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# Combined Paravertebral and Intrathecal vs Thoracic Epidural Analgesia for Post-thoracotomy Pain Relief


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## Abstract and Introduction

**Abstract**

**Background** Although thoracic epidural analgesia (TEA) is considered the gold standard for post-thoracotomy pain relief, thoracic paravertebral block (PVB) and intrathecal opioid (ITO) administration have also been shown to be efficacious. We hypothesized that the combination of PVB and ITO provides analgesia comparable with that of TEA.

**Methods** After local ethics committee approval, 84 consecutive patients undergoing open thoracic procedures were randomized to the TEA (ropivacaine 0.2%+sufentanil) or the PVB (ropivacaine 0.5%)+ITO (sufentanil+morphine) group. The primary endpoints were pain intensities at rest and during coughing/movement at 1, 2, 4, 8, 12, 24, 48, and 72 h after operation assessed by visual analogue scale (VAS) score. Data were analysed by multivariate analysis (anova; $P<0.05$).

**Results** Patient and surgical characteristics were comparable between the groups. The mean and maximal VAS scores were lower in the TEA ($n=43$) than in the PVB+ITO group ($n=37$) at several time points at rest ($P<0.026$) and during coughing/movement ($P<0.021$). However, in the PVB+ITO group, the mean VAS scores never exceeded 1.9 and 3.5 at rest and during coughing/movement, respectively; and the maximal differences between the groups (TEA *vs* PVB+ITO) in the maximal VAS scores were only 1.2 (3.4 *vs* 4.6) at rest, and 1.3 (4.4 *vs* 5.7) during coughing/movement.

**Conclusions** Although VAS scores were statistically lower in the TEA compared with the PVB+ITO group at some observation points, the differences were small and of questionable clinical relevance. Thus, combined PVB and ITO can be considered a satisfactory alternative to TEA for post-thoracotomy pain relief.

ClinicalTrials.gov number. NCT00493909.

**Introduction**

Post-thoracotomy pain is frequent and associated with considerable complications.[1,2] Severe postoperative pain, in general, impairs postoperative patient mobilization, increases perioperative morbidity, and may trigger a chronic pain syndrome.[3–5] Post-thoracotomy pain, in particular, will adversely affect pulmonary function by impairing deep breathing and effective coughing, resulting in retention of secretions, atelectasis, and pneumonia.[6]

Various regional techniques (e.g. intercostal, paravertebral, interpleural, and epidural blocks with local anaesthetics and opioids) have been used to provide pain relief after thoracotomy. Thoracic epidural anaesthesia (TEA) has emerged as the gold standard for post-thoracotomy pain control.[7] However, this method is not suitable for all patients and is associated with numerous risks (e.g. dural perforation, spinal cord damage by formation of haematoma, infection and abscess; hypotension; urinary retention).[8] Thoracic paravertebral nerve block (PVB) produces unilateral analgesia over several thoracic segments and has been shown to provide effective post-thoracotomy pain control.[7,9–13] PVB was as effective as TEA in controlling post-thoracotomy pain and associated with less haemodynamic side-effects.[12,13]

Single injection of an opioid into the subarachnoid space is a long-established but infrequently used analgesic technique in thoracic surgery.[14–16] Both sufentanil and morphine have been used for this purpose.[17] Related to their different lipid solubility, intrathecal (IT) sufentanil has a rapid onset (peak effect <5 min after injection) and relatively short duration of action (~1 h), whereas IT morphine has delayed onset (peak effect 6–7 h after injection) and long duration (~24 h).[17,18] Thus, the combination of IT sufentanil and morphine provides rapid onset and long-lasting analgesia. Based on the various findings, we hypothesized that the combination of thoracic PVB with local anaesthetic and IT sufentanil and morphine would provide post-thoracotomy pain relief comparable with that of TEA with local anaesthetic and sufentanil.

## Methods

The study was approved by the local ethics committee and registered (AZ: 35/07) (ClinicalTrials.gov number:

NCT00493909). Inclusion criteria were age between 18 and 75 yr, and lung resection via open thoracotomy. Exclusion criteria were additional chest wall resection, emergency surgery, pregnancy, and contraindications to regional techniques (i.e. allergy to local anaesthetics, infection around the site of catheter insertion, evidence of systemic inflammation, coagulation disorder) (Fig. 1).

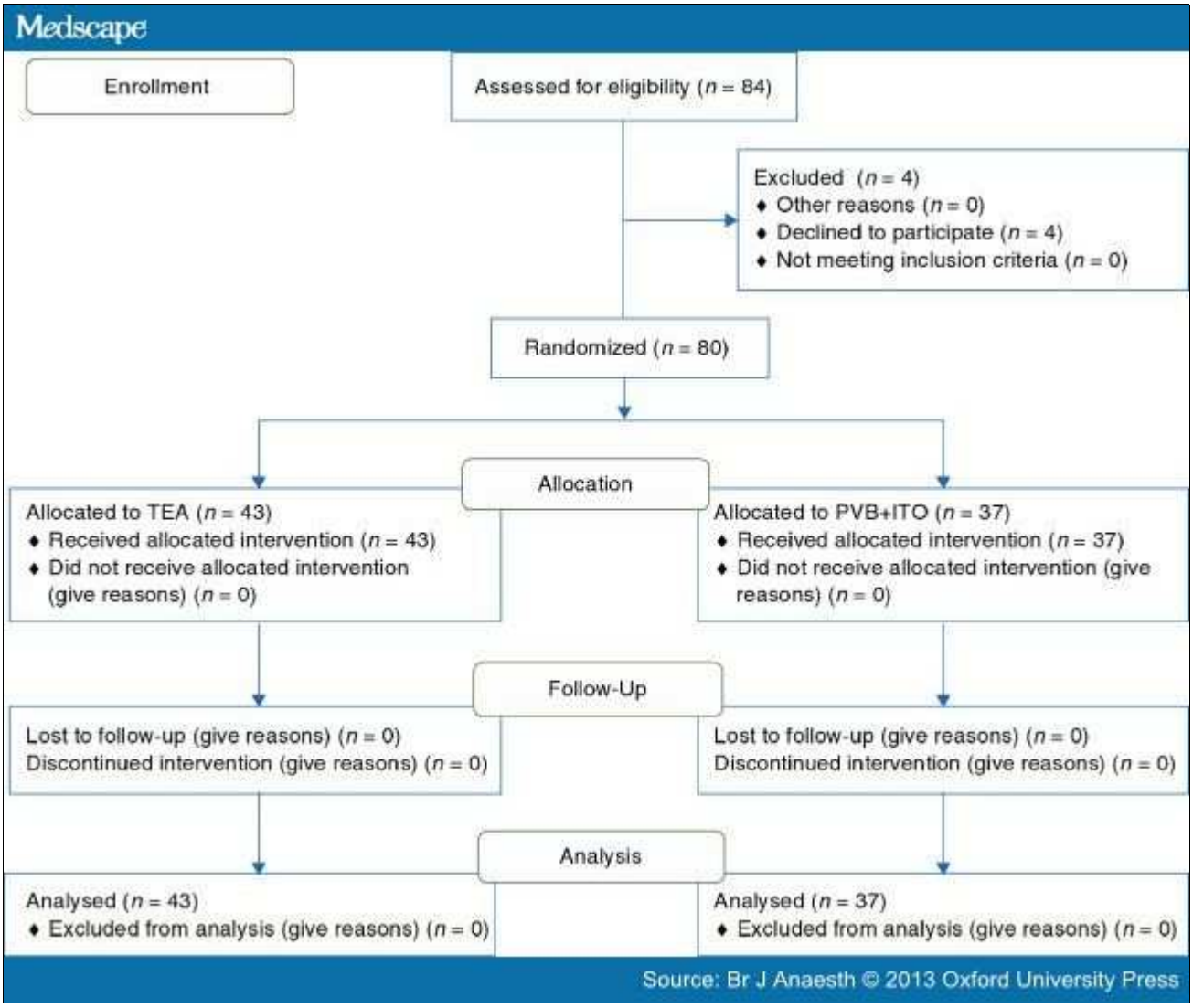


**Figure 1.**

The flow diagram.

Patients were recruited between June 2007 and August 2008. After written informed consent had been obtained, patients were randomly allocated by computer-generated randomization to one of the following two groups: Group I: TEA with ropivacaine and sufentanil; Group II: combined thoracic PVB with ropivacaine and IT administration of opioids (ITO) sufentanil and morphine (PVB+ITO). Before operation, forced vital capacity (FVC), forced expiratory volume in 1 s (FEV1), and peak expiratory flow (PEF) were measured.

All patients were pre-medicated with midazolam (3.75–7.5 mg p.o.) shortly before transfer to the operating theatre area. All thoracic epidural and paravertebral catheters were placed by one of the two investigators (S.H., T.L.) in the anaesthetic pre-induction room before induction of anaesthesia. In patients randomized to the TEA group, an epidural catheter was placed in the sitting position at interspaces T4/5, T5/6, or T6/7 (depending on the site of surgery) via an 18 G Tuohy needle (Pajunk, Geisingen, Germany) using the midline approach and hanging drop technique. A test dose of 2 ml of mepivacaine 1% (20 mg) with epinephrine (10 µg) was administered through the catheter to rule out inadvertent IT or intravascular placement. Epidural analgesia was induced by slow injection of a total of 10 ml of ropivacaine 0.2% and sufentanil (0.2–0.3 µg $kg^{-1}$ maximally 25 µg), followed by a continuous epidural infusion of ropivacaine 0.2% and sufentanil 0.5 µg $ml^{-1}$ at 8 ml $h^{-1}$ during surgery and until 72 h after operation.

In patients randomized to the PVB+ITO group, the paravertebral space ipsilateral to the thoracotomy (T4–8) was located as described by Richardson and Lonnqvist.[19] The catheter was introduced through an 18 G Tuohy needle and advanced 3 cm into the paravertebral space. After gentle aspiration, a test dose of 3 ml of ropivacaine 0.5% with 15 µg epinephrine (5 µg $ml^{-1}$) was administered through the catheter. Thoracic PVB was induced with 30 ml ropivacaine 0.5% with epinephrine (5 µg $ml^{-1}$) followed by continuous paravertebral infusion of ropivacaine 0.2% at 8 ml $h^{-1}$ intraoperatively and until 72 h after operation.

For IT opioid (ITO) injection, the skin overlying the area of the L3/4 or L4/5 interspaces was disinfected, draped, and infiltrated with 2–3 ml of 1% lidocaine for local anaesthesia. The subarachnoid space was punctured with a 25 G pencil-point spinal needle (Pencant; Braun, Melsungen, Germany). After return of clear, free-flowing cerebrospinal fluid, preservative-free sufentanil 0.2–0.3 µg $kg^{-1}$ (maximally 25 µg) (Sufenta®; Janssen-Cilag, Neuss, Germany) and morphine 4–5 µg $kg^{-1}$ (maximally 500 µg) were intrathecally injected over 5–10 s in two separate syringes. After verification of correct needle placement by successful aspiration of cerebrospinal fluid after injection of opioids, the spinal needle was removed.

Subsequently, anaesthesia was induced with i.v. sufentanil 0.4–0.6 µg $kg^{-1}$ and target-controlled infusion (TCI) of propofol (Propofol 1% MCT and Injectomat® TIVA Agilia, Fresenius-Kabi GmbH, Bad Homburg, Germany) at plasma concentrations of 2–4 µg $ml^{-1}$. Anaesthesia was maintained with propofol TCI at plasma concentrations of 2–4 µg $ml^{-1}$ and additional bolus doses of sufentanil 0.1–0.2 µg $kg^{-1}$ to avoid arterial pressure values above 20% of baseline. The depth of anaesthesia was monitored by the bispectral index of the EEG (BIS) (BIS® A-2000 monitor, averaging time=30 s; Aspect Medical Systems, Newton, MA, USA). If the BIS value decreased below 30, the propofol TCI plasma concentration was decreased to minimal 2.2 µg $ml^{-1}$.

An i.v. bolus of cisatracurium 0.1 mg $kg^{-1}$ (Nimbex®, GlaxoSmithKline, Munich, Germany) was given to facilitate tracheal intubation with a double-lumen endobronchial tube. Correct position of the double-lumen tube after tracheal intubation and after patient positioning for surgery was verified by flexible fibreoptic bronchoscopy. During two-lung ventilation, patients were ventilated in a pressure-controlled mode (Zeus®, Draeger, Luebeck, Germany) at tidal volumes of 6–8 ml $kg^{-1}$, at respiratory rates to maintain end-tidal carbon dioxide concentration between 4.9–5.7 and 5.3–5.9 kPa, with a positive end-expiratory pressure of 5 mbar, and an inspired oxygen fraction ($FI_{O\,2}$) of 0.6. During one-lung ventilation, tidal volume was decreased to 6 ml $kg^{-1}$, respiratory rates were increased to maintain end-tidal carbon dioxide concentration between 5.3 and 5.9 kPa, and $FI_{O\,2}$ was increased to 0.8–1.0.

Catheters were inserted into the radial artery for invasive arterial pressure and blood gas monitoring, and into the subclavian vein for central venous pressure monitoring. The bladder was catheterized for measurement of urinary output. Core temperature was maintained above 36.0°C by a forced-air warming system. At the end of surgery, two chest tubes (anterior 21 Ch and posterior 24 Ch, silicon chest tubes, Redax Company, Mirandola, Italy) were placed before chest closure. The chest tubes were connected to a water seal chest drainage collection device. Continuous suction of −10 cm $H_2O$ was applied until the absence of an air leak for 24 h. After reversal of neuromuscular blocking agent and response to verbal command, patients were extubated in the operating theatre. They were then transferred to the intermediate care unit. Criteria for discharge from the intermediate care unit were VAS score ≤2 and removed chest tubes.[20]

**Postoperative Pain Management**

The day before surgery, patients were instructed in the use of a patient-controlled analgesia (PCA) device (Graseby PCA 3300; Smiths Medical International Ltd, Hythe, Kent, UK) and in the visual analogue scale (VAS) score. The VAS score consisted of an unmarked 100 mm line, with 0 mm representing no pain and 100 mm the worst imaginable pain. Patients were asked to score pain on the VAS before operation.

After operation, all patients received i.v. infusions of paracetamol or metamizol (15 mg $kg^{-1}$ administered over 20 min every 6 h for 3 days). When sufficiently awake for pain assessment after operation, patients were asked by investigators blinded to the group assignment (E.H., K.O.) to score their pain on the VAS. This observation point was defined as T0. When the VAS score exceeded 30 mm, i.v. piritramide 3 mg (equivalent to 2 mg morphine) was administered and repeated at 5 min intervals until the VAS score decreased to <30 mm at rest. Patients whose VAS pain score at T0 was <30 mm (effective analgesia by definition) were directly connected to the i.v. PCA device, which was programmed to deliver bolus doses of piritramide 1.5 mg, with a lockout time of 5 min and a total dose of 40 mg per 4 h. VAS pain scores at rest and during coughing/movement, and PCA piritramide consumption were recorded hourly until 12 h (T12), 2 hourly until 24 h (T24), and 8 hourly until 48 h after operation (T48).

### Postoperative Non-pain Management

Respiratory rate, heart rate, and arterial pressure were recorded hourly in the intermediate care unit and 8 hourly after discharge to the ward. Respiratory depression was defined as respiratory rate <8 bpm, and hypotension as a decrease in mean arterial pressure by 20% of baseline value and/or in systolic arterial pressure to <10.6 kPa for more than 3 min. Hypotension was treated by i.v. bolus doses of 10 μg norepinephrine. Arterial blood gases were measured 1 h after tracheal extubation and on the morning of postoperative day (POD) 1 with the patients breathing 3 litre $min^{-1}$ of oxygen via a nasal cannula. Twelve-lead ECGs were recorded on PODs 0 and 1, and additionally, if cardiac arrhythmias, a heart rate >100 beats $min^{-1}$, or signs and symptoms of myocardial ischaemia were observed.

Patient sedation was assessed 4 hourly by investigators blinded to the group assignment on a five-point sedation score (1, wide awake; 2, drowsy or dozing intermittently; 3, mostly sleeping but easily awakened; 4, asleep, difficulty responding to verbal commands; 5, awakened only by shaking). Over-sedation was defined as sedation score >4 combined with a respiratory rate <8 bpm, and was treated with i.v. naloxone.

Chest radiographs were obtained on PODs 0, 1, and 3. FVC, FEV1, and PEF were measured daily during PODs 0–3, and at hospital discharge after chest physiotherapy using a portable spirometer (FlowScreen®, Viasys Healthcare GmbH, Hoechberg, Germany). Between T0 and T48, patients were assessed twice daily for sensory and motor function, nausea, vomiting, pruritus, and urinary retention.

### Outcome Measures

The primary outcome measures were pain intensities at rest and during coughing/movement assessed by VAS score. The quality of effective analgesia was expressed as VAS values derived from the VAS pain score <30 mm at rest and during coughing during each assessment period (T0–12, T12–24, T24–48). Secondary outcome measures included respiratory function, pulmonary complications, nausea and vomiting, degree of sedation, hypotension, pruritus, urinary retention, consumption of i.v. piritramide, surgical revisions, time to chest tube removal, and length of hospital stay.

### Statistical Analyses

The *a priori* power calculation was based on the assumption of ~30% incidence of severe post-thoracotomy pain as defined as VAS >60 mm. The aim was to detect a clinical relevant reduction in VAS score by 30 mm. To be able to detect a difference of 20 cm $h^{-1}$ in the area under the curve of the VAS score during coughing with an expected standard deviation of 50 cm $h^{-1}$, and $\alpha$- and $\beta$-errors of 0.05 (two-sided hypothesis) at a power of 0.8, the calculated sample size was 60 patients. To compensate for unforeseen drop-outs and a possibly higher variability than expected, we *a priori* planned to study 80 patients. Patient characteristic data (age, height, weight, lung function) were compared by analysis of variance (anova) using the Kruskal–Wallis test. Comparisons of serial measurements (VAS for pain) were performed with repeated-measures anova. Ranked data were analysed with the Kruskal–Wallis and Mann–Whitney *U*-tests when appropriate. Categorical data were examined by Fisher's exact test. Probability values under 0.05 were considered significant.

## Results

Four patients were excluded from analysis because of surgical revision for postoperative bleeding (Group TEA; *n*=2) and accidental premature removal of the paravertebral catheter (Group PVB+ITO; *n*=2). They were randomly replaced by consecutive patients fulfilling the inclusion criteria, resulting in data from 80 patients for analysis (TEA group, *n*=43; PVB+ITO, *n*=37). Patient and surgical characteristics were comparable between the groups (). On the day of surgery (T0), and on PODs 2 (T24) and 3 (T48), pain scores in the TEA group were lower at rest ($P<0.026$) and during coughing/movement ($P<0.021$) than in the PVB+ITO group (Figs 2 and 3). However, at the various time points, (i) mean VAS scores never exceeded 1.9 at rest, and 3.5 during coughing/movement in the PVB+ITO group; (ii) the differences between groups in the mean VAS scores varied by only 0.1–0.8 at rest, and 0.4–1.3 during coughing/movement; and (iii) the maximal differences between the TEA and the PVB+ITO groups in the maximal VAS scores were only 1.2 (3.4 *vs* 4.6) at rest, and 1.3 (4.4 *vs* 5.7) during coughing/movement.

**Table 1. Patient and surgical characteristics. TEA, thoracic epidural analgesia; PVB+ITO, thoracic paravertebral blockade and intrathecal opioid; COPD, chronic obstructive pulmonary disease; FEV1, forced expiratory volume in 1 s; FVC, forced vital capacity; VC, vital capacity**

| | TEA (*n*=43) | PVB+ITO (*n*=37) |
|---|---|---|
| Sex (*n*) (%) | | |
| Female | 16 (37.2) | 8 (21.6) |
| Male | 27 (62.8) | 29 (78.4) |
| Age (median/range) (yr) | 64 (39–82) | 68 (38–82) |
| Height (median/range) (cm) | 170 (168–176) | 174 (170–178) |
| Weight (median/range) (kg) | 82 (68–90) | 76 (69–84) |
| ASA physical status (*n*) | | |
| I | 0 | 1 |
| II | 18 | 15 |
| III | 25 | 21 |
| Hypertension (*n*) | 18 | 21 |
| COPD (*n*) | 5 | 8 |
| Ischaemic heart disease (*n*) | 6 | 5 |
| Diabetes mellitus (*n*) | 2 | 2 |
| Renal impairment (*n*) | 2 | 2 |
| Lung function (median/range) (%) | | |
| FEV1 | 81 (71–96) | 85 (77–98) |
| FVC | 88 (76–106) | 90 (78–99) |
| FEV1/VC×100 | 79 (72–90) | 77 (68–96) |
| $Sp_{O\ 2}$ on room air | 96 (94–96) | 96 (95–97) |
| Types of surgery (*n*) | | |
| Right-sided procedures | 16 | 17 |
| Segment resection | 5 | 3 |
| Lobectomy | 19 | 25 |
| Pneumonectomy | 5 | 2 |
| Decortication | 1 | 0 |
| Other | 13 | 7 |

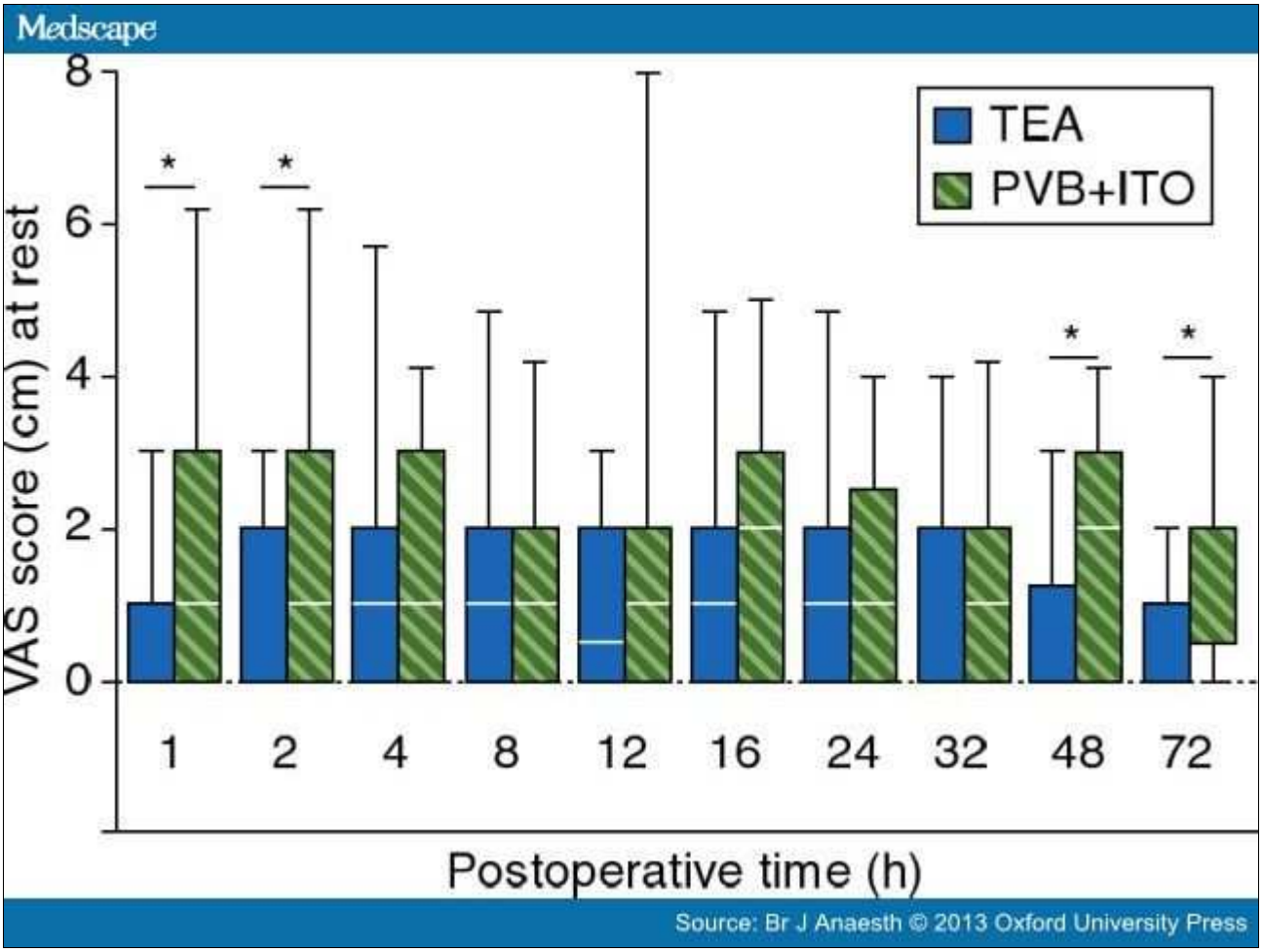


**Figure 2.**

VAS for pain at rest. TEA, thoracic epidural analgesia; PVB+ITO, thoracic paravertebral block and intrathecal opioid. (*$P$<0.05.) Boxplots show median, 25/75th, and 5/95th percentiles.

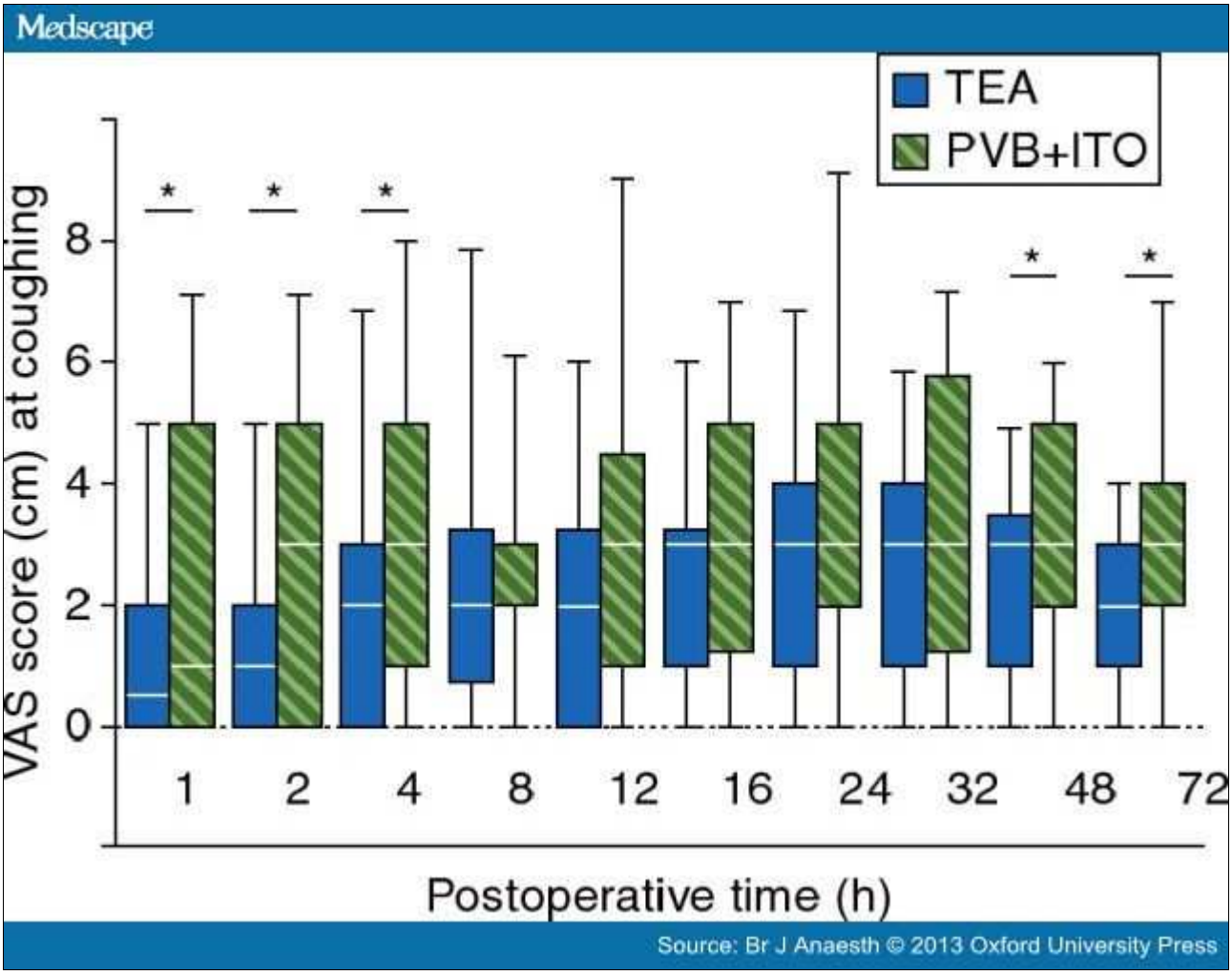


**Figure 3.**

VAS for pain at coughing/movement. TEA, thoracic epidural analgesia; PVB+ITO, thoracic paravertebral blockade and intrathecal opioid. (*$P$<0.05.) Boxplots show median, 25/75th, and 5/95th percentiles.

There were no significant differences (all $P$>0.05) between the groups in cardiovascular, respiratory, and renal complications; postoperative nausea and/or vomiting; fever; sedation; piritramide consumption; blood loss and blood transfusions; intermediate care readmission; length of hospital stay; mortality (). Over-sedation requiring treatment developed in two patients (~5%) of each group () and occurred on POD 1. Postoperative FVC, FEV1, and PEF were lower than baseline values in both groups (all $P$<0.05; data not shown). However, PEFs were comparable between the groups at POD 2 and hospital discharge ($P$<0.05; Fig. 4).

**Table 2. Intra- and postoperative characteristics. TEA, thoracic epidural analgesia; PVB+ITO, thoracic paravertebral blockade and intrathecal opioid**

| | **TEA (*n*=43)** | **PVB+ITO (*n*=37)** | ***P*-value** |
|---|---|---|---|
| Total blood loss (ml) [mean (range)] | 100 (0–500) | 100 (0–700) | 0.58 |
| Total pleural effusion (ml) [mean (range)] | 1100 (0–2300) | 1520 (0–7200) | 0.11 |
| Blood transfusion (*n*) | 0 | 0 | not tested |
| Increase in serum creatinine concentration >20% of baseline (*n*) | 3 | 2 | 0.57 |
| Supraventricular arrhythmia (*n*) | 2 | 2 | 0.63 |
| Hypotension (*n*) | 36 | 28 | 0.44 |
| Sedation requiring therapy (*n*) | 2 | 2 | 0.63 |

| | | | |
|---|---|---|---|
| Pulmonary infection (*n*) | 10 | 11 | 0.39 |
| Body temperature >38°C (*n*) | 13 | 12 | 0.52 |
| Ropivacaine/sufentanil solution at 72 h (ml) | 576 | ▪ | ▪ |
| Ropivacaine solution at 72 h (ml) | ▪ | 576 | ▪ |
| Total i.v. piritramide at 72 h [mean (sd)] | 52±39 | 60±47 | 0.36 |
| Postoperative nausea and/or vomiting (*n*) | 2 | 2 | 0.63 |
| Pruritus | 2 | 2 | 0.63 |
| Length of hospital stay (days) [mean (range)] | 8 (5–10) | 9 (5–12) | 0.39 |
| Intensive care readmission/death (*n*) | 2/0 | 2/0 | 0.63 |

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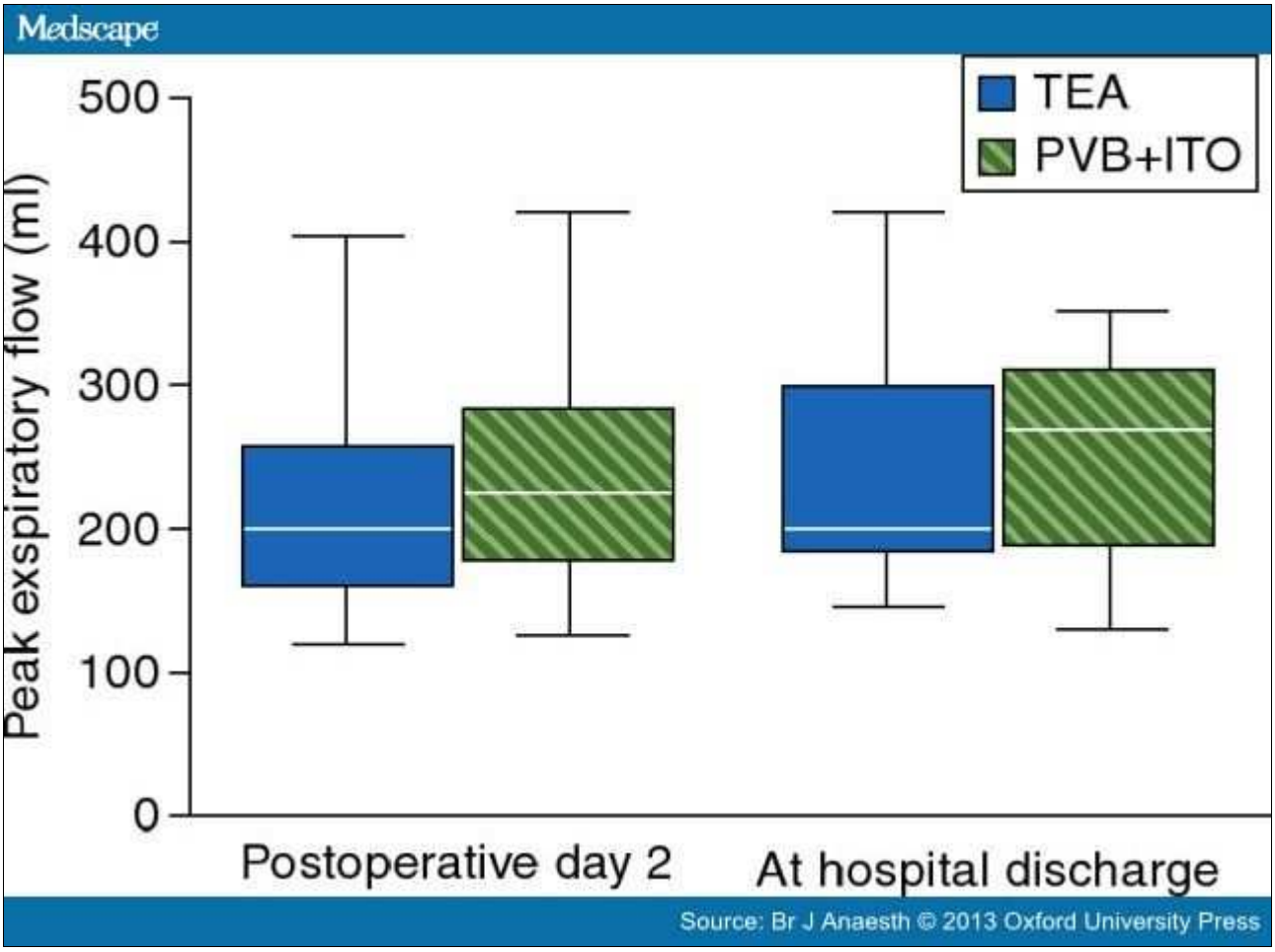


**Figure 4.**

Peak expiratory flow. TEA, thoracic epidural analgesia; PVB+ITO, thoracic paravertebral blockade and intrathecal opioid. Boxplots show median, 25/75th, and 5/95th percentiles.

## Discussion

This prospective randomized clinical study compares TEA with the combination of PVB and ITO for postoperative pain control in patients undergoing open lung resection. The main findings can be summarized as follows: (i) TEA provided statistically better acute postoperative pain relief than a combination of PVB and ITO administration at rest and during coughing/movement; (ii) the differences between the groups in the mean and maximal VAS scores varied by maximally 1.3; (iii) in the PVB+ITO group, the mean VAS scores never exceeded 3.5; and (iv) secondary outcome measures did not differ between the groups. As TEA provided statistically better pain relief than the combination of PVB and in ITO, these findings do not entirely support our hypothesis that both methods would provide comparable pain relief. However, the differences in VAS scores at rest and during coughing/movement were small, not observed at all observation points, and of questionable clinical relevance. Furthermore, the statistically higher pain scores in the PVB+ITO group were not associated with worse postoperative outcome (e.g. pulmonary function, morbidity, length of intermediate care unit and hospital stay). Our findings thus indicate that the combination of thoracic PVB and IT administration of opioids is an acceptable alternative to TEA for post-thoracotomy pain relief. This is of special clinical relevance whenever TEA is not an option.

For two main reasons, good post-thoracotomy pain relief is essential for postoperative recovery. First, uncontrolled pain is one of the major risk factors for the quite common post-thoracotomy syndrome which is associated with a significant decrease in quality of life and need for chronic pain medication.[1,4,21] With the exception of limb amputation, thoracotomy is associated with the highest incidence of chronic pain syndrome (up to 50%).[4] Intercostal nerve injury (by incision, rib retraction, sutures) and pleural irritation (e.g. by chest tube placement) promote pain transmission to the central nervous system causing a pain memory. Effective block of neural afferents reduces acute post-thoracotomy pain and may thereby blunt the development of pain consciousness.

Secondly, patient satisfaction and successful surgical 'fast-tracking' largely depend on good post-thoracotomy pain relief. Preferably, good pain relief is achieved with as little as possible systemic administration of opioids because this will improve patient satisfaction and fast-tracking by reducing the debilitating opioid-related side-effects (e.g. nausea and vomiting, sedation), thereby facilitating early mobilization and oral nutrition, effective physiotherapy, and early discharge.[5] This is the rationale for using regional anaesthetic techniques and IT administration of opioids.

Until recently, TEA has been considered the gold standard and method of choice for post-thoracotomy pain relief.[7,22] The role of thoracic paravertebral block in this context has not been as clear.[13,23] A meta-analysis of 10 randomized, non-blinded trials including 520 thoracic surgical patients compared PVB and TEA.[12] There were considerable differences between studies in the use of drugs for TEA and PVB, the technique of PVB, type of additional postoperative analgesia, and study endpoints. In the TEA groups, opioids were infused together with local anaesthetics via epidural catheter in four of the 10 included studies (including 254 patients), but in the PVB groups only one of them (including 50 patients).[12] This should have favoured pain outcome in the TEA group because the combination of local anaesthetic and opioid provides superior analgesia compared with the use of local anaesthetic alone.[24,25] However, the meta-analysis did not find a significant difference in postoperative pain scores between the PVB and the TEA groups.[12] Furthermore, PVB was associated with a lower failure rate, less pulmonary complications, and other side-effects (e.g. urinary retention, nausea and vomiting, and hypotension).[12,13] Because of the better side-effect profile, the authors recommended PVB for pain relief after major thoracic surgery.[12]

In contrast to all studies included in the meta-analysis, we did not compare TEA with PVB alone but with PVB plus IT administration of opioids. This was to compensate for the administration of local anaesthetic and opioid in the TEA group. As IT administration of opioids (i.e. morphine and/or sufentanil) provided pain relief after thoracic surgery,[14–16] it is thus likely that the additional IT administration of opioids resulted in pain relief in our PVB+ITO group comparable with that in the TEA group.

Over-sedation and respiratory depression requiring treatment is a possible complication of epidural and IT administration of opioids.[26] This occurred in two patients (~5%) of each group. This finding indicates that patients managed as described require postoperative monitoring of sedation and respiration. We ensured that the investigators assessing pain and sedation were unaware of group assignment.

Our study has several limitations. First, the study was underpowered to evaluate the secondary outcomes of respiratory function, pulmonary complications, nausea and vomiting, degree of sedation, hypotension, and pruritus. Secondly, gas diffusion was not investigated which limits the interpretation of the spirometric results. Thirdly, we do not know the failure rate of the TEA and PVB because we did not assess the level of sensory block in either study group after placement of the respective catheters before inducing general anaesthesia. The failure rate of mostly (~95%) non-catheter-induced, single-shot, nerve stimulator-guided PVB in adults for thoracic, abdominal, and orthopaedic surgery has been reported as 6.1%.[27] Based on the anatomy of the paravertebral space, it is conceivable that a continuous infusion of a combination of local anaesthetic and opioid via a paravertebral catheter reduces the failure rate.[11] It might be argued that the combination of a central block (i.e. PVB) and IT injection of opioids carries a higher risk of injury than TEA alone. Complications after PVB (accidental vascular puncture, pneumothorax, nerve damage, and Horner syndrome) vary between 0.5% and 6.8%,[13,27,28] and those after IT injection of opioids (nausea, vomitus, respiratory depression) between 0.8% and 6.7%.[16,29] This compares favourably with the rate of complications of 0.004% and 5.3% after TEA.[13,30]

In conclusion, in this prospective randomized clinical trial, TEA provided statistically better acute pain relief after open thoracotomy than a combination of PVB and ITO administration. However, as the differences in VAS scores between the groups were small and of questionable clinical relevance, our findings indicate that combined PVB and ITO is a satisfactory alternative for post-thoracotomy pain relief.

## Sidebar

**Editor's Key Points**

- This study compared thoracic epidural analgesia (TEA) and a combined thoracic paravertebral block (PVB) and intrathecal opioid (ITO) administration for post-thoracotomy pain relief.
- Only small difference in the quality of pain relief was found between both therapies.

- Combined PVB and ITO might be an accurate alternative to TEA.

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