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<p>Empirical evidence has demonstrated that fish experience pain, and so to ensure their good welfare, it is vital that we can recognize and assess pain. A range of general, behavioral, and physiologic indicators can be used when assessing pain in fish. Many of these can be used at the tank side and are termed operational welfare indicators, whereas some require further computer or laboratory analysis. Behavioral indicators are valid and have been shown to profoundly differ between nonpainful and painful treatments in fish. However, these are not universal, and species-specific differences exist in behavioral responses to pain.</p>	
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<p>This chapter provides an overview of our current understanding of clinical analgesic use in fish. Recently, the efficacy and pharmacokinetics of several analgesic drugs for use in fish have been investigated, and the most important data indicates that μ-opioid agonist drugs (e.g, morphine) are consistently effective as analgesics across fish species. In addition, bath application of some analgesic drugs may be useful, which affords multiple methods for delivering analgesics to fish. Although few published studies of non-steroidal anti-inflammatory drugs administered to fish show promise, we have much to learn about the analgesic efficacy of most drugs in this class.</p>	
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<p>Advances in reptile cognitive research would help to (1) better qualify behavioral responses to pain experiences, (2) monitor welfare impacts, and (3) model analgesic studies with ecologically relevant insight to better qualify interventional responses. The focus of future analgesic studies in reptiles require the continued elucidation of the opiate systems and the given variations across taxa in efficacy in nociceptive tests. In addition, the development of ethograms based on ecological relevance is necessary to more appropriately identify complex behaviors as subtle perturbations that could be linked to pain responses may go unobserved. Lastly, animal models that mirror different types of clinical pain are needed for reptiles, as the most common studies are constricted to locally noxious chemo- and thermo-nociceptive models.</p>	

Treatment of Pain in Reptiles

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Kurt K. Sladky

This chapter provides an overview of our current understanding of clinical analgesic use in reptiles. Currently, μ -opioid agonist drugs are the standard of care for analgesia in reptiles. Reptile pain is no longer considered a necessary part of recovery to keep the reptile from becoming active too early. Rather, treating pain allows for the reptile to begin normalizing their behavior. This recognition of pain and analgesia certainly benefits our reptile patients and greatly improves reptile welfare, but it also benefits our students and house officers, who will carry the torch and continue to demand excellence in reptile medicine.

Pain Recognition and Assessment in Birds

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Nicole A. Mikoni, David Sanchez-Migallon Guzman, and Joanne Paul-Murphy

The recognition and assessment of pain in avian species are crucial tools in providing adequate supportive care in clinical, laboratory, zoologic, rehabilitation, and companion animal settings. With birds being a highly diverse class of species, there is still much to be determined regarding how to create specific criteria to recognize and assess pain in these animals. This article provides a clinical review on the physiology of pain in birds, observed behavioral and physiologic alterations with pain, how different sources and degrees of pain can alter behaviors observed, and how this information can be applied in a clinical setting.

Treatment of Pain in Birds

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David Sanchez- Migallon Guzman and Michelle G. Hawkins

This article provides an overview of the current understanding of evidence-based clinical analgesic use in birds. The field of avian analgesia has dramatically expanded during the last 20 years, affording more options for alleviating both acute and chronic pain. These options include opioids, nonsteroidal anti-inflammatory drugs, local anesthetics, and/or other drugs like gabapentin, amantadine, and cannabinoids, acting at different points in the nociceptive system thereby helping to provide greater pain relief while reducing the risk of adverse effects when combined.

Pain Recognition in Rodents

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Vanessa L. Oliver and Daniel S.J. Pang

Available methods for recognizing and assessing pain in rodents have increased over the last 10 years, including the development of validated pain assessment scales. Much of this work has been driven by the needs of biomedical research, and there are specific challenges to applying these scales in the clinical environment. This article provides an introduction to pain assessment scale validation, reviews current methods of pain assessment, highlighting their strengths and weaknesses, and makes recommendations for assessing pain in a clinical environment.

Treatment of Pain in Rats, Mice, and Prairie Dogs 151

Rhonda Oates and Danielle K. Tarbert

Recent myomorph and scuiromorph rodent analgesia studies are reviewed and evaluated for potential clinical application. Differences between laboratory animal studies and clinical use in diseased animals are discussed. Analgesia classes reviewed include local anesthetics, nonsteroidal anti-inflammatories, acetaminophen, opioids, and adjuvants such as anticonvulsants. Routes of administration including sustained-release mechanisms are discussed, as are reversal agents. Drug interactions are reviewed in the context of beneficial multimodal analgesia as well as potential adverse effects. Dosage recommendations for clinical patients are explored.

Hystricomorph Rodent Analgesia 175

Miranda J. Sadar and Christoph Mans

Limited information on the analgesic efficacy and safety of even clinically commonly used analgesic drugs in guinea pigs and chinchillas is available. Buprenorphine and meloxicam are currently the most common analgesics routinely used to treat painful conditions in guinea pigs and chinchillas. Hydromorphone has also shown to be an effective analgesic drug in these species, with limited adverse effects. Tramadol in chinchillas does not provide analgesia even at high doses, and no information is available on the efficacy of this drug in guinea pigs. Multimodal analgesic protocols should be considered whenever possible.

Pain Recognition in Rabbits 187

Amy L. Miller and Matthew C. Leach

Rabbits typically undergo at least one painful procedure during their lifetime and appropriate methods of assessment are essential to reduce or alleviate pain. Various methods of assessing pain in rabbits have been investigated, with the validity of spontaneous behavior and grimace scale scoring being the most studied to date. Assessment of pain is challenging, compounded by rabbits being a prey species that display freezing behavior in the presence of unfamiliar caregivers. Here we discuss some key changes in rabbits that can be used in the assessment of pain and provide some practical suggestions to ensure that the assessment can be carried out effectively.

Treatment of Pain in Rabbits 201

Sarah Ozawa, Alessia Cenani, and David Sanchez-Migallon Guzman LV

Rabbits occupy facets of veterinary medicine spanning from companion mammals, wildlife medicine, zoologic species, and research models. Therefore, analgesia is required for a variety of conditions in rabbits and is a critical component of patient care. Considerations when selecting an analgesic protocol in rabbits include timing of administration, route of administration, degree or anticipated pain, ability to access or use controlled drugs, systemic health, and any potential side effects. This review focuses on pharmacologic and locoregional management of pain in

rabbits and emphasizes the need for further studies on pain management in this species.

Pain Recognition in Ferrets

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Yvonne van Zeeland and Nico Schoemaker

Recognition and accurate assessment of the severity of pain can be challenging in ferrets as they are unable to verbally communicate, and often hide their pain. Pain assessment relies on the assessment of behavioral, physiologic, and other clinical parameters that serve as indirect indicators of pain. Assessment of physiologic and clinical parameters requires handling, which results in changes in these parameters. Behavioral parameters can be assessed less invasively by observing the patient. Due to their nonspecificity, correct interpretation may be challenging. Just as in other species, a grimace scale seems to be the most helpful tool in recognizing pain in ferrets.

Treatment of Pain in Ferrets

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Olivia A. Petritz and Ricardo de Matos

Ferrets often require pain management as part of comprehensive veterinary care. Recognition and objective quantification of pain, such as the ferret grimace scale, are the first steps of an analgesic plan. As in other species, a multimodal approach to pain management is preferred, which includes combining analgesic drugs of multiple classes and/or techniques to affect different areas of the pain pathway. This article reviews the current published literature on analgesic medications in domestic ferrets, including specific drugs, doses, dosing intervals, and routes of administration.

Acupuncture in Zoological Companion Animals

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Ronald B. Koh and Tara M. Harrison

Over the past years, the concept of pain management in veterinary medicine has evolved and led to the establishment of a new concept of multimodal approach to pain management, as the current standard of care. The use of multimodal analgesia combining pharmacologic and nonpharmacologic techniques not only helps optimize the quality and efficacy of analgesia but also may prevent the development of chronic or persistent pain. During the past decade, acupuncture has become more popular and evolved into one of the most used forms of integrative medicine interventions and nonpharmacologic therapeutic options for pain management in humans and animals in North America and Europe. There is ample evidence from basic and clinical research for acupuncture is effective in the treatment of acute and chronic pain by influencing neural networks of the nervous system. While in the modern days' veterinary acupuncture has been predominantly used in horses and dogs, its popularity in zoologic companion animals (ZCA) has increased in recent years as an adjunct therapy for treating musculoskeletal, neurologic, and gastrointestinal disorders due to its minimal invasiveness and low risk of adverse events. The integrative use of acupuncture has become even more important with the increasingly limited use of opiates in veterinary medicine due to the

opiate crisis. The purpose of this article aims to provide guidance for using acupuncture for pain management in ZCA in clinical practice, based on available information and recommendations from experienced veterinary acupuncturists.

Physical Rehabilitation in Zoological Companion Animals

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Ronald B. Koh, Jessica Rychel, and Lindsey Fry

Animal physical rehabilitation is one of the fast-growing fields in veterinary medicine in recent years. It has become increasingly common in small animal practice and will continue to emerge as an essential aspect of veterinary medicine that plays a vital role in the care of animals with physical impairments or disabilities from surgery, injuries, or diseases.¹ This is true now more than ever because of the increasing advances in lifesaving treatments, the increased lifespan of companion animals, and the growth of chronic conditions, of which many are associated with movement disorders. The American Association of Rehabilitation Veterinarians (AARV) defines APR as “the diagnosis and management of patients with painful or functionally limiting conditions, particularly those with injury or illness related to the neurologic and musculoskeletal systems.” Rehabilitation not only focuses on recovery after surgical procedures but also on improving the function and quality of life in animals suffering from debilitating diseases such as arthritis or neurologic disorders. The overall goal of APR is to decrease pain, reduce edema, promote tissue healing, restore gait and mobility to its prior activity level, regain strength, prevent further injury, and promote optimal quality of life. Typically, a multimodal approach with pharmaceutical and nonpharmaceutical interventions is used by APR therapists to manage patients during their recovery. The purpose of this article aims to provide knowledge and guidance on physical rehabilitation to help veterinarians in the proper return of their patients with ZCA safely after injury and/or surgery.