13.7.5 Orthopaedic surgery

Orthopaedic procedures are particularly painful procedures, and pain control is vital to allow for early mobilisation, prevent complications (DVT, PE, contractures and pressure sores) and decrease chronic pain syndromes. Opioids are usually prescribed, either orally or using PCA. NSAID therapy is efficacious in these patients, but needs to be used judiciously.

Orthopaedic patients often take NSAIDs chronically. Between 1% and 5% of these patients run the risk of postoperative GI bleeding. Therefore, a history of GI ulceration must be excluded. If NSAIDs are prescribed postoperatively, especially after major orthopaedic procedures, a PPI, misoprostol or ranitidine should also be prescribed.

If a patient is admitted to an HCU or the ICU postoperatively, a low-dose ketamine is morphine-sparing. Ketamine 0.12 mg/kg/h IVI is effective after hip arthroplasty. It facilitates rehabilitation and decreased pain for up to 6 months after surgery.

The intra-articular instillation of opioids, LAs and corticosteroids in joint surgery, day case arthroscopy and joint injury is controversial, and evidence is conflicting. There is evidence that supports intra-articular opioid instillation after some orthopaedic procedures.

Regional and neuraxial blocks are particularly useful in the early postoperative period. Routine postoperative prophylactic anticoagulation does not contraindicate epidural analgesia.

13.8 Acute burn injuries

Burn wounds are caused by thermal injury (flame, scalds, explosives or any hot material), cold injury (frostbite), electrical shock, chemicals or radiation.

Depending on the extent of injury, burn injury is probably the most drastic insults regarding pain, anxiety, number of procedures and duration of hospitalisation. Burn injuries often have vast anatomical and physiological complications. It is probably the type of trauma that can launch the biggest stress response. These patients have suppressed immunity, are prone to infection and have special nutritional demands. Moreover, burn injury is renowned for severe and protracted pain. Each of these aspects form part of the management and caregivers must be cognisant of the behaviour of burns: these aspects vary over time, which necessitates adjustment of management.

Although anatomical and physiological aspects take preference during immediate (resuscitation, early wound care, management of associated injury) and subsequent management, analgesia should be part of immediate/early management. It is not only anatomically and physiologically necessary, but also humane – even in patients with a poor prognosis.

Poorly managed pain aggravates the stress response and the subsequent sequelae. Inadequate early analgesia leads to the development of chronic pain. Moreover, the psychological consequences such as anxiety, depression and posttraumatic stress disorder can impact on the healing process.

13.8.1 Evaluation and classification of burn wounds

Burn injury can be trivial and the patients are usually discharged home with advice regarding wound care and analgesics such as paracetamol, an NSAID and codeine.

Evaluation of the burn patients is the same as that of other trauma patients: anatomically (issues associated with burn injury such as the face, airway, circumferential and torso burns) and physiologically (including breathing and circulation), as well as pharmacologically/toxicologically. These aspects will determine the appropriate investigations and interventions. Burn-specific evaluations include the mechanism of injury (thermal, chemical, inhalation or electrical) and a physical examination to exclude associated injuries, including inhalational injury.

Burn wounds are classified according to their extent (body surface area) and depth. However, wounds are usually not uniform in depth, varying from deep (third-degree) in the centre to partial-thickness (second-degree) and superficial (first-degree) at the periphery, and are often underestimated regarding depth and area. Therefore, the initial grading of wound depth and area affected does not necessarily correlate with pain intensity. This may also vary while healing takes place or when infection sets in. Nonetheless, classification according to depth and area directs initial management regarding resuscitation and wound management.

In children, associated trauma and distribution of burns, lesions indicative of previous injury, conflicting stories and delayed presentation for help, can indicate the possibility of drug misuse. This should be referred for further investigation.

The following are the classifications of burn wounds:

- *First-degree (superficial)* burns are damage to the epidermis and are often caused by intense sun exposure. The wounds are red and dry. Since the cutaneous nerves are intact, these wounds are may be very painful.
- *Second-degree (partial-thickness)* burns involve the dermis ('dermal burns') and do not penetrate beyond the dermis and are either superficial or deep. This depth of injury is seen typically after exposure to hot liquid or steam. These wounds have fluid-filled blisters and are red and wet, and since deeper nerves may be spared, the wound may be excruciating.
- *Third-degree (full-thickness)* burns extend beyond the dermis to the SC tissue, muscle, tendons, joints and bone. These wounds are usually caused by a flame or prolonged exposure to any hot material. The wounds are dry and leathery, and since all nerves have been destroyed,

these are insensate. However, shallower burns and inflammation at the periphery cause severe pain. Furthermore, when nerve regeneration starts, neuropathic pain may set in.

- *Circumferential* wounds of the torso and limbs may cause hypoventilation and ischaemia, respectively.

13.8.2 Pain in the burn victim

Pain experienced directly after injury usually differ from pain that patients experience during the healing process. It can either improve or increase in intensity and character, becoming more complex and chronic.

Pain evolves during management and healing. Management of burn wounds involves wound debridement and skin grafts. These procedures cause further tissue injury and acute pain, which may be worse than the original wound. Nerve injury and regeneration cause protracted neuropathic pain, manifesting as tingling and itching.

It is important to believe the patient regarding their pain intensity. Complete absence of pain is preferable, but often not attainable – except under GA. Analgesia is adequate when the pain level is a VAS ≤ 3/10, the patient is comfortable, and the pain does not interfere with nighttime sleep.

It must be stressed from the outset, that early and adequate multidisciplinary pain management is essential. Adequate wound care prevents physical scaring, but psychological scaring should also be prevented. Psychological scarring results from pain (it is inhumane to tolerate pain in patients), anxiety, experience of disfigurement, loss of function (and limbs), prolonged hospitalisation, loneliness, financial and educational losses, etc. Management of all these aspects from the outset ensures less pain and better functioning over different fronts after discharge. The larger and the more disfiguring the injury (face, head, neck, hands, perineum), the higher the morbidity and challenges.

13.8.3 Analgesia is required in the following scenarios

- Immediate pain
- Background pain and breakthrough pain
- Procedural pain
- Chronic pain

In all these circumstances, changes in pharmacokinetics (vasoconstriction, hypovolaemia, anaemia, hypoalbuminaemia, weight loss) and pharmacodynamics (multimodal analgesia, tolerance) should be kept in mind.

Immediate pain

Immediate pain and the efficacy of analgesics are determined by the nature of injury (depth, area and other injuries), previous experience, anxiety and drug tolerance. Immediate pain is aggravated by the initial evaluation process. This pain should be minimised by prompt IV analgesia.

IV opiates are usually indicated for large wounds. Incremental doses of opiates (usually *morphine sulphate*) are titrated until the patient is comfortable and less anxious (VAS of approximately 3/10). The titration dose of morphine sulphate is 50 µg/kg every 5 minutes. In the absence of IV access, oxycodone 5–10 mg p.o. or buprenorphine 0.2–0.4 mg sublingually can be used. PCA may be offered in the acute setting. *Paracetamol* 15 mg/kg is administered p.o. or IV. NSAIDs are not safe during the period of resuscitation (hypovolaemia, pigmenturia).

Background and breakthrough pain

Background pain occurs at the site of injury and skin donor sites and is constantly present between interventions (wound dressings, physiotherapy, surgery). *Breakthrough pain* occurs when background pain is adequately addressed but not pain during movement, physiotherapy, etc. The intensity and character of pain varies from day to day and over time depending on healing, interventions, complications, inappropriate analgesia (caregivers' misconception about addiction and tolerance) and mood. Background pain can persist even after the wounds have healed. Over time, background pain may become more intense, change in character (chronic pain), and is often accompanied by itching, which is indicative of nerve regeneration (neurogenic pain).

Protracted background pain can, to some extent, be prevented by early and appropriate analgesia and non-pharmacological measures. Therefore, comforting patients (analgesia, anxiolysis and psychotherapy) must be *individualised* according to pain intensity and character, complications and healing. To this end, pain intensity and character monitoring during the day and day-to-day must be used to preempt exacerbations of pain to prevent chronicity.

Managing background and breakthrough pain

Multimodal analgesia must be used. Adequate and timely management of background and breakthrough pain improves pain associated with wound interventions. Patients are less apprehensive since they are confident that their pain will be addressed adequately. Therefore, it is advised that preemptive doses of analgesics be allowed before wound care procedures. Nighttime sleep is important. If pain is responsible for insomnia, it must be addressed; if it is caused by anxiety or depression, it must be managed. As healing progresses, background pain and anxiety decrease and the patient may get more involved in wound care and active

movement physiotherapy without the need for analgesics and sedatives. Patients who are treated on an outpatient basis must follow the same principles as inpatients.

The ladder approach applied for postoperative pain is followed for background pain, namely paracetamol; paracetamol + NSAID; paracetamol + NSAID + opioid. If burn injury has justified hospitalisations, opioids are usually appropriate from the beginning. Long-acting opioids are useful. Of course, patients who are admitted for observation (e.g. facial or inhalational injury), do not necessarily need opioids.

Analgesics must be given around the clock, but adult patients (and even children) must, over time, be allowed to manage their own analgesia; they may refuse analgesics if they are comfortable, but analgesics must be available to allow for doses of opioids preemptively as well as for breakthrough pain.

Breakthrough pain and preemptive analgesia can be afforded with shorter-acting analgesics such as morphine sulphate or morphine chloride syrup and oxycodone.

Adjuncts such as *pregabalin* (it is opioid-sparing and addresses emerging central hyperalgesia of neuropathic pain), *clonidine*, antidepressants (amitriptyline, not more than 75 mg daily, at night), and *anxiolytics* may be added. *Subcutaneous ketamine* has been used in the hospice setup for the triad of depression, anxiety and chronic pain. *Oral ketamine* has also been used, but more prospective studies are needed to prove its efficacy and safety. The dose of racemic ketamine that has been used is 0.5 mg/kg p.o. 8-hourly.

Procedural pain

Additional tissue trauma during wound management, such as wound dressings, debridement, skin grafting, as well as physiotherapy, is unavoidable. For these procedures, preemptive analgesia is required (see above), as well as postoperative analgesia if the procedures are done under GA. Hyperalgesia in both the healing and the newly traumatised parts will be aggravated, and background pain will often shift to a higher level. However, wound dressing and sloughectomy may improve pain. Therefore, analgesia should be adjusted after wound interventions. The frequency of these intercurrent procedures decrease over time, but may contribute to sustained background pain and subsequent chronic pain.

Managing procedural pain

Depending on the extent of injury and degree of healing that has taken place, procedures can be done without any extra analgesia or sedation, under sedation, or under GA.

When done under sedation, preemptive analgesia and/or sedation may be necessary. Paracetamol and NSAIDs must be given as close as possible to the procedure. Analgesia and sedation are achieved with a dose of opioid used for breakthrough pain and a sedative administered approximately 30 minutes before wound care.

Sedation can be accomplished with midazolam and the opioid-sparing sedative analgesics ketamine and dexmedetomidine (which are very expensive). Opioids and ketamine are administered p.o. or IV. IV sedation using propofol and short-acting opioids can be used, but should preferably be done in the operating theatre and by an anaesthesiologist.

When using ketamine or other potent sedatives, patients should be NPO for 6 hours. Keep in mind that opioids slow gastric emptying. Therefore, dressings should be done early in the morning or 6 hours after early breakfast. Patients must eat lunch.

One of the following regimens may be used:

- Ketamine
  - *IV ketamine combined with an opioid* (the opioid is administered p.o. 30 minutes before or IV just before the procedure): ketamine approximately 1.0 mg/kg IVI with additional doses of 0.1 mg/kg IV. Midazolam 0.05 mg/kg IVI may also be added.
  - Without *venous access* and with *preemptive opioids*: 0.5–3.0 mg/kg (2.5 mg/kg) p.o. approximately 15 minutes before wound care. (This is much lower than the dose of 5–10 mg/kg needed for procedural sedation in children.) Midazolam approximately 0.1 mg/kg p.o. (the oral bioavailability is about 50%) can be given.
  - Without *an opioid*: 6 mg/kg p.o.
- Dexmedetomidine 4 µg/kg p.o., but it is less effective than ketamine.
- A methoxyflurane inhaler has been used with success, but should be studied further in this setting. This method is probably useful in the outpatient setting.
- If more extensive wound care involving GA is done, postoperative analgesia should be tailored to the procedure and preoperative needs.

Chronic pain after burn injury

Chronic pain correlates with wound area, depth, the efficacy of wound care, analgesia, management of psychological issues, and complications such as scarring, contractures and nerve entrapment. Amputation often results in phantom pain. Some patients experience pain at the site of injury after the wound has healed. Opioids, antidepressants (SSRIs, amitriptyline) and antiepileptics (gabapentin and pregabalin) are used.

Itching in or around the healing wounds or in scars (keloid) commonly occur and may persist for decades after injury. Scratching damages healing wounds and normal skin. Itching is either a manifestation of local mediators such as histamine and prostanoids secreted in healing tissue or may be a manifestation of central or peripheral neurogenic origin (an indication of neuropathic pain). Itching is often aggravated by movement, heat and psychological factors. *It is managed* by skin cooling, fragrance-free skin moisturisers, oral antihistamines (cetirizine), NSAIDs, gabapentanoids, antidepressants such as amitriptyline, and topical anaesthetics. Several antihistamines are anxiolytic and sedating and improve nighttime sleep.