Acute on Top of Chronic Pain in Geriatric Patients
Michael Petty, DVM, CVPP, CVMA, CCRT, CAAPM
Animal Pain Center
Canton, MI

1. Introduction
   a. Many veterinarians fear the treatment of older dogs and cats with analgesics and anesthetics.
   b. Fear of use of these agents results in suffering and untreated conditions for which anesthesia is necessary

2. Things to consider
   a. Being old doesn’t mean that anything is wrong
   b. Being old means that there are a number of patients with subclinical organ function
      i. Renal, hepatic, and cardiac are the most common
   c. Body composition itself can have a pharmacodynamics effect in geriatric patients
      i. Decreased lean body mass
      ii. Drug receptors
      iii. Neurotransmitters

3. Decreased Resilience
   a. It is not unusual for geriatric dogs and cats to have reduced recovery times from physiological disturbances such as those brought on by anesthesia or sedation.
   b. Geriatric animals may have heightened response to both pain and other stimuli that a younger animal would not have.

4. Concurrent Treatments
   a. Many Caregivers give OTC drugs or supplements
      i. They often don’t consider them important enough to tell you
      ii. St. John’s Wort is common

5. Behavioral Considerations
   a. Environmental changes
      i. Hospitalization can bring on signs of cognitive dysfunction
      ii. Can cause decreases in willingness to eat, drink or interact
      iii. Encourage caregivers to bring items from home
   b. Nursing Care
      i. Pay special attention to food and water intake
      ii. Padded bedding as most have OA
      iii. Socialization is important during time in clinic

6. Diagnostics
   a. Always check for concomitant disease.
      i. Lab work
      ii. Radiographs
      iii. Urinalysis

7. Treatment
   a. Treatment of long term pain can be challenging.
      i. Many causes are not curable; caretaker should understand that the goal is palliative not curative.
   b. Easy to give drugs, impossible to take them back
      i. Start with lower doses and monitor for effect of drug and adverse events
   c. Try to use reversible drugs

8. Cardiopulmonary Issues
   a. As many as 58% of geriatric dogs show evidence of valvular disease
   b. Both cats and dogs have decreased alveolar plasticity
   c. Both of these issues mean less oxygen availability to tissues

9. CNS
   a. Mean alveolar concentration requirements decrease with age by an unknown mechanism(s).
      i. Always use lower settings for older animals

10. Hepatic Issues
    a. Total hepatic mass decreases with age and subsequently the ability of the liver to metabolize drugs.
11. Metabolic Issues
   a. As most animals age, their muscle mass decreases. At the same time body fat increases
      i. Affects both water soluble and fat soluble drugs
   b. Many older animals are either hypothyroid (dogs) or hyperthyroid (cats)

12. Renal Issues
   a. Many geriatric animals have a decrease in renal function, which can impair their ability to excrete or clear certain drugs.
      b. This can be complicated by cardiac issues

13. Pain drugs for chronic use
   a. NSAIDs
      i. The side effects of NSAIDs in geriatric animals are similar to those of other age groups
         1. Monitoring for ulcer formation may be a challenge in older dogs that eat sporadically
      ii. Use of NSAIDs in cats with renal disease
         1. Over 90% of cats of any age have some DJD
         2. Renal disease in cats is inflammatory in part
            a. OK to give in cats with renal disease
            b. Follow other precautions
            c. Use is off label in the U.S.
   b. Amantadine
      i. Amantadine works on the NMDA pathway
      ii. Important to use in dogs that are refractory to NSAIDs alone
   c. Gabapentin
      i. Exact mechanism is unknown, no big studies in dogs or cats
         1. Encouraging reports on its effectiveness
      ii. Cleared by kidneys
         1. Decrease dose with possible renal impairment
         2. Start at half the recommended doses.
   d. Maropitant
      i. Confusing recommendations to use for pain
      ii. Use it for vomiting
         1. Given the day before, may relieve nausea as well
   e. Acetaminophen
      i. Bad in cats
      ii. OK for dogs
         1. Pharmacodynamics are uncertain, should never be sole source of pain relief
   f. Grapiprant
      i. New class of drugs, piprant class, approved for use in dogs
      ii. Blocks the prostaglandin E2 at the EP4 receptor
      iii. Has had pilot studies in cats

14. Other drugs
   a. No evidence to support:
      i. Oral tramadol
      ii. Oral hydrocodone
      iii. Oral Oxycodone
   b. All risk, no benefit

15. Physical Modalities
   a. Rehabilitation
   b. Acupuncture
   c. Massage
   d. Weight Loss
   e. Myofascial Pain Treatments
   f. Hot and cold therapy
References


An Update on NSAID Use and Safety
Michael Petty, DVM, CVPP, CVMA, CCRT, CAAPM
Animal Pain Center
Canton, MI

1. NSAIDs are the most widely used analgesics in veterinary medicine
   a. Crucial in the treatment of acute pain
   b. Cornerstone of treatment in chronic painful conditions

2. Review of COX pathway
   a. Cox-1 not used in veterinary medicine
      i. Considered constitutive or for physiologic function
   b. Cox-2 popular NSAIDs are Deramaxx, Metacam, Prevecx and Rimadyl
      i. Work on pain and inflammation
   c. Work by stopping production of prostanoids from prostaglandins by inhibition of cyclooxygenase pathway
   d. Prostanoids cause pain and inflammation through stimulation of PGE receptors at both the nociceptor and dorsal horn of the spinal cord

3. Adverse effects of NSAIDs in Dogs
      i. Had sufficient data to compare carprofen, deracoxib, ketoprofen, meloxicam and rebenacoxib
      ii. Most studies were not randomized, controlled and blinded
      iii. Most did not use a clinical population of dogs
   b. Most common Ae’s
      i. Vomiting and diarrhea
      ii. Melena and fecal blood
      iii. Colitis
      iv. Abdominal Pain
      v. Icterus
      vi. GI ulceration and perforation
   d. Results
      i. Difficult to discern if a significant difference exists between NSAIDs regarding safety
      ii. AE’s were similar to placebo when only the highest quality studies were included.

   a. Events per 1 million oral NSAIDs administered to DOGS
      i. Renal insufficiency 44
      ii. Emesis 170
      iii. Anorexia 74
      iv. Lethargy 83
      v. Death 113
   b. Events per 1 million oral NSAIDs administered to CATS
      i. Renal insufficiency  122
      ii. Emesis  254
      iii. Anorexia  180
      iv. Lethargy  172
      v. Death  164

5. New NSAIDs for Dogs
   a. Onsior injectable
      i. Injectable same for dogs and cats
      ii. Refrigeration required
      iii. Use within 12 weeks of broaching vial
      iv. 2 mg/sq
      v. Maximum use 3 days
   b. Onsior Tablets
      i. 2 mg/kg
ii. Indicated for post-surgical pain
iii. Maximum 3 days
iv. Fast absorption
   1. Tablets 30-60 minutes
   2. SQ 1-2 hours
v. Rapid Clearance
   1. Tablets 1 hour
   2. Injection 1-4 hours
vi. Onsior persists longer at the site of inflammation than in the blood, so mechanism of action is 24 hours despite short clearance time
vii. Efficacy
   1. Injectable p=0.0055
   2. Tablets p=0.0188
   3. P value < 0.05 is good
viii. Adverse Reactions
   1. Similar to all NSAIDs, diarrhea, vomiting, decreased appetite
c. Galliprant (Grapiprant)
   i. Classified as a “Non-COX inhibiting NSAID” by the FDA
      1. Actually belongs to its own class, the piprants
   ii. Inhibits the EP4 receptor which is responsible for pain
      1. NSAIS block the entire COX pathway
   iii. Tested in dogs, without significant pathology other than OA
   iv. AE’s
      1. Vomiting and diarrhea more common in grapiprant than in NSAIDs
         a. However most resolved within a few days and without intervention
         b. No further AE’s developed (i.e ulcer or gastric perf)
         c. Was given at 15 times the package dose daily for 9 months, no dogs developed an ulcer or gastric perforation
      2. Efficacy
         a. P=0.0315

6. Chronic Use of NSAIDS in Cats
   a. Not approved for long term use in cats in the U.S.
   b. Mode of Action in Cats
      i. Like dogs, inhibits COX
      ii. Metabolism of Meloxicam
         1. Oxidation, which is a good thing. More reliable in cats than glucoronidation
         2. Half-life about 24 hours but variable from cat to cat
      iii. Metabolism of Robenacoxib (Onsior)
         1. Degrades to form y-lactam
            a. Extensively metabolized by liver
         2. Half-life is 1 ½ hours
            a. Persists in tissues longer
c. Approved use
   i. Meloxicam single injection
   ii. Onsior 3 days
d. Potential problems with long-term administration
   i. Dosing: Label dose of meloxicam is not appropriate for long-term administration
   ii. Half-life in meloxicam is near or exceeds 24 hours
      1. Can be cumulative at higher doses

7. Why chronic use in cats?
   a. Transitional Cell Carcinimal
   b. Degenerative Joint Disease
      i. High prevalence of DJD
         1. Lascelles study showed 92% rate of OA in cats from 6 months to 20 years

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8. Treatment of OA in cats
   a. Clinicians scared away
      i. Potential for toxicity
      ii. Off label Use
      iii. Black Box warning
   b. AAFP Guidelines
      i. Before starting any cat on a long term NSAID perform PE, Blood Pressure, CBC, Blood Chemistry, Urinalysis
      ii. Routinely monitor the patient every 3-6 months
      iii. Base dose on lean body mass
      iv. Give drug with or after food
      v. Feed moist food to insure good fluid intake
      vi. Educate owners on potential side effects
      vii. Stop drug if cat stops eating
      viii. Titrate to lowest effective dose
      ix. Reduce the dose if other drugs are being used
      x. Never give with corticosteroids
   c. Cats with renal disease
      i. Renal disease in cats has an inflammatory component
      ii. Most cats with renal disease will benefit from the administration of meloxicam, both pain and renal function
1. Philosophy of the pain practice
   a. As much a state of mind as it is about a set of skills
   b. The Five Freedoms
      i. Freedom from thirst, hunger and malnutrition by ready access to fresh water and a diet to maintain full health and vigor
      ii. Freedom from discomfort by providing a suitable environment including shelter and a comfortable resting area
      iii. **Freedom from pain, injury and disease by prevention or rapid diagnosis and treatment**
      iv. Freedom to express normal behavior by providing sufficient space, proper facilities and company of the animal’s own kind
      v. Freedom from fear and distress by ensuring conditions that avoid mental suffering
   c. Euthanasia is the last pain treatment not the first
      i. Hospice is an option
      ii. People do get angry and will go elsewhere. But if enough of us say “no” the message will get across

2. Consideration of Pain in Animals
   a. Common pain misconceptions
      i. My dog doesn’t cry out, he isn’t in pain
      ii. My pet is just old
      iii. Animals don’t feel pain like we do
      iv. There is nothing we can do
      v. Post-op pain is a benefit
      vi. OHE’s, neuters and minor procedures don’t need pain meds
      vii. It is too dangerous to give sick and debilitated animals pain medication
      viii. My clients won’t pay for “that.”

3. A Pain Practice means a team approach
   a. Every person on staff needs to be on board
      i. If they are not, clients can tell
   b. Receptionist
      i. Should be handing out a chronic pain survey to every animal that is 6 years or older and walks into your door
      ii. Should be handing out the same questionnaire whenever a client voices a pain concern
   c. Technician and assistants
      i. Don’t underestimate their power of observations
   d. Kennel Help
      i. Sometimes they are the only ones that see an issue when the animal lets it’s guard down

4. Chronic Pain Questionnaire
   a. Many signs of pain not observable in clinical situation
      i. People write it off as “age”
   b. Use questionnaires designed for chronic pain, not acute pain
   c. If you get answers that you cannot reconcile with your own observations, go over the survey with the owners.

5. The Pain Exam
   a. Observe for gait abnormalities
      i. Take the time to walk the dog on a non-slip surface, often that means a parking lot or sidewalk
   b. Exam room
      i. Choose your quietest room
      ii. Consider a non-slip floor
         1. Elephant bark
      iii. Exam best done on the floor, not the table
         1. Small dogs cats and aggressive dogs may need a table
iv. Make it easy to get to the exam room
   1. If you have slippery tiles, roll out a carpet or a roll of yoga mat

6. The Pain Patient
   a. Examination techniques will vary based on the number of modalities you are familiar with
   b. Range of motion
      i. The flexion and extension of a joint
      ii. Normal ranges and “end feels” of the joint can be hard to determine unless you have rehab experience. Even still, if you look at the painful limbs of every dog, you will start to learn normal and abnormal feels
   c. Cruciate disease
      i. Learn the anterior tibial thrust technique to look for partial tears of the CCL
      ii. Look for medial buttressing in the cases of chronic rupture
   d. Myofascial exam. One of the most important exams to look for underlying pathology
      i. Really a two day lecture
      ii. In a nutshell, constant overuse of muscles because of underlying pathology will cause painful areas called trigger points to appear within a band of muscle
      iii. These areas are painful to palpation and only the most stoic dog will not react to firm palpation of the muscle.
      iv. These trigger points are almost always a symptom of underlying pathology. Finding them and having the owners see the dog’s reaction to palpation will invariably convince the owner that further diagnostics are necessary
   e. Direct digital pressure on joints
      i. Usually unrewarding unless there is joint infection or osteosarcoma
   f. Age should be considered when looking for an etiology
      i. Young dogs congenital disease and trauma
      ii. Old dogs, acquired disease and trauma
   g. Radiology. If you don’t look, you won’t know. Many cases of CCL have the precipitating cause of an osteosarcoma. Always radiograph suspect areas of pain
   h. Blood Work is necessary to look for concomitant issues and should always be done BEFORE the start of long term NSAID therapy
   i. Cats. History becomes more important and conversations about what the cat used to be able to do compared to what it can do now are essential
      i. History
         1. Jumping
         2. Sleeping
         3. Grooming
            a. Self grooming and being brushed can be painful
         4. Being picked up and held by the owner
      ii. Distant observation. Hair coat, mats, spindly legs
      iii. Palpation

7. Don’t forget other conditions
   a. Neurological conditions can mimic pain
   b. Neuropathic pain
      i. See notes on neuropathic pain lecture

8. Treatment Goals and Outcome measures
   a. The key to success
   b. If you don’t ask what they hope to achieve, how can you even start treatments
      i. If you think YOU did everything right but you didn’t get to the owner’s goal, they will be unhappy
   c. Ask the owner what they hope to accomplish
      i. Discuss if their desire is reasonable
      ii. Give time frame for re-evaluation
         1. This enlists the owner as part of the pain team and gets them to work with you.
      iii. Fill out the pain questionnaire at regular intervals and compare results.

9. Finding Pain Patients
   a. Satisfied clients will be the #1 source of pain referrals
b. Veterinary referrals
   i. Most veterinarians will not refer
      1. Afraid of losing clients
      2. Think that having three NSAIDs and two glucosamine products on the shelf make them pain vets

c. Dedicated pain website.
   i. Include testimonials, written or video
   ii. Services
   iii. General pain information

10. Learn new skill sets
    a. Acupuncture
    b. Rehabilitation
    c. Become a Certified Veterinary Pain Practitioner with the IVAPM
    d. Learn Myofascial pain diagnostic and treatment techniques (www.myopainseminars.com)
    e. Attend Pain seminars
       i. Listing on www.ivapm.org

11. Learn when to admit you are in above your head and refer. Working with a pain veterinarian, like working with an internist or ophthalmologist only instills confidence with your clients.
The Use of Cannabidiols for the Treatment of Pain
Michael Petty, DVM, CVPP, CVMA, CCRT, CAAPM
Animal Pain Center
Canton, MI

1. Hemp v Marijuana
   a. Marihuana
      i. High THC (5-30+%), low CBD
      ii. No known use in veterinary medicine
   b. Hemp
      i. Low THC, (<0.3%) high CBD, other cannabinoids and terpenes
      ii. Suggested uses in veterinary medicine

2. Both Marijuana and Hemp
   a. Medicinal, rope, cloth, canvas, paper and traditionally used for caulking ships

3. Marijuana
   a. Schedule I
   b. Can’t prescribe in veterinary medicine
   c. Research largely prohibited
      i. Federal regulation

4. History
   a. China
      i. Evidence of use as long ago as 5000 years
   b. Book of Exodus 30:23
      i. Moses was instructed by God to use hemp
   c. Egyptians
      i. Evidence of use 3500 years ago
   d. Indians (Atharvaveda)
      i. 3000 years

5. Mechanism of Action
   a. Endocannabinoid system THC
      i. Receptors in the brain and PNS
   b. Physiological effects
      i. Appetite
      ii. Pain
      iii. Nausea
      iv. Mood
      v. Inflammation
   c. Endocannabinoid Receptors CBD
      i. Mostly in the PNS
      ii. Especially immune system
      iii. In CNS as well
   d. THC and CBD
      i. Deeply involved in communication or neurotransmission
      ii. Act as modulator; telling some transmissions to speed up and others to slow down
      iii. Purpose it to return the body to a normal state

6. So why CBD?
   a. Was probably the active ingredient in marijuana that made it work
   b. Not psychoactive
   c. Higher safety levels than THC
   d. Many attributes given to CBD

7. Client Attitudes
   a. Are they using it?
      i. Many people that visited the Canna-Pet website bought it
   b. Why do they use it?
      i. Pain
      ii. Sleep aid
      iii. Anxiety
      iv. Nervous system support
      v. Reduce inflammation
      vi. Seizures
      vii. Nausea
c. Perceived Problems with use
   i. Increased appetite  
   ii. Lack of Energy  
   iii. Panic Reactions  
   iv. Dry mouth  
   v. Sedation  
   vi. Nausea  
   vii. Increased Seizures  

d. How did it stack up compared to conventional medications?  
   i. Better than any 19.3%  
   ii. Better than most 24.7  
   iii. Better than some 18.4%  
   iv. As well as some 20.8%  
   v. As well as most 9.3%  
   vi. Worse than many 2.8%  
   vii. Worse than any 2.6%  
   viii. Worse than most 2%  

8. Safety  
   a. Over 1000 research papers on CBD  
      i. Most all are human  
   b. CBD found to be non-toxic  
   c. Rare side effects  
      i. Possible interference with cytochrome P450  
      ii. Ivermectin? Discontinue CBD for 2-3 days  
   d. Not addictive, actually anti-addictive  
   e. In humans can be used as adjunct treatments to addictions such as tobacco, alcohol, opiates

9. Evidence  
   a. Mostly from human research  
   b. Anecdotal in animals  
   c. Anxiety  
   d. Stress areas of brain (e.g. amygdala) are rich in CBD receptors  
   e. Noise aversion  
   f. Separation anxiety  
   g. Fear of strangers  
   h. Cognitive Dysfunction

10. CBD’s in particular  
   a. Cognitive Dysfunction  
   b. Neuroprotective  
   c. Anti-inflammatory  
   d. Antioxidants  
   e. Regenerate new neurons in the part of the brain responsible for memory and can improve memory.  
   f. Autoimmune disorders  
      i. Autoimmune thyroiditis  
      ii. Immune Mediated Hemolytic Anemia  
      iii. Immune Mediated Thrombocytopenia  
      iv. Pemphigus  
      v. Lupus  
   g. Bone Health  
   h. Helps Heal Fractures  
   i. Cancer  
      i. Manage signs of cancer  
      ii. pain  
      iii. nausea  
      iv. Reduce inflammation  
      v. Induce cancer cells to die  
      vi. Slow cancer growth  
      vii. Inhibit neovascularization of tumors  
      viii. Protect non-cancerous cells  
   j. Inflammatory Bowel Syndrome  
      i. Reduces mobility and inflammation  
   k. Degenerative Myelopathy  
      i. No evidence in dogs
1. Works well in ALS
   l. Glaucoma
      i. Actual cat study!
         1. Unfortunately they used CBG cannabigerol
         2. Relieves pressure
   m. Degenerative Joint Disease
      i. Reduces inflammation and pain
      ii. Inhibits release of TNF
   n. Inflammation is the underlying basis of a number of diseases
      i. Pain suppression through attaching to receptors in parts of the brain responsible for pain reception
   o. Reduction of neuropathy
11. Endocannabinoid Deficiency Syndrome
    a. For some animals, there may be a problem where the endocannabinoids fail to do their job
    b. Supplementation may help
    c. Acupuncture has been shown to help as well
12. Sources of CBD
    a. Hemp plants absorb heavy metals, toxins and radiation from the soil at a high rate
    b. China produces 1/4 of the world's hemp
       i. Very high percentage has heavy metal contamination
    c. US hemp is high quality but not allowed to be used commercially
    d. European hemp is the best and safest option
13. Production of Hemp
    a. Cold Press extraction produces low CBD
    b. CO2 extraction is best
       i. Most effective and safest extraction method
       ii. Similar to decaffeinating coffee
       iii. Expensive method
Myofascial Pain Therapy and Massage for Successful Surgical and Pain Treatment Outcomes
Michael Petty, DVM, CVPP, CVMA, CCRT, CAAPM
Animal Pain Center
Canton, MI

1) 3 Abbreviations and Definitions
a) MPS Myofascial Pain Syndrome
b) MTrP Myofascial Trigger Point
   i) A contracted region of muscle
c) TB Taut Band
   i) The band of muscle which is tight because of the MTrP

2) DN Dry Needling
a) The invasive method by which MTrP’s are treated, using an acupuncture needle

3) Twitch Response
a) An involuntary muscle reaction that occurs as a result of dry needling. Involves spinal pathways.

4) History of Muscle Pain
a) Janet Travell
   i) Cardiologist in the 1940’s
   ii) Took a strong interest in the amount of muscle pain seen in many of her cardiology patients
   iii) Rediscovered myofascial pain
   iv) Along with David Simons wrote the Trigger Point Manual
      (1) Still used as text today
b) Interest has slowly but steadily grown in the human field
   i) Barely known in the veterinary field
c) Past History
   i) French physician Guillaume de Baillou (1538-1616) published book on “muscular rheumatism”
   ii) Thomas Sydenham (1624-1689) published book in 1676 that included description of MPS
   iii) British Physician Balfour (1816) wrote: “Patients as having a large number of nodular tumours and thickenings which were painful to the touch and from which pain shot to neighbouring parts”

5) Has been called….
a) Fibrositis (Gowers, 1904)
b) Fibromyositis (Telling, 1911)
c) Myofascitis (Albee, 1927)
d) Myofibrositis (Murray, 1929)
e) Perineuritis (Clayton & Livingstone, 1930)
f) Idiopathic myalgia (Gutstein-Good, 1940)
g) Rheumatic myalgia (Good, 1941)
h) Myofascial Pain Syndrome (Travell, 1948)
i) Myodysneuria (Gutstein, 1955)
j) Fibromyalgia (Yunus, 1977)

6) Trigger Point Development
a) Primary
   i) Acute injury after trauma
   ii) Chronic muscle overload
   iii) Poor mechanics
   iv) Repetitive movements

7) Secondary Causes: Most common
a) Underlying disease or inflammation from any chronic painful condition
b) Even when the primary cause is not muscular, central excitatory effects tend to expressed in the muscles, making this a frequent complication accompanying other sources of pain
c) Satellite MTrPs: Primary trigger points may cause or may induce and maintain referred pain in the form of satellite
   i) MTrP’s elsewhere.
   ii) Example of Satellite MTrP from Human literature
      (1) Pain from MTrPs in the upper trapezius may induce and maintain MTrPs in the anteror temporalis or masseter muscle
      (2) Dry needling of the trapezius can reduce the irritability of satellite MTrPs
d) Stress
   i) It is known that stress can activate trigger points in humans.
   ii) In animals??

8) Characteristics of Muscle Pain
a) Human description
   i) Usually a cramp or an ache, sometimes hard to localize.
   ii) Animals cannot tell us
b) Cortical structures unique to muscle pain are activated
   i) Inhibited more strongly than other types of pain by descending pain modulating pathways
c) Activation of muscle nociceptors are much more effective than other types of nociceptors at inducing changes in the spinal cord’s dorsal horn

9) 3 Types of electrical contractility
   a) Normal
   b) Abnormal
   c) Pathological
      i) More on this later

10) Acetylcholine (ACh) is necessary for all contractures, normal, abnormal or pathological
    a) Increased ACh action can be present for a variety of reasons
       i) Lack of acetylcholinesterase
       ii) Sensitized receptors
       iii) Excess ACh
       iv) Low pH
    b) Excess calcitonin gene related peptide

11) Action Potential
    a) Release of acetylcholine causing an impulse via T tubule and release of Ca++ into the sarcoplasmic reticulum

12) Contraction
    a) Ca++ binds to troponin and exposes active site of actin
       i) Allows bridge between myosin and actin to form
    b) ADP released
    c) ATP necessary to detach the myosin-actin bridge

13) Pathophysiology
    a) There are several components that make up the pathophysiology of the trigger point. They are:
       i) The Motor Endplate Component
          (1) The motor endplate is the place where alpha motor neurons synapse with target muscle fibers
          (2) These neurons cause the release of acetylcholine (ACH) which through a cascade of reactions causes myosin and actin to bind causing sarcomere contraction
          (3) A decrease in acetylcholinesterase results in the inability of the contraction to “release.”
       ii) The Motor Component
          (1) Muscle contraction compresses local sensory nerves, which reduces the axoplasmic transport of molecules that normally inhibit ACH release
          (2) Muscle contraction also compresses local blood vessels resulting in a decrease in oxygen at a time when the muscle contraction requires an increase in the amount of oxygen
          (3) This results in a rapid depletion of ATP resulting in an energy crisis ATP is needed to turn off ACH release. This results in a vicious cycle of continued muscle contraction and ATP depletion
       iii) Sensory Component
          (1) Micro-sampling from within the MTrP revealed elevated concentrations of inflammatory substances: protons, bradykinin, serotonin, substance P, norepinephrine, tumor necrosis factor and interleukin-1b
          (a) Persistent barrage of nociceptive signals from MTrPs may eventually cause central sensitization leading to allodynia or hyperalgesia
          (b) These changes can become permanent
       iv) Autonomic Component
          (1) Autonomic phenomena associated with MTrPs may include vasoconstriction/vasodilation and pilomotor activity.
          (2) The autonomic nervous system may indirectly exacerbate MTrP formation via viscerosomatic reflexes.
             (a) Again, another reflex arc where MTrPs stimulate the ANS which causes disturbances in the viscera which then can increase the central sensitization

14) Theory to Therapy
    a) Deep digital pressure? Only increases compression and worsens the condition
    b) Affected muscles that cross an articular surface can reduce the functionality of that joint via decreased muscle length
    c) Constant pressure on the joint increases sensitization which then sends constant nociceptive signals to the CNS which responds with further activation of the MTrPs
    d) Needling with botulinum toxin type A prevents release of ACh
    e) Dry needling in animals is very effective

15) Why that muscle?
    a) The Cinderella Hypothesis
       i) Works on the idea that within any muscle, certain fibers are always the first recruited during contraction and the last released during relaxation
ii) This is very significant during activities that do not require full muscle contraction, but only subtle contraction
   iii) e.g. Chronic cruciate rupture or hip dysplasia results in very slight and subtle contraction to take just a little weight off
       the affected leg.

16) What is a trigger point?
   a) Not all trigger points are active.
      i) We have latent trigger points, either through lack of a triggering event or because it has been treated
   b) A trigger point is an area of disturbed motor function
      i) As described in the previous slides, there are areas of unrelenting myosin and actin binding
      ii) This results in the “taut band” an area of muscle fibers that are abnormally shortened and which mechanically impair
           the action of the muscle AND reduces joint space in the joint the muscle crosses resulting in restricted range of motion

17) Biochemical changes in trigger points
   a) Shah J, Phillips T M, et al. analyzed substances within a trigger point
   b) Use of a microdialysis needle capable of continuously collecting extremely small samples of physiological saline after
      exposure to the trigger point
   c) Findings
      i) Protons
      ii) Bradykinin
      iii) Calcitonin gene-related peptide
      iv) Substance P
      v) Tumor necrosis factor -Alpha
      vi) Interleukin -1 beta
      vii) serotonin
      viii) norepinephrine

18) Muscle weakness
   a) Results because of the disturbed motor function
   b) Vasoconstriction often results secondary to the muscle compression of the taut band but can be an autonomic response
      i) This happens at a time when the muscle needs MORE oxygen to generate ATP molecules

19) Pain
   a) The affected muscle is painful
   b) Referred pain may be present
   c) Muscle cramps can be induced by irritation of the latent MTrPs
      i) Glutamate injected into both latent trigger points and into normal muscle
         (1) Normal muscle had zero muscle cramps
         (2) Trigger point injections resulted in 93% of the muscles having cramps
         (3) Pain propagation of MTrP after glutamate
      ii) Mechanical stimulation of latent MTrP
      iii) Pain propagation to latent MTrP

20) What causes Trigger Points in the clinical setting?
   a) Mechanical Stresses
      i) Most common perpetuating factor in dogs
   b) Chronic Muscle Overload
      i) Contributes to the muscle mechanisms that develop taut bands by different causes all which can result in:
         ii) Low level sustained muscle contractions
         iii) Direct trauma
         iv) Eccentric muscle contractions
         v) Submaximal concentric muscle contractions
         vi) Maximal concentric contractions
   c) Orthopedic Injury
   d) Post Operative surgical trauma and pain
   e) Neuropathy
   f) Joint dysfunction
   g) Acute Trauma
      i) Acute trauma may activate MTrPs but does not perpetuate them. Sudden activation of muscles resulting in
         (1) Muscle strain
         (2) Joint sprain
      ii) Fractures
      iii) Direct trauma
      iv) Excessive or unusual exercise
      v) Acute trauma seen most commonly in
         (1) Performance dogs
         (2) Hit by car
         (3) Falls of any kind
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(4) “Weekend Warrior”

h) Osteoarthritis
   i) Osteoarthritic joint dysfunction will lead to postural changes
   ii) Postural changes result in muscle mechanisms causing
   iii) Low level muscle contraction
   iv) Eccentric muscle contraction
   v) Unaccustomed muscle contraction

21) Visceral somatic Pain
   a) It is known in humans that visceral pain will perpetuate MTrPs in the area of referred pain
   b) Dorsal horn of spinal cord receive input from viscera and from receptors in the skin and deeper tissues
   c) Muscle pain due to visceral nociceptive activation of dorsal horn probably causes MTrPs in dogs as well
      i) Disease organs and nerves can manifest themselves in both skin and muscle problems
      ii) Occasionally I see dogs that have MPS for no apparent reason but they also have Inflammatory Bowel Syndrome

22) Nutritional Inadequacies
   a) In humans
      i) Cobalamin and folate is a perpetuating factor
      ii) Not known to cause issue in dogs
         1) But: Often present in bowel disease in dogs which often have concurrent MPS
         2) Possible future link?
      iii) Iron deficiency
         1) Recognized as a perpetuating factor in people
         2) No evidence in dogs as of yet

23) Metabolic
   a) Hypothyroidism in humans causes
      i) Muscle pain and weakness
      ii) Cramps
      iii) Pain
      iv) Not known to cause MTrPs in dogs

24) Nerve impingement
   a) Peripheral nerves
   b) Spinal
      i) MTrPs are formed in the extremity corresponding to the involved spinal cord segment

25) Stress
   a) Stress and tension in humans can cause trigger points to form.
      i) How do we measure this in dogs?

26) Neurologic Conditions
   a) There can be postural changes and weight shifting brought about by any neurologic dysfunction
      i) Mechanical stresses result
      ii) Eccentric contractions
      iii) Unaccustomed concentric contractions
      iv) Low level sustained contractions
   b) Development of MTrPs in muscles innervated by injured or damaged nerves
      i) Action potentials are generated at the site of compression in both directions
   c) Radiculopathy
      i) Most common in thoracic limb
      ii) Usually a C6-T2 spinal cord injury causing MTrPs in long head of triceps

27) Treatment Techniques and Patient Evaluation
   a) Principals of Management
      i) Identify and control perpetuating factors
         1) Then and only then apply specific trigger point therapies
      ii) Treating the trigger points without treating the causes will result in temporary pain relief at best
   b) In Veterinary Medicine….
      i) Dry needling seems to be the most efficacious treatment in veterinary medicine
      ii) Palpation of taut bands just requires practice
      iii) Needling technique is different than needle placement for acupuncture
   c) Steps in Finding and Treating MTrPs
      i) Palpate muscles to locate taut bands and trigger points
      ii) Look for all of classic signs of painful palpation. Depends on dog and personality...licking lips, turning and looking, vocalization, jump, menace response
   d) Dry needling the points
      i) Twitch response is the desired response to treatment
      ii) Don’t confuse with a jump response, the animal voluntarily reacting to the painful palpation

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You cannot feel the trigger point itself. You are looking for the taut band of muscle.

You might find the trigger point by palpating along the taut band: The taut band is painful. The trigger point is very painful.

Humans can report referred pain from palpation of the trigger point.

Client Education

a) Most veterinarians don’t know about MPS, even more true of your clients.

b) Explain role of perpetuating factors.

c) Always form a treatment outline and the rationale and expected outcome measures.

d) Enlist the owners help to modify the animal’s environment or routine.

e) Explain importance of schedule, medications, exercises, etc. etc.

f) I try as hard as possible to make the next appointment before the client leaves my office.

g) Usually weekly to start.

The veterinarians role

a) Identify and treat perpetuating factors.

b) Apply specific therapies as indicated (DN, medication, acupuncture, etc).

c) Re-evaluate patient about every three weeks and reconsider diagnosis of perpetuating factors if poorly responsive.

Palpation

4 kg of pressure on a muscle should not be painful.

i) If it is, then it is probably a trigger point.

b) Algometer.

i) Works great in people. Dogs quickly learn to think that the algometer is causing the pain.

c) Palpation Techniques.

i) For most muscles, a pincer technique is used.

   (1) No matter the technique, never apply more than 4 kg of pressure.

ii) For muscles such as the triceps that can be grabbed.

iii) Single finger or flat hand palpation.

   (1) For muscles that don’t lend them selves to “grabbing”

   (2) Infraspinatus, tensor fascia latae.

iv) Spade hand palpation.

   (1) Iliopsoas.

Dry Needling

a) You know you have got the spot when you get a localized twitch response.

   i) This is actually a spinal reflex.

b) MTrPs are often clustered together. You keep pecking away at the same spot over and over. I find it very common to get 15-20 twitch responses in the same spot.

   i) The same needle can be re-sheathed and used over and over until it starts to feel dull or bend.

c) Dry needling also causes micro trauma, increased local blood flow helping to relieve the energy crisis and release of inflammatory agents.

d) Muscles with taut bands feel different than normal muscles when you put a needle in them. There is a heavy “clay” feel to the muscle. Some people describe it as feeling “gritty.”

e) Accurate needle placement produces a twitch response. The needle is moved in and out of the MTrP until the twitches stop.

Other Treatment Techniques

a) Massage.

   i) Massage brings some instant relief to any trigger point.

   ii) The relief is temporary compared to dry needling.

   iii) Twitch response is seldom attained.

   iv) Massage compresses muscles.

   (1) These muscles are already compressed along with blood vessels.

v) Massage further moves blood from the muscle...all at a time when there is low blood flow, low oxygenation of the tissue and lack of ATP.

vi) Does it make it worse in the long run?

b) Stretch.

   i) Stretching the muscle provides relief from trigger points.

   ii) It usually involves a “spray and stretch” technique wherein a coolant is sprayed on the skin and the affected muscle is then stretched.

   (1) The coolant is really just a distraction for the patient.

   (2) Just as in dry needling, a twitch response should occur.

   iii) As in massage, I question the wisdom of muscle compression when the muscle is already compressed, along with blood vessels.

   iv) This technique (without the coolant) is mostly used by physical therapists working with animals.

c) Procaine Injections.

   i) Local anesthetic injected into trigger points allows longer periods of time between treatments.
ii) It is necessary to know exactly where the trigger point is, not practical to inject procaine along the length of every taut band.
   (1) In humans, this is easy because they can tell you when you are exactly on the most painful “spot.”
   (2) We can’t get the same feedback in dogs
   (3) I don’t know of anyone who is using it in animals

d) Botulinum Toxin Injections
   i) Not used in veterinary medicine
   ii) As in the case of procaine injections, it is easy to identify the taut band in the dog, but unlike in people, it is difficult to impossible to identify the most painful trigger point
   iii) Doesn’t allow for treatment of key points
   iv) Toxic doses of botox can occur trying to treat all painful points
   v) In theory, injection of a trigger point with botox would inactivate it for several months
   vi) The U.S. Food and Drug Administration has approved the use of botox for migraine headaches that are the result of MPS
   vii) There is not strong evidence for the use of botox outside of migraine treatments.
   viii) More due to lack of good studies, lots of clinical evidence of its effectiveness.

33) Massage Techniques.
   a) There are three techniques of massage.
      i) Pettrissage
      ii) Effleurage
      iii) Tapotement
   b) I recommend the book Medical Massage by Narda Robinson to learn these techniques
   c) Massage is one of the oldest forms of manual therapy used to employ pain relief.
   d) Common treatment
      i) Muscle Damage
      ii) Degenerative Myelopathy
      iii) Pain and relaxation, especially in cancer patients
What is pain?
Pain has been called the “fourth vital sign” after body temperature, heart rate, and respiratory rate, and its potential presence should be evaluated in patients just as the other vital signs. (Goldberg, 2010) (AAHA Task Force, 2011) Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage. (IASP, 2009) Pain motivates us to withdraw from potentially damaging situations, protect a damaged body part while it heals, and avoid those situations in the future. (Lynn, 1984) It is initiated by stimulation of nociceptors in the peripheral nervous system, or by damage to or malfunction of the peripheral or central nervous systems. (Woolf and Mannion, 1999) Most pain resolves promptly once the painful stimulus is removed and the body has healed, but sometimes pain persists despite removal of the stimulus and apparent healing of the body; and sometimes pain arises in the absence of any detectable stimulus, damage or pathology. (Raj, 2007)

Types of pain

Acute pain has been defined as pain that exists during the expected time of inflammation and healing after injury (up to 3 months). (Epstein et al, 2015) It generally associated with tissue damage or the threat of this and serves the vital purpose of rapidly altering the animal’s behavior in order to avoid or minimize damage, and to optimize the conditions in which healing can take place, stopping when healing is complete. Acute pain varies in its severity from mild-to-moderate to severe-to-excruciating. It is evoked by a specific disease or injury; it serves a biological purpose during healing and it is self-limiting. (Mathews et al, 2014)

Chronic pain persists beyond the expected course of an acute disease process, has no biological purpose and no clear end-point and in people, as well as having an effect on physical wellbeing, it can have a significant impact upon the psychology of the sufferer. Chronic pain may be considered a diseased state. (Mathews et al, 2014)

Neuropathic pain is defined as pain caused or initiated by a primary lesion, injury or dysfunction in the peripheral nervous system or central nervous system. (Mathews et al, 2014)

Nociceptive pain occurs when peripheral neural receptors are activated by noxious stimuli (e.g., surgical incisions, trauma, heat or cold). (Epstein et al, 2015)

Inflammatory pain results gradually from activation of the immune system in response to injury or infection. (Epstein et al, 2015)

Pathological pain, also called maladaptive pain, occurs when pain is amplified and sustained by molecular, cellular and microanatomic changes, collectively termed peripheral and central hypersensitization. (Epstein et al, 2015) Maladaptive pain, or the risk for it, can occur within a matter of minutes of certain acute pain conditions (e.g., nerve injury, severe tissue trauma, or presence of pre-existing inflammation).

Anticipate

In order to anticipate pain, we must first be able to recognize pain. Prior to categorizing procedural pain, let us first look at how do we know what we are seeing is pain?

Signs of pain and distress

There are numerous stereotypical responses to stress or pain stimuli in animals, particularly in mammals. Nevertheless, species differences do exist. Recognition of changes in behavior and physical appearance in the species under study will allow early identification of an animal experiencing pain or distress. As caregivers, humans may know that an event or situation is no threat, but the animal usually does not function with the same information base as humans. (Clark et al, 1997)

Dogs

Dogs in pain generally appear quieter, less alert, and withdrawn, with stiff body movements and an unwillingness to move. In severe pain, the dog may lie still or adopt an abnormal posture in order to minimize its discomfort. In less severe states, it may appear restless and the immediate response to acute, but low intensity pain may be an increased alertness. There may be inappetance, shivering, and increased respirations with panting. Spontaneous barking is unlikely; the dog is more likely to whimper or howl, especially if unattended, and may growl without apparent provocation. A dog may lick or scratch at painful areas of its body. When handled, it may be abnormally apprehensive or aggressive. The animal exhibits anxious glances; it seeks cold surfaces. Its tail is often between its legs. Penile protrusion and frequent urination may also be noted.

- Key Signs: inappetance, bites at pain regions, abnormally apprehensive.
**Cats**

Cats in pain are generally quiet, with an apprehensive facial expression; the forehead may appear creased. There may be crying or yowling and the cat may growl and hiss if approached or made to move. There is inappetance and a tendency to hide or to separate from other cats. The posture becomes stiff and abnormal, varying with the site of the pain. A cat with head pain may keep its head tilted. If the pain is generalized in the thorax and abdomen, the cat may be crouched or hunched. With thoracic pain alone, the head, neck, and body may be extended. In abdominal or back pain, the cat may lie in lateral recumbency with its back arched. If the animal is standing or walking, the back is arched and the gait stilted. Incessant licking is sometimes also associated with localized pain. Pain in one limb usually results in limping or holding up of the affected limb.

A cat in severe pain may show demented behavior and make desperate attempts to escape. If a painful area is touched or palpated, there may be an instant and violent reaction. There may be panting, with an increased pulse rate and pupillary dilatation. A cat in chronic pain may have an ungroomed appearance and show a marked change from its normal behavior. The animal exhibits tucked in limbs, hunched head and neck, and utters a distinctive cry or hissing and spitting sound. Its ears are flattened. It shows fear of being handled and may cringe.

- **Key Signs**: stiff posture, demented behavior, lack of grooming, hunched head and neck, inappetance.

**Recognition**

**Dogs**

- Is the pain acute, chronic or neuropathic? (type of pain)
- Where is the pain (anatomical location)?
- How long was the surgery (duration)?
- Are there medical problems with this pain (medical problem)?
- Is the injury large or small (extent of injury)?

Acute pain occurs commonly in dogs as a result of trauma, surgery, medical problems, infections or inflammatory disease. The severity of pain can range from very mild to very severe. The duration of pain can be expected to be from a few hours to several days. Objective measurements including heart rate, arterial blood pressure and plasma cortisol and catecholamine levels have been associated with acute pain in dogs; however, they are unreliable as stress, fear and anesthetic drugs affect them. Thus, evaluation of pain in dogs is primarily subjective and based on behavioral signs. (Mathews et al, 2014)

**Behavioral Indications of pain**

- change in posture or body position
- change in demeanor
- vocalization
- altered reaction to touch
- altered interaction with people (e.g. reduced interaction, aggression)
- altered mobility (e.g. lameness, reluctance to move)
- reduction in appetite

**Cats**

- We need to look at where is the pain (anatomical location)?
- How long did the surgery last? (duration)
- Does this at the hospital or patient’s home (the environment)?
- Is this particular cat have any co-morbidities or behavioral problems (individual variation)?
- Is the cat young/old or healthy/impaired (age, and health status)?

Cats should not be awakened to check their pain status; rest and sleep are good signs of comfort but one should ensure the cat is resting or sleeping in a normal posture (relaxed, curled up). (Mathews et al, 2014) In some cases cats will remain very still because they are afraid or it is too painful to move, and some cats feign sleep when stressed (Taylor and Robertson, 2004).

**Look at**

**Facial expressions and postures** - these can be altered in cats experiencing pain: furrowed brow, orbital squeezing (squinted eyes) and a hanging head (head down) can be indicators of pain. Following abdominal surgery, a hunched position and/or a tense abdomen is indicative of pain. Abnormal gait or shifting of weight and sitting or lying in abnormal positions may reflect discomfort and protection of an injured area. Comfortable cats should display normal facial expressions, postures and movement after successful analgesic therapy. (Mathews et al, 2014)

**Behavioral changes associated with acute pain in cats** - reduced activity, loss of appetite, quietness, hiding, hissing and growling (vocalization), excessive licking of a specific area of the body (usually involving surgical wounds), guarding behavior, cessation of grooming, tail flicking and aggression may be observed. Cats in severe pain are usually depressed, immobile and silent. They will appear tense and distant from their environment. (Mathews et al, 2014)
Dysphoria versus pain - thrashing, restlessness and continuous activity can be signs of severe pain in cats. However, these can also be related to dysphoria. Dysphoria is usually restricted to the early postoperative period (20–30 minutes) and/or associated with poor anesthetic recoveries after inhalant anesthesia and/or ketamine administration and/or after high doses of opioids. Hyperthermia associated with the administration of hydromorphone and some other Opioids may lead to anxiety and signs of agitation in cats. (Mathews et al, 2014)

Assess

Pain measurement tools

Pain measurement tools should possess the key properties of validity, reliability and sensitivity to change. Few of the scales available for use in dogs have been fully validated. Simple unidimensional scales, including the Numerical Rating Scale (NRS), the Visual Analogue Scale (VAS) and the Simple Descriptive Scale (SDS) have been developed.

<table>
<thead>
<tr>
<th>Resource</th>
<th>Internet Address</th>
<th>Content</th>
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</thead>
<tbody>
<tr>
<td>Colorado State University Canine Acute Pain Scale</td>
<td><a href="http://www.csuanimalcancercenter.org/assets/files/csu_acute_pain_scale_canine.pdf">www.csuanimalcancercenter.org/assets/files/csu_acute_pain_scale_canine.pdf</a></td>
<td>Psychological and behavioral indicators of pain Response to palpation</td>
</tr>
<tr>
<td>Colorado State University Feline Acute Pain Scale</td>
<td>csuanimalcancercenter.org/assets/files/csu_acute_pain_scale_feline.pdf</td>
<td>Same as above</td>
</tr>
<tr>
<td>University of Glasgow Short Form Composite Measure Pain Score</td>
<td><a href="http://www.newmetrica.com/cmps">www.newmetrica.com/cmps</a></td>
<td>Clinical decision-making tool for dogs in acute pain Indicator of analgesic requirement Includes 30 descriptors and six behavioral indicators of pain</td>
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</tbody>
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Table 2 Multifactorial clinical measurement instruments for chronic pain (taken from Epstein et al, 2015)

<table>
<thead>
<tr>
<th>Measurement Instrument</th>
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<tr>
<td>Helsinki Chronic Pain Index (HCPI)</td>
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<tr>
<td>Canine Brief Pain Inventory (CBPI)</td>
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<tr>
<td>Cincinnati Orthopedic Disability Index (CODI)</td>
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<tr>
<td>Health-Related Quality of Life (HRQL)</td>
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<tr>
<td>Liverpool Osteoarthritis in Dogs (LOAD)</td>
</tr>
<tr>
<td>Feline Musculoskeletal Pain Index (FMPI)</td>
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Chronic pain indices usually incorporate input and observations from the pet owner.

Alleviate

Let’s look at the definition of Alleviate. (www.Vocabulary.com)

1. The act of reducing something unpleasant (as pain or annoyance).
2. The feeling that comes when something burdensome is removed or reduced.

Pharmacologic

Some important concepts have been adopted in management of pain over the last decade: pre-emptive analgesia; preventive analgesia; and multimodal analgesia.

Pre-emptive analgesia

If analgesics drugs can be administered prior to the onset of noxious stimulation, they will prevent the hypersensitivity that may occur at the site of tissue damage, and also that which occurs within the central nervous system. (Flaherty, 2013) The drugs must be administered at an appropriate dose (i.e. adequate to reach therapeutic concentrations) and also sufficiently in advance of the noxious stimulus being applied so that they have time to reach their peak effect. In trauma situations, it may not be possible to get this “jump” on preventing pain. For those cases, it is important that analgesic therapy is started as soon as possible, and in a sufficient dose so that further wind-up of the central nervous system is lessened. (Woolf and Wall, 1986)

Preventive analgesia

Preventive analgesia is defined as ‘an attempt to block pain transmission prior to the injury (incision), during the noxious insult (surgery itself), and after the injury and throughout the recovery period’. (Hurley and Adams, 2011) The aim is to prevent sensitization of the central nervous system by noxious stimuli throughout the period of tissue damage including post operatively. Adequate intra-
and post-operative pain relief is imperative, moving the emphasis away from focusing on preemptive analgesia, which is but one potential component of preventive analgesia. (Flaherty, 2013)

**Multimodal analgesia**

Multimodal analgesia is combining drugs from different analgesic classes, with each acting at different areas of the nociceptive pathways, to improve analgesia in the patient. Due to synergistic analgesic effects between different drug groups, there is the potential to reduce side effects since lower doses (of opioid drugs, in particular) are likely to be required. (Buvanendran and Kroin, 2009) Non-steroidal anti-inflammatory drugs (NSAIDs) have been shown to consistently reduce post-operative opioid consumption in humans (Buvanendran et al., 2003). Local anesthetic techniques have the potential to abolish nociceptive input to the CNS during the period of nerve blockade, producing profound analgesia of the innervated area. (Hunt, 2014) Intraoperatively, lidocaine can provide analgesia for 60-90 minutes. Drugs such as bupivacaine and ropivacaine produce a slower onset of analgesia (approximately 30 minutes) but analgesia may then persist for 4–6 hours. The evidence of an analgesic action of ketamine, given as a CRI at currently recommended doses, in dogs and cats is poor. (Murrell, 2014) However, intra-operative administration of ketamine (loading dose 0.5 mg/kg, CRI 10 μg/kg/min) can contribute to a balanced anesthesia technique and reduce the required concentration of volatile agent (Wagner et al., 2002). Recommended doses for postoperative analgesia are a 0.5 mg/kg bolus (slowly IV) followed by a CRI of 2–5 μg/kg/minute. The use of combinations of morphine (or another opioid) combined with ketamine and lidocaine to provide intra-operative analgesia and reduce the required concentration of volatile agent to maintain anesthesia in cats and dogs is increasing. (Murrell, 2014) The principle for the use of these combinations is application of multi-modal analgesia. The three drugs act on different receptors in the pain pathway and should provide more effective analgesia than when any single drug is administered alone. But, in cats, lidocaine CRI is not recommended because it causes significant direct hemodynamic depressant effects. (Pypendop and Ilkiw, 2005) It is common practice to combine all drugs in a single fluid bag and therefore deliver all drugs at a fixed rate and start and stop them at the same time. This practice, although easy, is not recommended. The stability of the three drugs in combination has never been established. Ideally, the drugs should be administered separately using three different infusion apparatus (e.g. infusion pumps). (Murrell, 2014) This allows the different drugs to be started and stopped independently, particularly in the postoperative period, where it is good practice to continue the opioid infusion for a longer time period than ketamine or lidocaine when weaning a patient off intensive multi-modal analgesia.

**Specific drugs**

**Simbadol**

A sustained-release formulation of buprenorphine (Simbadol) has recently been approved for use in cats. It is recommended that the product be given subcutaneously approximately 1 hour before surgery and then once every 24 hours for up to 3 days. 0.24 mg/kg SC q 24 h (Berry, 2015)

**Recuvyra**

Recuvyra from Elanco penetrates canine skin and is released for sustained action of 3-5 days. (Harvey, 2016) A long-acting topically applied form of fentanyl (Recuvyra) is approved for use in dogs, only. It is applied to the skin 2 to 4 hours before surgery with a needleless application system and dries rapidly. (Berry, 2015) A single application applied to the interscapular skin of beagles resulted in plasma concentrations consistent with analgesia 4 hours after administration and lasting for 96 hours. It should also be noted that the opioid antagonist naloxone was able to reverse the effects of overdose when administered at hourly intervals. (Freise et al, 2012) 2.7 mg/kg topical Duration is at least 96 h (Berry, 2015)

**Non-pharmacologic techniques**

Incorporating minimally invasive surgery and gentle intraoperative handling of tissues, reducing stress in the patient with gentle handling, and optimizing fluid therapy. Appropriate nutrition should be included to aid in healing and recovery. Cold therapy should be considered postoperatively because there is evidence that patients receiving cold compression therapy after orthopedic surgery exhibited decreased pain, swelling, and lameness during the first 24 hours after surgery. (Drygas et. al, 2011) Acupuncture and electroacupuncture may also reduce the need for systemic analgesics postoperatively. (Groppetti et al, 2011) Low-level laser therapy may also shorten the time to return to function. (Draper et. al, 2012)

**Comfort**

**Thermal support**

Anesthetics, other drugs and ambient environment of the operating room combine to cause profound changes in temperature control, heat production and heat dissipation. A body, being homoeothermic, has multiple mechanisms that sense temperature and maintain a constant set point temperature in the hypothalamic temperature-regulating center. Homeostasis is achieved by balancing heat production and heat loss. Heat production is adjusted by changes in metabolic rate mainly from voluntary muscle movement and shivering.

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Hypothermia
Heat loss occurs via radiation, evaporation, convection and conduction. (Kaplan, 1991)

- Radiation occurs via room temperature; loss from the body to the room
- Evaporation occurs via prep solutions and open body viscera
- Convection occurs from movement of cooler air over body surface – air conditioning = wind chill
- Conduction occurs between two surfaces in contact with each other = an example is a stainless steel table and an animal’s body surface.

Accidental Hypothermia has been studied. One study found that through use of a warm water circulating blanket canine patients were protected from accidental hypothermia. (Waterman, 1975) Based on published evidence, we can conclude several things: (Read, 2011)

a. small animal patients WILL become hypothermic under anesthesia
b. following anesthesia in people, there is an increased risk of death if patients are hypothermic
c. veterinary patients that are MORE prone to hypothermia (small patients, old patients) have an INCREASED risk of dying
d. nearly HALF of all anesthesia-related deaths in dogs and cats occur in the early postoperative period (first three hours)
e. veterinary staff are overwhelmingly UNAWARE of their patients’ temperatures during anesthesia and in the recovery period.

Veterinarians and their staff need to take better care of their surgical patients, and this starts with monitoring their patients’ temperatures more frequently, learning how to keep their patients warm during anesthesia, and instituting proven methods of temperature support appropriately based on scientific evidence, not outdated dogma.

Complications from hypothermia
- Metabolic activity is slowed and the action of injectable anesthetics may be prolonged.
- Inhalational agent needs are reduced by hypothermia and can result in a relative overdose.
- Coagulation factor activity and platelet function are decreased.
- Oxygen distribution to the tissues is disturbed and hypoxia can occur.
- Impaired immunologic function occurs and increased wound infections are documented.
- Severe hypothermia decreases cardiac output and increases myocardial irritability. Ventricular fibrillation can result.
- Upon recovery, shivering can increase metabolic oxygen requirements by 300%, at a time when the patient may be hypoventilating and not oxygenating well. Hypothermia and resultant shivering is a very unpleasant experience and is a common complaint from human patients.

Because geriatric animals have decreased thermoregulatory capacity, every effort should be made during the perianesthetic period to keep them warm with warmed fluids, circulating water blankets, and forced air warmers. (Carpenter, Pettifer, Tranquilli, 2005) Hypothermia occurs more readily in pediatric patients than in adults because of the greater surface area, minimum subcutaneous fat, and reduced ability to shiver. Providing a warm environment and maintaining the animal on a heat source during presurgery, intrasurgery, and postsurgery are essential. (da Cunha, 2015)

Monitoring protocol
- Normal body temperature of dogs and cats: 100 – 102.5°F (37.8 – 39.2°C)
- Mild hypothermia: 92 - 99°F (33.3 – 37.2°C)
- Moderate hypothermia: 82 - 92°F (27.7 – 33.3°C)
- Severe hypothermia: below 82°F (27.7°C)

Steps to safely reduce heat loss and re-warm hypothermic patients (Brock, 2009)
1. Place all anesthetized patients on circulating hot water heating pads.
2. Place a forced air warming device such as the Bair Hugger around the patient making sure that the device does not impede the surgeon or the anesthetist. My favorite is the tube shaped blanket that surrounds the animal while allowing me unimpeded visual access to the patient’s chest and abdomen for monitoring purposes. (The Hot Dog Patient Warming System – Veterinary, http://vetwarming.com/)
3. If a forced air device is not available, place warmed oat, bean or fluid bags around the patient, ensuring that they do not come in direct contact with the patient and do not impede breathing.
4. Prevent direct contact between the patient and any heat source that is not controlled by an accurate thermostat.
5. Practice low flow anesthesia.
Hyperthermia
The term hyperthermia relates to an elevation in body temperature above the normal range usually caused by an external source. The term pyrexia relates to an elevation in body temperature above the normal range, which is a physiological response of the body to infection, pain or an inflammatory process. (Pollock, 2009)

Factors that affect the patient
- Is the patient obese?
- Does the patient have a thick heavy coat?
- Is the patient pyrexic due to an existing condition, for example does the patient have sepsis or an inflammatory condition?
- Is the patient brachycephalic?
- Specific medications used in anesthesia

All these things could contribute to an elevated temperature. The patient’s temperature should be monitored before anesthesia, pre-operatively, intraoperatively (at least every 15 minutes) and post-operatively until the patient is in sternal recumbency. Continual monitoring every 30 minutes is advised until the patient is awake enough to maintain its own body temperature.

Temperature can be measured rectally, esophageally or tympanically.

Signs of hyperthermia
1. Increased temperature
2. Tachycardia
3. Tachypnea
4. Brick red mucous membranes
5. Hypercapnia
6. The anesthetic plane may lighten due to hyperventilation of the patient resulting in reduced intake of anesthetic gases and therefore more volatile agent is needed to maintain anesthesia
7. Increase or decrease in blood pressure

Why do some cats become hyperthermic following anesthesia?
All opioids can result in an elevated body temperature in cats. The degree of hyperthermia appears to be more associated with full mu opioid agonists (e.g., hydromorphone) and in cats that have been anesthetized. Although not proven, it is likely that opioid drugs alter the thermoregulatory set point in cats and that cats that become cold during anesthesia have an exaggerated response and “overshoot” their temperature set point. Affected cats have been documented to have body temperatures in excess of 41.7 °C (107 °F).
Interestingly there has not been any documented morbidity and mortality in these cats. The hyperthermia is transient and normally resolves within 3–4 h (about the duration of the opioid drugs). Treatment of hyperthermia is primarily supportive. Hyperthermic cats should have external heating sources removed and should be monitored for signs of distress and dehydration. Reversal with naloxone or butorphanol can be considered if the hyperthermia is severe. For cats that have had an opioid reversal, other methods of analgesia need to be provided.

Malignant hyperthermia (Pollock, 2009)
Malignant Hyperthermia is a genetic disorder of skeletal muscle, which results in the mutation of a chemical channel protein within the muscle cell (some breeds of dogs e.g. Greyhounds, Golden Retrievers and Border Collies may be predisposed to this condition but this is rare). Signs include a rapid increase in body temperature, muscle rigidity, hypercapnia, respiratory and metabolic acidosis and poor/discolored urine output. Malignant hyperthermia can occur during general anesthesia and can be triggered by any volatile agent and some depolarizing muscle relaxants; it can have serious consequences and must be acted on as quickly as possible. This condition should be treated with a drug called dantrolene sodium which is specifically indicated to reverse malignant hyperthermia. It is packaged as a powder, which takes several minutes to reconstitute, forming an alkaline solution, which is administered intravenously in its reconstituted state.

Passive causes of hyperthermia due to external sources
- Magnetic resonance imaging (MRI) scanners
- Heat bags
- Electric Heat pads
- Electric lamps
- Bair Hugger

If corrective action needs to be taken
- Localized heat source should be removed
- Breathing circuit can be changed to non-rebreathing
- Vaporizer switched off
Vomiting after premedications is NOT thought to be a contributing risk factor for the occurrence of GER. GER can occur at any time the refluxed gastric content reaches the pharynx it is called regurgitation. If a significant amount of regurgitation is present it puts the patient at risk for aspiration into the lungs. Recognition of regurgitation is usually made by visualization of reflux occurs during the anesthetic period and usually goes unnoticed because no clinical signs are apparent. This is termed ‘silent regurgitation’. If sedatives are responsible for decreasing the gastroesophageal sphincter tone thus allowing gastric fluid to enter into the esophagus more easily. Risk factors that may predispose a patient to GER are not well defined. Prolong fasting (>18 hours) has been associated with a decrease in gastroesophageal tone and may put the patient at risk for GER during anesthesia but results are inconclusive. Nausea and vomiting occurs when intragastric pressure exceeds or equals the LESP, and the barrier pressure (BP) normally present between the two areas is lost. Clinical GERD is much less common in dogs and cats than humans but has been identified in both species.

**Gastroesophageal reflux**

Gastroesophageal reflux (GER) is a common occurrence in anesthetized patients. Studies have shown that inhalants, opioids and some sedatives are responsible for decreasing the gastroesophageal sphincter tone thus allowing gastric fluid to enter into the esophagus more easily. Risk factors that may predispose a patient to GER are not well defined. Prolong fasting (>18 hours) has been associated with a decrease in gastroesophageal tone and may put the patient at risk for GER during anesthesia but results are inconclusive. Vomiting after premedications is NOT thought to be a contributing risk factor for the occurrence of GER. GER can occur at any time during the anesthetic period and usually goes unnoticed because no clinical signs are apparent. This is termed ‘silent regurgitation’. If the refluxed gastric content reaches the pharynx it is called regurgitation. If a significant amount of regurgitation is present it puts the patient at a higher risk for aspiration into the lungs. Recognition of regurgitation is usually made by visualization of GER occurs commonly in dogs and cats under general anesthesia; incidence varies from 0 to 66% of cases. Gastroesophageal reflux (GER) occurs when the lower esophageal sphincter relaxes and is a normal physiologic postprandial event. (Han, 2003) The mechanisms of reflux in GERD include abnormally low lower esophageal sphincter (LES) pressure (LESP) and increased frequency and duration of transient lower esophageal sphincter relaxations (TLSRs). (Adams, 2015) Although the specific mechanism of anesthetic induced GER is unclear, reflux occurs when intragastric pressure exceeds or equals the LESP, and the barrier pressure (BP) normally present between the two areas is lost. Clinical GERD is much less common in dogs and cats than humans but has been identified in both species.

**Nausea, vomiting, nutrition and appetite**

Nausea and vomiting are common adverse effects of anesthetic agents, especially in human patients. NAUSEA is an unpleasant, subjective sensation often associated with the urge to vomit, and has the function of aversion and avoidance. (Grant, 2010) The sensation starts in the back of the throat and spreads up to the epigastrium. Usually, when nausea reaches intolerable levels (reaches a threshold), retching and then vomiting occurs. Nausea and vomiting can occur either separately or together, and are caused by a diverse range of diseases and drugs. Nausea is a highly aversive sensation and leads to a poor quality of life if it persists. (Grant, 2010) The prevailing view is lower levels of activation of the same inputs as identified for vomiting can induce nausea. Nausea is induced by the same inputs as vomiting, but at a much lower threshold. Nausea appears to be clinically manifested in dogs and cats by excess salivation, inappetance, restlessness (anxiety), licking of lips, gagging, retching, exaggerated and increased frequency of continued overleaf swallowing, and depression. (Fuller et al, 2009)

The Vomiting center, a neural pathway, is activated by neurotransmitters such as histamine, acetylcholine, dopamine, serotonin, and neurokinin-1 (NK-1 or substance P) are important neurotransmitters in the VC. (Adams et al, 2015) Dopamine, serotonin, and α2-adrenergic receptors are found in the chemoreceptor trigger zone (CTZ). Located outside the blood–brain barrier (BBB), the CTZ is sensitive to low levels of emetic agents in the circulation. Input from the cerebral cortex (anxiety, anticipation), the vestibular apparatus (motion sickness), and local damage to the gastrointestinal tract also directly stimulate the vomiting center. (Adams, 2015)

Vomiting is most likely to occur after the use of morphine in dogs and cats (KuKanich et al., 2005) and is less likely after administration of other opioids. Vomiting is thought to be due to stimulation of the chemoreceptor trigger zone. Administration of morphine as a premedicant also significantly increases the risk of gastroesophageal reflux during general anesthesia in dogs (Wilson et al., 2005). Other drugs given during anesthesia may cause vomiting. Up to 75% of dogs administered a very high dose of lidocaine (200 μg/ kg/min) as a continuous infusion during sevoflurane anesthesia vomited in recovery. When the dose was reduced (50 μg/kg/min) vomiting did not occur postoperatively. (Matsubara et al, 2009) α2-Adrenergic receptor agonists and μ-opioid receptor agonists cause vomiting in dogs and cats. (Adams, 2015) The incidence of vomiting clinically appears to be more common at higher doses and is generally greater in cats than dogs. Vomiting was not reported with continuous infusions of very low doses of dexmedetomidine or medetomidine in healthy dogs and cats. There is minimal difference in the incidence of vomiting between the different α2-adrenergic receptor agonists in dogs and cats; however, a significant difference is seen with different opioids. (Adams, 2015) Morphine, meperidine, and hydromorphone (especially in cats), and to a lesser extent oxymorphone, are associated with the highest risk of vomiting. (Adams, 2015) Vomiting is much less frequent with fentanyl and its derivatives, and is rare with methadone, butorphanol, and buprenorphine. (KuKanich et al, 2009) Vomiting is also less frequent with lower dosages and when patients are fasted prior to administration.

**Medications used for nausea and vomiting include**

- Maropitant
- Metoclopramide
- Ondansetron

**Gastroesophageal reflux**

Gastroesophageal reflux (GER) is a common occurrence in anesthetized patients. Studies have shown that inhalants, opioids and some sedatives are responsible for decreasing the gastroesophageal sphincter tone thus allowing gastric fluid to enter into the esophagus more easily. Risk factors that may predispose a patient to GER are not well defined. Prolong fasting (>18 hours) has been associated with a decrease in gastroesophageal tone and may put the patient at risk for GER during anesthesia but results are inconclusive. Vomiting after premedications is NOT thought to be a contributing risk factor for the occurrence of GER. GER can occur at any time during the anesthetic period and usually goes unnoticed because no clinical signs are apparent. This is termed ‘silent regurgitation’. If the refluxed gastric content reaches the pharynx it is called regurgitation. If a significant amount of regurgitation is present it puts the patient at a higher risk for aspiration into the lungs. Recognition of regurgitation is usually made by visualization of GER occurs commonly in dogs and cats under general anesthesia; incidence varies from 0 to 66% of cases. Gastroesophageal reflux (GER) occurs when the lower esophageal sphincter relaxes and is a normal physiologic postprandial event. (Han, 2003) The mechanisms of reflux in GERD include abnormally low lower esophageal sphincter (LES) pressure (LESP) and increased frequency and duration of transient lower esophageal sphincter relaxations (TLSRs). (Adams, 2015) Although the specific mechanism of anesthetic induced GER is unclear, reflux occurs when intragastric pressure exceeds or equals the LESP, and the barrier pressure (BP) normally present between the two areas is lost. Clinical GERD is much less common in dogs and cats than humans but has been identified in both species.

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Brachycephalic breeds may be predisposed. (Poncet, 2005) GER is more frequent with intraabdominal and orthopedic procedures in dogs and is seen more often in dogs than cats. (Adams, 2015) Vomiting associated with premedication prior to anesthesia was not associated with increased GER in dogs. Most cases of anesthesia-related GER in dogs develop fairly soon following induction, usually before 30 min. Choice of premedication plays a role, as has been demonstrated by higher doses of morphine causing more GER than lower doses. (Adams, 2015)

Although prevention of GER is difficult, vigilant monitoring to identify when it has occurred and appropriate intervention will minimize complications. Management recommendations include the following:

- Observe patients following premedication, especially with heavy sedation, drugs that cause emesis (e.g., morphine, α2-adrenergic receptor agonists).
- Attain a secure airway (AW) quickly following induction.
- The endotracheal tube (ET):
  - Correctly sized.
  - Properly lubricated.
  - Appropriate cuff inflation.
- Recheck tube placement and cuff inflation, especially with transport, positioning.
- Keep head tipped down to encourage drainage of GER away from airway.
- Have supplies close by for suctioning, cleaning of pharynx, esophagus.
- If vomiting occurs – get head down.
- Recovery
  - Examine pharynx before extubation.
  - Lavage esophagus when large-volume GER has occurred.
  - Extubate with cuff partially inflated.
  - Position with head/nose down, lower than shoulder at all times.

**Aspiration (Adams, 2015)**

Aspiration of GI contents can occur perioperatively following GER, vomiting, and/or regurgitation. It can also occur during heavy sedation that impairs normally protective airway reflexes. Respiratory complications following aspiration include hypoventilation and/or hypoxemia, pneumonitis, bacterial pneumonia, and sometimes cardiac arrest. The extent of airway pathology depends on the volume and type of fluid aspirated. Three phases of damage have been identified: (Adams, 2015)

1. is immediate – due to direct toxic damage to the epithelium. Depending on the volume of aspirated material, the end result is atelectasis, decreased compliance, ventilation/perfusion mismatch, and decreased oxygenation.
2. follows within 4–6 h – an inflammatory reaction that causes pneumonitis. If not severe, this lesion may resolve.
3. is seen when bacteria invade damaged tissue, producing aspiration pneumonia

Early recognition and intervention are paramount to limiting the severity of aspiration pneumonia and its associated mortality. Signs of aspiration range from ‘silent’ with no apparent abnormalities to obvious airway obstruction following visible regurgitation of gastric contents. Unexplained oxygen desaturation, tachypnea, dyspnea or irregular respiratory patterns, auscultable abnormalities, and blanching of mucous membranes may be seen. Oxygen (100%) should be administered and the patient immediately positioned with the head down for drainage. Suction of the airways is necessary for liquid aspiration. Bronchoscopy may be required when particulate matter has been aspirated. Bronchodilator therapy and mechanical ventilation with positive end expiratory pressure may be needed to improve oxygenation. Prophylactic antibiotics are not usually recommended for pneumonitis cases owing to the potential for emergence of resistant bacteria. Multivariate analysis revealed the following to be associated with anesthetic-related aspiration pneumonia: patient factors – megaesophagus and pre-existing respiratory or neurologic disease; procedures – upper airway surgery, endoscopy, thoracotomy, laparotomy, and neurosurgery; and anesthetic events – regurgitation during or after anesthesia and hydromorphone given intravenously at induction. (Ovbey, 2014) Additional factors include male gender and increasing ASA patient score, age, and body weight. Use of continuous infusion of analgesics or anesthetic agents was associated with a greater incidence of aspiration pneumonia when utilized during anesthesia but not when given postoperatively. (Ovbey, 2014)

Pre-existing neurologic and respiratory disorders, megaesophagus, perioperative vomiting/regurgitation, and anesthesia have been consistently identified in veterinary patients with aspiration pneumonia. Even though the incidence of aspiration is low, predisposing factors are common and aspiration pneumonia carries a high risk of mortality. Vigilant monitoring for signs of aspiration is necessary, especially since most cases are subclinical, similarly to GER and esophagitis. Perioperative management to prevent these complications with appropriate intervention as soon as possible is always indicated.
Nutrition and importance in postoperative recovery

A good intake of fluids and essential nutrients in the first fourteen days is of vital importance to recuperating animals. Moreover, it is important to encourage cats and dogs to eat after illness or surgery, in order to promote optimal functioning of the gut and the immune system. Enteral nutrition is to be preferred to nasogastric feeding or parenteral nutrition. In the first stage of recovery, during the first 24 to 48 hours, it is important to feed the gut with nutrients, and thereafter, in the second stage of recovery (after day 3), the calorie intake can be increased. Timely nutritional support with nutraceuticals, such as arginine, glutamine, taurine, long-chain polyunsaturated omega-3 fatty acids, and prebiotic fibers, can considerably shorten the recovery period of cats and dogs after illness or surgery. (Corbee and van Kerkhoven, 2012) Nutritional support of hospitalized dogs and cats improves recovery from illness, reduces mortality, and improves responses to trauma and stress. (Donoghue, 1994) The primary goal of nutritional support is to prevent use of tissue protein. This is accomplished by the provision of sufficient calories and dietary protein in optimal proportions. For nutritional support, calorie intake is adjusted according to the patient's metabolic rate so that the animal may be fed above or below its usual intake. Nutritional support should always be started gradually, no matter what the final calorie goal may be. For many sick dogs fed enterally, dieters proved about 30% of calories from fat and at least 27% of calories from protein. Carbohydrates in nutritional support diets should not include maize, wheat or, especially, soy. Sick cats fed enterally should receive at least 30% of calories from both fat and protein. Energy supply, even if modest and close to resting energy requirements appears to be positively associated with hospital discharge. However, disease severity was the main negative factor on outcome and also had a negative effect on energy intake, making it difficult to separate the effects of both factors when interpreting hospital discharge. Thin animals with low BCS had greater mortality. (Brunetto et al, 2010) The first step of nutritional support is to identify patients most likely to benefit from nutritional intervention. Careful assessment of the patient and appraisal of its nutritional needs provide the basis for a nutritional plan, which includes choosing the optimal route of nutritional support, determining the number of calories to provide, and determining the composition of the diet. (Chan, 2004) Providing nutrition via a functional digestive system is the preferred route of feeding, and thus particular care should be taken to evaluate if the patient can tolerate enteral feedings. Even if the patient can only tolerate small amounts of enteral nutrition, this route of feeding should be pursued and supplemented with parenteral nutrition as necessary to meet the patient’s nutritional needs. The first steps of instituting nutritional support include restoring proper hydration status, correction of electrolyte or acid-base disturbances, and achieving hemodynamic stability. (Chan, 2004) Implementation of the nutritional plan should be gradual, with the goal of reaching the target level of nutrient delivery in 48 to 72 hours. An excellent textbook is Nutritional Management of Hospitalized Small Animals, 2015, Daniel L. Chan, John Wiley and Sons, Oxford, UK, 266 pages. Currently, it is generally accepted that hospitalized dogs should be supported with 4 to 6 g of protein/100 kcal (15-25% of total energy requirements), whereas cats are usually supported with 6+g of protein/100 kcal (25-35% of total energy requirements). (Freeman and Chan, 2001)

Appetite

Appetite is the manifestation of hunger and is a normal adaptive response to periods of decreased energy intake, while anorexia is a maladaptive response that results in the absence of food intake despite inadequate energy consumption. Left untreated, prolonged anorexia can result in generalized wasting, delayed wound healing, impaired immune function, altered drug metabolism, and is known to increase morbidity and mortality in human patients (Donohoe, Ryan and Reynolds, 2011).

Does use of an endotracheal tube (ETT) cause a sore throat in cats?

One study found that securing the airway of the cat with a V-gel superglottic airway device (SGAD) is faster than endotracheal intubation with an ETT. (van Oostrom et al., 2013) One parameter measured in the study was ‘reluctance to eat’ to indicate upper airway discomfort, as post-anesthetic complications such as esophagitis due to gastro-esophageal reflux might also lead to reluctance to eat. Other parameters scored were coughing and hoarseness of voice.

The V-gel comes in 6 different sizes. The v-gel provides a protected and secured airway, allowing use of positive pressure ventilation and administration of inhalant anesthetics without exposure to staff or the environment. It can also be used for emergency resuscitation if an endotracheal tube is not available. (Messenger, 2016)

Syringe or assisted/force feeding is rarely indicated and is never appropriate for more than a couple feedings. It is often stressful, disliked by patients, and can occasionally cause oral trauma. The amount of nutrition that can be supplied through this method is limited, making it difficult to meet the resting energy requirement (RER) of a patient. Force feeding can also lead to food aversion causing a patient, who would otherwise eat, to refuse the appropriate diet. (Frye et al, 2015) It is contraindicated in any patient with orofacial trauma, a decreased ability to swallow, or a reduced gag reflex.

Inappetence

Loss of appetite can occur with a variety of medical conditions in dogs and cats including kidney disease, cardiovascular disease, pancreatitis, neoplasia, gastrointestinal diseases and dental disease. Since appetite is also viewed as a “quality of life” indicator by pet owners, pharmacological appetite stimulants may be more effective at managing the caregiver’s perception of health than
stopping or reversing anorexia. In patients that are not already exhibiting signs of malnutrition (e.g., severe lean muscle loss) nutritional management should involve addressing the primary underlying disorder, coaxing the animal to eat by modifying the diet to increase palatability, addressing pain and nausea. (Weeth, 2015) If these measures are not effective, consideration should be given to using pharmacological agents to stimulate appetite. Whether a potential food item is appealing to an individual will depend on a number of external stimuli, such as past experiences (e.g., learned food aversions or preferences), environmental triggers (e.g., location of food, other animals or people nearby), and food characteristics (e.g., aroma, texture and temperature). Animals that experience mouth pain, pain related to chewing or swallowing, or that experience maldigestion associated with food consumption (whether related to a primary disease or a side effect of treatment) may refuse to eat to avoid real or anticipated pain or discomfort. (Weeth, 2015) Balance of hormones, chronic disease and even old age can affect appetite. Food textures and aromas will highly affect the animals desire to eat.

Today, there are few therapeutic treatment options veterinarians can offer clients with dogs with no or reduced appetite. But, what if there were a safe, simple way to stimulate appetite and improve the outlook for pets that are picky eaters or stop eating altogether? At Aratana Therapeutics, they are working to develop a unique answer for inappetance in dogs and cats — one that’s easy for pet owners to use daily at home. Capromorelin is a small molecule that mimics ghrelin. Ghrelin is the naturally-occurring hormone that stimulates appetite and may help to increase muscle mass by increasing growth hormone and insulin-like growth factor-1 levels. http://www.aratana.com/therapeutics/inappetence/ Capromorelin may help to increase appetite in cats and dogs experiencing inappetence due to acute or chronic illness, undergoing chemotherapy, recovering from surgery, approaching end of life or other chronic conditions.

There are generally two causes of inappetence

- Pseudoinappetence, which may occur due to:
  - Dental disease
  - Neuromuscular disease
  - Unpalatable food
  - Food aversions

- True Inappetence, which may be caused by:
  - Systemic or chronic disease, e.g. renal failure, cancer
  - Pain
  - Nausea
  - Medications, e.g. opioids, chemotherapeutics
  - Respiratory distress
  - Neurologic disease
  - Congestive heart failure

The first goal of therapy for any inappetence diagnosis is to correct the underlying cause. Often veterinarians will begin treatment of inappetence by recommending a change to a highly palatable diet, such as tuna for cats, and chicken or beef for dogs.

Depending on the severity of the condition, the animal may be supported with fluids and electrolytes until the diagnosis of the underlying condition is made, and effective treatment is initiated where possible. Prolonged or severe inappetence may require hospitalization and feeding tube placement. Current veterinary drug therapy to address inappetence has focused on using human drugs that affect the central nervous system, such as benzodiazepines, cyproheptadine and mirtazapine.

In animals that experience persistent anorexia for more than three days despite medical management of the underlying disease state or those requiring longer-term nutritional support (i.e., expected anorexia for more than one week), placement of an indwelling feeding tube should be considered. We should consider the use of a low profile feeding tube instead of an indwelling red rubber feeding tube.

**Constipation**

An excellent review on the subject of constipation induced by opioids highlighted the substantial increase in the use of opiates and opioids for chronic pain over the past 2 decades in humans. (Nelson et al, 2015) A recent systematic review of treatment for OIC concluded that 3 different μ-opioid receptor antagonists: methylnaltrexone (6 trials, 1610 patients), naloxone (4 trials, 798 patients), and alvimopan (4 trials, 1693 patients) were all superior to placebo for OIC. (Ford et al, 2013)

**Recovery**

According to a large scale veterinary study conducted in the United Kingdom the greatest risk for anesthetic related death occurs during the post-operative period. (Brodbelt et al, 2008) This study showed that 47% of death in dogs, 61% of death in cats and 64% of death in rabbits occurred during the post-operative period with the majority of deaths occurring within 3 hours of termination of the procedure. The results of this study indicate how crucial it is to continue monitoring and managing our patients during the post-
operative period. The recovery period should be smooth, rapid and stress free for the patient. The recovery area should be a quiet environment with the lights dimmed to help prevent unnecessary stimulation as the animal emerges from anesthesia. This area can be a specific room that is monitored by an assistant or technician in a busy practice or it can be a general area in the hospital that is easily monitored by all personnel while other tasks are being performed. It is mandatory that a designated technician or trained assistant stay with the patient at all times until extubation occurs and the patient is comfortable in the cage. All patients will benefit from oxygen supplementation for at least 3-5 minutes after the inhalant has been discontinued. This helps dilute out the inhalant as the patient is breathing which can hasten recovery and it also helps scavenge the waste anesthetic gas (WAG) so that personnel are less exposed. Extubation should not be delayed just to provide them with oxygen in recovery. Extubate the patient when they are ready!

When a balanced anesthesia drug protocol has been utilized the majority of our patients will wake up smoothly from general anesthesia. Unfortunately, despite our best efforts, there will be times when a patient wakes up and displays a rough recovery. Rough recoveries are often characterized by the patient displaying behaviors such as excessive vocalization, paddling their legs, head bobbing or head thrashing, agitation (constantly attempting to move around) and disorientation.

The three most likely causes of a rough recovery are pain, emergence delirium and dysphoria. The patient’s temperament and anxiety level while in the hospital may also influence how the patient recovers from general anesthesia. It can be difficult to predict when a particular patient will have a rough recovery so having a plan to manage rough recoveries is recommended for every patient. History tends to repeat itself. If a patient was anesthetized in the past and had a rough recovery, chances are they will have a rough recovery the next time they are anesthetized. Also, if the patient has a rough induction there is a really good chance that they will have a rough recovery as well. Before the inhalant is turned off, the anesthetist should evaluate the anesthesia record to determine the time that analgesic and sedative drugs were given in the premedications and if/when additional doses were administered during the procedure. If the duration of action of the analgesic and sedative agent has been exceeded, then additional doses should be drawn up and administered, if needed, during recovery.

Because our patients cannot verbally communicate with us it is often difficult to determine if a rough recovery is due to pain or anxiety. Therefore, it is better to treat with an analgesic drug (pure mu opioid) and sedative agent together rather than give either drug alone. A sedative agent such as acepromazine may mask the signs of pain but it will not adequately address the painful state when given alone because it does not have any analgesic properties. Dexmedetomidine is superior to acepromazine because it also provides analgesia in addition to its sedative effects. An example of a treatment protocol for a rough recovery would be to administer a pure mu opioid such as hydromorphone IV combined with microdosages of either acepromazine (0.01mg/kg) or dexmedetomidine (1-2mcg/kg) IV providing no contraindications exist for the sedative agent. Microdosages of the sedative agent are usually sufficient enough to calm a patient that has having a rough recovery so it is not necessary to use the dosages commonly used for premedication. A painful patient will generally relax and stop vocalizing after an analgesic agent has been administered. They also are responsive to human interaction so it helps to talk calmly to them while providing gentle restraint. If the anesthetist suspects that the rough recovery was due to pain, it is a reasonable option to just give the pure mu opioid alone and wait 3-5 minutes to evaluate the effects of the drug on the patient. If there are no contraindications, microdosages of dexmedetomidine can be added if the opioid does not appear to be enough.

**Emergence delirium** is defined as a dissociated state of consciousness in which the patient is unaware of their surroundings. Patients can display excitement, agitation, restlessness and vocalization. In pediatric human patients, emergence delirium has been shown to occur with just about every anesthetic agent, including the inhalants. In veterinary medicine, emergence delirium is more likely to occur when there is no sedative agent on board during the recovery period. If dexmedetomidine was administered as a premedication and more than 2-3 hours have lapsed before recovery, there is a good chance that the patient will display emergence delirium behavior. The term is also used to describe the behavior seen when ketamine is the only agent on board during recovery and is more likely to be seen in cats than dogs. Dogs tend to have rough recoveries when given Telazol® because the zolazepam has a shorter duration of action than the tiletamine. These patients are usually treated with a combination of opioids and sedative agents so that both analgesia and sedation are addressed. In humans, other conditions that may result in disorientation and altered mental status in the recovery period include hypoxia, severe hypercapnia, hypotension, hypoglycemia, increased intracranial pressure and distended bladder. All of these conditions can occur in animals so it is reasonable to consider them as causes for emergence delirium in animals as well. Appropriate monitoring of the patient should detect the majority of these conditions and prompt treatment is required if present. As long as there are no contraindications, expressing the bladder before a patient recovers can help rule out this source of a rough recovery.

**Dysphoria** in dogs has been described as causing agitation, excitement, restlessness, excessive vocalization and disorientation. Dysphoria in cats has been described as causing hallucinatory behavior, open-mouth breathing, agitation, vocalization and pacing. When classifying a rough recovery, the term ‘dysphoria’ is often inappropriately used to describe the behavior. Just because a patient is vocalizing in recovery does NOT necessarily mean the patient is dysphoric. As you can see, the words used to describe dysphoria can also be used to describe emergence delirium and pain in recovery. From an anesthesia standpoint, dysphoria is often associated

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with administering excessively high dosages of opioids to patients’ not experiencing a painful condition. It is usually associated with pure mu opioid agonists but the other opioid drug classes (partial agonists, agonists/antagonist) can also result in dysphoria. Although it can be difficult to determine if a patient is painful versus dysphoric there are some key differences with how a patient responds to treatment. The source of the pain is often difficult to identify in a truly dysphoric patient whereas it is easily identified in a painful patient. Unlike a painful patient, a dysphoric patient is unresponsive to human interaction. They will not respond to being talked to and will continue to be vocal and agitated even when properly restrained. Administering an analgesic agent (opioid) will either do nothing or make the condition worse. If a patient does not respond to the administration of an opioid, the potency of the catheter should be checked first to ensure that the drugs actually went IV. Administering a sedative agent is the treatment of choice for a dysphoric patient and should be given concurrently with the opioid. If dysphoria is determined to be the cause of the rough recovery, then a sedative such as dexmedetomidine may need to be administered as a continuous rate infusion in order for the patient to be comfortable in the recovery period. Another option for treatment of dysphoria is partial reversal with butorphanol. Butorphanol will antagonize the mu receptor and will reverse the sedative and analgesic effects of pure mu opioids but will still provide some analgesia due to the kappa agonist activity. This is called sequential analgesia. Partial reversal with butorphanol is a viable option for treatment if sedative agents are contraindicated but it might not provide enough analgesia to address pain associated with a surgical procedure. Other means of analgesia should be implemented before using butorphanol as a treatment for a rough recovery. Complete reversal of the opioid with naloxone should only be considered in the event of an opioid overdose. It should not be used as a treatment for dysphoria unless all other treatment options have been attempted and were unsuccessful. Some breeds of dog such as arctic breeds (Husky, Malamute, Akita, etc) tend to display behavior that is commonly termed dysphoria after the administration of pure mu opioids. These breeds tend to be very vocal in recovery no matter what procedure was performed. It is important to provide these patients appropriate sedatives in combination with opioids to help smooth out the recovery period. Opioids are not contraindicated in these breeds simply because of this tendency to respond in this manner.

**Low stress handling**
Take note of the patient’s posture and behavior (Hagler, 2015) while providing low stress examination techniques which include (Yin, 2009):

- Have toys and treats available for the patient
- Use distractions, food, praise, play and petting when appropriate
- Watch the patient’s body language
- DO NOT directly stand over a dog or reach out for it. Allow the patient to come to you (treats help)
- Allow a cat to willingly come out of a carrier
- Avoid direct eye contact
- Examine the pet where they are comfortable. For cats, this could be in a carrier with the top off, using towel wrapping techniques, on your lap, or on the floor
- Dogs do not need to be on an exam table. They can be on the floor or small dogs can be on your lap.
- For difficult dogs, use head halters around the head and mouth
- Make use of pheromone diffusers in exam rooms

**Fear, anxiety and stress (disruption of routine)**
Stress is a state of threatened homeostasis where an individual is responding to something that is external. (Clark et al, 1997) There is now sufficient evidence to show that it is not the physical nature of an aversive stimulus that has negative consequences on the animal but rather the degree to which the stimulus can be predicted and controlled. (Amat et al, 2015) As a result, it has been suggested that the term ‘stress’ should be restricted to conditions where an environmental demand exceeds the regulatory capacity of the organism, in particular when such conditions include unpredictability and uncontrollability. In domestic animals, stressors can be conveniently divided into physical stressors, social stressors resulting from the interactions with individuals of the same species and stressors related to handling by humans. According to its duration, stress is classified as acute or chronic. (Amat et al, 2015) If stress becomes chronic, a correlation has been shown between stress and disease development. (Weiss, 1972) (Meaney, 2007) It has even been shown that early-life stress produces muscle hyperalgesia and nociceptor sensitization in the adult rat. (Green et al, 2011) The study showed that that neonatal stress induces a persistent decrease in skeletal, but not cutaneous, mechanical nociceptive threshold and that this behavioral musculoskeletal hyperalgesia is associated with changes in nociceptor function in muscle is associated with enhanced activity in muscle nociceptors, namely, a lowered mechanical threshold, and increased conduction velocity. Furthermore, this early-life stress produces hyperalgesic priming in skin as well as muscle. These changes provide the first demonstration of neonatal stress-induced changes in primary afferent nociceptor function; changes that could contribute to the enhanced nociception observed in this model of an adult pain syndrome induced by early-life stress.
Dr. Marty Becker, in the Aug 1, 2014 edition of DVM360, Veterinary Medicine, (http://veterinarymedicine.dvm360.com/handout-signs-anxiety-and-fear), gave the following list as Signs of Anxiety and Fear that can result in a pet experiencing unnecessary stress and lead to reduced quality of life:

- Avoiding eye contact
- Barking
- Biting
- Blinking, squinting
- Clinging to owner
- Cowering
- Defecation
- Dilated pupils
- Dribbling urine/submissive urination
- Ears lowered or flattened
- Freezing or walking slowly
- Furrowed brows
- Growling
- Hardened eyes (direct stare with pupils dilated)
- Hiding
- Hissing
- Hypersalivation
- Hypervigilance
- Jumping and startling easy at slight changes—hyperalert state
- Licking lips
- Lifting one paw
- Lip curling
- Mouth closed tightly or pulled back
- Mouth pursed forward
- Mouthing
- Nails extended
- Nipping
- Pacing
- Panting
- Piloerection (raised hair)
- Rigid forward stance
- Running off
- Screaming
- Self-grooming (scratching, licking self)
- “Shaking off”
- Shedding
- Slow-motion moving
- Snapping
- Sniffing/appearing distracted
- Staring
- “Sweaty” paws
- Tail tucked
- Taking treats harder than usual, being pickier with treats, or not taking treats at all even if hungry
- Trembling
- Turning away (C-shape)
- Turning head
- Whining
- Whiskers erected
- Wide-eyed/sclera showing
- Will not settle down and rest, or will for a moment but back up and moving again
- Won’t accept treats
- Yawning

Patients that are frightened from the moment they enter the veterinary clinic are not only unlikely to clearly display the same behavioral signs of illness that they have been displaying at home, but also any samples collected are likely to be altered by their stress response.

More definitions
Fear is an emotion that induces an animal to avoid situations and activities that may be dangerous. The emotional response occurs when an animal perceives that something or someone is dangerous. It is critical that veterinarians and pet owners understand that just because they do not think the person, event, or thing is to be feared does not mean that the fear is not real to the pet. A pet's perception is its reality, and that is what the pet will act on. When pets cannot escape a fearful stimulus, they may freeze or they may fight. Veterinarians and veterinary staff should be cognizant of a fearful, compliant animal and attempt to make the visit as pleasant as possible by moving slowly, handling the animal extremely gently with a minimum of restraint, talking quietly, and plying the patient with special food treats before, during, and after the appointment. (Tynes, 2014)

Anxiety is the anticipation of future danger that may be unknown, imagined, or real. It can result in physiologic responses similar to those associated with fear. The animal may begin to pace, pant, tremble, and salivate. Pupils dilate and heart rate, blood pressure, and respiratory rate may increase. Anxious or fearful animals may exhibit avoidance behaviors such as hiding and may be hypervigilant—constantly on alert—and possibly even startle at the slightest sudden stimuli. In the case of intense fear, an animal may lose bladder and bowel control and may express its anal sacs. Animals that live in a constant state of anxiety are not normal nor healthy. Just because their behavior is not a concern for their owners does not mean it should not be a concern to us. As the pet's advocate, we must ask questions about the pet's behavioral responses in a variety of environments so that we can determine if the behaviors we are seeing in the clinic are typical for the pet. If the pet is commonly anxious or fearful about many novel situations, it may need behavioral help. (Tynes, 2014) This is a real health concern for the pet. It can lead to stress and in turn distress.

How stress and pain intersect
The responses of humans to potential or actual tissue damage are parts of a complex experience that has sensory qualities and motivational and emotional consequences. The nervous system encodes the sensory features of tissue-damaging stimuli, such as their quality, intensity, location, and duration. What we perceive results in behavioral and physiologic responses that are under the influence of emotional, motivational, and cognitive processes. Noxious or tissue-damaging stimuli are unpleasant and can evoke strong negative feelings that include memories of previous discomfort, cultural beliefs about pain, and our awareness that pain can imply serious harm to our body.

Pain and distress can be thought of in terms of a continuum of emotional and experiential states that may occur in an animal. Comfort represents a state of well-being, where the animal is contented and comfortable. Stressors acting upon the animal in increasing severity cause the animal to progressively become uncomfortable (Discomfort), then stressed (Stress), and finally distressed (Distress). Distress represents the extreme point in this continuum, on the far right. Stressors acting upon the animal may move the animal’s experience along this continuum between the extremes of well-being and distress. Depending on the nature and severity of a stressor and on the animal’s current state of being, the animal may adapt successfully to a stress (Adaptive Behaviors) or it may become distressed in a way that threatens its well-being or health (Maladaptive Behaviors). Maladaptive behaviors include abnormal feeding, absence or decreased grooming, and changes in social interaction (aggression, withdrawal).

A departure from an animal’s normal behavior is an important indicator that it is undergoing pain and distress. This is why it is so important to be aware of an animal’s normal behavior, both as a species and individually. Responses to stress differ widely within and among species, and oftentimes signs of pain and distress are subtle and can be difficult to detect. Some of the more easily recognizable signs are listed below.

- Changes in temperament or attitude; a friendly, docile animal becomes aggressive or unresponsive
- Restlessness; pacing, changing position frequently
- Decreased activity; reluctance to move, does not respond normally when approached
- Isolation; stays in the corner of the cage, does not interact with cage mates
- Change in posture; hunching, huddling, crouching, stiff movement, head down
- Protecting a part of the body; growls or attempts to bite when that body part is approached or touched
- Abnormal vocalization, especially when a painful area is touched; whimpering, hissing, squealing, squeaking
- Change in appetite and water consumption leading to weight loss and dehydration (in small rodents, dehydration causes rapid weight loss)
- Self-mutilation, excessive licking of the area, biting, scratching, rolling, kicking
• Changes in hair coat appearance; decreased grooming leading to rough-looking coat, greasy appearance, piloerection (hair erect), loss of hair (baldness, hair shafts broken)
• Changes in facial expression; sleepy appearance, avoidance of light
• Discharge from eyes (tears, pus, blood) or nose (runny)
• Changes in bowel movement or urination; diarrhea with soiling around the anus, or lack of bowel movements (constipation)
• Sores, reddened areas on the skin, open wounds
• Increased body temperature
• Changes in respiration rate or character; rapid, shallow breathing

**What procedures can cause pain/discomfort/stress that we don’t normally think about?**
• Clipper burn
• Repeat venipuncture (put in an IV catheter!)
• IV catheter placement (using topical local anesthetic creams)
• Urinary catheters (local anesthetic creams)
• Restraint techniques (low stress handling techniques)
• Hungry (pre-op fasting)
• Full bladder (Help the patient get outside to void or defecate)
• Sore throat from intubation (Another use of local anesthetic cream?)

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**Differentiating cognitive impairment from pain**
Cognitive dysfunction is a neurodegenerative disorder of senior dogs and cats that is characterized by gradual cognitive decline over a prolonged period (18–24 months or longer). (Landsberg and Araujo, 2005) Diagnosis of cognitive dysfunction syndrome (CDS) is based on recognition of behavioral signs and exclusion of other medical conditions and drug side effects, which in some cases can mimic or complicate CDS. Clinical categories include disorientation, alterations in social interactions, sleep-wake cycles, elimination habits, and activity, as well as increasing anxiety. Deficits in learning and memory have also been well documented. (Landsberg et al, 2012) The diagnosis was initially based on clinical signs represented by the acronym DISH, representing disorientation, altered sleep–wake cycles, and housesoiling. (Landsberg et al, 2013a)

**Signs of cognitive impairment**
• Confusion
• Altered relationships and social interactions
• Altered response to stimuli
• Changes in activity: increased anxiety, pacing, repetitive behaviors (vocalizing, pacing)
• Changes in activity: apathy, depression
• Altered sleep–wake cycles; reversed day/night schedule
• Learning and memory problems: housesoiling
• Learning and memory problems: deficits in work, tasks, and commands
• Getting stuck behind doors

If the pet has learned to expect pain and uncomfortable restraint during previous experiences, then the debilitated or compromised pet will be more anxious, defensive, or even aggressive rather than appreciative of even the most compassionate geriatric care. (Landsberg et al, 2011)

Behavioral signs are often the first, or only, signs of pain, illness, and cognitive decline. Senior pets may be less able to cope with stress, which may make them more susceptible to changes in their environment. Pain assessment, response to pain medications, and the overall well-being of the pet depend heavily on the measurement and assessment of the pet’s behavior. (Mathews, 2000) A wide range of behavior problems, ranging from avoidance, decreased activity, and inappetance to irritability, restlessness, and aggression could be due to underlying pain. In fact, any change from normal behavior and the development of new and abnormal behaviors can also be due to underlying pain or disease. (Landsberg et al, 2013b) When pain affects behavior, it can manifest as altered response to stimuli, decreased activity, restless/unsettled, vocalization, house soiling, aggression/irritability, self-trauma, waking at night. (Landsberg et al, 2012)

**See how easily cognitive impairment can be confused with pain... or is it both?**
Monitoring both age-associated cognitive and physiological changes should be conducted at least annually in dogs (starting at 5–8 yr for larger breeds and 8–10 yr for smaller breeds) and cats (starting at 10–12 yr). (Hammerle et al, 2015) Owners of elderly animals will not always mention behavior changes during veterinary visits so veterinary nurses should be asking owners about any changes in their pets’ behavior whenever they see dogs from 8 years of age and cats from 10 years at the latest (ideally they should do this from puppy-or kitten-hood onwards!).
In cats, a thorough medical and behavioral history are required for diagnosis. Cognitive and motor performance appears to decline from approximately 10–11 years of age, for cats, but functional change in the neurons of the caudate nucleus have been seen by 6–7 years. (Landsberg et al, 2010)

**Pain and the brain (Hedges, 2014)**

Pain triggers activity in many areas of the brain. These include the primary and secondary somatosensory cortices in the cerebral cortex, which are the prime centers for associative learning. It also affects the limbic system, which is the emotional center in the brain, and in particular the amygdala, which is responsible for fear and anxiety. Which center has greatest short- and long-term influence over the dog’s behavior will depend on the pain’s intensity, how readily it can be avoided, past learning and temperament. As such, its impact on behavior can be variable and unpredictable.

**How can pain influence behavior? (Warnes, 2015a)**

- Anxiety — pain can increase anxiety and the likelihood of an animal developing fear-and anxiety-related behavior problems (Overall, 2013)
- Irritability — painful animals are more likely to show defensive aggression, both to people and other animals (Overall, 2013)
- Reduced mobility — if movement is difficult or painful this can increase the likelihood of animals toileting in inappropriate places because they are unable to reach a more appropriate toileting area in time. Animals with reduced mobility also find it harder to move away from people or animals if they feel threatened, which will further increase the likelihood of them showing defensive aggression (Landsberg et al, 2013b)
- Restlessness — painful animals often find it difficult to rest, which can result in them being unsettled both during the day and at night (Landsberg et al, 2013b). Painful animals may also show repetitive behaviors such as licking, pacing, digging or spinning, as a way of coping with uncontrolled pain (Overall, 2013)
- Reduced interaction with owners — painful animals may not want to play or enjoy other interactions with their owners such as petting or going for walks (Overall, 2013). This can negatively affect the pet-owner relationship, and if pain is unrecognized and/or untreated this may be a risk factor for relinquishment or euthanasia.
- Polydipsia and polyuria. Conditions associated with polydipsia and polyuria such as diabetes mellitus, hyperadrenocorticism or chronic kidney failure will increase the likelihood of an animal house soiling or waking their owners at night to ask to be let outside (Landsberg et al, 2013b; Overall, 2013)
- Neurological and circulatory disorders. Medical problems affecting the central nervous system, e.g. brain tumors, or the circulatory system, e.g. hypertension, can cause or contribute to cognitive decline (Gunn-Moore, 2011; Landsberg et al, 2011)
- Some medications can also increase the likelihood of animals showing behavior problems, for example corticosteroids can be associated with increased appetite, urine output, restlessness and reactivity to stimuli which can increase the likelihood of an animal showing problem behaviors including house soiling, wandering and pacing and also aggression to owners or other pets (Landsberg et al, 2012).

An example of a Canine Cognitive Function Screening Questionnaire can be found at: [http://merrimackvet.evetsites.net/sites/site-3774/documents/CDS_checklist.pdf](http://merrimackvet.evetsites.net/sites/site-3774/documents/CDS_checklist.pdf)

Provided here is an example of a feline mobility//Cognitive dysfunction questionnaire

**Feline mobility/Cognitive dysfunction questionnaire (Gunn-Moore, 2011; 2014)**

<table>
<thead>
<tr>
<th>My Cat…</th>
<th>Yes</th>
<th>Maybe</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is less willing to jump down</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Will only jump up or down from lower heights</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sometimes shows signs of being stiff</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is less agile than previously</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shows signs of lameness or limping</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has difficulty getting in or out of the cat flap</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has difficulty going up or down stairs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cries when they are picked up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Has more accidents outside the litter tray</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spends less time grooming</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is more reluctant to interact with me</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plays less with other animals or toys</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sleeps more and/or is less active</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cries loudly for no reason/to try to gain my attention</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appears forgetful</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
NB. Need to ensure there are no environmental reason(s) for these behavior changes.

It can be difficult to differentiate between the signs caused by cognitive dysfunction and those caused by osteoarthritis. Both conditions often occur concurrently in old cats and many of the treatments for one condition will also help the other.

Management strategies to improve QOL
Let’s discuss management strategies that can improve the quality of life for elderly animals with mobility problems including conditions associated with chronic pain, sensory deficits and cognitive dysfunction.

Geriatric animals need to be able to navigate their surroundings easily. This can be particularly challenging for animals with medical problems affecting their mobility, including conditions associated with chronic pain such as degenerative joint disease or spinal problems, reduced sensory abilities or cognitive dysfunction, which can be associated with impaired spatial awareness and navigational ability. Important resources include food, water, comfortable resting places, toilet locations and, for cats in particular, places to withdraw to or hide if they do not wish to interact with people or other animals in the home. (Warnes, 2015b) Cats like to have food, water and toilet areas kept separate. These must be easily accessible from the cat’s resting area. If a cat spends time on different floors in the home it is sensible to locate a full set of resources, including a litter tray, on each floor. Once resources have been located appropriately they should always be kept in the same places so animals can find them easily. If other animals are in the home, then it is imperative that there is not unnecessary competition for these resources.

Suggestions for improving the environment and increasing access to resources for elderly cats and dogs. (Warnes, 2015b)

<table>
<thead>
<tr>
<th>Resource</th>
<th>Dogs</th>
<th>Cats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food and water</td>
<td>• Raising bowls off the ground will help dogs with joint and spinal problems to eat and drink more comfortably • Non-slip matting underfoot will prevent dog slipping when eating or drinking</td>
<td>• Need to be in separate locations • Raise bowls off ground by a few inches to enable cats with joint and spinal problems to eat and drink more comfortably • Cats used to be fed on raised surfaces, e.g. windowsills or worktops may need a ramp or steps to enable access, or food and water should be provided in more accessible locations</td>
</tr>
<tr>
<td>Toileting areas</td>
<td>• Dogs with mobility problems may need to learn to use a toileting area closer to the house, or even be provided with a toileting area indoors, e.g. by placing puppy pads in a large tray • Owners may need to encourage dogs to go to their toilet area regularly because they may no longer indicate when they need to toilet</td>
<td>• Needs to be separate from feeding and drinking locations • Cats with mobility problems will prefer large, low sided litter trays, or equivalents such as gardeners’ potting trays • Finer-grained litters are easier to stand on and dig than coarser litters • Cats that have previously toileted outside may no longer be able to access these locations, and will need to be provided with litter trays indoors</td>
</tr>
<tr>
<td>Sleeping areas and beds</td>
<td>• Beds should be comfortable and supportive, e.g. memory foam, easy for animal to get into and out of, and large enough for them to lie out flat if they wish • Elderly animals can become cold very easily: sleeping areas should be kept warm especially at night in the winter. Electrically heated beds may be welcomed • An Adaptil™ diffuser plugged in close to the bed may help reduce anxiety and help dogs settle better at night • Items containing the owner’s scent may also help some dogs settle better at night</td>
<td>• Beds should be comfortable and padded, easy for animal to get into and out of, and large enough for them to lie out flat if they wish • Cats prefer to rest in raised places, but animals with mobility problems may need ramps or steps in order to access these locations. Elderly animals can become cold very easily: sleeping areas should be kept warm especially at night in the winter. Electrically heated beds may be welcomed • A Feliway™ diffuser plugged in close to the bed may reduce anxiety and help cats settle better at night</td>
</tr>
</tbody>
</table>
### Moving around inside and outside home

- Non-slip matting or carpet in locations of important resources and on the walkways between important areas can improve accessibility for elderly animals with mobility problems
- Non-slip ramps can help dogs navigate steep steps outside the home and also get into and out of cars
- Specially designed harnesses can be helpful for supporting dogs with mobility problems to enable exercise and access to toilet areas
- Non-slip matting or carpet in locations of important resources and on the walkways between important areas can improve accessibility for elderly animals with mobility problems
- Most cats prefer raised resting places where they can feel safe and observe household activity from a safe distance. Providing ramps or steps may enable cats with mobility problems to continue to use withdrawal as a way of avoiding things that scare them
- Cats with mobility problems may no longer be able to use a cat-flap so owners will need to let them in and out unless they prefer to stay indoors.

### Other considerations for cognitively impaired pets

- Introducing a new pet into the household can be extremely stressful for an older animal with cognitive dysfunction, and owners would be better advised not to do this, especially with cats and any dog that does not have good social skills or is showing severe cognitive dysfunction.
- Play can be associated with a positive emotional response and increasing aerobic activity will also boost circulation, increasing oxygen supply to the brain. Low-impact games such as gentle throw-and fetch or search games are appropriate for most elderly dogs, and for dogs with vision loss, search games to find food or toys are particularly suitable. Short play sessions with fishing rod toys or toys that roll and/or make sounds will suit most cats. Older pets can become bored with toys quickly, so the toys need to be rotated every few days.
- Dogs with mobility problems can be taken out in the car and then given a short walk in a new location, or accompany owners on longer walks by riding in a modified baby stroller. Some elderly cats prefer to remain indoors, but if cats do want to go outside they can do this more safely if the cat will wear a harness, or possibly by fencing the garden to prevent the resident cat leaving and other cats entering. Screened back porches are excellent for this stimulation.
- Animals with severe cognitive dysfunction must have an environment that remains stable and is unchanging. Highly anxious animals, and especially cats, may cope best when restricted to a single room containing food, water, a litter tray, resting and hiding places. It is important to keep furniture and resources in the same places and to avoid big changes in the scent profile of the room, for example by not using strongly-scented cleaning products, as these can be very challenging for cats. It also helps to maintain a fairly consistent routine, ensuring that important events occur in the same order and at approximately the same times every day.
- Nurses are very well placed to discuss all these issues with pet owners whenever they come to the surgery, from puppy and kitten-hood onwards.

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