Thoracic epidural analgesia or patient-controlled local analgesia for radical retropubic prostatectomy: a randomized, double-blind study†‡

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Editor’s key points

- Retropubic prostatectomy can cause moderate-to-severe pain, with potential implications for the quality of recovery and length of hospital stay.
- Thoracic epidural analgesia (TEA) is superior to patient-controlled analgesia. This study looks at the effectiveness of peripherally delivered local anaesthetic (LA) for retropubic prostatectomy.
- TEA performed better than peripheral (intra-abdominal) LA, with better pain relief up to 48 h afterwards, reduced opioid consumption.
- Other factors, did not show any benefit for TEA, including length of hospital stay and quality of life 1–3 months later.

Background. Postoperative pain after radical retropubic prostatectomy is moderate to severe. The primary aim of this study was to assess whether intra-abdominal local anaesthetics provide similar analgesia compared with thoracic epidural analgesia (TEA).

Methods. Fifty patients, ASA I–II, participated in this prospective, double-blinded study. All patients had TEA. After operation, they were randomized into two groups of 25 patients: Group PCLA (patient-controlled local analgesia): self-administration of 10 ml of ropivacaine 2 mg ml⁻¹ via the intra-abdominal catheter for 48 h. Group TEA: infusion of 10 ml h⁻¹ of ropivacaine 1 mg ml⁻¹, fentanyl 2 μg ml⁻¹, and epinephrine 2 μg ml⁻¹ epidurally for 48 h. The primary endpoint was pain on coughing at 4 h after operation. Rescue medication was morphine i.v. as required.

Results. Pain on coughing at 4, 24, and 48 h was significantly lower in Group TEA [0 (0–10)] compared with Group PCLA [4 (0–10)] (P < 0.05). Significantly lower pain intensity was also found in Group TEA compared with Group PCLA at the incision site, deep pain, and pain on coughing at 4 and 24 h (P < 0.05). Morphine consumption was significantly greater in Group PCLA [12 (0–46)] compared with Group TEA [0 (0–20)] at 0–48 h after operation [median (range)] (P = 0.015). Maximum expiratory pressure was higher in Group TEA compared with Group PCLA at 24 h (P < 0.01).

Conclusions. TEA provides superior postoperative pain relief with better preservation of expiratory muscle strength compared with PCLA.

Keywords: anaesthetics, local; analgesia, epidural; analgesia, patient-controlled; prostatectomy, retropubic

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Thoracic epidural analgesia (TEA) is a common method for postoperative pain management in major abdominal surgery and has been shown to have beneficial effects on respiratory function,1 reduction in deep vein thrombosis, and possibly lower cardiac morbidity. These benefits are specifically seen in high-risk patients undergoing high-risk surgery.2 Recent data confirm the usefulness of TEA in facilitating the return of gastrointestinal function both in open and laparoscopic abdominal surgery by reducing pain and opiate intake3 and retrospective studies indicate a role for epidural block in reducing the risk for increase in prostate cancer markers (prostate-specific antigen) after surgery.4 In our previous study comparing the effect of TEA with i.v. patient-controlled analgesia (PCA) after radical retropubic prostatectomy (RRP), we found better pain relief, improved expiratory function, and a higher quality of life at 1 month after the operation in patient receiving TEA.5 The use of TEA for postoperative pain management remains controversial, since prospective studies have not shown the same benefits suggested by retrospective data,6 the complications related to the use of

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epidurals have recently been highlighted in the literature, and costs for management of catheters remain high.\textsuperscript{7,8} Patient-controlled local analgesia (PCLA) using local anaesthetics (LAs) on demand has recently become a popular method for postoperative pain management after abdominal\textsuperscript{9} and orthopaedic surgery.\textsuperscript{10} The benefits include ease of performance, satisfactory analgesia, safety, and patient satisfaction. Complications provoked by the insertion of a catheter and side-effects related to the LA are few and of minor clinical importance.\textsuperscript{11} The most convincing results of PCLA have been shown during minor surgical procedures\textsuperscript{12,13} and during orthopaedic surgery.\textsuperscript{14} In intra-abdominal surgery, however, the results are inconclusive with some studies showing a reduction in morphine consumption after hysterectomy\textsuperscript{15} and lower pain score after open colonic surgery.\textsuperscript{16} In view of the uncertainty of this technique for analgesia, we designed the present study to assess the analgesic effect of intra-abdominal retropubic catheter on postoperative pain during the first 48 h after RRP, compared with TEA, which is the standard of care at our hospital. Our hypothesis was that patient-controlled peripheral analgesia is equally efficacious as TEA for pain relief after RRP.

Methods

After approval from the Hospital Ethics Committee, and the Swedish Agency for Drugs, 50 patients in the ASA physical status I–II group undergoing open RRP were recruited from the University Hospital in Örebro into this prospective, randomized, parallel group, double-blinded study. Written informed consent was obtained from each patient before randomization. Exclusion criteria were: chronic pain, regular consumption of analgesics, or both; contraindications for epidural analgesia; allergy/intolerance to morphine, epinephrine, fentanyl, or ropivacaine; age more than 75 yr; and participation in another clinical trial.

Randomization and blinding

The Hospital Pharmacy, which also prepared the drugs, randomized patients into two groups using computer-generated randomized numbers.

Group PCLA

Ten millilitres of self-administered ropivacaine 2 mg ml\textsuperscript{−1} as needed for pain relief via an intra-abdominal catheter, maximum one dose per hour for 48 h. These patients had a continuous infusion of 10 ml of 0.9% saline in the epidural catheter.

Group TEA

Twenty-five patients had an infusion of 10 ml h\textsuperscript{−1} of ropivacaine 1 mg ml\textsuperscript{−1}, fentanyl 2 μg ml\textsuperscript{−1}, and epinephrine 2 μg ml\textsuperscript{−1} epidurally for 48 h and could self-administer 10 ml of 0.9% saline via PCLA intra-abdominally as needed if pain relief was inadequate.

All patients had both an intra-abdominal catheter and an epidural catheter in order to ensure complete blinding of patients, surgeons, anaesthesiologists, and nurses involved in direct patient care.

The hospital pharmacy sent two double-blinded bags, one for epidural use (total volume 500 ml) and the other for intra-abdominal use (total volume 500 ml), according to the randomization sequence described above.

Preoperative preparation and epidural catheter insertion

Before operation, the following information was recorded from all patients: expiratory muscle strength, health-related quality-of-life questionnaire, and pain scores using a numeric rating scale (NRS).

After oral premedication with midazolam 0.1 mg kg\textsuperscript{−1} 15–45 min before planned surgery, 500 ml of Ringer’s solution was given to all patients. An epidural catheter was inserted at the Th9–12 inter-space and mepivacaine 2% with epinephrine was injected epidurally to obtain an adequate epidural block. If the desired block was not achieved, we offered the patient a choice of reinsertion of the epidural catheter or to be excluded from the study.

Anaesthesia

General anaesthesia was induced with fentanyl 2 μg kg\textsuperscript{−1} and thiopental 3–4 mg kg\textsuperscript{−1}. After tracheal intubation using rocuronium 0.5 mg kg\textsuperscript{−1}, the patients were ventilated with 33% oxygen in air and sevoflurane using pressure-controlled ventilation. Monitoring included non-invasive arterial pressure (AP) and heart rate (HR), oxygen saturation (Sp\textsubscript{O2}), end-tidal concentration of anaesthetic gases and CO\textsubscript{2}, neuromuscular transmission, and anaesthetic depth monitoring. Analgesia was achieved in all patients with an epidural infusion of mepivacaine 2% with epinephrine 2–3 μl h\textsuperscript{−1}. Ringer’s acetate was administered in order to maintain basal fluid requirements and colloids or blood administered when deemed necessary. Bradycardia (HR <45 beats min\textsuperscript{−1}) was treated with atropine 0.5 mg i.v. and AP maintained with volume replacement or phenylephrine infusion as necessary. At the end of surgery, the surgeon placed the tip of a thin multi-holed catheter retro-peritoneally, close to the prostatic bed, and fixed it to the skin using a bacterial filter, 2–3 cm lateral to the lower abdominal, midline incision. Twenty minutes before the end of the operation, 15–20 μg of sufentanil was injected epidurally in all patients. Muscle relaxation was reversed using glycopyrrolate 0.2 mg and neostigmine 2.5 mg i.v. The patients were transferred to the post-anaesthesia care unit (PACU) after return of consciousness and adequate ventilation. The intraoperative epidural infusion was stopped before the patient was transferred to the PACU.

Surgical technique

RRP was performed as described by Walsh.\textsuperscript{17} A unilateral or bilateral nerve-sparing technique was applied when the tumour and patient characteristics permitted. A passive
drain was left in situ on the side opposite to the PCLA catheter for 24 h in all patients.

**Postoperative analgesia and rescue medication**

On arrival in the PACU, the patients in Group PCLA received ropivacaine 2 mg ml⁻¹ via a Gemstar⁶ PCA pump (Hospira, Inc., Lake Forest, IL, USA) programmed to deliver 10 ml intra-abdominally on demand (lockout time 60 min) in the case of inadequate analgesia (NRS score >3) and a constant infusion of 0.9% saline via the epidural catheter. Patients in Group TEA received ropivacaine 1 mg ml⁻¹, fentanyl 2 μg ml⁻¹, and epinephrine 2 μg ml⁻¹ at a constant rate of 10 ml h⁻¹ epidurally and 0.9% saline intra-abdominally on demand (lockout time 60 min) in the case of inadequate analgesia. A nurse, blinded to the study arm, was allowed to administer a bolus dose of morphine 2–4 mg i.v. as rescue medication to all patients, irrespective of group allocation. Paracetamol 1 g was given orally before and every 6 h after surgery to all patients during their hospital stay.

**Outcome measures**

The primary outcome measure was pain on coughing 4 h after operation using the NRS (0–10) where 0, no pain, and 10, worst imaginable pain.

The following secondary parameters were also recorded.

**Postoperative pain**

Pain at the incision site and deep intra-abdominal pain were recorded on arrival in the PACU at 4, 24, and 48 h, while pain on coughing was recorded at 24 and 48 h.

**Rescue medication**

The total amount of morphine administered during 0–24 and 24–48 h was recorded.

**Respiratory function**

The maximum expiratory pressure (P_{Emax}) (MicroMedical, Moreton-in-Marsh, UK) was recorded before operation and at 24 and 48 h after operation. P_{Emax} has been shown to be an indirect, but objective, measure of pain intensity after abdominal surgery: low pain intensity implies that the patient can generate a greater expiratory effort and achieve higher P_{Emax} values and vice versa.¹⁸

**Gastrointestinal function**

The time to drinking and eating was recorded.

**Time to mobilization**

Patients were encouraged to sit in bed as soon as possible and the time to sit and walk unaided was recorded.

**Side-effects and complications**

All side-effects, including postoperative nausea and vomiting, pruritus, tiredness, respiratory depression, and surgical complications including infection (fever, high leucocyte count, and increased C-reactive proteins), bleeding, and reoperation, were recorded.

**Length of hospital stay**

A standardized criteria to assess home discharge was used once each day until actual home discharge.⁵

**Health-related quality of life**

The SF-36 is a multi-purpose, short-form health survey with 36 questions.¹⁹ ²⁰ The questionnaire was given before operation and sent home to the patient after 1 and 3 months.

**Statistical analysis plan**

Power calculation was performed using results of our previous study in which we found that the SD of the primary variable (pain on coughing as measured by the NRS at 4 h) was 2.4 (5). Our hypothesis was that the PCLA is equi-efficacious method compared with TEA in pain management. We agreed that a median NRS difference between the groups of >2 on coughing at 4 h would be a clinically relevant difference in pain intensity. Therefore, values >2 in median pain intensity on the NRS would reject this hypothesis. Thus, sample size determination was performed using a non-inferiority study design. We assumed an α=0.05, one-sided test, and β=0.20. We calculated that we would need 18 patients in each group [n1=n2=2(z_{α/2})²×σ²/(δ−δ)²=2(1.64+0.84)²×\(2.4^2)/(0−(−2))^2=17.7)].²¹ We decided to recruit 25 patients in each group in order to account for any dropouts. NRS pain intensity difference between the groups was analysed using the Mann–Whitney U-test followed by the Bonferroni–Holm correction at the following measurement points: 4, 24, and 48 h. Morphine consumption, length of hospital stay, times to achieve recovery criteria, and health-related quality of life were also analysed using the Mann–Whitney U-test. Incidence of side-effects and other complications were analysed using the χ² test. Operation and anaesthesia time, total bleeding, and perioperative drug requirements were analysed using the two-sample t-test. Results are presented as mean and SD or median and range, as appropriate. A P-value of <0.05 was considered to be statistically significant.

**Results**

A total of 50 patients were recruited and followed-up between May 2007 and December 2009 (Fig. 1). Two patients, both in Group TEA, interrupted the study after 24 h, the first because of a misunderstanding in the surgical ward about duration of treatment and the other because of patient reluctance to continue participation. In a third patient in Group TEA, the study drug infused epidurally was interrupted after 36 h. In one patient in Group PCLA, the epidural infusion was stopped first and then restarted at a lower dose because of paraesthesia. Thus, data for the primary endpoint were registered in all patients and 47 of 50 patients completed the study.
Patient characteristic, thoracic epidural catheter placement, and spread of analgesia after 10 min are shown in Table 1.

No differences were found between the groups in the intraoperative operation or anaesthesia times, drug requirements, peroperative bleeding, and fluid requirements (Table 2).

Postoperative pain in the two groups at 4–24–48 h at the incision site, deep pain, and pain on coughing are shown in Figures 2–4. Statistically significant lower NRS values were found in Group TEA compared with Group PCLA at 4–24 h at the incision site and at 4–24–48 h in deep pain and pain on coughing.

The median (range) rescue analgesic consumption in Group PCLA was 12 (0–46) and 2 (0–25) mg at 0–24 and 24–48 h, respectively, and significantly greater than in Group TEA, 0 (0–20) and 0 (0–10) mg (P<0.05) (Table 2).

The median time to recovery of physiological body functions, including time to sitting and mobilization, and the time to home discharge were similar between the groups (Table 2).

There was a low incidence of nausea and vomiting with no statistically significant differences between the groups (Table 2). Postoperative bleeding was minimal and similar between the groups. No differences were found in the SF-36 questionnaire between the groups at 1 and 3 months after surgery.

Postoperative adverse events were seen in two patients in Group TEA and in three patients in Group PCLA. One patient in Group TEA had a low haemoglobin value and breathlessness after operation which subsided after blood...
transfusion. No pathological changes were found on a CT scan of the chest to exclude pulmonary embolism. The second patient developed cystitis, which was resistant to antibiotic therapy. This patient was subsequently re-admitted to the hospital because of a hydronephrosis that needed decompression via a pyelostomy. In Group PCLA, one patient developed symptoms of post-spinal headache after home discharge and needed to be re-admitted for management. Another patient developed a stricture of the urethra, which required surgical dilatation and antibiotic treatment. The third patient developed fever before discharge, had a CT scan to exclude an abdominal abscess, was treated with antibiotics, and subsequently discharged home.

Discussion

We found significantly lower pain intensity in the TEA group compared with the PCLA group at 4, 24, and 48 h after operation at rest, in deep pain, and on coughing. We also found significantly lesser morphine consumption in the epidural group at 0–48 h and better expiratory muscle strength at 24 h compared with the PCLA group. Other parameters including recovery and home discharge and also quality of life were similar between the groups.

The advantages of TEA during lower abdominal surgery are primarily related to improved patient comfort from better postoperative pain relief. However, the increased costs for management of postoperative pain using TEA combined with some iatrogenic complications have led to it being questioned for routine use in pain management for lower abdominal surgery over the last few years. Therefore, we were interested in finding alternative ways to provide satisfactory pain relief. We chose PCLA since recent reports have documented good pain relief using LAs injected via infra-abdominal catheters, a technique that appears to be efficacious, easy to use, and not associated with any

Table 1 Patient characteristics, thoracic epidural catheter placement, and spread of analgesia are shown. ASA, American Society of Anesthesiology physical status classification; Th, thoracic segment; L, lumbar segment. All results are presented as mean (SD) or median (range). Age as mean (range)

<table>
<thead>
<tr>
<th>Group PCLA (n = 25)</th>
<th>Group TEA (n = 25)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative</td>
<td></td>
</tr>
<tr>
<td>Age (yr) (mean, range)</td>
<td>63.5 (54–73)</td>
</tr>
<tr>
<td>(cm)</td>
<td>178.2 (5.4) 176.8 (6.3)</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>83.7 (8.9) 80.6 (11.1)</td>
</tr>
<tr>
<td>ASA status [median (range)]</td>
<td>I (I–II) I (I–II)</td>
</tr>
<tr>
<td>Gleason score [median (range)]</td>
<td>7 (4–9) 6 (4–9)</td>
</tr>
<tr>
<td>Level of epidural catheter placement [median (range)]</td>
<td>Th10–11 (9–10/10–11) Th10–11 (10–11/12)</td>
</tr>
<tr>
<td>Epidural sensory block [median (range)]</td>
<td>Upper level Th6 (Th4–10) Th6 (Th2–10)</td>
</tr>
<tr>
<td>Lower level L1 (Th10–L5) L1 (L2–3)</td>
<td></td>
</tr>
</tbody>
</table>

Table 2 Time to surgery and anaesthesia, drugs, fluid requirements, peroperative bleeding, perioperative respiratory functions, and postoperative rescue morphine requirements are shown. All results are presented as mean (SD) or median (range) unless otherwise shown. *Respiratory Rate <8/min at any time point.

<table>
<thead>
<tr>
<th></th>
<th>Group PCLA (n = 25)</th>
<th>Group TEA (n = 25)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perioperative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration of operation (min)</td>
<td>113 (22) 123 (33)</td>
<td>0.210</td>
<td></td>
</tr>
<tr>
<td>Duration of anaesthesia (min)</td>
<td>145 (27) 154 (33)</td>
<td>0.289</td>
<td></td>
</tr>
<tr>
<td>Total dose of thiopental (mg)</td>
<td>456 (60) 441 (52)</td>
<td>0.346</td>
<td></td>
</tr>
<tr>
<td>Total dose of fentanyl (µg)</td>
<td>155 (49) 150 (13)</td>
<td>0.623</td>
<td></td>
</tr>
<tr>
<td>Total ephedrine (mg)</td>
<td>5 (0–15) 0 (0–25)</td>
<td>0.682</td>
<td></td>
</tr>
<tr>
<td>Total phenylephrine (µg)</td>
<td>0 (0–15) 0 (0–24)</td>
<td>0.192</td>
<td></td>
</tr>
<tr>
<td>Interooperative bleeding (ml)</td>
<td>893 (537) 768 (359)</td>
<td>0.339</td>
<td></td>
</tr>
<tr>
<td>Postoperative</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>morphine requirements 0–24 h</td>
<td>12 (0–46) 0 (0–20)</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>24–48 h (n=47)</td>
<td>2 (0–25) 0 (0–10)</td>
<td>0.015</td>
<td></td>
</tr>
<tr>
<td>Emax Preoperative</td>
<td>92.1 (24.2) 90.0 (23.5)</td>
<td>0.770</td>
<td></td>
</tr>
<tr>
<td>24 h</td>
<td>53.2 (20.3) 70.6 (15.4)</td>
<td>0.002</td>
<td></td>
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<tr>
<td>48 h</td>
<td>59.9 (22.1) 71.2 (18.1)</td>
<td>0.076</td>
<td></td>
</tr>
<tr>
<td>Nausea or vomiting [n (%)]</td>
<td>8 (33%) 7 (28%)</td>
<td>0.686</td>
<td></td>
</tr>
<tr>
<td>Anti-emetics given [n (%)]</td>
<td>11 (44%) 10 (40%)</td>
<td>0.77</td>
<td></td>
</tr>
<tr>
<td>Hypopnoea* [n (%)]</td>
<td>2 (8.7%) 4 (16.7%)</td>
<td>0.413</td>
<td></td>
</tr>
<tr>
<td>Time to start drinking (h)</td>
<td>16.5 (3–25) 19.3 (2–27)</td>
<td>0.625</td>
<td></td>
</tr>
<tr>
<td>Time to start eating (h)</td>
<td>21.5 (7–43) 21 (4–96)</td>
<td>0.510</td>
<td></td>
</tr>
<tr>
<td>Time to sit (h)</td>
<td>21.5 (5–27) 21 (17–25)</td>
<td>0.843</td>
<td></td>
</tr>
<tr>
<td>Time to walking without support (h)</td>
<td>29.5 (18–51) 24.5 (17–49)</td>
<td>0.247</td>
<td></td>
</tr>
<tr>
<td>Time to readiness for discharge (days)</td>
<td>3 (2–5) 3 (2–5)</td>
<td>0.278</td>
<td></td>
</tr>
</tbody>
</table>
We used a double-blind design using both epidurals and intra-abdominal catheters in all patients. The pain intensity on coughing was similar in this study compared with our previous study with a similar study design, suggesting that the results are reproducible. Our present study shows that patients in both groups had mild-to-moderate postoperative pain and the rescue analgesic consumption was low, even in the PCLA group. However, pain intensity and rescue morphine consumption were significantly lower in patients having TEA, thus confirming the advantages of this method compared with PCLA. Nevertheless, using LA intra-abdominally, patients had low pain intensity, which implies that this method of pain management is also efficacious. In addition, compared with our previous study, we found a 75% reduction in rescue morphine consumption (14 vs 51 mg) in the PCLA group compared with patient-controlled i.v. analgesia (PCA) during 0−48 h. This further suggests that LA injected intra-abdominally by intermittent injection provides good pain relief. Whether this analgesic effect is via local receptors intra-abdominally or via systemic absorption of LA remains uncertain. Unfortunately, we did not measure plasma concentration of ropivacaine and therefore it is difficult to rule out the hypothesis of a systemic effect. Previous studies do show that significant amount of LA is absorbed into the systemic circulation, but whether this is sufficient to provide analgesia remains unclear.

The site of catheter placement has been an uncertain factor. Liu and colleagues studied the efficacy of continuous wound catheters delivering LA for postoperative analgesia. They found a reduction in pain intensity and lower analgesic consumption in patients receiving LA compared with PCLA. This study also showed a significant reduction in rescue morphine consumption, suggesting that LA may be a more effective analgesic than opioids.

![Fig 2](image1.png)

**Fig 2** Pain at the incision site shown as box plot. Unadjusted $P$-values are shown between the groups at different time-points. Group PCLA, patient-controlled local analgesia group; Group TEA, thoracic epidural analgesia group; NRS, numeric rating scale.

![Fig 3](image2.png)

**Fig 3** Deep pain shown as box plot. Unadjusted $P$-values are shown between the groups at different time-points. Group PCLA, patient-controlled local analgesia group; Group TEA, thoracic epidural analgesia group; NRS, numeric rating scale.

![Fig 4](image3.png)

**Fig 4** Pain on coughing shown as box plot. Unadjusted $P$-values are shown between the groups at different time-points. Group PCLA, patient-controlled local analgesia group; Group TEA, thoracic epidural analgesia group; NRS, numeric rating scale.
with placebo, irrespective of catheter site placement. In a previous study by Wu and colleagues, subfascial catheter placement and infusion of LA after RRP were not found to provide any analgesic benefit. In contrast, one study using an intra-abdominal catheter after abdominal hysterectomy found lower analgesic consumption. Whether the parietal pain after abdominal surgery contributes in any way to the analgesia seen when using intra-abdominal catheters remains to be seen in future studies. We agreed to allow the patients to self-inject a maximum of 20 mg of ropivacaine (10 ml)/dose (maximum 480 mg 24 h⁻¹), which is above the maximum recommended dose, but found no evidence of clinical toxicity. Previous studies have administered 400–500 mg of ropivacaine and levobupivacaine with low plasma concentrations and without any evidence of toxicity. However, further pharmacokinetic data on intra-abdominal LA are needed before the risk for significant toxicity can be excluded.

Maximum expiratory pressure (Pmax) is an objective measure of abdominal muscle strength and an indirect measure of analgesic efficacy. It has been used in several studies to quantify pain and found to be inversely related to the pain intensity. In our present study, we found that patients with TEA had better expiratory muscle strength compared with the PCLA group at 24 h, which would imply that better analgesia was achieved when using TEA. This method for indirectly, but objectively, measuring pain relief needs to be further evaluated in prospective studies on pain management after abdominal surgery.

The recovery of physiological functions and time to mobilization did not differ between the two groups. This is similar to the results of our previous study in which we found no differences when comparing TEA with i.v. PCA. Many of the parameters used for assessment of recovery are crude and dependent on active participation of patients and personnel, which is not always possible in clinical practice. The time to home readiness and discharge was also similar between the groups, which may suggest that improved pain management alone does not lead to shortened length of hospital stay, since several other factors affect home discharge. Similar findings have been seen in other surveys reflecting the difficulty in translating better pain management to shorter hospital stay.

We did not find any differences between the groups with respect to perioperative bleeding, side-effects, and complication. Perioperative bleeding was less than in one previous study and the incidence of side-effects was low and comparable with other studies. Similarly, follow-up after 1 and 3 months using the health-related quality of life questionnaire did not reveal differences between the groups, further confirming that better short-term pain relief does not translate into improved quality of life.

Study limitations
The study size was limited to 50 patients and therefore it could be difficult to generalize these results. However, we found the results in the TEA group to be consistent and replicable compared with our previous study. Patients having an RRP at our hospital usually have a surgical drain inserted intra-abdominally. Therefore, it is possible that LA may come out of the surgical drain, thus limiting their efficacy in pain management. We ensured that the surgical drain was on the opposite side to the intra-abdominal catheter and that the drain was not on active suction. The catheter tip was placed along the prostatic bed and this was standardized in all patients. We did not confirm postoperative catheter site placement using contrast injection and it is possible that the catheter may not have remained in the same position during mobilization. Since satisfactory analgesia was obtained in the PCLA group, we believe that most of the LA solution did remain inside the abdominal cavity. Another limitation of this study is that we did not measure plasma concentrations of LA and therefore a systemic effect of LA cannot be excluded. Finally, we did not use i.v. PCA as rescue medication but nurse-assisted analgesia and it is possible that patients may have received lesser analgesics than they desired. However, a PCA device in this study was not possible since patients already had a PCA pump for intra-abdominal injection of LA/saline.

Our results indicate that TEA is associated with low postoperative pain, lesser analgesic consumption, and better expiratory muscle strength compared with patient-controlled intra-abdominal analgesia using LAs. No differences were, however, found in the time to recovery, home discharge, or quality of life after 1 and 3 months. When a thoracic epidural catheter cannot be sited, patient-controlled intra-abdominal analgesia using LAs can be a good alternative after RRP.

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Conflict of interest
None declared.

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