SHORT REPORT

Delivery of local anaesthetic via a sternal catheter to reduce the pain caused by sternal fractures: first case series using the new technique

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Sternal fractures cause considerable pain, and a proportion of patients require admission for analgesia. Local anaesthetic techniques have been used to reduce the pain from chest wall injuries and may reduce complications from these injuries. The use of a local anaesthetic delivered via a sternal catheter over a fractured sternum has been described in a patient whose pain was inadequately controlled with opiates. This technique was recently offered to patients in the emergency department at the Royal Devon and Exeter Hospital, Exeter, UK, and the experiences of patients and doctors are reported. Findings from this first case series suggest that the technique seems to be effective, well tolerated and acceptable to patients.

Sternal fractures are painful injuries,¹ most commonly resulting from road traffic accidents.² Their incidence has increased since seat belt legislation was introduced,³ and presentations may further increase in a growing population of elderly but active people.

Many patients are seen in the emergency department and can be safely discharged with simple analgesia, but a proportion of patients require admission for analgesia or observation.⁴ Control of pain is important for adequate ventilation, effective cough and chest physiotherapy, and for patient comfort. Regional local anaesthetic techniques, such as epidural anaesthesia and intercostal nerve blocks used in the management of chest wall injuries, improve ventilation⁵ and may reduce the risk of pneumonia.⁶

Direct local anaesthetic infiltration is well recognised as a means to control pain from fractures. "Haematoma blocks" have been used effectively for wrist fractures for many years, with very few complications,⁷ and indwelling "epidural" catheters have been used to deliver bupivacaine over iatrogenic (eg, iliac crest bone harvest) fractures⁸ and sternotomy wounds,⁹ with good effect. A similar technique was recently described in a patient with a sternal fracture whose pain could not be adequately controlled with opiates.^{10 11} This technique has been used in the Department of Emergency Medicine, Royal Devon and Exeter Hospital, Exeter, Devon, UK, which sees approximately 30 new patients with sternal fractures every year. We report the first 10 patients in our department in whom a sternal catheter was used, and the patients' experience and satisfaction with this new method for analgesia.

METHOD

The technique

The technique as previously described by Duncan *et al*¹¹ makes use of a standard epidural catheter set (fig 1; 16G Epidural minipack, System 1, Portex, Smith-Medical, Hythe,

Kent, UK) to introduce a catheter over the sternal fracture site. After skin preparation, the overlying skin is anaesthetised with a few millilitres of lignocaine. Under strict aseptic conditions, the Tuoy needle is introduced at 45° to the skin, 2–3 cm below the level of the fracture, and advanced gently until it reaches the periosteum of the sternum. The catheter is then fed via the Tuoy needle to lie across the fracture site, aiming to advance the catheter 5–6 cm from the tip of the needle (15 cm mark at the needle hub) before securing it in place.

Vascular cannulae can be used,¹⁰ but the epidural catheter has the advantage of multiple perforations to spread the anaesthetic over the fracture site, an antimicrobial filter and a means to tunnel the catheter laterally to take the entry site of the line away from the fracture.

After aspiration to exclude intravenous placement, 10–20 ml 0.5% levobupivacaine (1–2 mg/kg maximum dose) is injected via an antimicrobial filter in the emergency department before admission and 10 ml 0.5% levobupivacaine every 4–6 h on the ward thereafter. A protocol for insertion and use of the sternal catheter is in use.

Patients and follow-up

Patients admitted to the emergency department with acute sternal fractures, in whom pain at the fracture site was not adequately controlled with initial intravenous morphine boluses and simple oral analgesics, were offered sternal catheters. All catheter insertions were carried out in the emergency department by emergency physicians or a consultant anaesthetist (PAMI), as described above. Patients otherwise received routine ward care, including regular paracetamol and non-steroidal anti-inflammatory drugs (if tolerant) and parenteral opiate analgesics as required.

Patients were followed up on the ward by members of the pain team, and after discharge by means of a postal patient satisfaction questionnaire after ethical approval and patient consent. Hospital notes of all patients were reviewed to assess efficacy and to check for any complications.

RESULTS

Review of notes

Notes were available for all patients and table 1 shows the details. Ten patients were recruited over 1 year and were aged 21–88 (mean 52.6) years. People who wore seat belts in motor vehicle accidents accounted for 60% of the cases; six patients had isolated sternal fractures, for whom control of pain was the main reason for admission. Mean (range) duration of admission and catheter placement was 8 (3–16) and 5.3 (2–8) days, respectively. Pain scores recorded in the trauma chart showed a mean initial pain score of 8.5 (6–10), which reduced to 2.9 (1–5) after initial analgesia, sternal catheter insertion and an initial bolus injection of levobupivacaine. In many cases, the nursing, pain team and

Figure 1 A standard epidural pack containing Tuoy needle, 16G catheter and an antimicrobial filter (16G Epidural minipack, Portex).

physiotherapy notes gave supporting evidence for the efficacy of subsequent boluses of levobupivacaine allowing effective physiotherapy and cough; however, formal pain scores were not routinely recorded outside the emergency department.

Only two of the six patients with isolated sternal fractures required further intravenous morphine, although morphine was required in three of the four patients with other injuries.

No episodes of infection at catheter site, local anaesthetic toxicity or other major complications from the sternal catheters were recorded.

Questionnaire

A postal questionnaire (available on request) was sent out to all 10 patients after their discharge. The response rate was 100%, although one patient (number 4) had dementia and was unable to recall having a catheter or being admitted to hospital.

Of the remaining nine cases, 8 patients (89%) reported that the sternal catheter had given good or excellent pain relief, despite finding their fracture initially very painful (fig 2); 7

Figure 2 What pain relief did the injections of local anaesthetic give you?

Figure 3 Did the local anaesthetic injection help you move and cough more easily?

patients (78%) reported being able to breathe and move more easily after the injections of local anaesthetic (fig 3); and most patients (67%) found this to be better than all other forms they were given for analgesia.

One patient found insertion and removal of the catheter painful. Another patient recalled transient tingling at the fracture site, but no other problems were reported. All but one patient (who was indifferent) were satisfied or very satisfied with this form for analgesia, and several very positive comments were received (fig 4).

Table 1 Details of patients who received a sternal catheter

Patient number	Age	Sex	Mechanism of injury	Isolated injury	ED analgesia	ED VAS pain score (where recorded)	Pain score after sternal catheter	Ward parenteral morphine (mg/day of admission)	Duration (days) of admission (sternal catheter)	Complications/ comments recorded in hospital notes
1	54	Female	RTA (seat belt)	Yes	Not given	NR	NR	None	6 (5)	Enabled effective physiotherapy
2	53	Female	RTA (seat belt)	Yes	M, P, D	10	4	2.2	9 (8)	Catheter fell out and was replaced
3	30	Male	RTA (motorcycle)	No	M, C, D	8	2	19.8	9 (5)	Later required PCA for other injuries
4	88	Female	Fall	Yes	M, C, D	9	1	None	16 (6)	Dementia
5	21	Female	RTA (seat belt)	Yes	M	8	3	1.6	6 (6)	Good response
6	76	Female	RTA (seat belt)	No	M, C	NR	NR	None	10 (8)	Able to cough and deep breathe after inserting catheter
7	78	Female	RTA (seat belt)	Yes	M, P, D	8	NR	None	6 (4)	Indifferent
8	45	Female	RTA (seat belt)	No	M, P	10	5	62.5*	8 (6)	Painful at removal
9	58	Male	Fall	Yes	M, P, D	6	3	None	3 (2)	Enabled effective physiotherapy, pain VAS 0/10 by day 3
10	23	Male	RTA (motorcycle)	No	M, D	9	2	14	7 (6)	Also offered PCA but preferred sternal catheter

C, codylamol; D, diclofenac; ED, emergency department; M, morphine; NR, not recorded; P, paracetamol; PCA, patient-controlled analgesia; RTA, road traffic accident; VAS, visual analogue scale.

*Fentanyl (µg/day).

Figure 4 Level of patient satisfaction and comments. Comments included "helped me rest at night", "better than morphine which made me feel sick", "I was grateful for the 'top ups'" and "without doubt the best form of pain relief that I received".

DISCUSSION

Initial pain scores recorded in hospital and in subsequent questionnaire responses confirm that sternal fractures were painful injuries in this group of patients. However, most patients reported that the use of levobupivacaine via a sternal catheter gave effective pain relief that allowed them to cough and move more easily. This effect was reported despite the initial use of parenteral opiate and, furthermore, more than two thirds of the patients thought that levobupivacaine was superior to other forms of analgesics (including morphine). Although retrospective patient opinions are open to recall and expectation bias, follow-up of ward notes further supports the analgesic efficacy of this technique. However, the extent to which other analgesics contributed to the reduction in recorded pain scores cannot be determined in this non-trial setting.

Although no major adverse events were recorded in this small case series, the infiltration of local anaesthetic via an indwelling catheter over a fracture site has several potential risks. The introduction of infection is a feared complication, and strict asepsis must be adhered to. As with all local anesthetic procedures, the risk of toxicity must also be considered, and the expertise and equipment made available to recognise and treat it.

Despite these potential limitations, the technique seemed to be quick, effective, easy to learn and satisfactory to most patients. Its use in patients whose pain is difficult to control may reduce the risks associated with high-dose intravenous opiate use. Sternal fractures are more common in frail elderly patients.¹² These patients are particularly at risk of respiratory compromise from both chest wall injuries and opiate analgesics, and so may benefit most from this technique of administering a local anaesthetic. The presence of other

injuries requiring opiate analgesics would, however, reduce this potential benefit.

Large, well-designed trials would be required to adequately assess the efficacy and safety of this technique. However, recruiting sufficient numbers of patients in formal studies will be difficult in a single centre as most patients with uncomplicated, isolated sternal fractures can be managed conservatively, without admission to hospital.

CONCLUSION

For patients with sternal fractures whose pain cannot be adequately controlled with routine analgesics, our experience with these first 10 patients suggests that this novel technique of local anaesthetic infiltration seems to be effective, satisfactory to patients and a potential alternative to frequent opiate analgesics, and is worthy of further research.

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REFERENCES

- 1 **De Oliveira M**, Hassan TB, Sebewufu R, *et al*. Long-term morbidity in patients suffering a sternal fracture following discharge from the A and E department. *Injury* 1998;**29**:609–12.
- 2 **Hills MW**, Delprado AM, Deane SA. Sternal fractures: associated injuries and management. *J Trauma* 1993;**35**:55–60.
- 3 **Budd JS**. Effect of seat belt legislation on the incidence of sternal fractures seen in the accident department. *BMJ (Clin Res Ed)* 1985;**291**:785.
- 4 **Velissaris T**, Tang ATM, Patel A, *et al*. Traumatic sternal fracture: outcome following admission to a thoracic surgical unit. *Injury* 2003;**34**:924–7.
- 5 **Osinowo OA**, Zaharani M, Softah A. Effect of intercostals nerve block with 0.5% bupivacaine on peak expiratory flow rate and arterial oxygen saturation in rib fractures. *J Trauma* 2004;**56**:345–7.
- 6 **Wisner David H**. A stepwise logistic regression analysis of factors affecting morbidity and mortality after thoracic trauma: effect of epidural analgesia. *J Trauma Injury Infect Crit Care* 1990;**30**:799–805.
- 7 **Basu A**, Bhalai V, Stanislas IA, *et al*. Osteomyelitis following haematoma block. *Injury* 2003;**34**:79–82.
- 8 **Puri R**, Moskovich R, Gusmorino P, *et al*. Bupivacaine for postoperative pain relief at the iliac crest bone graft harvest site. *Am J Orthop* 2000;**29**:443.
- 9 **Dowling R**, Thielmeier K, Ghaly A, *et al*. Improved pain control after cardiac surgery: results of a randomized, double-blind, clinical trial. *J Thorac Cardiovasc Surg* 2003;**126**:1271–8.
- 10 **Inweregbu K**, Blackburn A. Management of sternal fracture pain using bupivacaine via a subcutaneous cannula. *Acute Pain* 2000;**3**:44–5.
- 11 **Duncan MA**, McNicholas W, O'Keefe D, *et al*. Periosteal infusion of bupivacaine/morphine post sternal fracture: a new analgesic technique. *Reg Anesth Pain Med* 2002;**27**:316–18.
- 12 **Brookes JG**, Dunn RJ, Rogers IR. Sternal fractures: a retrospective analysis of 272 cases. *J Trauma* 1993;**35**:46–54.