HOT TOPIC

SHOULD WE PERFORM REGIONAL ANAESTHETIC TECHNIQUES ON CHILDREN AFTER TRAUMA?

SUMMARY OF KEY POINTS:

- Regional anaesthetic techniques are commonly performed in children who have sustained trauma related injuries. These techniques provide excellent pain relief with few reported cases of morbidity.
- Compartment syndrome is seen in children after traumatic and non-traumatic events. Prompt recognition of the syndrome is essential to prevent serious complications.
- The anaesthetic and surgery teams need to know how and when to evaluate for compartment syndrome, and ensure all children have good, timely analgesic treatment for their injury.

REVIEW OF EVIDENCE

There are concerns regarding the use of regional and nerve blockade for limb surgery after trauma. The main concern is based upon the risk of a delayed diagnosis and treatment of compartment syndrome. Pain control is one of the fundamental skills of the anaesthetist and many use regional anaesthetic techniques to deliver this care to patients. Some clinicians, both surgeons and anaesthetists, feel that regional techniques should not be used in patients who have undergone trauma due to the risks of compartment syndrome. How should the anaesthetist decide if a regional technique is suitable for a child after trauma?

Compartment Syndrome

Compartment Syndrome is a painful and potentially serious condition caused by bleeding or swelling within an enclosed bundle of muscles – known as a muscle compartment. The compartments enclose skeletal muscle and are created by fascial layers that have a limited ability to stretch. Any process that results in increased pressure within a muscular compartment exceeding the perfusion pressure of the tissue has the potential to cause compartment syndrome. Once the interstitial pressure increases, perfusion to the tissue decreases with resultant tissue hypoxia. Compartment syndrome is a clinical emergency and needs urgent recognition and treatment. Acute compartment syndrome happens suddenly usually after a fracture or an acute injury. This is often trauma related, such as a fracture, crush or penetrating injury but may be associated with a vascular disorder.

The majority of compartment syndrome cases in children are associated with trauma. The consequence of the trauma may be upper limb or lower limb fractures, but significant soft tissue injury may also cause the syndrome. It is most common in the lower leg and forearm but can occur in the hand, foot and upper arm. One study has suggested the overall incidence of compartment syndrome in children is lower than adults at an incidence of 0.02% after trauma (1).

Diagnosis of Compartment Syndrome

Symptoms of acute compartment syndrome develop after an injury and worsen quickly. Symptoms include –

●Pain out of proportion to injury, an early and common finding

●Persistent deep ache or burning pain

●Paresthesia (onset within approximately 30 minutes to two hours of acute compartment syndrome; suggests ischemic nerve dysfunction)

Examination findings suggestive of compartment syndrome include the following:
●Pain with passive stretch of muscles in the affected compartment (early finding)
●Tense compartment with a firm "wood-like" feeling
●Pallor from vascular insufficiency (uncommon)
●Diminished sensation
●Muscle weakness (onset within approximately two to four hours of compartment syndrome)
●Paralysis (late finding)

This has coined the 5 P's to diagnose the condition – pain, pallor, paraesthesia, pulselessness and paralysis. Some have added a sixth P – perishing cold to the list. Pain and pain with passive stretch are the main clinical symptoms. Paraesthesia and paralysis are late signs.

Children present unique challenges in the diagnosis and management of compartment syndrome. They constitute a diverse group. Young children and those with learning difficulties may have difficulty articulating symptoms which assist in the diagnosis of compartment syndrome. As described above the main symptom to alerting to a possible compartment syndrome is pain. These symptoms may be difficult to identify in young children. One group has suggested the use of the three As to diagnose compartment syndrome in children – anxiety, agitation and analgesic requirements. (2)

Although pain is the most useful clinical symptom there have been reports of patients with compartment syndrome that do not have severe pain. Lee et al (3) described 5 children with a median age of 7 years without the presence of significant pain at rest or on passive range of motion. One group reported a two-year-old child in whom a stone table had fallen onto their hand. They had received a dose of ibuprofen. The child did not complain of pain however due to the dense swelling of the hand and impaired perfusion of the skin, the patient was taken to the operating room. The compartment pressure was high. Several studies support the use of compartment syndrome delta pressure to aid diagnosis of acute compartment syndrome, where delta pressure is the difference between diastolic blood pressure and the measured compartment pressure. A delta pressure <20 to 30 mmHg indicates a need for fasciotomy. The British Orthopaedic Association suggest that all hospitals treating patients with significant injuries should have the capability to perform intracompartmental pressure monitoring (2).

Management of Compartment Syndrome

Immediate management of suspected compartment syndrome includes relieving all external pressure on the compartment. Any dressing, splint, cast, or other restrictive covering should be removed. The limb should be placed level with the heart to avoid reductions in arterial inflow and increases in compartment pressures from dependent swelling, both of which can exacerbate limb ischemia (4).

Analgesics should be given, and supplementary oxygen provided. Hypotension reduces perfusion, exacerbating tissue injury, and should be treated promptly, initially with boluses of intravenous crystalloid.

Extremity fasciotomy is the only recognized treatment. Early fasciotomy (ideally within four hours of symptom onset) can save the extremity.

Regional Anaesthetic techniques

Many anaesthetists use regional anaesthesia techniques in children. A good successful regional anaesthetic technique may remove many of the symptoms and signs of compartment syndrome. Should we employ these techniques in children whose injury puts them at risk of compartment syndrome?

The use of regional anaesthetic techniques in children who had experienced trauma stimulated a review by ESRA European Society of Regional Anaesthesia and Pain Therapy. The European Society of Regional Anaesthesia and Pain Therapy (ESRA) and the American Society of Regional Anesthesia and Pain Medicine (ASRA) concluded in guidance published in 2015 (5) that: "*there is no current evidence that the use of regional anaesthetics increases the risk for ACS or delays its diagnosis in children*" and to recommend that after discussion with the child, parents and surgical team, low concentrations of local anaesthetic (bupivacaine or ropivacaine 0.1–0.25% for single shot and 0.1% for continuous nerve blocks) can be used safely for single-shot and continuous nerve blocks for surgery associated with an increased risk of compartment syndrome. The guidelines recommended cautious use of adjuncts to local anaesthetics, as these can increase the density and duration of blocks. An acute pain service should also be in place and rapid provision of intracompartmental pressure monitoring should be available.

Case reports (6) have suggested that a regional anaesthetic technique does not stop the early signs of pain being identified by a patient at the early stages of compartment syndrome. They suggest that regional anaesthesia does not consistently block ischemic pain and is therefore not contraindicated.

NYSORA is a group promoting education in Anaesthesia, ultrasound, regional anaesthesia and pain medicine. They have developed clinical pearls to help clinicians manage difficult clinical scenarios – the pearl when regional analgesia is planned to treat pain in patients with risk of compartment syndrome is as follows (7):

• Reduce the concentration of local anaesthetics (0.1% to 0.25% bupivacaine, levobupivacaine, or ropivacaine) as lower concentrations are less likely to mask ischemic pain.
• For continuous infusions of bupivacaine, levobupivacaine, or ropivacaine, limit concentrations to 0.1%.
• In high-risk surgeries for compartment syndrome (e.g., tibial compartment surgery), restricting both volume and concentration is advisable.
• Patients should have follow-up by acute pain services to allow for early detection of signs and symptoms.
• If acute compartment syndrome is clinically suspected, compartment pressure measurement is mandatory.

Summary

The risk of compartment syndrome is low in children, however the consequences of late diagnosis of this syndrome can be devastating. The important steps to ensuring cases are not missed and are managed appropriately are:

- Identification of cases at risk of compartment syndrome
- Consent the parents and where appropriate the child to the regional anaesthetic technique if planned.
- Use low concentrations of local anaesthetic – e.g., 0.1% - 0.25% levobupivacaine
- Be cautious in using adjuncts to regional techniques – example clonidine
- Ensure there are clear observation charts in use, and these might be specifically for children who are at higher risk of compartment syndrome – i.e., those whose trauma involves the forearm or distal lower limb
- Be alert to increasing requirements of analagesia
- Ensure the equipment to monitor compartment pressures is available, monitor trends over time
- Alert the responsible medical/surgical teams at an early stage if compartment syndrome is suspected

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