperative pain was compared. The data were subjected to meta-analysis using relative risks with 95% confidence intervals (95% CI) for dichotomous variables and weighted mean differences with 95% CI for continuous variables. Thirty publications were included. PCB is an effective intervention for analgesia after hip and knee surgery. It appears superior to opioids for pain relief after hip surgery. This analgesic benefit may be extended beyond 8 h by the use of a catheter technique. Compared with Winnie’s 3-in-1 block, PCB is associated with more consistent block of the obturator nerve. PCB may be an alternative to postoperative neuraxial block. Although PCB combined with sciatic nerve block and sedation is an effective technique for minor knee surgery, there is currently insufficient data to recommend the use of this approach for hip and major knee surgery. PCB is a safe and effective alternative for analgesia after hip and knee surgery. More research is required to define its role in the intraoperative setting and confirm potentially beneficial effects on variables such as perioperative haemodynamics and blood loss.

Br J Anaesth 2008; 101: 750–60

Keywords: anaesthetic techniques, regional, lumbar plexus; anaesthetic techniques, regional, psoas compartment block; analgesia, postoperative; analgesics opioid; surgery, orthopaedic

Lower limb orthopaedic interventions such as total hip arthroplasty (THA) and total knee arthroplasty (TKA) present a challenge to the anaesthetist, as these procedures typically involve elderly patients often suffering from multiple co-morbid conditions. In addition, these procedures generate significant postoperative pain.3 Anaesthetic management usually involves the use of central neuraxial blocks or general anaesthesia (GA), with systemic analgesics administered for pain after surgery. The psoas compartment block (PCB) is an alternative approach which may circumvent many of the side-effects associated with these techniques. Combined with a sciatic nerve block, unilateral anaesthesia of the lower limb may be induced (‘Psoas compartment sciatic nerve block or PCSNB’). Today PCB remains underutilized due to the familiarity and proven track record of alternative techniques such as neuraxial block and GA. Case reports describing life-threatening complications such as seizures and cardiac arrest as a result of local anaesthetic toxicity have resulted in some resistance to the routine use of PCB.3

This systematic review was conducted to evaluate the efficacy and safety of PCB compared with conventional anaesthetic techniques for hip and knee surgery in both the intraoperative and the postoperative settings. For intraoperative anaesthesia, PCB is compared with GA and neuraxial anaesthesia. For postoperative analgesia, PCB is compared with opioids, neuraxial block, and ‘3-in-1’ or femoral nerve block (FNB). We proposed that the performance of PCB is at least equivalent to the alternative anaesthetic techniques investigated.

An electronic search of PubMed, EMBASE, and the Cochrane Library up to December 2007 was carried out using the following search terms: ‘nerve block’, ‘psoas compartment’, ‘lumbar paravertebral’, ‘lumbar plexus’, ‘sciatic’,...
and ‘parasacral’. Reference lists of identified studies were scanned for additional relevant undetected publications. The following inclusion criteria were applied.

(i) Types of studies: randomized-controlled trials (RCTs), case-controlled studies, and case series.
(ii) Types of participants: only studies involving adult patients.
(iii) Types of interventions:
(a) for intraoperative anaesthesia, studies in which PCB was compared with either GA or neuraxial anaesthesia;
(b) for postoperative analgesia, studies in which PCB was compared with opiates, ‘3-in-1’ or FNB, or neuraxial block;
(c) in terms of surgery, only studies involving hip or knee surgery.
(iv) Types of outcomes:
(a) for intraoperative anaesthesia, anaesthetic success rates were compared. ‘Anaesthetic success’ was defined as the ability to successfully complete surgery using either PCB alone or PCB combined with a sciatic nerve block, or PCB combined with a sciatic nerve block and sedation;
(b) for analgesia after surgery, studies using measures of pain quantified using a visual analogue scale (VAS, zero, no pain; 10, worst pain imagined) or postoperative analgesic consumption;
(c) studies assessing the degree of the sensory block, the motor block, or both generated by PCB;
(d) the pharmacokinetic studies reporting plasma levels of local anaesthetic after injection into the psoas compartment.

Data pertaining to the type of surgery, population characteristics, interventions, outcomes, and results were extracted from the studies and tabulated. Methodological quality of the studies was assessed using the Jadad criteria (Table 1). Within each of the investigated comparisons, outcome data were grouped and analysed both qualitatively and quantitatively. Qualitative analysis involved a synthesis of best evidence using a system of levels of evidence and grades of recommendation (Table 1). High-quality studies were distinguished from low-quality studies using the methodological quality

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Aldahish and colleagues</td>
<td>1</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>1</td>
<td>2</td>
<td>B</td>
</tr>
<tr>
<td>Becchi and colleagues</td>
<td>1</td>
<td>?</td>
<td>?</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>B</td>
</tr>
<tr>
<td>Biboulet and colleagues</td>
<td>1</td>
<td>?</td>
<td>?</td>
<td>1</td>
<td>?</td>
<td>1</td>
<td>A2</td>
</tr>
<tr>
<td>Bogoch and colleagues</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>?</td>
<td>5</td>
<td>A2</td>
</tr>
<tr>
<td>Buckenmaier and colleagues</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>C</td>
</tr>
<tr>
<td>Chelly and colleagues</td>
<td>1</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>0</td>
<td>1</td>
<td>B</td>
</tr>
<tr>
<td>Chudinov and colleagues</td>
<td>1</td>
<td>?</td>
<td>?</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>A2</td>
</tr>
<tr>
<td>Farny and colleagues</td>
<td>1</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>0</td>
<td>1</td>
<td>B</td>
</tr>
<tr>
<td>Gaillat and colleagues</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>—</td>
<td>1</td>
<td>B</td>
</tr>
<tr>
<td>Ganiadagli and colleagues</td>
<td>1</td>
<td>?</td>
<td>0</td>
<td>—</td>
<td>0</td>
<td>1</td>
<td>B</td>
</tr>
<tr>
<td>Hadzic and colleagues</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>—</td>
<td>1</td>
<td>3</td>
<td>A2</td>
</tr>
<tr>
<td>Jankowski and colleagues</td>
<td>1</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>1</td>
<td>2</td>
<td>B</td>
</tr>
<tr>
<td>Kaloul and colleagues</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>A2</td>
</tr>
<tr>
<td>Kaloul and colleagues</td>
<td>1</td>
<td>1</td>
<td>?</td>
<td>1</td>
<td>?</td>
<td>3</td>
<td>A2</td>
</tr>
<tr>
<td>Luber and colleagues</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>?</td>
<td>?</td>
<td>1</td>
<td>B</td>
</tr>
<tr>
<td>Morin and colleagues</td>
<td>1</td>
<td>?</td>
<td>?</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>A2</td>
</tr>
<tr>
<td>Odoom and colleagues</td>
<td>1</td>
<td>?</td>
<td>?</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>A2</td>
</tr>
<tr>
<td>Ozalp and colleagues</td>
<td>1</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>1</td>
<td>2</td>
<td>B</td>
</tr>
<tr>
<td>Parkinson and colleagues</td>
<td>1</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>1</td>
<td>2</td>
<td>B</td>
</tr>
<tr>
<td>Rainer and colleagues</td>
<td>1</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>1</td>
<td>2</td>
<td>B</td>
</tr>
<tr>
<td>Siddiqui and colleagues</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>A2</td>
</tr>
<tr>
<td>Simon and colleagues</td>
<td>1</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Souron and colleagues</td>
<td>1</td>
<td>?</td>
<td>?</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>B</td>
</tr>
<tr>
<td>Stevens and colleagues</td>
<td>1</td>
<td>?</td>
<td>?</td>
<td>—</td>
<td>2</td>
<td>2</td>
<td>B</td>
</tr>
<tr>
<td>Tokat and colleagues</td>
<td>1</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>0</td>
<td>1</td>
<td>B</td>
</tr>
<tr>
<td>Turker and colleagues</td>
<td>1</td>
<td>?</td>
<td>?</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>B</td>
</tr>
<tr>
<td>Vantrop and colleagues</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>B</td>
</tr>
<tr>
<td>de Visme and colleagues</td>
<td>1</td>
<td>?</td>
<td>0</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>B</td>
</tr>
<tr>
<td>Vree and colleagues</td>
<td>1</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>0</td>
<td>1</td>
<td>B</td>
</tr>
<tr>
<td>Watson and colleagues</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>?</td>
<td>1</td>
<td>4</td>
<td>A2</td>
</tr>
</tbody>
</table>
scores of the individual studies as measured using the Jadad criteria. Studies fulfilling three or more of the Jadad criteria were arbitrarily defined as high quality.

Quantitative analysis or meta-analysis was conducted, if the studies were clinically and statistically homogenous. Statistical homogeneity was assessed using the χ² test with P<0.05 considered significant. If the studies were found to be homogenous, the outcome data were pooled using a fixed-effects model. In the case of significant statistical heterogeneity, reasons for heterogeneity were explored and the data were pooled using a random-effects model. To enable meta-analysis, data had to be presented in the form of mean and standard deviation. If data were summarized using the median with a corresponding range, the mean and standard deviation of the data were estimated using the formulae derived by Hozo and colleagues. All meta-analyses were conducted using the software program RevMan® version 4.2 (Cochrane Collaboration, Oxford, UK) with effect sizes expressed as relative risk (RR) ratios with 95% confidence intervals (95% CI) for dichotomous variables and weighted mean differences (WMD) with 95% CI for continuous variables. Data were depicted in the form of forest plots. A WMD <0 indicates a superior effect of PCB. Statistical significance is indicated by a 95% CI interval not including zero. For RR, a ratio >1 indicates a superior effect of PCB with statistical significance inferred by a 95% CI not including '1'.

Results
The literature search resulted in inclusion of 20 RCT, one case-controlled study, three case series, and six pharmacokinetic studies. Methodological quality and levels of evidence of the various studies are listed in Table 1. Study characteristics are given in Table 2.

PCB for anaesthesia for hip surgery
Two case series were identified, in which a total of 21 patients for THA were successfully operated on using PCSNB combined with propofol sedation. One RCT compared PCSNB with spinal anaesthesia for hip surgery. Spinal anaesthesia resulted in the sensory block compared PCSNB with spinal anaesthesia for hip surgery. Sensory block failures. In the PCSNB group, anaesthesia was judged inadequate in four of the 15 patients (27%). Three of the four patients reported pain at incision that was relieved by a single bolus of alfentanil 250 μg, whereas the fourth patient required sedation.

Conclusion
There is insufficient evidence to support the use of PCB combined with a sciatic nerve block and sedation as an alternative to GA or spinal anaesthesia for hip surgery [Grade 3: Buckenmaier and colleagues (C), Gaillat and colleagues (C), and de Visme and colleagues (B)].

PCB for analgesia after hip surgery
Two RCTs compared PCB with neuraxial block for analgesia after THA. Turk and colleagues compared PCB with epidural analgesia and found no statistically significant difference in VAS pain scores and consumption of rescue analgesia after surgery. Sourn and colleagues compared single-injection PCB with 0.1 mg of intrathecal morphine for THA. The spinal morphine group had lower VAS pain scores and also required less rescue morphine during the first 48 h after surgery (P<0.05).

One study compared PCB with FNB. VAS pain scores at rest were lower in the PCB group immediately after extubation and during the first 4 h after surgery (P=0.001). During mobilization, no difference in VAS pain scores was noted. Hourly morphine consumption was also lower in the PCB group during the first 4 h after operation (P<0.002).

Three studies compared single-injection PCB with i.v. opioids for pain after THA. Chudinov and colleagues in a case-controlled study found that continuous PCB reduced 48 h morphine consumption by 60% (P=0.001 and 0.021 for days 1 and 2, respectively). Pooled analysis of the remaining three RCTs resulted in a WMD of −7.83 (−10.14, −5.52) at 4–8 h, −6.77 (−10.06, −3.48) at 8–12 h, and −6.10 (−10.98, −1.22) at 20–24 h, all in favour of PCB (Fig. 2). The study by Bogoch and colleagues was excluded from meta-analysis as it included a mix of THA and TKA patients.

Four studies compared continuous PCB with opioids. Chelly and colleagues in a case-controlled study found that continuous PCB reduced 48 h morphine consumption by 60% (P=0.001 and 0.021 for days 1 and 2, respectively). Pooled analysis of the remaining three RCTs resulted in a WMD of −2.71 (−3.25, −2.17) at 4–8 h, −2.87 (−3.45, −2.29) at 8–12 h, and −1.05 (−1.38, −0.72) at 20–24 h, all in favour of PCB (Fig. 3).

Conclusions
Compared with opioids for analgesia after hip surgery, it is likely that single-injection PCB reduces pain during the first 4–8 h after surgery [Grade 2: Biboulet and colleagues (A2) and Stevens and colleagues (B)]. This analgesic benefit may be extended beyond 8 h by the use of a continuous infusion [Grade 2: Becchi and colleagues (B), Chudinov and colleagues (B), Chelly and colleagues (B), and Siddiqui and colleagues (A2)].

Compared with other locoregional techniques for analgesia after hip surgery, there are indications that continuous PCB is equivalent to continuous epidural block [Grade 3: Turk and colleagues (B)]. In addition,
## Table 2: Included studies (NS, not significant)

<table>
<thead>
<tr>
<th>Reference</th>
<th>Interventions</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aldash and colleagues, 1 n=64, major knee surgery</td>
<td>Continuous PCSNB (n=32) vs lumbar epidural (n=32)</td>
<td>Anesthetic success rate—NS; VAS pain scores—NS</td>
</tr>
<tr>
<td>Becchi and colleagues, 4 n=73, THA</td>
<td>PCB (n=37) vs morphine/ketorolac infusion (n=36)</td>
<td>VAS pain scores—lower in the plexus group (P&lt;0.0001); rescue analgesia—lower in the plexus group during the first 24 h after surgery</td>
</tr>
<tr>
<td>Luber and colleagues, 24 n=87, TKA</td>
<td>PCSNB with fentanyl/midazolam sedation</td>
<td>Anesthetic success rate—NS; morphine consumption—reduced by 50% in the plexus group during the first 4 h after surgery (P&lt;0.001)</td>
</tr>
<tr>
<td>Morin and colleagues, 27 n=90, TKA</td>
<td>(i) PCB (n=30); (ii) FNB (n=30); and (iii) femoral–sciatic nerve block (n=30). After surgery: diclofenac 50 mg t.i.d., PCA piritramide 2 mg per 10 min</td>
<td>Anesthetic success—all 10 patients underwent THA without the need for conversion to GA</td>
</tr>
<tr>
<td>Odom and colleagues, 28 n=14</td>
<td>PCB with 40 ml bupivacaine 0.25% vs PCB with 40 ml bupivacaine 0.25%+epinephrine</td>
<td>Morphine consumption—lower in the PCB group in the PACU and on the first 2 days after operation</td>
</tr>
</tbody>
</table>

Continued
single-injection PCB is superior to single-injection FNB [Grade 3: Biboulet and colleagues\(^5\) (A2)]. Single-injection PCB is, however, inferior to intrathecal morphine [Grade 3: Souron and colleagues\(^{35}\) (B)].

**PCB for anaesthesia for knee surgery**

Four studies investigated PCB for anaesthesia for knee surgery. Luber and colleagues\(^{24}\) described a series of 87 patients undergoing TKA using PCSNB with fentanyl/\(\text{lidocaine}\) and midazolam sedation. Sixteen of 87 patients (18%) experienced incomplete anaesthesia requiring conversion to GA. Aldahish and colleagues\(^{4}\) found that PCSNB was as effective as epidural anaesthesia for major knee surgery. In the PCSNB group, there was one case of block failure.

Two RCTs used PCB for outpatient knee arthroscopy. In a comparison of PCB with GA and spinal anaesthesia,\(^{20}\) there were no block failures in 19 patients receiving PCB. In a similar study comparing PCSNB with propofol sedation with GA,\(^{14}\) 25 patients randomized to the PCSNB/propofol group successfully underwent arthroscopy without need for conversion to GA.

**Conclusions**

It is likely that PCB combined with either a sciatic nerve block or sedation or both is equivalent to GA and neuraxial anaesthesia for knee arthroscopy [Grade 2: Hadzic and colleagues\(^{14}\) (A2), Jankowski and colleagues\(^{51}\) (B), and Luber and colleagues\(^{24}\) (C)].

There is, however, conflicting evidence to support the use of this technique as an alternative to GA and neuraxial anaesthesia for TKA [Grade 2: Aldahish and colleagues\(^{4}\) (B) and Luber and colleagues\(^{24}\) (C)].

**PCB for analgesia after knee surgery**

Two RCTs compared PCB with epidural analgesia.\(^{1\ 32}\) Pain scores were found to be comparable between the epidural and the PCSNB groups. Four RCTs compared PCB with FNB. Two studies\(^{21\ 29}\) found postoperative VAS pain scores were lower in the PCB group than in the FNB group. However, the difference was not statistically significant. Another study reported that VAS scores were lower in the PCB group than in the FNB group, but the difference was not statistically significant.

---

### Table 2 Continued

<table>
<thead>
<tr>
<th>Reference</th>
<th>Interventions</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parkinson and colleagues,(^{30}) (n=80)</td>
<td>L3 approach PCB ((n=20)) vs L4–5 approach PCB ((n=20)) vs FNB with paresthesia ((n=20)) vs FNB with neurostimulator ((n=20))</td>
<td>Sensory and motor block—no difference in incidence of block of the femoral and lateral femoral cutaneous nerves. Block of the obturator nerve was significantly higher in the PCB group</td>
</tr>
<tr>
<td>Rainer and colleagues,(^{32}) (n=63), TKA</td>
<td>Continuous PCB vs epidural PCB or PCA (pirbuterol/phenoperidine)</td>
<td>Opioid consumption and pain scores at rest and during movement were highest in the PCA group. There was no difference between the PCB and the epidural groups</td>
</tr>
<tr>
<td>Siddiqui and colleagues,(^{33}) (n=34), THA</td>
<td>Continuous PCB + PCA ((n=17)) vs PCA (morphine) ((n=17))</td>
<td>Morbidity—lower in the PCB group ((P=0.02))</td>
</tr>
<tr>
<td>Simon and colleagues,(^{34}) (n=20), lower limb surgery</td>
<td>PCB and sciatic nerve block</td>
<td>Plasma concentrations of mepivacaine remained below 6 (\mu)g ml(^{-1}) in all but one patient who developed a peak plasma level of 7.07 (\mu)g ml(^{-1}) with no clinical signs of local anaesthetic toxicity</td>
</tr>
<tr>
<td>Souron and colleagues,(^{35}) (n=56), THA</td>
<td>PCB ((n=27)) vs intrathecal morphine ((n=26))</td>
<td>VAS pain scores—lower in the intrathecal morphine group with the difference reaching significance at 30/90 min and 6/12/18 h; cumulative morphine consumption—lower in the intrathecal morphine group in the PACU and at 24 and 48 h after surgery ((P&lt;0.05))</td>
</tr>
<tr>
<td>Stevens and colleagues,(^{36}) (n=60), THA</td>
<td>PCB ((n=30)) vs sham procedure (skin puncture) ((n=30))</td>
<td>VAS pain scores—lower in the plexus group up to 6 h after surgery; cumulative morphine consumption—significantly lower in the plexus group up to 12 h after surgery. Two of the 28 patients in the plexus group required rescue analgesia compared with 22/29 in the control group ((P&lt;0.0001))</td>
</tr>
<tr>
<td>Tokat and colleagues,(^{37}) (n=60), lower limb surgery</td>
<td>PCSNB vs femoral–sciatic nerve block</td>
<td>PCB group showed more consistent block of the lateral femoral cutaneous and obturator nerves ((P&lt;0.05)). In addition, there was a higher rate of complete sensory block in the PCB group ((P&lt;0.05))</td>
</tr>
<tr>
<td>Turker and colleagues,(^{38}) (n=30), THA</td>
<td>Continuous PCB ((n=15)) vs epidural ((n=15))</td>
<td>VAS pain scores—NS; rescue analgesia—NS; motor block (Bromage 0–3)—mean Bromage score was higher in the epidural group ((P&lt;0.001)) at time 0 but not at subsequent time points</td>
</tr>
<tr>
<td>Vanterpool and colleagues,(^{40}) (n=20)</td>
<td>PCB with sciatic nerve block ((n=10)) vs PCB without sciatic nerve block ((n=10))</td>
<td>The combined blocks group showed higher peak concentrations of local anaesthetic which remained below the level for systemic toxicity</td>
</tr>
<tr>
<td>de Visme and colleagues,(^{10}) (n=29), proximal femur fracture</td>
<td>PCSNB with iliac crest block ((n=15)) vs spinal anaesthesia ((n=14))</td>
<td>Anaesthetic success—no block failures in the spinal group. In the PCSNB group, anaesthesia was judged inadequate in 4/15 (27%) patients. Three of the four patients reported pain at incision that was relieved by a single bolus of 250 (\mu)g of alfentanil, whereas the fourth patient reported nausea and vomiting</td>
</tr>
<tr>
<td>Vree and colleagues,(^{41}) (n=10), lower limb surgery</td>
<td>PCSNB</td>
<td>Maximum plasma concentrations of the R (+) and S (−) isomers were 1.54 (0.34) and 2.34 (0.51) (\mu)g ml(^{-1}), respectively. There were no cases of toxicity</td>
</tr>
<tr>
<td>Watson and colleagues,(^{42}) (n=32), TKA</td>
<td>Continuous PCB with infusion of 0.1% levobupivacaine ((n=16)) vs continuous PCB with infusion of 0.9% saline ((n=16))</td>
<td>VAS pain scores—NS; total morphine consumption was reduced by 41% in the levobupivacaine infusion group (19 vs 32 mg, (P=0.04))</td>
</tr>
</tbody>
</table>
Fig 1 WMD between single-injection PCB and opiates for VAS pain scores measured at four time periods after surgery (0–4, 4–8, 8–12, and 20–24 h).

Fig 2 WMD between PCB and opiates for postoperative opiate consumption measured at five time periods after surgery (0–4, 4–8, 8–12, 20–24, and 44–48 h).

scores to be comparable. A comparison of continuous PCB with continuous FNB and continuous femoral–sciatic block found no difference in supplemental piritramide consumption between the PCB and the FNB groups. However, patients receiving a femoral–sciatic nerve block required less rescue piritramide compared with the PCB group during the first 48 h after surgery (P=0.0048). Ganidagli and colleagues compared PCSNB with
femoral–sciatic nerve block and measured lower VAS scores in the PCSNB group at 10, 15, and 20 min after block injection (P<0.05). Meperidine consumption in the PCSNB group was lower during the first 24 h after surgery (P<0.01).

Three trials compared PCB with i.v. opiates for pain after knee surgery. Kaloul and colleagues found continuous PCB to be superior to patient controlled i.v. anaesthesia (PCA) for postoperative analgesia. This was statistically significant at 6 and 24 h after surgery (P<0.0001). The 48 h morphine consumption was reduced by 50% in the continuous PCB group. Other studies similarly found a 41% reduction in 48 h morphine consumption in their continuous PCB group or lower pain scores in a PCSNB group both at rest (P<0.001) and during movement (P=0.001) and postoperative opioid requirements were lower in the PCSNB group (P<0.001).

**Conclusions**

It is likely that continuous PCB is superior to patient-controlled opiate administration for pain after knee surgery [Grade 2; Kaloul and colleagues (B), Morin and colleagues (A2), Ganidagli and colleagues (B), and Ozalp and colleagues (B)].

Compared with other locoregional techniques: it is likely that continuous PCB combined with a sciatic nerve block is equivalent to epidural analgesia for pain relief after knee surgery [Grade 2: Aldahish and colleagues (B) and Raimer and colleagues (B)]. It is likely that there is no difference in analgesic effect between isolated PCB and FNB for knee surgery. However, when these blocks are combined with a sciatic nerve block, PCB provides superior analgesia compared with FNB [Grade 2: Kaloul and colleagues (B), Morin and colleagues (A2), Ganidagli and colleagues (B), and Ozalp and colleagues (B)].

**Anterior vs posterior approach to the lumbar plexus**

Four studies were identified in which the distribution of neural block after PCB and ‘3-in-1’ block was compared. The frequencies of block of the three branches of the lumbar plexus at 1 h after block injection were pooled using the random-effects model. If data at 1 h were not available, the data set closest to 1 h was used (Fig. 4). For block of the femoral and lateral femoral cutaneous nerves, this resulted in a RR ratio of 1.08 (0.96, 1.20) and 1.32 (0.54, 3.21), respectively. For obturator nerve block, this resulted in a RR ratio of 4.02 (1.47, 11.04).

**Conclusion**

It is likely that the posterior and anterior approaches to the lumbar plexus are equally effective in blocking the femoral and lateral femoral cutaneous nerves. The posterior approach is, however, more effective in blocking the obturator nerve [Grade 2: Ganidagli and colleagues (B), Kaloul and colleagues (B), Parkinson and colleagues (B), and Tokat and colleagues (B)].

**Complications and plasma concentrations of local anaesthetics after PCB**

Three studies measured plasma concentrations of local anaesthetic after injection into the psoas compartment. In all three studies, plasma concentrations generally remained below toxic thresholds. No cases of local
anaesthetic toxicity were reported. Plasma concentrations of ropivacaine measured after PCB or PCSNB found that the combined block resulted in earlier peak concentrations which remained below the threshold for toxicity.\(^{40}\) In a comparison of plasma concentrations of bupivacaine after PCB with bupivacaine 0.25% with and without epinephrine 1:200,000,\(^{28}\) plasma bupivacaine concentrations were lower with bupivacaine 0.25% with and without epinephrine.

Comparison of plasma concentrations of bupivacaine after PCB or PCSNB found that the combined block resulted in earlier peak concentrations which remained below the threshold for toxicity.\(^{40}\) In a comparison of plasma concentrations of bupivacaine after PCB with bupivacaine 0.25% with and without epinephrine 1:200,000,\(^{28}\) plasma bupivacaine concentrations were lower with bupivacaine 0.25% with and without epinephrine.

Conclusions

There are indications that plasma concentrations of local anaesthetic after bolus administration into the psoas compartment remain below accepted levels of toxicity [Grade 3: Odoom and colleagues\(^{28}\) (B)]. Compared with single-injection PCB, plasma concentrations of local anaesthetic increase more rapidly but remain below the threshold for toxicity when PCB is supplemented with a sciatic nerve block [Grade 3: Vanterpool and colleagues\(^{40}\) (B)]. Compared with the anterior approach, peak plasma levels of local anaesthetic are significantly higher after the posterior approach. However, after continuous administration into the lumbar plexus, plasma levels are comparable for the posterior and anterior approaches [Grade 3: Kaloul and colleagues\(^{22}\) (A2)].

Discussion

As hypothesized, the pooled data suggest that for postoperative analgesia, PCSNB is an alternative to neuraxial block and is superior to both i.v. opiates and the ‘3-in-1’ block. There is, however, insufficient evidence to support
the use of PCB combined with a sciatic nerve block and sedation as an alternative to GA or neuraxial anaesthesia. These conclusions must, however, be interpreted against the background of several limitations of the review. No attempt was made to identify unpublished studies. This review may therefore be subject to publication bias. In addition, the majority of the comparative studies were of low quality. The main methodological shortcoming in the studies was failure to describe the method of randomization, blinding, or both that were used. The quality assessment was therefore carried out assuming a ‘worst case scenario’ in which the method of randomization, blinding, or both were considered inappropriate, if not specifically described. This had minor consequences for the evidence synthesis. A ‘best case analysis’ assuming the opposite would increase the number of high-quality studies. As a result, the level of evidence applied to Grade 2 conclusions would be increased to Grade 1, thus strengthening the various recommendations.

**PCB for postoperative analgesia**

The anterior approach to the lumbar plexus (‘3-in-1’ or inguinal paravascular block) was first described by Winnie in 1973. This technique is often recommended for lower limb surgery due to the potential complications of PCB. This review, however, confirms earlier reports that Winnie’s ‘3-in-1’ block is at most a ‘2-in-1’ block. In addition, PCB provides better analgesia. This may be related to the fact that the posterior approach results in consistent block of the obturator nerve. PCB may therefore be the true ‘3-in-1’ block. For knee surgery, it has been demonstrated that addition of an obturator nerve block to femoral–sciatic nerve block significantly improves analgesia. The posterior approach to the lumbar plexus may therefore be the peripheral block of choice for knee surgery. Similarly, for hip surgery, PCB was found to be superior to FNB for postoperative analgesia. The authors of this study speculated that this may have been the result of more extensive anaesthesia by PCB in which the ilioinguinal, iliohypogastric, and genitofemoral nerves are also blocked. However, the data also indicate that single-injection PCB is of limited benefit as the duration of analgesia is limited to the first 4–8 h after block injection. Intrathecal morphine was found to provide superior and longer lasting analgesia after surgery. For effective postoperative analgesia, a catheter technique may be used to extend the duration of analgesia. However, continuous infusion into the lumbar plexus reduces morphine consumption, but does not completely eliminate it. This is probably the result of pain arising from structures innervated by the sacral plexus. This suggests that for optimal results, continuous PCB must be combined with either a sciatic nerve block or systemic analgesics. Further research is required to determine if the sciatic nerve block should be continuous or single injection.

**PCB for intraoperative anaesthesia**

Several studies have reported more stable haemodynamics with PCB when compared with GA and neuraxial anaesthesia. Clinically, PCSNB with sedation has been successfully used for anaesthesia for cardiac compromised patients undergoing hip surgery. In addition, PCB as a supplement to GA resulted in an anaesthetic-sparing effect and reduced blood loss. Despite these encouraging observations, there is currently insufficient evidence to recommend the use of PCB as an alternative to GA or neuraxial anaesthesia for intraoperative anaesthesia. For hip surgery, the evidence for PCB in the intraoperative period is based on two small case series and two low-quality studies. In addition, PCB alone is insufficient for hip surgery. The addition of a sciatic nerve block and possibly sedation or supplementary analgesia appears to be required for successful anaesthesia. For knee surgery, the evidence is more favourable. However, with the exception of one comparative study that involved TKA, the studies identified primarily involved minor knee procedures such as knee arthroscopy. In addition, an 18% failure rate was noted in a case series involving 87 patients undergoing TKA using PCSNB with fentanyl and midazolam sedation. More research is therefore required to define the role of PCB in intraoperative anaesthesia and to confirm the purported beneficial effects on variables such as intraoperative haemodynamics and perioperative blood loss.

**Safety of PCB**

In this review, a low incidence of complications was noted. The main complication described was epidural extension. The pharmacokinetic studies identified indicate that administration of local anaesthetic into the psoas compartment both as a bolus or as a continuous infusion is safe. However, reports of local anaesthetic toxicity cannot be ignored. Awareness of toxic doses and use of the less cardio-toxic local anaesthetics is to be recommended. Other potential complications include total spinal anaesthesia, renal injury, and retroperitoneal haematoma. An ultrasound-guided posterior approach to the lumbar plexus has been described which may assist in needle placement and improve the safety profile of PCB.

**Conclusions**

**PCB for postoperative analgesia**

Single-injection PCB is probably of limited benefit for postoperative analgesia as it only reduces pain during the first 4–8 h after surgery. A catheter technique may be applied to extend analgesia beyond 8 h. As PCB does not cover the sacral plexus, continuous PCB must be combined with either a sciatic nerve block or multimodal systemic analgesia.
PCB for intraoperative anaesthesia

It is likely that PCB combined with a sciatic nerve block and sedation is an effective alternative to GA and neuraxial anaesthesia for knee arthroscopy. PCB may be combined with GA for total arthroplasty. Further research is required to evaluate the efficacy of PCB combined with sciatic nerve block and sedation for hip and major knee surgery and to confirm potentially beneficial effects of PCB on intraoperative variables such as haemodynamic stability and perioperative blood loss.

Anterior vs posterior approach to the lumbar plexus

PCB is superior to Winnie’s anterior approach to the lumbar plexus (‘3-in-1’ or inguinal paravascular block) for blocking all branches of the lumbar plexus. PCB is therefore the true ‘3-in-1 block’.

Complications of PCB

Epidural extension resulting in bilateral block was the main complication reported. The pharmacokinetic data indicate that PCB is a safe technique. Further studies on factors contributing to systemic toxicity and epidural extension and the role of ultrasound in improving the safety profile of PCB are required.

References

26 McNamara DA, Parks L, Milligan KR. Post-operative analgesia following total knee replacement: an evaluation of the addition of
an obturator nerve block to combined femoral and sciatic nerve
and functional recovery after total-knee replacement: comparison
of a continuous posterior lumbar plexus (psoas compartment)
block, a continuous femoral nerve block, and the combination of
a continuous femoral and sciatic nerve block. Reg Anesth Pain
Med 2005; 30: 434–45
28 Odoom JA, Zuurmond WW, Sih IL, Bovill J, Osterlof G, Oosting
HV. Plasma bupivacaine concentrations following psoas compart-
ment block. Anaesthesia 1986; 41: 155–8
different approaches to the lumbar plexus for patient-controlled
30 Parkinson SK, Mueller JB, Little WL, Bailey SL. Extent of blockade
with various approaches to the lumbar plexus. Anesth Analg 1989;
68: 243–8
31 Peters CL, Shirley B, Erickson J. The effect of a new multimodal
perioperative anesthetic regimen on postoperative pain, side
effects, rehabilitation, and length of hospital stay after total joint
32 Rainer C, Priem K, Wiese AA, et al. Continuous psoas and
sciatic block after knee arthroplasty: good effects compared to
epidural analgesia or i.v. opioid analgesia: a prospective study of
33 Siddiqui ZI, Cepeda MS, Denman W, Schumann R, Carr DB.
Continuous lumbar plexus block provides improved analgesia
with fewer side effects compared with systemic opioids after hip
arthroplasty: a randomized controlled trial. Reg Anesth Pain
Med 2007; 32: 393–8
34 Simon MA, Gielen MJ, Lagerwerf AJ, Vree TB. Plasma concen-
trations after high doses of mepivacaine with epinephrine in the
combined psoas compartment/sciatic nerve block. Reg Anesth
1990; 15: 256–60
35 Souron V, Delaunay L, Schirine P. Intrathecal morphine provides
better postoperative analgesia than psoas compartment block
36 Stevens RD, van Gessel E, Flory N, Fournier R, Gamulin Z.
Lumbar plexus block reduces pain and blood loss associated with
total hip arthroplasty. Anesthesiology 2000; 93: 115–21
37 Tokat O, Turker YG, Uckunkaya N, Yilmazlar A. A clinical
comparison of psoas compartment and inguinal paravascular
30: 161–7
38 Turker G, Uckunkaya N, Yavasagolu B, Yilmazlar A, Ozcelik S.
Comparison of the catheter-technique psoas compartment block
and the epidural block for analgesia in partial hip replacement
39 van Everdingen J, Burgers JS, Assendelft WJJ, Swinkels JA, van
Barneveld TA, van de Klundert JLM, eds. Evidence-Based
Richtlijnontwikkeling. Een leidraad voor de praktijk. Houten: Bohn
Stafleu Van Loghum, 2004
40 Vanterpool S, Steele SM, Nielsen KC, Tucker M, Klein SM.
Combined lumbar-plexus and sciatic-nerve blocks: an analysis of
plasma ropivacaine concentrations. Reg Anesth Pain Med 2006;
31: 417–21
41 Vree TB, Beumer EM, Lagerwerf AJ, Simon MA, Gielen MJ.
Clinical pharmacokinetics of R(+) - and S(−) -mepivacaine after
high doses of racemic mepivacaine with epinephrine in the com-
75: 75–80
42 Watson MW, Mitra D, McInntock TC, Grant SA. Continuous
versus single-injection lumbar plexus blocks: comparison of the
effects on morphine use and early recovery after total knee
43 White IW, Chappell WA. Anaesthesia for surgical correction of
Anaesthesia 1980; 35: 1107–10