Case Study: Multimodal analgesic plan for dental pain in a cat

Introduction: Oral pain is one of the most common and least treated forms of pain in cats. Dental extractions, resulting in moderate to severe acute inflammatory pain, are frequently necessary to treat causes of oral pain such as periodontal disease, tooth fractures, resorptive lesions, and gingivostomatitis.[1, 2] Pain severity during recovery from a dental procedure is predictable based on the severity of the initial dental disease, number of missing teeth, and the extent of dental work required during the procedure.[2] This case report examines a feline patient presented for dental surgery to treat a class 4 malocclusion with associated tooth breakage. The Feline Grimace Scale, which has been validated in feline dental patients, was used to assess the patient.[3] Comprehensive multimodal analgesic therapy, including standard drug classes such as opioids, non-steroidal anti-inflammatories, and local anesthetics, were utilized, as well as non-pharmacological photobiomodulation.

Clinical Report: Squawk is a 5.9kg, 13yr old FS DLH feline. She presented to the dental clinic for an examination on 12/22/24 with a chief complaint of bruxism following a previous dental with nine extractions on 10/3/24 at which this author was not present. The patient's appetite was normal and the client did not perceive the patient as being painful. On physical exam the patient was found to have a class 4 malocclusion causing contact between 404 and 103, as well as 107 and the 400 molars. The previous extraction sites were fully healed. The patient's pain score was 2/10 on the Feline Grimace Scale, with the patient receiving one point for whisker position and one point for muzzle tension. As no malocclusion had been previously noted, iatrogenic injury to the temporomandibular joint was considered as a differential. The client declined referral for CT scan and elected to pursue further surgical extractions to relieve the contact between teeth. No treatments were administered at this time.

The patient was presented on 1/15/25 for further dental extractions. Pre-anesthetic labwork was within normal limits. The pre-surgical pain score was 3/10 on the Feline Grimace Scale. The patient received one point each for her ear position, whisker position, and orbital tightening. The client had administered gabapentin 8mg/kg PO three hours prior to admit to reduce stress associated with transportation to the hospital. Maropitant 1mg/kg was administered SC at admit to control emesis from the planned hydromorphone premedicant as well as for the MAC-reducing effect.[4] Due to significant hypotension during the previous dental procedure, the anesthetic plan was adjusted to reduce risk of further hypotension.[5] A benzodiazepine, which does not provide analgesia, was substituted for acepromazine due to the latter's vasodilatory effect and potential contribution to hypotension.The patient was pre-medicated with hydromorphone 0.05mg/kg IM, midazolam 0.18mg/kg IM, robenacoxib 2mg/kg SC, cefovecin 8mg/kg SC, induced with propofol to effect, and maintained on sevofluorane.

The oral exam under anesthesia revealed that 404 was making contact with the gingiva where 104 was previously extracted, 103 was making contact with 404, and there was mild bilateral TMJ instability. Dental radiographs revealed 403 and 301 were fractured, a retained root at 401, an early resorptive lesion on 409, and reactive alveolar bone associated with the missing 104. The patient once again experienced anesthetic hypotension with a MAP as low as 37 on oscillometric NIBP. Blood pressure support consisted of an initial 8ml/kg crystalloid fluid bolus followed by a 2ml/kg colloid bolus, which resolved the hypotension. Vasopressors were available if necessary. The author performed bilateral infraorbital blocks and a right mandibular block using bupivacaine 1mg/kg with buprenorphine 0.015mg added to extend the duration. Teeth 403, 103, 301, and 409 were extracted, as well as retained roots found at 104 and 401.

The patient had a prompt recovery. The extraction sites and surrounding tissues were treated with low-level laser therapy for a total dosage of 4J/cm^2. One hour post-extubation the patient was pain scored at a 1/10 on the FGS, receiving one point for her ear position. Two hours post extubation the patient was pain scored at 1/10 on the FGS, receiving one point for orbital tightening. The patient had no response to gentle oral palpation at either assessment time. The patient was discharged two hours post extubation with buprenorphine 0.01mg/kg OTM TID for three days. The client was educated on behavioral signs of oral pain in cats and instructed to call the clinic if they had any concerns.

Clinical Outcome: The patient presented for a recheck exam on 1/27/25. The client reported that the bruxism had initially resolved immediately post-procedure and recurred after three days, coinciding with the end of analgesia administration. They had also observed head shaking and difficulty grasping food. On physical exam the extraction sites were healing well and a slight clicking was audible when opening the patient's jaw. The patient's pain score was 2/10 on the FGS, with one point for ear position and one point for head position. Due to persistent bruxism and pain, the patient was referred for a CT scan. As the patient was displaying behavioral signs of pain and the return of bruxism coincided with end of analgesia administration, pain was considered as a cause. An NSAID was recommended for analgesia until the patient could be seen by the referral hospital, however the client declined medication.

Discussion: Multimodal analgesia refers to using multiple pharmacological and non-pharmacological therapies that target different points on the nociceptive pathway. This provides the most effective pain control and reduces adverse drug effects by allowing for lower

doses of each individual drug to be used. Analgesia should be started preemptively when possible to take advantage of the MAC sparing effects of many analgesic drugs and to reduce risk of peripheral and central sensitization.[6] The Feline Grimace Scale (FGS) was used to assess this patient, which has been validated for use in dental pain. While the FGS has been shown to be accurate when used by caregivers, it does require training. For this reason, the client in this case was counseled on dental-specific behavioral signs of pain in cats such as head shaking, pawing at the mouth, and difficulty with prehension,[17] and instructed to inform the clinic of any concerns.

In many patients dental pain has components of both acute and chronic pain. Periodontal disease often goes unrecognized by pet owners for long periods of time, during which the constant noxious stimuli can lead to central sensitization. The treatment itself frequently requires acutely painful surgical care. The oral structures are innervated by branches of the trigeminal nerve, the maxillary and mandibular nerves, through A-delta, A-beta, and C fibers, producing a variety of sensations from sharp to dull and aching. Unlike in much of the body where nociceptive signals from the periphery are modulated in the dorsal horn of the spinal cord, signals from the oral cavity undergo modulation in the medulla.[7] Dental pain is primarily inflammatory and nociceptive in nature.[1,2] Due to the acute-on-chronic nature of dental surgical pain, an NMDA antagonist such as ketamine could have been beneficial for this patient.

Opioids are the main-stay treatment for moderate to severe pain. The most clinically relevant opioid receptors in veterinary medicine are the mu and kappa receptors, with receptors located in both the peripheral and central nervous systems. Opioids affect transmission by inhibiting calcium channels, which leads to a reduction in the release of excitatory neurotransmitters such as substance P, and changes in post-synaptic excitability. Opioids also affect the perception of pain by inducing euphoria and analgesia.[8] The ability to effectively

antagonize most opioids, buprenorphine being a notable exception, contributes to their high level of safety. Adverse effects are dose dependent and in cats include sedation, dysphoria, bradycardia, mydriasis, and hyperthermia.[9(pp161-168)] Hydromorphone is comparatively likely to cause vomiting, so administering an anti-emetic is important for patient safety and comfort. In this case a long-acting opioid such as Simbadol could have been administered prior to discharge to reduce caregiver burden and the need to administer oral opioids immediately following dental extractions, reducing stress on the patient. The author prefers higher dosages of buprenorphine, 0.02-0.05mg/kg, and hydromorphone, 0.1-0.2mg/kg, than the prescribing clinician in this case.

Non-steroidal anti-inflammatories such as meloxicam and robenacoxib are used as part of multi-modal analgesic plans in cats to address inflammatory pain. NSAIDs block production of prostaglandins by inhibiting action of cyclooxygenase 1 and 2 to various degrees. Potential adverse effects such as vomiting, diarrhea, anorexia, and nephrotoxicity are related to the role of prostaglandins in gastroprotection, renal blood flow, and homeostasis. Therefore NSAIDs are contraindicated in patients with uncontrolled gastrointestinal, renal, or hepatic disease, or hypovolemia.[6] NSAIDs are more efficacious when administered prior to the noxious stimuli. There is some evidence that withholding the NSAID until after anesthesia may be beneficial in patients at high risk for experiencing hypotension, which was discussed as an option in this case.[10] It was ultimately decided that the change to the anesthetic protocol reduced the risk of hypotension to an acceptable degree and it is unfortunate that the patient once again experienced a hypotensive episode. Robenacoxib is a COX-2 preferential NSAID. COX-2 has fewer homeostatic functions than COX-1, which may reduce but not eliminate risk of gastrointestinal ulceration, platelet inhibition, and nephrotoxicity. Gastrointestinal support, correction of hypovolemia, and screening for renal and hepatic insufficiency can reduce risk of NSAID-related

complications.[11] Discharging the patient with an additional two days of robenacoxib would be ideal for continued multimodal analgesia as recommended by the WSAVA 2020 Dental Guidelines and was not done in this case due to surgeon concern regarding the client's ability to administer tablets without disturbing the extraction sites.[18] In this author's opinion, continued NSAID therapy would have been beneficial for this patient.

Local anesthetics are one of the most effective methods of preventing transduction and transmission of noxious stimuli from the periphery to the CNS.[7] Local anesthetics bind to voltage-gated sodium channels in the neuron cell membranes, preventing membrane depolarization and the production of an action potential triggered by an influx of sodium. Lipid solubility affects the time to onset and duration of action of the various local anesthetics. Drugs with high lipid solubility have greater membrane permeability and therefore faster onset of action. Because local anesthetics are lipid soluble, if symptoms of systemic toxicity such as cardiovascular and central nervous system effects occur they can be treated with Intralipids and support care.[12, 14] Bupivacaine was chosen in this case for its long duration of action, which was extended with buprenorphine. One canine study found that a combination of buprenorphine and bupivacaine used for infraorbital nerve blocks extended the analgesic duration to 24-72 hours.[13]

Low-level laser therapy, also known as photobiomodulation, has been shown to decrease pain and inflammation, and improve wound healing, including surgical wound healing. There are several mechanisms of action, including stimulating production of adenosine triphosphate, reducing production of inflammatory cytokines, and inhibiting substance P and bradykinin.[15(pp73-74)] Reduction in pain following treatment with photobiomodulation is reported in both human[16] and veterinary patients.[15(pp73-77)] The suggested dosage for dental disease is 4-6 J/cm2.[15(pg77)]

Summary: Dental disease is an under-recognized cause of pain in veterinary patients that can be severe and on-going. This case demonstrates the importance of pain scoring not just in the immediate peri-operative period, but during all follow-up appointments in order to detect potential complications and the need for further intervention. It also shows the important role that client education plays in identifying behavioral signs of pain in the home environment. This patient was treated for acute surgical pain with a variety of therapies including hydromorphone, buprenorphine, bupivacaine, robenacoxib, and photobiomodulation, before being referred for specialist care. There are many valid approaches to this type of patient and care could have been enhanced by optimizing opioid doses, providing additional NSAIDs for home use, and administration of an NMDA antagonist.

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