Management and treatment of patients with fractured ribs

RIB FRACTURES are among the most common injuries to the chest, accounting for more than half of the thoracic injuries sustained from non-penetrating trauma (Honick and Sinert, 2001; O’Kane et al, 1998). Ribs usually fracture at the point of impact or at the posterior angle where structurally they are weakest. Middle ribs 4 – 9 are more commonly fractured (Honick and Sinert, 2001). Rib fractures are less common in children because their ribs are more elastic and require considerable force to fracture.

There is potential for underlying organ injury when ribs are fractured. The position of the fracture within the thorax can be used to identify areas of possible damage (Fig 1). Fracture of the first or second ribs can result in injury to the lungs, ascending aorta, subclavian artery and brachial plexus. (These particular ribs are not commonly fractured because they are well protected and therefore more difficult to break.) Fracture of the lower ribs on the left can cause injury to the spleen and on the right to the liver. Fractures of the eleventh and twelfth ribs may be associated with renal injuries. Evaluation of respiratory parameters in patients who suffer significant chest trauma can be a useful predictor of injury severity and possible prognosis (Mullan, 1999).

Multiple fractures may interfere with normal movement of costovertebral and diaphragmatic muscles, causing ventilatory insufficiency. If two or more connected ribs are each fractured in more than one place, flail chest occurs. In this condition, part of the chest wall is able to move independently because of the negative intrapleural pressure generated on inspiration, which causes the isolated segment of chest wall to collapse inward, compromising ventilation (Mullan, 1999).

Table 1 lists the physical signs of fractured ribs.

### Diagnosis
Chest-ray (anteroposterior and lateral views) can assist with the diagnosis of rib fractures and underlying injuries such as pneumothorax (air in the pleural cavity), haemot-

### Table 1. Physical Signs of Fractured Ribs

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<th>Sign</th>
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<tr>
<td>Tenderness on palpation</td>
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<td>Chest wall deformity</td>
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<td>Paradoxical or abnormal chest wall movements (ie in flail chest, when the flail segment falls during inspiration while the rest of the chest rises)</td>
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<td>Signs of ventilatory insufficiency such as cyanosis or tachycardia</td>
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<td>Anxiety and distress.</td>
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Diagnosis

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### Treatment
The mainstay of treatment for rib fractures is to provide the patient with adequate analgesia coupled with meticulous respiratory care in order to prevent complications such as atelectasis and pneumonia (Easter, 2001).

Single rib fractures: Patients with isolated rib fracture without other associated injury may be treated as outpatients. Patients should be made aware that pain could last for up to eight weeks, therefore during this time adequate oral analgesia should be prescribed. A non-steroidal anti-inflammatory drug (NSAID) and a combination drug such as co-codamol (unless contraindicated) is normally prescribed. A physiotherapist should emphasise
to patients the importance of deep breathing and coughing to clear phlegm from the chest. To ease the pain of coughing, patients may support the rib area with their hands, a towel or a pillow. Any strenuous activities should be avoided for the first three to four weeks following the fracture, but after this, physical exercise can be undertaken as pain allows. No attempt should be made by a patient to participate in contact sports for six weeks so as to avoid the possibility of further damage.

Patients should be advised that if they develop fever, uncontrollable cough, abdominal pain, have increased difficulty breathing or cough up thick or discoloured sputum they should contact their doctor or a hospital urgently. Elderly patients with a single fracture or those with cardiopulmonary disease may require hospitalisation, as there is evidence of an increased risk of complications in these patient groups (Honick and Sinert, 2001).

**Multiple rib fractures:** Patients with multiple fractures will require admission to a trauma ward or a high dependency unit depending on the severity of the injury. Initial care will focus on multi-system evaluation and stabilisation, adequate pain relief and physiotherapy. In rare cases, surgical stabilisation is necessary using Kirschner wires (Solomon et al, 2001).

**Pain management**

Effective management of acute pain relies on accurate and appropriate assessment of the patient’s pain. The assessment should systematically record pain intensity on movement using a recognised tool that requires patient involvement.

Epidural analgesia is a particularly effective method of pain control as it provides an excellent level of pain relief with minimum sedation. It has also been shown to improve pulmonary function and reduce morbidity associated with multiple rib fractures (McCaffery and Pasero, 1999). Epidural analgesia involves the administration of agents into the epidural space. Giving a combination of a local anaesthetic, for example, bupivacaine, and an opioid, for example fentanyl, via an epidural catheter is synergistic, therefore achieving the desired analgesic effect while potentially reducing the possibility of unwanted side-effects. In some hospitals, patients receiving epidural analgesia are nursed only in high dependency units.

Patient-controlled analgesia is a useful alternative to the administration of epidural analgesia and allows parenteral administration of opioid analgesia (that is, morphine). It is a safe method of analgesic delivery, and has significant benefits over conventional methods such as intramuscular injections. It is adaptable, allowing titration of dose to reduce the risk of respiratory depression (Thomas, 1996). It also allows the patient to control the amount of analgesia required at any one time, for example, before having physiotherapy. Some patients, however, are unable to grasp the concept of patient-controlled analgesia, in which case an alternative method of analgesia will be required.

Intercostal nerve block can provide an excellent level of pain relief, allowing patients to cough and undergo physiotherapy with minimal discomfort. The drawback of this method is that the block would have to be given by an anaesthetic staff approximately every 12 hours.

In a study carried out by Wisner (cited by McCaffery and Pasero, 1999, p26) epidural, intravenous, intramuscular and intercostals blocks were compared as methods of delivering analgesia after thoracic trauma. The epidural route was found to be the most effective method of reducing pulmonary complications and reduced mortality was also found within the patient sample. Similar results were reported by Mackersic et al (cited by McCaffery and Pasero, 1999, p26).

A multi-modal approach is the most effective way of controlling pain, therefore whichever one of the above methods of analgesic administration is chosen, adjunctive medication should also be considered.

Paracetamol has beneficial effects, particularly when used in combination with other drugs – it enhances analgesia and has a morphine-sparing effect when given regularly in combination with patient-controlled analgesia. Research has demonstrated that adding a non-steroidal anti-inflammatory drug (NSAID) to this combination further enhances pain relief (Kehlet, 1997). NSAIDs such as diclofenac or ibuprofen inhibit the activity of cyclo-oxygenase (COX) and therefore prevent the production of inflammatory mediators or prostaglandins and the swelling associated with bone injury and surrounding tissue damage. However, caution must be employed because it is known that NSAIDs reduce osteoblast (bone-forming cell) activity. Discontinuation of the drug should therefore be considered if any signs of delayed bone union are noted during the recovery period.

NSAIDs are contraindicated in some patients, for example, those who have previously had gastrointestinal disturbances including ulceration, who have impaired renal function, impaired coagulation problems, liver damage or central nervous system disturbance (Jordan and White, 2001). The newer COX II inhibitors such as rofecoxib or celecoxib may be suitable alternatives for these patients.

**Physiotherapy**

Aggressive pain management techniques, such as epidural analgesia, need to be employed before patients have physiotherapy. The aim of physiotherapy for a patient with multiple fractured ribs is to minimise any compromise of the respiratory system. An initial assessment is carried out to obtain a set of baseline objective markers from which to develop a treatment programme; these include respiratory rate, oxygen saturation, breathing pattern, peak expiratory flow rate, arterial blood gases, and auscultation (listening to chest sounds). Treatment is carried out at a minimum of twice a day for the first three days and then on an ‘as required’ basis. At each session the patient is reassessed and the initial objective markers re-tested.
Prevention of complications

The main problem for patients with multiple fractures of the ribs is pain from the fracture. The consequence of this is reflex inhibition of movement of the affected part of the chest wall, resulting in poor ventilation of the lung. The consequence may be atelectasis, hypoxia (lower than normal levels of oxygen) and retention of secretions. Increased production of secretions as a result of chest trauma and suppression of the cough reflex combined with hypoventilation, increases the risk of the patient developing a chest infection and possible further complication of respiratory failure.

To minimise these problems, the patient (if conscious and compliant), is taught the active cycle breathing technique. This involves deep breathing thoracic expansion exercises, relaxed breathing and a forced expiratory technique. Postural drainage, supported cough and incentive spirometry may be initiated at the same time. (Incentive spirometry is a procedure that is used to increase transpulmonary pressure and inspiratory volumes, improve inspiratory muscle performance and re-establish or stimulate the normal pattern of pulmonary hyperinflation.) These techniques are particularly useful if the patient is unable to mobilise.

Bronchodilators and nebulised saline may be prescribed and given regularly to aid the expectoration of secretions and should be linked with physiotherapy. Oxygen should be humidified to prevent the drying of airways and secretions.

Some clinical areas use rib belts. These devices consist of a broad band of material with handles at either end that the patient places around his/her chest and holds firm to ‘splint’ the ribcage during coughing. Anecdotally, many patients report increased confidence in their ability to cough while using the belt and some find it also reduces their pain. The evidence to support this technique is inconclusive: Quick (1990) found a significant amount of additional pain relief without compromising respiratory function, whereas Lazcano et al (1989) reported no significant reduction in pain and an apparent increase in complications.

If a patient is unconscious or struggling to clear secretions independently, suction via a nasopharyngeal or oral airway can be carried out. If ventilation is required, Bolliger and Van Eeden (1990) suggest that continuous positive airway pressure with analgesia is preferable to endotracheal intubation and mechanical ventilation because it provides a shortened and more simplified treatment, and is associated with a reduced infection rate. As soon as possible the patient is encouraged to get up and mobilise.

Significant morbidity and mortality rates have been reported with rib fractures (Easter, 2001). Delayed morbidity is often associated with the following complications:

- Hypoventilation
- Hypocapnia
- Hypoxia
- Atelectasis
- Pneumonia.

There is a relationship between increased risk of complications and increasing age of the patient and also the higher number of ribs fractured (Honick and Sinert, 2001).

Conclusion

Rib fractures vary from being a minor injury that can be treated in outpatients, to a major injury that can have life-threatening consequences. Accurate diagnosis, adequate analgesia and effective physiotherapy are all essential components in the management of rib fractures if complications are to be avoided.