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# Patient-controlled interscalene analgesia with ropivacaine after major shoulder surgery: PCIA *vs* PCA

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## Summary

We have compared the efficacy of patient-controlled interscalene analgesia (PCIA) using ropivacaine with patient-controlled analgesia (PCA) using nicomorphine in 60 patients ($n=30$ in each group), in a prospective, randomized study. In both groups, all patients received interscalene block with 0.75% ropivacaine before induction of anaesthesia. Six hours after interscalene block, patients in group PCIA received continuous infusion of 0.2% ropivacaine at a rate of 5 ml $h^{-1}$ with a bolus dose of 3 or 4 ml and a lockout time of 20 min; patients in group PCA received continuous infusion of nicomorphine 0.5 mg $h^{-1}$ and a bolus dose of 2 or 3 mg with a lockout time of 20 min. Control of pain was significantly better from 12 to 48 h after operation (except at 42 h) in group PCIA. Nausea and pruritus occurred significantly more frequently in group PCA. Patient satisfaction was greater in group PCIA. We conclude that the use of 0.2% ropivacaine using PCIA was an efficient way of managing pain after major shoulder surgery and compared favourably with PCA nicomorphine in terms of pain relief, side effects and patient satisfaction. (*Br. J. Anaesth.* 1998; **81**: 603–605).

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Severe postoperative pain, particularly within the first 48 h after operation, is frequently observed after major shoulder surgery.[1] Adequate management of pain after surgery is important, not only to improve the patient's well being, but also to facilitate recovery.

Interscalene block is a recognized effective means of providing anaesthesia–analgesia for shoulder surgery.[2] Use of long-acting local anaesthetics provides prolonged postoperative analgesia and reduces the need for opioids and the incidence of associated side effects. Recently, we have shown that patient-controlled interscalene analgesia (PCIA) with bupivacaine was superior to patient-controlled analgesia (PCA) with nicomorphine in the management of postoperative pain after major shoulder surgery.[3] Ropivacaine has less cardiotoxicity and a greater degree of separation between motor and sensory block compared with bupivacaine.[4] To our knowledge, there are no studies on continuous infusion of ropivacaine and major shoulder surgery. In this study, we have assessed and compared the efficacy of PCIA with ropivacaine and PCA with nicomorphine after shoulder arthroplasty or rotator cuff repair.

## Methods and results

After obtaining approval from the Institutional Ethics Committee and written informed consent, we studied prospectively 65 adults of both sexes, ASA I or II, aged 18–75 yr, weighing 50–100 kg, undergoing elective shoulder arthroplasty or rotator cuff repair. Exclusion criteria were contraindications to interscalene block, including severe bronchopulmonary disease, known allergy to ropivacaine or opioids, prior analgesic treatments with opioids and pain in the shoulder as a result of other pathologies. Patients were allocated randomly to one of two groups (PCIA or PCA) according to a computerized randomization list. All patients had an interscalene block performed before induction of general anaesthesia. In both groups, the interscalene brachial plexus was identified using a nerve stimulator (Stimuplex, DIG, B. Braun Melsungen AG, Melsungen, Germany) connected to the proximal end of the metal inner needle of a plastic cannula (Contiplex, B. Braun Melsungen AG, Melsungen, Germany). Placement of the needle was considered successful when a group of muscles distal to the deltoid was stimulated with a threshold stimulation of less than 0.5 mA.

In both groups, interscalene block was performed with 0.75% ropivacaine (Naropin) 30 ml. In the PCIA group, a catheter (Contiplex, od 0.85 mm) was introduced distally within the interscalene sheath for up to 7–8 cm and fixed to the skin with adhesive tapes. In this group, interscalene block was performed by administering ropivacaine through the catheter, after it was placed within the interscalene sheath. In the PCA group, interscalene block was performed by administering ropivacaine when the stimulation needle was adequately placed. Interscalene block was confirmed in all patients by sensory (inability to recognize cold temperature) and motor (inability to extend the arm) block involving the radial and median nerves, within 20 min after administration of the local anaesthetic.

General anaesthesia was similar for all patients. Patients were premedicated with midazolam 0.1 mg $kg^{-1}$ orally, 1 h before anaesthesia. After completion of interscalene block, anaesthesia was induced with propofol 1.5–2 mg $kg^{-1}$ and maintained with propofol 8–10 mg $kg^{-1}$ $h^{-1}$. Tracheal intubation was facilitated with rocuronium 0.8 mg $kg^{-1}$, and fentanyl 2–3 μg $kg^{-1}$

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was given within the first 20 min after induction. For all patients, infusion of either ropivacaine via the interscalene catheter or i.v. nicomorphine was started in the recovery room, 6 h after the initial interscalene block.

Group PCIA (Pain Management Provider/Abbott Lab., North Chicago, IL, USA) received continuous infusion of 0.2% ropivacaine at a rate of 5 ml $h^{-1}$ and a bolus dose of 4 ml (8 mg) for patients >65 kg and 3 ml (6 mg) for patients <65 kg, with a lockout time of 20 min, via the interscalene catheter. At the same time, group PCA (Pain Management Provider/ Abbott Lab.) received continuous infusion of nicomorphine 0.5 mg $h^{-1}$ and a bolus dose of 3 mg for patients >65 kg and 2 mg for patients <65kg, with a lockout time of 20 min. The study was ended 48 h after the initial interscalene block. If pain was not controlled adequately (pain score >40 on the visual analogue scale), patients received paracetamol 1 g i.v. to a maximum dose of 6 g per day.

A research nurse, not involved in the intraoperative part of the study, was responsible for asking the patient about pain scores, appearance of side effects, patient satisfaction and recording technical problems associated with PCA or PCIA pumps. Pain was assessed using a visual analogue scale, from 0=no pain to 100=worst pain imaginable, at the time interscalene block was performed ($t=0$), at the beginning of PCIA or PCA ($t=6$) and every 6 h for the next 42 h.

The incidence of nausea, vomiting, pruritus or other side effects was noted. The time of the first PCIA or PCA was checked, in addition to the number of paracetamol supplements needed. Nausea and pruritus were recorded only when patients asked for treatment. Nausea and vomiting were treated by tropisetron 2 mg i.v. and pruritus by propofol 10 or 20 mg i.v., repeated as necessary.[5]

Motor block was considered present when the patient complained of difficulties in flexing or extending any of the fingers, 12 h after interscalene block. Patient satisfaction, assessed 6 h after the end of the study, was evaluated using a visual analogue scale, from 0=not satisfied to 10=entirely satisfied.

Results are reported as mean (SD). Patient data were compared using one-way analysis of variance, pain score (VAS) by the Mann–Whitney test with Bonferroni's correction for multiple comparisons, patient satisfaction, time of first bolus and paracetamol supplements by the Mann–Whitney test, and side effects with Fisher's exact test. For all determinations, $P<0.05$ was considered significant.

The two groups were comparable in patient characteristics and surgical data. Five patients were excluded from the study: three in group PCIA and two in group PCA. In two patients in group PCIA, the interscalene catheter was accidentally pulled out while in the other, insertion of the catheter within the interscalene sheath could not be achieved. In group PCA, one patient was withdrawn after 18 h because of intractable vomiting secondary to nicomorphine while the other asked to be withdrawn from the study after 30 h as he felt dizzy every time he pushed the PCA switch. The time of the first PCIA or PCA bolus was similar in both groups. There was no significant difference between groups in the mean dose of supplementary paracetamol (table 1).

*Table 1* Side effects and analgesic requirements in the two groups. Number (*n*) of patients or mean (SD). *$P<0.05$

| | PCIA group | PCA group |
|---|---|---|
| Nausea (*n*) | 3* | 14 |
| Vomiting (*n*) | 2 | 8 |
| Pruritus (*n*) | 0* | 8 |
| Motor block (*n*) | 6 | 4 |
| Time of first bolus (min) | 930 (444) | 786 (276) |
| Paracetamol supplement (g) | 2.1 (3.3) | 3.5 (3.4) |
| Patient satisfaction | 9.6 (0.7)* | 7.5 (2.4) |
| Range | (7–10) | (2–10) |

Pain scores were similar in both groups at the time the interscalene block was performed ($t=0$) and when PCIA and PCA was started ($t=6$). Except for 42 h after operation, pain scores were significantly decreased at all times (12,18, 24, 30, 36 and 48 h) ($P<0.05$) (fig. 1).

Side effects during the study are summarized in table 1. Nausea and pruritus were observed less frequently in group PCIA ($P<0.05$). Vomiting was less frequent in group PCIA (ns). Motor block was comparable in both groups.

Patient satisfaction was significantly greater in the PCIA group ($P<0.05$) (table 1).

## Comment

We have shown that 0.2% ropivacaine via an interscalene catheter provided efficient control of postoperative pain after major shoulder surgery, and was associated with a low incidence of side effects and high patient satisfaction.

Continuous infusion of ropivacaine 10 mg $h^{-1}$ was chosen, as according to pharmacodynamic differences,[6] this dose may be considered equivalent to bupivacaine 7.5 mg $h^{-1}$, which was satisfactory in our previous study.[3] A background infusion was used as patients showed a high degree of satisfaction in our first study.[3] The dose of nicomorphine was unchanged from our previous investigation as we observed a favourable ratio between analgesic treatment and side effects.[3] A background infusion of nicomorphine was also given to avoid methodological bias, knowing that PCA with a concurrent infusion did not show any advantages compared with PCA alone.[7] Study duration was limited to the first 48 h after operation, as it was well demonstrated that after major shoulder

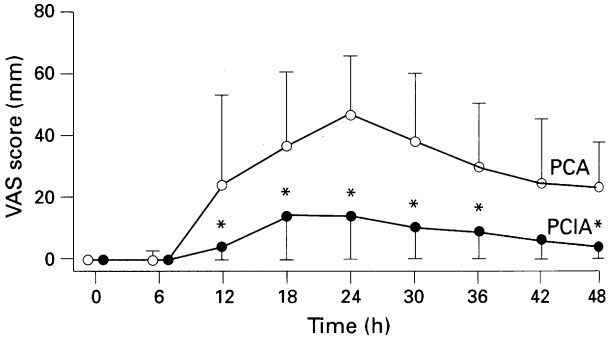


*Figure 1* Pain assessment by visual analogue scale (VAS, 0–100 mm) (mean, SD) in the patient-controlled analgesia (PCA) and patient-controlled interscalene analgesia (PCIA) groups (*$P<0.05$).

surgery, the most severe pain occurred within this time interval.

Clinical experience with ropivacaine and peripheral block is still limited. Nolte, Fruhstrorfer and Edstrom[8] demonstrated in a dose–response study in human volunteers undergoing bilateral nerve block that ropivacaine was maximally effective at concentrations of 0.5–0.75%, with a profile of action similar to bupivacaine. This is in accordance with our initial bolus of 0.75% ropivacaine. Hickey and colleagues[9] compared the effectiveness of 0.25% ropivacaine and 0.25% bupivacaine in patients receiving interscalene block for upper extremity surgery and found that both drugs were inadequate for this type of surgery. The same authors, using the same technique, investigated the efficacy of 0.5% ropivacaine with or without epinephrine (adrenaline) for shoulder surgery.[10] They found that 0.5% ropivacaine, even without epinephrine, provided excellent sensory and motor block of prolonged duration in 87% of patients. This is slightly lower than the incidence observed in our study (100%) but may be explained by the higher concentration (0.75%) used in our study.

In group PCA, VAS satisfaction was 7.5; this value is similar to that found in our previous study.[6,7] Difference in the scale used and type of surgery may explain the slightly lower value reported in our study compared with that found in the literature (90–95%).[11] The incidence of vomiting (27%) was comparable with the 25% found in the first study[3] and is within the usual range of the incidence of vomiting after general anaesthesia and PCA.[7] The incidence of pruritus (25%) was also comparable with previous work.[3] In the PCIA group, VAS satisfaction was 9.6. This value is similar to that reported after bupivacaine using a similar protocol.[3]

The study design may be criticized by the unblinded nature of the study. In order to minimize this bias, a nurse in the pain clinic, not involved in the study or informed directly about its aims, was asked to collect the data.

In summary, we have demonstrated the efficacy of continuous infusion of 0.2% ropivacaine using a PCIA technique to manage pain after major shoulder surgery. PCIA with ropivacaine compared favourably with PCA nicomorphine in this clinical setting in terms of quality of analgesia, side effects and patient satisfaction. In view of the lesser potential for toxicity and its pharmacokinetic properties, ropivacaine may be an advantageous and safer alternative to bupivacaine to provide analgesia.

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