An alternative method of wound pain control following hepatic resection: a preliminary study

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Background

Epidural analgesia is considered one of the optimal methods for provision of postoperative pain relief in patients recovering from major upper abdominal operations. Concerns regarding the potential risk of neurological complications prompted an evaluation of an alternative strategy using a continuous intermuscular bupivacaine (CIB) infusion combined with patient-controlled analgesia (PCA).

Methods

Two fine-bore catheters are inserted in the deep intermuscular intercostal neuronal plane during abdominal wound closure, and a continuous infusion of bupivacaine 0.25% is commenced for 72 h postoperatively. Simultaneously, patient-controlled analgesia provided intravenous morphine on demand. The study comprised 10 consecutive patients undergoing liver resection in whom CIB infusion and PCA were employed. The feasibility, safety and efficacy of the technique were investigated, analysing postoperative pain scores, morphine requirements, spirometry and oxygen saturation.

Results

There were no postoperative deaths. Postoperative morbidity included one urinary tract infection, one minor chest infection and acute confusional episodes in two patients. Median pain scores and morphine requirements at 12, 24, 48 and 72 h postoperatively were satisfactory. Spirometry and oxygen saturation values also remained within the normal range.

Discussion

Preliminary experience with CIB infusion/PCA in the aftermath of major liver resection has demonstrated its simplicity and safety as an alternative method of postoperative pain control. Further study is required to investigate the role of CIB infusion/PCA as a practical alternative to epidural analgesia or PCA alone.

Keywords

analgesia, intermuscular bupivacaine, hepatic resection

Introduction

Epidural analgesia is one of the best methods for the provision of postoperative pain relief in patients recovering from major upper abdominal operations [1–5]. Liver resections usually entail relatively large incisions and prolonged operation times, and routine epidural analgesia has been established as 'best practice' in the authors' unit for some 15 years. However, there have been studies questioning its efficacy [6]. Being an invasive technique, epidural analgesia also carries an inherent risk of several complications [2, 4]: hypotension, bradycardia, immediate or delayed respiratory depression, urinary retention, dural puncture and, perhaps of most concern, haematoma and/or infection within the spinal canal [3, 7]. Major neurological damage, causing both sensory deficits (incidence 0–0.7%) and motor deficits (incidence 0.005–0.02%), is a rare but potentially catastrophic

complication [8, 9]. Epidural analgesia may therefore be regarded as unacceptable by some patients and is contraindicated in others, particularly those who are anticoagulated. Furthermore, technical difficulty sometimes precludes the technique [7]. These concerns prompted us to evaluate an alternative method of postoperative pain relief for patients undergoing elective major liver surgery.

Abdominal wall incisions, rather than visceral factors, are the main source of postoperative pain [10], and infusion of the wound with local anaesthetic agents has been reported as a logical, simple, safe and effective method of analgesia [11–14]. CIB infusion plus PCA has been investigated as an alternative to routine epidural analgesia in patients undergoing major hepatic resection. This study describes the technique and provides a preliminary report of its safety and efficacy.

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Methods

Incision and closure

Operative access for hepatic resection is achieved by a right subcostal incision extended to the bed of the right 12th rib laterally and through the upper midline to the level of the xiphoid superiorly ('L' incision) [15]. This has been the senior author's preferred approach for the past 15 years instead of bilateral subcostal incision, which would require bilateral intercostal nerve blocks with larger volumes of bupivacaine and the associated possibility of systemic toxicity and phrenic nerve palsy [16, 17]. A standardised two-layer wound closure technique utilised monofilament synthetic suture material (0 looped Ethilon, Ethicon, Edinburgh, UK), which was closed loosely to achieve a suture-to-wound length ratio of approximately six. Thus, the mean measured wound length was 27 cm, the mean suture length used to close the deep layer was 156 cm and the resultant suture/wound length ratio was 5.8.

Catheter placement

During initial closure of the deep wound layer (transversus abdominis, internal oblique and the posterior rectus sheath), a Tuohy needle (Tuohy Maersk Medical Ltd, Redditch, UK) is inserted into the upper abdominal wall, perpendicular to the plane of incision, permitting the introduction of a 16G plastic catheter with three side-holes (Portex epidural catheter, SIMS Portex Ltd, UK). The plastic cannula is positioned within the intermuscular plane between internal oblique and transversus abdominis, in line with the T7–T11 intercostal nerve supply to the abdominal wall. Similarly, a second 16G plastic cannula is introduced deep to rectus abdominis within the rectus sheath some 8–10 cm medial to the first catheter. When the incision lies close to the costal margin, the tips of one or both catheters may lie deep to the ribs and superficial to the right parietal pleura. Having completed the initial deeper suture line, the free ends of the catheters are brought out inferiorly through two separate tunnels in the lower abdominal wall, again using the Tuohy needle. Disposable 0.22-µm bacterial filter units are connected to the catheters (Millex-GS, Carringtwohill, Co. Cork, Eire).

Delivery of analgesic drugs

Following closure of the second (superficial) musculo-aponeurotic layer (i.e. external oblique and anterior rectus sheath) and 'mass' suture of the upper midline incision, skin edge apposition is achieved with a subcuticular non-absorbable suture (2/0 Prolene, Ethicon), using closed suction drainage of the subcutaneous space. It is our routine practice to drain any excess body fluid in the subcutaneous space for the first three postoperative days. The wound infection recorded for 850 liver resections for the unit is only 0.8%. The intermuscular catheters are each flushed with a 10-ml bolus of 0.25% bupivacaine immediately after wound closure, and the CIB infusions of 0.25% bupivacaine are commenced at a rate of 3 ml/h by syringe pump for 72 h into the postoperative period.

An intravenous morphine infusion (50 mg morphine in 50 ml of 0.9% normal saline) is delivered by syringe pump on patient demand according to the PCA protocol (1 mg morphine bolus with 5-min lockout time delivering a maximum 12-mg hourly morphine dose).

Clinical material

Ten consecutive patients undergoing major liver resection for colorectal metastases were managed in this way with CIB infusion and PCA. There were five men and five women with a median age of 62 (38–82) years. There were two non-smokers and eight smokers, seven of whom had stopped smoking 6 weeks preoperatively. Median body mass index was 21 (17–25). Both a 5-point verbal rating pain score (VRS: 0, no pain; 1, mild pain; 2, moderate pain; 3, severe pain; 4, very severe pain) and a visual analogue score (VAS: 0–10 cm scale) were used to quantify the severity of postoperative pain. The methods were explained to the patients preoperatively, and pain scores were recorded at 12, 24, 48 and 72 h postoperatively. Studies have shown verbal rating pain score (VRS) and visual analogue score (VAS) to be complementary to each other. In our experience, patients had difficulty translating sensory experience (pain) into a linear format for VAS, as reported previously [18], and this particular measurement had to be abandoned after the first three patients.

Oxygen saturations on air were measured by pulse oximetry, and pulmonary function parameters (FEV1 and FVC) were recorded preoperatively and at 24, 48 and 72 h postoperatively. The total morphine usage within the 72-h postoperative period was recorded. All data, including clinical outcomes, were recorded prospectively on dedicated proforma sheets. Informed consent was obtained in each case.

Table 1. *Postoperative verbal rating pain scores and morphine requirements in 10 patients managed with CIB infusion/PCA after hepatic resection*

	12 h (0–12)	24 h (12–24)	48 h (24–48)	72 h (48–72)
Rest	0 (0–3)	1 (0–3)	0 (0–3)	0 (0–3)
Movement	3 (0–3)	2 (1–4)	2 (1–3)	2 (0–4)
Cough	2 (1–4)	2 (1–4)	2 (1–4)	1 (0–3)
Morphine usage (mg)	14 (2–45)	29 (6–127)	24 (5–62)	4 (1–13)

Values are median (range). CIB, continuous intermuscular bupivacaine; PCA, patient-controlled analgesia.

Results

Five patients required overnight admission to a critical care bed, two patients stayed there for 2 days and three returned to the surgical ward from the recovery bay following their operation.

Median postoperative verbal rating pain scores are shown in Table 1 and appear to indicate satisfactory pain relief. Morphine usage was seen to peak on postoperative day 1, declining to minimal levels by day 3 (Table 1). Two patients suffered from brief acute confusional episodes from which they made complete recovery. Two patients suffered from minor infection, one urinary and the other respiratory. There was no postoperative death.

The perioperative lung function parameters (FEV1/FVC ratio) shown in Table 2 demonstrate no clinically relevant deterioration in patients managed with CIB infusion/PCA in the postoperative period, although the expected modest decline from baseline measurements (80.2) through to day 3 (87.7) was evident. No episodes of oxygen desaturation were observed by pulse oximetry with the patient breathing room air. The median SaO_2 value recorded at 24, 48 and 72 h was 96% on all three occasions. Median hospital stay for these patients was 8 (7–15) days.

Discussion

Since Capelle's seminal description in 1935 of direct infiltration of the surgical wound with local anaesthetic agents [19], the technique has acquired universal acceptance, in conjunction with the development of the long-acting local anaesthetic bupivacaine hydrochloride [20]. Numerous studies have testified to the benefits of local anaesthetic wound infiltration [11–14], although not all studies have demonstrated clear benefit [21]. This variability in reported results may reflect differences in the techniques of infiltration.

It is well recognised that inadequate postoperative pain control in patients with major upper abdominal incisions is associated with an increased incidence and severity of cardio-respiratory complications [22–24]. Adequate operative access for hepatic resection usually requires a relatively large and extended subcostal incision with fixed retraction of the costal margin for prolonged periods of time. Although epidural analgesia has become established as 'best practice' in the management of such patients, the technique of CIB infusion plus an intravenous morphine PCA system was devised as a practical alternative, to address concerns regarding potential

Table 2. *Perioperative lung function tests (FEV1/FVC ratio) in 10 patients managed with CIB infusion/PCA after hepatic resection*

Patient no.	FEV1/FVC ratio			
	Preoperative	24 h	48 h	72 h
1	80.4	39.0	82.8	87.5
2	61.2	73.7	75.0	79.8
3	80.1	92.6	90.0	90.7
4	64.9	66.9	68.9	71.6
5	83.1	88.4	84.0	88.6
6	82.8	94.8	83.5	86.6
7	46.3	88.9	87.5	87.8
8	71.7	76.1	80.8	82.1
9	90.3	91.7	93.7	90.4
10	95.5	68.0	76.0	96.1
Median	80.2	82.3	83.2	87.7

CIB, continuous intermuscular bupivacaine; PCA, patient-controlled analgesia.

morbidity or technical failure inherent in the technique of epidural analgesia. Continuous wound perfusion with bupivacaine has been well described for other abdominal and thoracotomy procedures. To our knowledge, this particular technique of intermuscular CIB infusion along the neurovascular plane described herein has not been reported and is ideally suited to liver surgery.

The satisfactory results of this preliminary clinical study in terms of morbidity, pain scores, lung function tests and oxygen saturation compare favourably with previously reported results [25]. We acknowledge the small size of this study group, and further evaluation of this technique in direct comparison with epidural analgesia and patient-controlled analgesia in a larger group is under way. In the meantime, we recommend CIB infusion as a simple, safe and effective alternative, particularly when epidural analgesia is not possible or is contraindicated.

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