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Numb and Number: Should We Use Regional Anesthesia in Orthopedic Trauma?

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Stem Case and Key Questions Content

You are assigned to two orthopedic trauma rooms on a Monday morning and the schedule is as follows. First case in room 17 is a 59 years old man scheduled for open reduction and internal fixation (ORIF) of right tibial mid-shaft fracture. The patient came through the ER after sustaining a motor vehicle accident (MVA) Sunday morning. His other injuries include right-side undisplaced fracture right 5th and 6th ribs. Computed tomography (CT) of the head was normal. Plain films of the cervical spine revealed no obvious fracture or displacement, but could not reliably see the C7 vertebra. CT scan of the neck revealed no bony injuries. He was still c/o some mild tenderness over the back of the neck and arrived at the OR in a soft collar. Ultrasound of the abdomen and pelvis revealed no free fluid. In the holding area, the patient is on a 4l nasal cannula with oxygen saturation of 95% and in no respiratory distress. His heart rate is 95 beats/min and his Blood pressure is 150/95. The patient PSH is remarkable for hypertension and hyperlipidemia. He underwent left total knee arthroplasty 2 years ago. He had spinal anesthesia and a nerve block for his knee replacement and he loved it and was wondering if you can offer him something similar as he does not do so well with pain and he would like everything possible to be done to control his pain. The patient is on IVPCA morphine and is still rating his pain as 9 out of 10. He was also receiving 30 mg of Enoxaprin twice daily for DVT prophylaxis. ON further questioning, our patient admits to occasional use of cocaine. The last time he used cocaine was Last Wednesday.

Key Questions:

1.Are you satisfied with the trauma work-up for this patient? What other information/investigations, if any, would you wish to have? Would you delay surgery for further work-up?

2. Do you have any concerns about the history of recent cocaine use? How are you planning to address these concerns?

3. What are the factors that may influence the decision for timing (early versus late) of the ORIF of long bone fractures?

4. What anesthetic technique are you planning to use for this case and why? What are the advantages and disadvantages of general versus (various types of) regional for this case?

5. How does the choice of the DVT prophylaxis would influence your anesthetic plan?

You had a discussion with the orthopedic surgeon, who is much bigger than you, and he mentioned that he is concerned about development of compartment syndrome in this patient

after surgery and he would rather you not do a block on that patient so as not to miss the diagnosis of compartment syndrome. He cited an article he read about a missed diagnosis of compartment syndrome under epidural analgesia. He added further that a peripheral nerve block is probably no different from an epidural and it will make the whole leg completely numb.

Key Questions:
5. What is compartment syndrome? What is the pathophysiology of this syndrome? and how do you diagnose it?

6.What are the implications of using a continuous peripheral nerve catheter technique this patient perioperatively? Are there concerns regarding potential diagnosis of compartment syndrome and how do you address these?

The first case in your other room is a 21 years old female scheduled for ORIF of fracture of a left bi-malleolar fracture. She sustained her fracture five days ago during a softball game for her college. She is a science major and read on the internet about peripheral nerve blocks as an option to control postoperative pain and was asking you if she can have a block and what are the risks. She hates needles though and was further questioning if you can place this block after putting her to sleep. You paused for a minute especially that the surgeon has just expressed his concern over compartment syndrome and the use of peripheral nerve blocks.

Key Questions:
7. Are all fractures of the lower extremities are prone to the risk of development of compartment syndrome? Explain why or why not?

8. What will you be telling your patient about the risks of nerve injury if the block is done under general anesthesia? What are the risks you discuss with your patients when you consent them for regional anesthesia?

You proceeded with your first case under general anesthesia and the plan for postoperative analgesia was intravenous narcotics. You also discussed the second case with the surgeon and he mentioned that it should be ok, from his standpoint, if this patient had a nerve block.

Key Questions:
9. Why would be an ankle fracture different from a fracture mid-shaft tibia, in terms of the risk of development of compartment syndrome?

10. Can you design or suggest an evidence-based protocol for using RA in patients who maybe at risk for development of compartment syndrome?

11. Are you going to use a narcotic only regimen for your first patient? Are you going to use other classes of analgesic medications as part of a multimodal analgesia protocol? Why or Why not?

12. For your second patient, are you going to use a single shot nerve block or a continuous perineural catheter?

13. Can you make a case for using nerve blocks in orthopedic trauma patients, citing benefits other than acute postoperative pain control?

14. What are the advantages of having a robust acute pain service in the two case scenarios listed in this discussion?

Model Discussion Content

Regional anesthesia provide better analgesia when compared to systemic narcotics in different practice settings(1, 2). Regional techniques provide site specific analgesia and avoid narcotic induced side effects which include sedation, nausea and vomiting, itching, and respiratory depression(3, 4). Avoidance of systemic sedation, in the polytrauma patients, makes it easier to monitor the mental status of patients with head injuries(5, 6). Use of regional anesthesia in the battlefield in recent military conflicts facilitated transport of soldiers with extensive trauma to the extremities out of the field hospital (7, 8). The military experience suggests that the use of regional anesthesia as an early intervention reduces pain and injury-related complications. In addition to the short-term benefits of acute pain control, early treatment of injuries to the extremities has potential long-term benefits including reduction in the incidence and severity of chronic persistent pain sequelae such as chronic regional pain syndrome and posttraumatic stress disorder(7, 9). Despite these known benefits, regional anesthetic techniques have been underutilized in trauma patients, especially during the acute phase of injury(10). One study reports that up to 36% of patients with acute hip fractures in the emergency department received no analgesia and even fewer patients were considered for regional nerve blocks(11, 12). The perioperative use of regional anesthesia for orthopedic trauma is no exception. Side effects, the time it takes to perform these blocks and potential to mask nerve injury or acute compartment syndrome are often cited as reasons to avoid regional techniques (6). Most trauma patients receives some form of DVT prophylaxis (13, 14) which often times complicates the decision for utilization of neuraxial techniques for anesthesia and analgesia. The ASRA guidelines for management of patients receiving anticoagulants or thrombolytic therapy (15) address mainly the concern over the development of spinal or epidural hematoma in patients undergoing neuraxial techniques. The most recent edition of the ASRA document addresses the risk of bleeding with peripheral nerve blocks, especially deep blocks, and recommends adopting guidelines similar to those suggested for neuraxial techniques. Other studies(16-18) demonstrated the relative safety of peripheral continuous nerve blocks and the rarity of bleeding complication following these procedures. The rare incidence of bleeding complications following peripheral nerve blocks in orthopedic trauma makes studying this question in a prospective randomized manner rather challenging.

The risk of masking and/or delaying the diagnosis of acute compartment syndrome (ACS), in the setting of orthopedic trauma, is another reason that often sways some of the anesthesiologists from offering regional anesthesia to these patients(19). Compartment syndrome is a condition in which increased pressure within a closed compartment compromises the circulation and functions of the tissues within that space. Ischemia eventually leads to muscle necrosis and loss of function(20). The osseo-fascial compartments of the leg and the forearm are most frequently affected (21) but it may occur in the upper arm, thigh, foot, hand, and buttock. The incidence of acute compartment syndrome varies depending on the inciting event. The incidence was estimated to be 6% in open tibial fractures and 1.2% of patients with

closed tibial fractures (22). The reported incidence of compartment syndrome may underestimate the true incidence because the syndrome may go undetected in severely traumatized patients. The frequency of compartment syndrome is much higher in patients who have an associated vascular injury. Feliciano et al reported that 19% of patients with vascular injury required fasciotomy (23, 24). Risk factors associated with development of compartment syndrome after tibial fractures include male gender, young age <35, and mid-shaft fractures when compared to proximal and distal end fractures of the tibia (25).

Pain, out of proportion to the injury, is believed to be the cardinal sign for diagnosis of ACS by some authors (26). The pain is often described as burning, deep and aching in nature and is worsened by passive stretching of the involved muscles. Classically, the 5 “Ps” associated with the diagnosis of compartment syndrome are pain, paresthesia, pallor, pulselessness, and paralysis (27, 28). Pain may be an unreliable symptom as it is subjective and variable (29). It may be absent in cases associated with nerve injury. Pain is usually minimal to absent in deep posterior compartment syndrome (21).Ulmer et al reported a high false positive rate for clinical symptoms and signs of compartment syndrome (30). Physical examination, alone, was determined to be inadequate screening tool for the diagnosis of compartment syndrome (31). Measurement of compartment pressure is recommended as an adjunct to clinical diagnosis (21, 31). Normal pressure in the muscle compartment is below 10-12 mm Hg (20). Absolute compartment pressures of 30 and 40 mm Hg have been suggested as thresholds for the diagnosis of compartment syndrome (32). Needle manometers are commonly utilized for compartment pressure measurement (33). They are cheap and easy to use, but have been shown to have inaccuracies (33). Pressure in all compartments in a limb suspected of having compartment syndrome should be measured (34). In a review of the published case reports of ACS (35), Mar et al analyzed a total of 28 case reports published until 2009 and discussed the influence of analgesic technique on the diagnosis of compartment syndrome. These techniques were patient-controlled analgesia (PCA; n =3), peripheral nerve block (PNB; n=2), and epidural analgesia (n=23). This review concluded that the evidence was not convincing enough that neither opioid PCA nor regional analgesia results in the delay of diagnosis of ACS (35). Johnson et al reviewed pediatric case reports of ACS in the context of epidural analgesia (36). They identified increasing analgesic use, increasing or breakthrough pain, and pain remote to the surgical site as important early warning signs of impending compartment syndrome in the lower limb of a child with a working epidural. They also suggested a clinical pathway for trauma patients who are candidates for epidural analgesia. Education, and clear communication are some of the core foundations of this pathway. Using a diluted concentration and low volume of local anesthetic and focusing on excluding the diagnosis of ACS in patients at risk rather than focusing on failure of the analgesia are also some of the recommendations included in this pathway (36). Currently, there are five cases in the literature citing the use of peripheral nerve block in the context of development of ACS. Three of the cases (37-39) describe ACS with single shot nerve blocks and two cases reports feature ACS in the context of continuous nerve catheter(40, 41). In all five case reports, compartment syndrome was suspected on the basis of significant pain despite the presence of a nerve block. However, it is possible that the increase in pain was concurrent with the initial single shot block wearing off. Patients still presented with breakthrough pain even when higher concentration of local anesthetic (0.75% of ropivicaine) was used (38). In one case (37), the distribution of pain and the final diagnosis did not match the sensory distribution of the peripheral nerve block. However, The authors went on to conclude that the nerve block masked the pain and delayed the diagnosis. Cometa and colleagues (41) went further to explain the mechanism of activation of the ischemic pain

pathway and postulated that hydrogen ion activation resulting from ischemic injury in the muscle and the resulting acidosis, which is the case with ACS, produces non-adapting activation of the pain receptors (42, 43). In contrast, the inflammatory markers associated with tissue injury and trauma undergo tachyphylaxis after activation of the nociceptor(42). This theory would explain why patients with evolving compartment syndrome would still present with breakthrough pain if they have a nerve block on board. In away, a local anesthetic used in concentrations low enough to provide postoperative analgesia may aid the diagnosis of compartment syndrome provided that we had the vigilance in monitoring and the high index of suspicion for the development of pain out of proportion to the surgical pain or any other symptoms suggestive of the development of ACS.

The approach of relying on withholding appropriate pain therapy from patient to evaluate the progress of their pain is regarded by some authors as inhumane and inappropriate (44). The analogy is always made between this approach and the old teaching of holding analgesia from patients presenting with signs and symptoms of acute abdomen before the advent of CT scan and other diagnostic modalities for diagnosis of acute abdominal pain.
The definitive surgical therapy for compartment syndrome is emergent fasciotomy. The goal of decompression is restoration of muscle perfusion within 6 hours.

The key to diagnosis of compartment syndrome is vigilance, high index of suspicion, and clear communication between all parties involved in patient care including surgeons, nurses, anesthesiologist, and acute pain service (35, 41, 44).

Reluctance to perform a regional anesthetic technique in the early management of trauma is also influenced by the practitioners' fear of nerve damage. Some authors consider preexisting nerve injury as a relative contraindication for peripheral nerve blocks. Proper evaluation and assessment of any pre-existing nerve damage is mandatory prior to performance of any regional technique(45). The assessment of the extent of injury and neurovascular compromise in the acute trauma patient can frequently be difficult and challenging due to altered mental status as a result of head injury, intoxicants, or sedation(5, 6). No nerve localization or monitoring technique has been shown to be clearly superior in terms of reducing the frequency of clinical injury(45). These techniques include paresthesia-seeking, peripheral nerve stimulation, defined minimal or maximal milliamperage for acceptance of a motor response (46, 47). Typically, peripheral nerve blocks are done with sedation while maintaining a meaningful contact with the patient. However, the practice of sedation during performance of nerve blocks is variable among anesthesiologists (48).

Multimodal analgesia is being used increasingly in the perioperative setting. Trauma should be no exception. From this standpoint, regional anesthesia should be utilized based on the individual patient circumstances and institutional infrastructure. Creating perioperative pain management protocols for different settings and maintaining clear communication with the trauma and orthopedic surgeons are some of the keys to the success of any regional anesthesia service.

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