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Advancing Veterinary Pain Management into a New Era

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"The greatest evil is physical pain."
Saint Augustine of Hippo (386)

1.1 Introduction

A living being, from the moment of birth, seeks pleasure as the ultimate good while rejecting pain as the ultimate adversity and does their best to avoid it. Pain is based on an anatomical and physiological foundation. It is the intent of this chapter to historically look at human pain, proceed forth into veterinary pain, and conclude with a veterinary technician's pivotal role moving forward in pain management today.

1.2 Brief History of Human Pain Management

Western cultural identity has, in part, been influenced by ancient Greek texts such as *The Iliad* and *The Odyssey* by Homer because of the emphasis these stories placed on pain. Sophocles continues to describe pain almost as an independent being that seizes possession of the subject, invades it, and takes over. Thus, words like *consuming* or *devouring* are used to describe the ill being (Rey 1993). Galen of Pergamon was a Greek physician, surgeon, and philosopher in the Roman Empire. Galen is known today for classifying the different forms of pain which have been handed down to modern times: *Pulsific* or throbbing, *gravative* or weighty, *tensive* or stretching, and *pungitive* or lancinating (Rey 1993).

In contrast to Western medicine, which can be traced back to Hippocrates, Chinese acupuncture was fully developed by the end of the second century BCE (before the common era). Among many ancient civilizations, such as kingdoms in Africa, Sumer, China, Mesoamerica, and the Indus-Ganges, China is the only civilization where acupuncture was well documented 2000 years ago that still survives (Chiu 2014).

Before the advent of modern anesthesia, humans used diverse means to diminish pain, including pressure or ice to numb extremities. Many indigenous cultures had their own understanding of pain and often took a more holistic approach to managing discomfort, something that we see a reawakening of today. They administered herbal medicines including mandragora, hemp-marijuana, and opium. Some used fermented drinks that contained alcohol used not only for pain but also for ceremonies and recreation. The Incas, as an example, knew of the

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topical effects of coca/cocaine leaves, but they had no way to administer it other than placing coca-laced saliva into wounds. Hua Tuo (in the second century CE) was a Chinese physician and surgeon who is best known for his surgical operations and the use of *mafeisan*, an herbal anesthetic formulation made from hemp. Using a preparation of hemp and wine, he was able to make his patients insensitive to pain (Tubbs et al. 2011). Other Mesoamerican Indigenous and Aboriginal Australian people not only used herbal and mechanical means for pain relief but also incorporated ceremony, showing a deep understanding of the interconnection between physical, emotional, and spiritual health in all creatures. Unfortunately, many of these ancient herbal remedies and other culturally significant practices were banned or lost during colonization, only to be "rediscovered" in modern times by the same but very distant relatives of the original colonizers. The loss or suppression of indigenous peoples' healing practices leaves us with a "Western" or "Eurocentric" perspective in textbooks on the evolution of pain management (Eger et al. 2014; Geck et al. 2020; Quiñonez-Bastidas and Navarrete 2021; Carmona Rosales 2021; Wren et al. 2011).

René Descartes, a French scientist and philosopher, was the first recorded person to claim that pain comes from the brain. His study focused on phantom limb pain and since there was no limb to feel pain, he concluded that pain must come from the brain. Descartes opened the door to the understanding that the brain was a key component of pain, though it would be centuries before the complete connection between the brain, nervous system, and pain was made (Rey 1993).

Albrecht von Haller was interested in the reactions of fibers and how to distinguish between the irritability of muscle fiber – which he called contractibility – and the excitability of nerve fibers – which he called sensitivity (Olson 2013a).

Pierre Jean George Cabanis' work incorporated a psychophysiological approach to pain, which included the emotional component. His work led to new techniques such as using electrical stimulation for the treatment of pain.

Xavier Bichat represented a passage from organic sensitivity to animal sensitivity and the *threshold concept*. Bichat's contribution to pain medicine was his discovery of the importance of the sympathetic nervous system (Olson 2013a).

The early part of the nineteenth century saw the development of health clinics, which increased interest in the study of pain. Pain research at this time remained within the framework of *specificity theory* advanced by Johannes Müller and later Maximilian von Frey, which saw pain as an independent sensation with its own sensory apparatus. Müller proposed a theory for pain, which considered findings from physiology, historical observations, pathology, and integrated psychological dimensions of pain. He believed that pain was not imaginary – that it could occur without an external stimulus. Von Frey was trying to identify points on the skin that responded specifically to one of the four cutaneous sensations: touch, heat, cold, and pain. To accomplish this task, he invented what he called an esthesiometer, where the stimulus consisted of hair (Olson 2013b).

In 1965, Ron Melzack and Patrick Wall proposed a theory suggesting that neural mechanisms in the dorsal horn of the spinal cord could act as a "gate," increasing or decreasing the flow of nerve impulses from peripheral fibers to the spinal cord cells projecting to the brain. In other words, the spinal cord "gate" either blocks pain signals or lets them pass onto the brain (Melzack and Wall 1965). Today, the gate control theory continues to thrive and evolve despite considerable controversy. The technology of spinal cord stimulation is also based on the gate control theory where products approved by the FDA are already on the market.

In 1973, John Bonica, the founding father of the modern-day field of pain medicine and the driving force in establishing the International Association for the Study of Pain (IASP), proposed that relief of pain is a basic human right (Jackson and Norman 2014).

1.3 Veterinary Pain Management Through the Centuries

The surviving records on the advancement of veterinary medicine occurred during the Greek, Roman, and Byzantine eras. During this period, many species were investigated, with primary attention paid to the horse.

The development of nailed-on horseshoes was a major technological step that enhanced the performance of draft and cavalry horses in the Dark Ages. The Celts were first to use red hot iron to fit under the strong rim of the horse's hoof. The Islamic world chose lighter shoes that could be shaped cold (Dunlop and Williams 1996).

During the Middle Ages, *mandragora* (or the root of the mandrake plant) was made into an anesthetic potion administered to the patient (human or animal) before surgery or cautery (Eger et al. 2014). It induced a deep sleep likely due to the plants natural production of deliriant hallucinogenic tropane alkaloids (atropine, scopolamine, and hyoscyamine) (Roberts and Wink 1998).

In 1656, Christopher Wren (the architect for St. Paul's cathedral and a founder of the Royal Society) infused wine and ale from a syringe made of a dog's bladder, through a goose quill needle into the vein of a dog. The dog survived the experiment. Wren later gave opium intravenously via a quill to dogs, causing unconsciousness in some animals, but killing others. Wren's experiment was the first known injection to produce anesthesia (Moon 2021).

Gasses and vapors later known as anesthetics had been synthesized or isolated before (ether, nitrous oxide, and carbon dioxide) but would be more regularly synthesized from 1798 through 1846 for research and medical use. In 1798–1800, Humphry Davy used nitrous oxide for recreation and research, noting its capacity to diminish or even abolish pain. He suggested its use for surgery, but no one noticed (Ramsay et al. 2005). In 1823, Hickman used carbon dioxide to cause what he called "suspended animation," a state that permitted apparently painless surgery in animals, but no one noticed (Eger et al. 2014). In the 1840s, William Clarke, Crawford Long, and Elton Romeo Smilie each administered ether in amounts sufficient to permit surgery to be undertaken without pain. But they thought too little of what they had done, or didn't know what they had done, to request public credit for their accomplishment and no one noticed (Keys 1996).

Veterinary anesthesia/analgesia has paralleled human anesthesia/analgesia for the most part, but also still lags in many ways. The two have been intimately intertwined, each contributing to the advancement of the other. The introduction of veterinary anesthesia was delayed by the misperception that the induction of anesthesia in animals was painful and unnecessary, one needed to only "hobble" the animal, in other words, forcefully restrain. This misperception gave way to the governmental demand for the application of anesthesia to relieve the pain of surgery in animals. The performance of anesthesia and surgery in animals today is remarkably like that in humans, particularly in the United States, Great Britain, and Europe (Steffey 2014).

1.4 Animal Research Contributions

Humans have been using other animal species as models of their anatomy and physiology since the dawn of medicine. Because of the taboos regarding the dissection of humans, physicians in ancient Greece dissected animals for anatomical studies (Franco 2013).

Jeremy Bentham was the first person to grant animals moral standing for the sake of their own sentience. He stated, "The question is not, can they reason? Nor, can they talk? But can they suffer?" (Bentham 1789).

Charles Darwin was known for his affection to animals and abhorrence for any kind of cruelty, but also for his commitment to scientific reasoning and progress (Franco 2013).

Joseph Lister pointed out the importance of animal experiments for the advancement of medical knowledge, stressed that anesthetics should always be used, and denounced the ill-treatment of animals in sports, cruel training methods, and artificial fattening of animals for human consumption as being crueler than their use in research (Gaw 1999).

While animal experiments have played a vital role in scientific and biomedical progress and are likely to continue to do so in the foreseeable future, it is nonetheless important to keep focusing on the continuous improvement of the well-being of laboratory animals, as well as further development of replacement alternatives for animal experiments (Franco 2013).

Pain is a major welfare issue in animal experiments and must be treated and minimized for ethical and scientific reasons. Unrelieved pain may have a substantial and difficult-to-control effect on many physiological processes and behaviors. Pain has the potential to increase the variability of data. Untreated pain may affect complex behavioral traits such as circadian rhythmicity or decision-making, attention, and learning via motivational changes, and may change the sensory capacities of animals via allodynia and hyperalgesia or affect many physiological and endocrine systems (Jirkof 2017). Thus, adequate pain relief has an important scientific and methodological dimension.

1.5 History of Animal Nursing Staff

Through the years, individuals have aided veterinarians in the care provided to animals. Spouses, family members, and other laypersons served as assistants, receptionists, and office managers for the veterinary practice.

The first record of a program for training, other than for veterinarians, occurred in 1908 with the formation of the Canine Nurses Institute in the United Kingdom (Turner & Turner 2011).

The term *veterinary technician* is commonly used in the United States and Canada, whereas *veterinary nurse* is uniformly used in countries throughout Europe and Asia.

Veterinary technicians were first called animal health technicians in the United States and Canada. The adjective *veterinary* referred exclusively to veterinarians until 1989, when the term *veterinary technician* was formally approved by the House of Delegates of the American Veterinary Medical Association (AVMA) (Bassert and Lazo 2021). The designations in the United States are Registered Veterinary Technician (RVT), Licensed Veterinary Technician (LVT), Certified Veterinary Technician (CVT), or Licensed Veterinary Medical Technician (LVMT); depending on where in the United States one lives.

Animal Health Technicians or Registered Veterinary Technicians/Technologists is the term used for those living in Canada. This is governed by the individual Canadian Province. The term for those in Europe and some Asian countries is Registered Veterinary Nurse (RVN).

The National Association of Veterinary Technicians in America (NAVTA) in the mid-1990s developed the Committee on Veterinary Technician Specialties (CVTS) to help guide and structure the development of specialties for credentialed veterinary technicians. The CVTS provides a standardized list of criteria and assistance for societies interested in attaining academy status. Each Veterinary Technician Specialist (VTS) has completed requirements of formal education, clinical training, and standardized testing within their specialty area of interest (Bassert and Lazo 2021).

1.5.1 National Association of Veterinary Technicians in America Recognized Veterinary Technician Specialty Academies

The Academy of Veterinary Emergency and Critical Care Technicians

The Academy of Veterinary Dental Technicians

The Academy of Internal Medicine Veterinary Technicians

The Academy of Veterinary Technicians in Anesthesia and Analgesia

The Academy of Laboratory Animal Veterinary Technicians and Nurses

The Academy of Veterinary Behavior Technicians

The Academy of Veterinary Clinical Pathology Technicians

The Academy of Veterinary Technicians in Clinical Practice

The Academy of Dermatology Veterinary Technicians

The Academy of Equine Veterinary Nursing Technicians

The Academy of Physical Rehabilitation Veterinary Technicians

The Academy of Veterinary Nutrition Technicians

The Academy of Veterinary Ophthalmic Technicians

The Academy of Veterinary Surgical Technicians

The Academy of Veterinary Zoological Medicine Technicians

The Academy of Veterinary Technicians in Diagnostic Imaging

1.6 Eyewitness to 50 Years of Changes for Veterinary Technicians

The author of this first chapter has been involved in veterinary medicine since 1971, beginning in high school working on weekends, holidays, and summer vacations, until she went to an accredited AVMA approved program in the fall of 1974. Over this time, there was relatively no pain management or analgesia practiced in veterinary medicine. The author was at the University of Pennsylvania's School of Veterinary Medicine and New Bolton Center, Large Animal Veterinary School located in Kennett Square, Pennsylvania, from 1974–1976. It was not uncommon to hear the equine surgeons state, "I want my patients to **have** pain to prevent movement that would damage my work."

Since graduation, the author has worked in various aspects of veterinary medicine from small animal and equine to mixed practice, coccidiosis research for a pharmaceutical company, zoo animal medicine, and laboratory animal medicine.

This author can remember the first time pain relief was mentioned during her veterinary career. It was in the use of methoxyflurane (Penthrane® – Abbott Laboratories, Chicago, Illinois). This inhaled anesthetic was "better for orthopedic surgery because it provided analgesia" (remembered quote). In the textbook *Principles and Practice of Veterinary Anesthesia*, methoxyflurane is referred to: "At light surgical planes of anesthesia or more, profound analgesia is present" (Short 1987). Its clinical role gradually decreased in the 1970s because of reports of dose-dependent nephrotoxicity. In 1999, its manufacturer, Abbott Laboratories, discontinued the distribution of methoxyflurane in the United States and Canada. Outside of North America, however, methoxyflurane has been reborn as an inhaled human analgesic used for pain relief in the prehospital setting and for minor surgical procedures. First used in Australia and New Zealand, and subsequently in over 37 other countries, low concentrations of methoxyflurane are administered with a hand-held inhaler that provides conscious sedation (Ikeda 2020).

Injectable anesthetics and analgesics in veterinary medicine started with ketamine. The history of ketamine begins in the 1950s at Parke-Davis and Company's laboratories in Detroit, Michigan, USA. At that time, Parke-Davis was searching among cyclohexylamines for an "ideal" anesthetic agent with analgesic properties (Mion 2017). It was regularly used on dogs and horses and extensively used for surgical anesthesia during the Vietnam War (Domino 2010). Ketamine has been used in cats since this author can remember (early 1970s). Ketamine when used alone produces immobilization but not surgical anesthesia. It induces a state of

catalepsy or dissociative anesthesia (Thomas et al. 2021). Today, it is commonly used in the perioperative setting in anesthetic planning for sedation, in combination with other drugs for induction, intra-op infusion, and postoperative pain management.

In the 1980s, the only "analgesics" used were local anesthetics and alpha-2-antagonist agents. The author can remember the first bottle of butorphanol purchased for orthopedic surgery. Butorphanol was not a scheduled or controlled substance in 1988. In fact, butorphanol under the trade names Torbugesic® and Torbutrol® was first marketed as an injectable product in 1979. The veterinary product was marketed by Fort Dodge Animal Health, and the human product, under the trade name Stadol®, was marketed by Bristol-Myers Squibb. The Federal Register Volume 62, Number 190 (Wednesday, October 1, 1997) placed butorphanol into a Schedule IV category by the Drug Enforcement Administration, Department of Justice (Federal Register 1997).

The use of analgesics has grown by leaps and bounds over the past 50 years in the veterinary profession. The variety of analgesics available for use in the United States is vast. European countries have a wide variety of analgesics, too. However, it should be noted that not all countries globally have access to newer analgesics.

1.7 Veterinary Technician Pioneers in Pain Management

No history of veterinary analgesia use would be complete without the mention of Nancy Shaffran CVT, VTS-ECC (Veterinary Technician Specialist, Emergency and Critical Care). Nancy is a professional veterinary educator with an extensive background in critical care and pain management. She graduated from the University of Pennsylvania. She is a charter member and a past president of the Academy of Veterinary Emergency and Critical Care Technicians and Nurses. After 12 years at the University of Pennsylvania Veterinary Hospital, where she was the supervisor of the intensive care unit, Nancy spent 5 years as director of Education and Staff Relations at Cardiopet's Veterinary Referral Center followed by 7 years as a senior specialist on the sedation and pain management team at Pfizer Animal Health, now Zoetis Animal Health. Nancy has given over 2500 lectures to technicians and veterinarians around the world. She has authored more than 25 journal articles and book chapters besides editing books. The focus of Nancy's career has been the ethics and appropriate management of pain in companion animals.

*Editor's Note: The editors would also like to acknowledge the tremendous efforts of the author of this chapter, Mary Ellen Goldberg, for her passion and dedication to the field of animal care, particularly in the fields of veterinary anesthesia, pain management, and physical rehabilitation. Mary Ellen was critical in the development and administration of the Certified Veterinary Pain Practitioner (CVPP) certification through the International Academy of Pain Management (IVAPM) and an organizing member for two of the veterinary technician specialty academies. Because of her dedication, she also received an honorary veterinary technician specialty from the Academy of Veterinary Technicians in Anesthesia and Analgesia. Mary Ellen is known worldwide for her selfless dedication and contribution in pushing for the advancement of veterinary nursing staff and education within the veterinary profession.

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1.8 Future Directions for Veterinary Technician Pain Management

Innovative trends in veterinary pain management will require advanced skills that would need specialization before the technician would be allowed to perform any techniques. Most of these medications and techniques are new to specialized veterinarians. One can already envision with educational and clinical training, that specialized veterinary technicians may be able to provide these therapies as directed by the veterinarians.

The advent of various specialty certifications like the veterinary technician specialties or CVPP from the IVAPM, or certificate programs like those from the World Small Animal Veterinary Association and American Animal Hospital Association offer veterinary technician's routes to grow professionally. We are also at a precipice for increasing the scope of practice for veterinary technicians with a VTS as multiple states have already increased the scope of practice for veterinary technician's specialists, which will allow for an increased access to care, particularly animals that need chronic pain case management.

1.9 Conclusion

Our increasing knowledge of the mechanisms and factors related to the multidimensional nature of pain has been translated into an improved understanding of the care for our veterinary patients in pain. We have improved surgeries, interventional procedures, medications, behavioral interventions, physical rehabilitation, acupuncture, and nutritional approaches. We also have a greater appreciation for the need for an interdisciplinary (veterinarian, veterinary technician/nurse, veterinary assistant, physical therapist, veterinary acupuncturist, veterinary behaviorist, veterinary nutritionist) team-based approach to optimize pain care, particularly for more complex cases. As we move into a new era of veterinary pain management, let us hope that we will begin to achieve our goal to have each of our patients be as pain-free as possible.

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