Management for a Multiple Trauma Injury Case

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CASE PRESENTATION

Randy, a six years old intact male Rottweiler, presented after being hit by a car several hours prior to arrival. His previous medical history, included bite wounds to the abdomen 4 years ago, bite wounds to the chest 3 years ago, and bite wounds to the neck at age 5, all of which were treated surgically with no complications. In the present event, he was hit by a car 12 hours ago. Following the accident the dog was able to stand up, but has since been having problems breathing and is limping on his left forelimb.

At presentation, the dog was mildly depressed but hard to handle due to aggressiveness. Physical examination findings include a mildly elevated rectal temperature, 38.9°C, a pulse rate of 140 bpm and the dog is tachypneic and dyspneic. Auscultation revealed weak heart sounds, and lung sounds, weak crackles could be heard in several areas of the lung field, the peripheral pulse was fairly good, yet the rhythm was slightly irregular. Mucous membranes appeared pale with a capillary refill time of 2 sec. The dog has a non-weight bearing lameness on left front leg, and palpation revealed a closed fracture of the humerus. The physical exam revealed no other abnormal findings

Abnormal CBC findings included normocytic- normochromic- anemia: PCV= 24%, RBC count $3.3x10^6/mm^3$ and severe thrombocytopenia (platelet count $35x10^3/mm^3$). The biochemistry profile revealed a hypoprotenemia with a total solids of 5.5gr/dl, and albumin of 2.7gr/dl (reference range 3- 4.4gr/dl). Chest radiograms revealed a single fracture in each of the ribs 6, 7, 8, and 9 on the left side, a radiologic pattern consistent with multiple lung contusions, and an intact diaphragm. Radiograms of the left forelimb showed a displaced transverse fracture in the distal third of the shaft of the humerus. Ventricular premature beats (VPC), at a rate of approximately 8 per minute were the only abnormal ECG finding.

Due to the nature and location of the humeral fracture, external co-aptation was not a clinically relevant option, and internal fixation was recommended. It was decided however that at this stage the dog was not stable enough for a long surgical procedure and he was therefore hospitalized with supportive treatment, to be reevaluated for surgery the following morning.

QUESTION

During the preoperative hospitalization, what analgesic protocol you will use on this dog?

In order to answer this question it would be helpful to address the following points:

1. Define the dog's problem list?
2. What are the sources of the pain in this animal?
3. What are the benefits that you will gain from analgesia?
4. What side-effects of analgesia could be expected and which of these may be contraindicated in this dog?
5. What analgesic drugs and techniques would you use in this dog?

WHAT IS YOUR ANALGESIC PROTOCOL?

1. The dog was in severe respiratory distress, probably due to multiple factors. Lung contusions cause a problem in oxygen diffusion which leads to arterial hypoxemia. The broken ribs further complicate gas exchange due to shallow breathing and pain caused by breathing effort, leading to hypoventilation and a decrease in ventilation and perfusion matching. All these factors lead to a state of hypoventilation and hypoxemia, which manifest as respiratory distress. In order to evaluate the extent and impor-

tance of these events an arterial blood gas measurement should be taken, and response to treatment (e.g. oxygen supplementation) evaluated.

Anemia is probably acute, due to internal bleeding and low platelets count. It is recommended to perform coagulation tests in order to evaluate the hemostatic state. The arrhythmia seen is probably due to the tissue oxygenation problems mention above, it is however, recommended to exclude primary heart problems.

2. This animal is in severe acute pain. Rib fracture is a very painful syndrome due to the constant moving of the chest wall. Continuous stimulating of nocioreceptors by this movement enhances peripheral and central hyperalgesia, leading to a lowering of the pain threshold. Central hyperalgesia (also referred to as wind up) is modulated via the activation of N-methyl-D-aspartate (NMDA) receptors and calcium influx into neural cells, causing long persisting stimulation with a low response to conventional analgesic therapy and an increased potential for development of chronic pain states.

   Humeral fracture can cause moderate to severe acute pain, depending on the contribution of nerve damage in injured area. In this case the concurrent rib fracture already contribute to lowering the pain threshold, so it can be assumed that even a simple fracture will lead to a severe pain perception, due to wind up.

   Stress also modulates the pain perception and may cause a short decrease in pain sensitization, however following this peracute period, stress causes augmentation of the pain perception. Mild to moderate increases in PaCO2 as are probably found in this case due to the decreased ventilation, causing a sympathetic response, and this together with the stress associated with the trauma and hospitalization could add to an increase in pain sensitivity.
3. Analgesic therapy will be of great benefit to this dog. Other than the obvious ethical issues of reducing suffering and improving wellbeing, treating the pain caused by the rib fractures will significantly improve breathing, leading to better ventilation and improve oxygenation. Concurrently this will decrease the respiratory rate, resulting in deeper, more effective breaths with better ventilation and perfusion matching and better gas exchange. This will also decreased the load of breathing and oxygen consumption, leading to a further increases in arterial and venous oxygen and lower incidence of heart arrhythmias. If applied early and aggressively, analgesic treatment will decrease level of peripheral and central hyperalgesia, and lead to further improvement with conventional analgesic therapy. Efficient analgesia has been shown to decrease hospitalization time and cost in both animals and humans.
4. Benefits of treatment with analgesics in this case outweigh the concerns of side effects, however, they still should be considered. Opoids are well-known for their potential for causing respiratory depression. Humans are much more prone for this side effect than animals, and in companion animals it is not considered an important side effect except in specific cases (e.g. increased intracaranial pressure). In this case there is already a compromise in respiratory function due to pain, and even if some depression of the respiratory system occurs, the analgesic effects, should give some improvement in gas exchange. The other common side effects of opioids, mainly gastrointestinal - e.g. nausea and vomiting, are not of specific importance in this case, furthermore in painful states as in this case, we can see increase of numbers of peripheral opioid receptors, to which systemically administered opioid drugs will attach, leaving a smaller fraction to cause side effects. In other words, painful animals exhibit fewer opioid related side effects.

   Non-steroidal anti-inflammatory drugs (NSAID's) are another group of drugs that can provide efficient analgesia, both through peripheral and central effects, especially in pain of an inflammatory nature. The main side effects of NSAID's include gastric ulceration, inhibition of platelet aggregation and impairment of renal function. The negative effects on hemostasis may be critical in this case, and in general NSAID's are contraindicated in trauma patients with active hemorrhage (1). Cyclooxygenase-2 (COX-2) specific NSAID's (e.g. carprofen) cause less inhibition of platelet aggregation and are not associated with increased bleeding (1). Therefore the use of NSAID's and especially COX2 specific NSAID's can be taken into the consideration if bleeding is controlled and further analgesia is required.
5. One of the first things to consider when making a treatment plan is to understand the nature of the patient. Beyond all the medical problems mentioned above, we have a large aggressive dog that will be hard to approach

and treat. Sedation in this dog will have several benefits for the staff and the patient. All analgesics drugs have clear synergistic actions with sedation. Stress itself even without physical injury lowers the pain threshold. In painful animals in stress, this low threshold makes animals non-responsive to conventional analgesics therapy. Besides synergism the addition of mild sedation prolongs analgesic drug action which may be very useful in treating unfriendly patients.

The drug of choice for this dog will be acepromazine. Acepromazine has an effect for upto 12 hours furthermore in small doses causes minimal cardiovascular effects and its synergism with opioids is considered good. The opioid of choice should be morphine, due to its superior analgesia especially for somatic pain and for its long action. Side effects, like respiratory depression and influence on gastrointestinal motility are less important as mentioned above. After initial loading dose, morphine can be given intravenously via a continuous rate infusion (CRI).

Local anesthesia is a must in this case. The drug of choice should be a long acting local anesthetic such as bupivacaine. Analgesia for the ribs can be performed with an intracostal nerve block which is easy to perform and will lead to significant improvement of breathing. A brachial plexus nerve block can be performed with nerve stimulator or ultrasound guidance, but even without it, using anatomical markers, it is fairly simple and successful (2), and will give good analgesia to the fractured forelimb. Placing a soaker catheter for delivering constant regional analgesia to the broken limb can give a more stable plane of analgesia (3). Adding analgesic adjuncts such as NMDA blockers (e.g. a low dose ketamine CRI), gabapentin, amitriptyline etc. may help in reducing the wind up phenomenon; although they do not provide analgesia *per se* they can help in decreasing pain augmentation, development of allodynia. (4, 5).

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