CONTINUOUS PAIN RELIEF FOR MULTIPLE FRACTURED RIBS

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SUMMARY
A technique for multiple intercostal nerve blocks using one intercostal injection is described. An indwelling catheter was placed in the intercostal space with the aid of a Tuohy needle. Injection through the catheter was used to obtain continuous analgesia extending over several intercostal segments in a patient with multiple fractured ribs.

Patients with fractured ribs admitted to an intensive care unit are in two categories: (a) multiple fractures with a flail segment; (b) one or more fractures but without a flail segment.

One of the latter group is described in this report. Usually these patients are treated in a general ward and are admitted to the intensive care unit when pain prevents coughing, deep breathing and bronchial toilette, causing atelectasis and pulmonary shunting of blood (Bendixen, Hedley-Whyte and Laver, 1963). Our method was prompted by the anatomical study of Nunn and Slavin (1980) which clearly demonstrated that there is relatively little resistance to flow of liquid upwards or downwards behind the parietal pleura once the posterior intercostal membrane is pierced. We have used a single injection of bupivacaine as a method of providing analgesia for a patient with fractured ribs but with a stable thoracic cage. The extent of pain relief achieved with bupivacaine injected at one interspace and the spread of the radio-opaque liquid injected subsequently further verifies their findings clinically.

CASE REPORT
A 67-yr-old man fell 2 m onto a wall and sustained fractures of the 6th, 7th, 8th, 9th and 10th left ribs and developed a left pneumothorax. He had a long history of moderate chronic obstructive airways disease and was a heavy smoker. He was admitted to a general ward where a chest drain was inserted and connected to an underwater seal. The pneumothorax lessened and x-ray on the evening of the first day revealed complete expansion of his lung. Pethidine 50 mg was given i.m. 4-hourly. His ability to tolerate breathing exercises, expectorate or even talk was severely impaired. During the following 48 h the patient's condition deteriorated with increasing dyspnoea, central cyanosis, agitation and mild confusion. $P_{aO_2}$ was 6.1 kPa when breathing air and a chest x-ray showed an expanded left lung with diffuse infiltration at the left base.

The patient was transferred to the intensive care unit. E.g., pulse and arterial pressure were monitored and remained relatively stable. The following procedure was then adopted: The patient sat upright with his legs over the edge of the bed in a comfortable position. Under aseptic conditions the skin was infiltrated with a local anaesthetic agent in the region of the angle of the 5th rib. A 19-gauge needle was advanced through the skin until the 5th rib was located. The needle was then "walked" to the lower edge of the ribs and advanced about 3 mm through the posterior intercostal membrane into the fifth intercostal space. Plain 0.5% bupivacaine 20 ml was injected and the needle withdrawn. The patient remained seated for a further 10 min and noticed marked pain relief. He was placed in a semi-recumbent position for a further 15 min when analgesia was complete from the 4th to the 9th segments, judged by pinprick and "springing" of fractured ribs. Increased skin warmth over the analgesic area was also noted. This single injection gave total pain relief for 8 h. During this period the patient was able to breathe deeply, talk more easily, became less confused and expectorated copious amounts of green sputum. $P_{aO_2}$ increased to 11.8 kPa (breathing 40% oxygen), allowing a reduction of $F_{IO_2}$ to 0.30.

Then we inserted an indwelling catheter to enable administration of continuous regional analgesia. The patient was positioned and prepared as...
described and a Tuohy needle was introduced into the fifth intercostal space and 0.5% plain bupivacaine 10 ml was injected. A catheter was introduced through the needle with the bevel pointed medially and 2 cm introduced to the space. It was then left in situ and the needle withdrawn. The catheter was secured in place and a further 10 ml of 0.5% bupivacaine was injected after negative aspiration for blood. This provided excellent analgesia over the 4th to the 10th segments. To confirm the spread of bupivacaine we injected radio-opaque fluid through the cannula after first ensuring adequate analgesia. Meglumine lothalamate 10 ml was injected and an oblique x-ray taken after 15 min (fig. 1). The dye can be seen to spread over five spaces. A quantity of dye can be seen in the paravertebral space, indicating horizontal and vertical spread.

During the next 4 days, the patient’s condition improved markedly, \( \text{PaO}_2 \), remaining within the range 9.5–10.5 kPa with \( \text{FiO}_2 \) of 0.30, and his ability to co-operate with the physiotherapist resulted in expectoration of large quantities of sputum. He did not require systemic analgesics during this period. The interval between injections was approximately 7–8 h and we continued to use 0.5% plain bupivacaine. On the 4th day we reduced the concentration to 0.25% plain, but continued to use the same volume (20 ml). The chest drain was removed after the 4th day and the intercostal cannula after the 6th day. On the 5th and 6th days the patient maintained \( \text{PaO}_2 \), between 9.3 and 9.8 kPa, breathing air. The patient was discharged to the ward on the 7th day and left hospital a few days later.

**DISCUSSION**

Pain related to respiratory movement is the principal problem in the patient with fractured ribs. This pain causes a reduction in respiratory excursion and thus increasing mismatch of ventilation and perfusion (Georg, Hornum and Mellemgaard, 1967) resulting in a decrease in arterial oxygen tension. The decrease in \( \text{PaO}_2 \) in our patient was sufficient to cause symptoms of mild cerebral hypoxia. The limitation of respiratory excursion limits expectoration particularly in a heavy smoker with chronic obstructive airways disease and causes atelectasis and shunting. Our method of alleviating the pain was simple to perform and very acceptable to the patient. Multiple intercostal blocks cause discomfort to the patient and are time-consuming for the anaesthetist (Engberg, 1975).

We believe that the increased warmth of the skin over the anaesthetized area was a result of blockade of the sympathetic ganglia and chain caused by medial spread as shown in figure 1. Our patient developed no complications, the arterial pressure remaining stable after each injection; the total dose of bupivacaine was within the acceptable range.

The frequency of accidental pneumothorax during intercostal block is very low (Cronin and Davies, 1976).

We are confident that the spread of bupivacaine and radio-opaque fluid was not facilitated by any disruption of thoracic anatomy as a result of the patient’s injury. The line of fractures corresponded roughly to the anterior axillary line and the site of our injection was at the angle of the rib—30 cm from the nearest fracture. It is unlikely that a
correspondingly large area of pleura was disrupted on the postero-lateral chest wall, thus facilitating spread of solution. Furthermore, it would not explain the medial and consequent paravertebral spread as seen on the x-ray. We believe that the anatomy in this area was normal.

Theoretically, spread of anaesthesia to adjacent segments could occur via the extradural route as a communication exists between the intercostal space and the extradural space via the intervertebral foramen (Atkinson, Rushman and Lee, 1977). However, the x-ray demonstrates more direct spread in our patient.

We believe this method to be of value after thoracotomy (Moore, 1975), cholecystectomy or upper abdominal surgery (Bartlett and Eastwood, 1952) and to merit further study.

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REFERENCES


