Getting Started with Physiotherapy Mini Series

Session 2: Pain and Movement

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Pain and Movement

The first step in pain management is the ability to accept that our animals are in pain and that subsequent changes in gait and posture are an attempt to minimise pain. Visualising acute pain is easy, it becomes much more of a challenge in the chronic state.

Pain has been defined in many ways including:

Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage and is described in terms of such damage - **IASP**

Pain is a multiple system output activated by an individual's specific pain neuromatrix. This neuromatrix is activated whenever the brain concludes that the body tissues are in danger and action is required. Pain is allocated an anatomical reference in the virtual body

Molony and Kent defined pain in animals as:
Pain in animals has been defined as "an aversive sensory and emotional experience representing an awareness by the animal of damage or threat to the integrity of its tissues; it changes the animal's physiology and behaviour to reduce or avoid damage, to reduce the likelihood of recurrence and to promote recovery

It is important to distinguish between pain and nociception. Nociception is derived from the Latin *nocere* which means to harm. It describes the process by which organisms can detect stimuli that can cause actual or potential harm. Pain is the subsequent process by which the animal deals with that stimulus. Nociception is not static and can be potentiated or dampened down. The gate control theory was first described by Melzack and Wall in 1965. It has been modified since then but remains significant and led to the acceptance that the brain and spinal cord are dynamic systems.The dorsal horn of the spinal cord is the location of the first synapse in the nociceptive pathway and is a powerful target for regulating nociceptive transmission.

Inputs to the dorsal horn that originate from large myelinated peripheral nerves (aβ) activate inhibitory interneurones which result in the inhibition of the projection of information to the brain. An inhibition of the inhibitory interneurone by the small C pain fibres results in increased projection to the brain.

Hyperalgesia occurs as a result of peripheral sensitisation. It is defined as an increase in painfulness of a noxious stimulus and a reduced threshold for pain. It occurs in the periphery as a result of inflammatory changes.

Since synaptic processing in the spinal cord is dynamic, prolonged noxious inputs can result in reorganisation of the brain and spinal cord. This allows peripheral neurones that are not normally associated with pain to evoke a nociceptive sensation and results in allodynia. The long term consequences of central sensitisation include:

Structural reorganisation of synaptic contacts:

- Neuronal loss
- Degeneration of axon terminals
- Loss of normal connections and formation of novel connections and loss of balance between inhibition and excitation

These changes persist after the injury has healed. In the acute stage, pain can be attributed to inflammation, scarring and remodelling and the Motor system facilitates a withdrawal response. In the chronic state however, pain persists even though original injury has healed and is now associated with the nervous system. The Motor response now becomes less meaningful and accurate as the brain wrongly concludes that the body remains under threat. Motor, autonomic, immune and endocrine responses now based on faulty information.

Musculoskeletal pain
Musculoskeletal pain in general is a consequence of repetitive strain and overuse. It affects bones, joints, muscle and surrounding structures. Its Pathophysiology remains a matter for debate but includes:

- Inflammation
- Fibrosis
- Tissue degradation
- Neurotransmitter and neurosensory disturbances

Clinical signs are diverse and include local or widespread pain, tenderness, peripheral nerve irritation, weakness and disturbed muscle function, limited motion and stiffness and altered nerve conduction velocity.

Assessing Pain.
Pain assessment in humans is challenging, in nonverbal species it is even more so. It is further complicated by interbreed variation and owner/patient interaction. Concurrent disease can also modify pain behaviour and no one behaviour can be taken as pathognomonic for pain. Common pain behaviours in acute pain include:

- Vocalization
- Mobility and postural changes
- Interaction and mood
- Appetite
- Urination/defecation
- Physiological changes

An attempt to quantify pain has been made through the use of pain scales. Composite pain scales are the most effective - e.g. Glasgow Composite Pain scale. It can be applied quickly and reliably within the clinic. Within each category the descriptors are ranked numerically according to their associated pain severity. The total CMPS (composite measure pain score has been shown to be a useful indicator of analgesic requirements). The recommended intervention level being 6/24 or 5/20.

Treatment of acute pain is best carried out preemptively. IN trauma cases however this is not possible and relies on five main drug categories:

- Opioids
- Local Anaesthetic
- Nonsteroidals
- α-2 adrenoreceptor antagoinsts
- Miscellaneous drugs or adjuncts

Nonpharmacological interventions are an extremely important adjunct to management. Such interventions include Acupuncture, thermoregulation, environmental modification and stress reduction, appropriate nutrition and bedding and a good nurse/patient bond. Physiotherapy interventions that are important include assisted walking, range of motion exercises, the use of hot and cold packs and modalities such as therapeutic ultrasound and low level laser.

Pain assessment in the chronic state is even more challenging. Changes in behaviour often happen very slowly and may be mistaken for simple age related changes. Significant individual variation in pain coping strategies also exist with some interbreed variation. Owners rewarding pain behaviours also serve to re-enforce such behaviours. Clinical signs can include and one or combination of the following:

- Decreased play and socialization
- Decreased movement
- Decreased grooming
- Decreased tail wagging
- Altered eating pattern
- Less inquisitive
- Aggression
- Increased dependency
- Sleeping more
- Self trauma
- Fearful
- Random scratching or licking
- Compulsive behaviour

Pain assessment scales can provide valuable information but not in every case and are often very uninformative in some breeds such as energetic border collies and spaniels.

The use of diagnostic tools to identify and quantify pain can in some cases prove useful but again can be missleading, particularly in older individuals where it is likely that radiographic changes and those identified on MRI whilst substantial may not necessarily be the source of nociception. Force plate analysis can provide information regarding limb usage and is the mainstay of research.

Successful treatment is dependent on correctly identifying the source of pain i.e. is it Inflammatory somatic, visceral, neuropathic or acute breakthrough. Each will require a different pain management protocol.

Management Tools
Movement is essential as it enhances joint nutrition and soft tissue function. It also has a positive effect on respiratory and cardiovascular function and facilitates fine motor control through enhancing motor and sensory representations within the CNS.

Movement or activity also results in elevation of plasma β endorphin. Cross tolerance exists between the activation of the endogenous opioid system and the exogenous opioid administration. Exercise activates the large afferent fibres and results in spinal inhibition of pain transmission. A possible link also exists between motor cortex activation and descending inhibition. Other treatment options include:

- Multimodal Pharmacology
- Surgery
- Acupuncture
- Trans Spinal Electrotherapy
- Movement strategies
- Physiotherapy

- Therapeutic exercises
- Massage
- Hot and cold therapy
- Therapeutic modalities
- Neutraceuticals and diet

Rehabilitation in the operating theatre

It is never to early to start with physiotherapy and preemptive techniques such as the application of cold therapy during extubation may go a long way to minimise tissue inflammation and swelling in the immediate post op recovery period.

Cryotherapy results in:

- Vasoconstriction
- Reduced tissue metabolism and oxygen requirements.
- Reduced sensory and motor nerve conduction velocity.
- Reduced Odema

During the acute stage of tissue injury, histamine and bradykinin release leads to increased vascular permeability and regional vasodilation. This along with hypoxic changes within the cell result in local odema. Cryotherapy reduces the tissue's metabolic rate and as a result, less metabolic byproducts including heat are produced. As tissue oxygen demands fall, hypoxic cell death is also reduced as cells can survive in less favorable conditions.

Cryotherapy also provides analgesia, possibly as a result of decreased nerve conduction velocity as they cool. Other explanations include the gate theory and propose that cold overstimulates cold receptors in the skin leading to pain control at the spinal level.

Muscle spasm may also be reduced through the application of cold. This may be the result of a change in activity of the muscle spindle and the golgi tendon organ.

Methods of Application.
Ice packs, cryomassage, ice baths vapor coolant sprays and cryokinetic devices have all been employed in the canine field. In practice Ice or cold packs are most frequently employed due to ease of application and cost. They should never be placed directly on the skin and in general, application at any one time should not exceed 10min. Treatment should be repeated several times a day and continued through to the end of the acute stage of tissue inflammation.

Certain precautions do apply in the application of cold. Care should be taken not to induce ice burning or frostbite through over vigorous application. Care should also be taken when in the region of a peripheral nerve as reports of peripheral nerve palsy have occurred in humans.

Massage.
Massage can assist with reducing muscle spasm and increasing local blood flow. It can also be used to release fascial planes and facilitate movement between tissue interfaces. It can also be an useful adjunct in pain management by improving lymphatic drainage and reducing local odema and tissue stretching.

Casting.
Using external casting or bandaging material although often essential can often result in a significant loss of mobility at the level of the joint. Therefore, wherever possible access to the limb should be provided, even if only intermittently in the form of a split cast. Even short periods of gentle mobilisation biweekly can help maintain joint range of motion.

Passive Range of Motion Exercises.
The full motion that a joint is capable of describing is known as it's range of motion. Range of motion exercises are important in maintaining or improving motion after injury or surgery and reducing pain. They are also known to assist with recovery from neural injuries and promote motor learning.

Passive range of motion describes movement performed without active muscle contraction while in active range of motion movements a degree of active muscle contraction occurs as the therapist moves the limb or joint. Apart from patients with severe LMN or UMN deficiencies, most movement is accompanied by a degree of muscle contraction.

Rehabilitation and critical care
Injury, whether traumatic or surgical has the potential to affect the:

- Musculoskeletal system
- Respiratory System
- Cardiovascular System
- Integument
- Digestive System
- Immune system and psychological well being

Following trauma, haemorrhage can occur into skin, muscle and joint spaces. Not only does this activate stretch receptors and lead to pain but it can also inhibit muscle function and lead to weakness. It can also be the first step to initiating skin, joint and muscle contractures through altering the balance between collagen synthesis and degradation. The effect is dose dependent and breed specific with heavily muscled breeds such as greyhounds being the worst affected.

Soft tissue trauma and subsequent haemorrhage stimulates an inflammatory response. This in turn results in increased collagen synthesis. In the absence of movement, collagen fibres become very densely packed and can lead to tissue contractures e.g. in the vacinity of a scar.

Within muscle, two types of contractures are seen. Intrinsic contracture occurs secondary to trauma, inflammation, ischaemia and haemorrhage. Fibrin is deposited within the tissues and after two to three days this becomes replaced with reticular fibres which form a loose connective tissue network. In the absence of movement, this network becomes dense and restrictive and inhibits the natural extensibility of the muscle fibres.

Extrinsic muscle contracture is seen secondary to neurological (lack of innervation) or mechanical factors (such as the application of a cast or external fixator). Paralysed muscles can not provide adequate resistance to opposing muscles across the joint. Eventually the antagonist muscle will shorten and lead to reduced range of motion in associated joints. This is commonly seen in the carpus following injuries to the brachial plexus.

Injuries to the head, neck and abdomen often result in altered or impaired respiratory function as a result of pain, immobility, damage to the the thoracic structures or altered levels of consciousness. As a result the following may occur:

- Altered breathing patterns
- Loss of cough reflex
- Restrictive breathing patterns - shallow, rapid ventilation
- Reduced Tidal Volume, functional residual capacity and lung compliance

These in turn can lead to regions of lung atelectasis and accumulation of respiratory secretions with an increased risk of pneumonia. Rehabilitation can assist with maintaining bronchial hygiene, eliminating airway secretions, re-expanding atelectactic lung segments, improving tissue oxygenation and reducing the incidence of pneumonia. This can be achieved through:

- Stimulating the cough reflex
- Frequent repositioning
- Postural drainage
- Percussion
- Vibration
- Exercise

The cough reflex is extremely important in expelling retained secretions. It can be stimulated through the application of gentle pressure to the trachea at the level of the third tracheal ring. Placing the animal in sternal recumbency also facilitates coughing. An individual should be stimulated to couch following postural drainage, percussion and vibration.

A patient should be placed on soft conforming bedding which insulates and keeps the animal dry. They should be turned frequently, alternating between right lateral, sternal and left lateral recumbency every 4 hours. This helps prevent atelectasis and pooling of secretions in dependent lung segments. It also alters the ventilation/perfusion (V/Q) relationship within the lungs. If the compromised lung is positioned in the dependent position, it will receive increased blood flow. This increases the V/Q mismatch. If the functioning lung is positioned down, tissue oxygenation is improved by avoiding a V/Q mismatch.

Frequent repositioning also helps prevent pressure sores, muscle and joint stiffness and limb odema. Postural drainage uses body positional changes to allow gravity to aid in the removal of tracheobronchal secretions. It helps prevent pooling of secretions and accelerates the clearance of mucus which in turn increases the functional residual capacity of the lung. The dog must be positioned in a way that the segmental bronchi are vertical to the main lung. It is most effective following cupping and percussion to loosen the secretions. Animals should be maintained in each position for 5-10min. Exercise however is by far the most effective form of airway drainage.

Percussion is performed by rhythmically striking the patient’s chest wall with a cupped hand. This applies a mechanical shock wave to the chest wall which is transmitted to the lungs and helps dislodge secretions from the bronchial wall. It is performed though inspiration and expiration in a steady rhythm in a circular pattern. Only the affected lung segments need be treated. Following percussion, vibration may be carried out. This involves gentle shaking of the chest wall to further dislodge secretions. This should only be performed during expiration.