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TECHNOLOGICAL ADVANCEMENTS IN VETERINARY MEDICINE

Urfeya Mirza* and Uiase Bin Farooq
Division of Veterinary Surgery and Radiology, FVSC&AH, SKUAST-Kashmir, 191201 (J&K), India
E-mail: urfeyamirza@gmail.com (**Corresponding author*)

Abstract: Technology is pushing the bounds of veterinary medicine to new limits. In this article, various new advancements and technologies in veterinary medicine are discussed. Importance of advent in stem cell therapy, fiber optics, anesthesia and anesthetic monitoring and laser surgery, which are novel and emerging therapies are highlights of the review. The clinical use of stem cells in veterinary medicine in several species is at its early stage but it has revolutionized the concept of healing. Use of fiber optic technology in diagnosis is one of the most exciting developments in veterinary medicine. Alfaxalone is the newest anesthetic induction agent approved by the FDA, while surgical lasers have been successful in enhancing the operating room experiences. Many additional new therapies and technologies are becoming available all the time, continually improving the health and longevity of animals. This review gives a brief presentation of all the important innovative technologies safeguarding the health of animals.
Keywords: Animal, Development, Research, Technology, Veterinary

Introduction

The world of medicine, including veterinary medicine, is a constantly changing one. The adage “adapt or die”, has never been more relevant that in current times, when technology is constantly advancing. Recent trends in veterinary technology have moved towards the integration of hand-held devices and consumer-based technology to monitor pets and interact with veterinarians. Over the past decade or so, veterinary medicine has seen many changes concerning diagnosis, treatment, and care. MRI (Magnetic Resonance Imaging), ultrasound scans, and laparoscopy that were used solely on human beings are now the norm for treating pets and other animals as well. Following suit are digital radiographs that replace X-ray films for digital communication, thorough assessment, and effective treatment. Digital dental X-rays and advanced oral surgery instruments also follow this pattern, enabling veterinarians to improve oral health in pets. Newer inventions further address health issues in pets not just within clinics, but on an all-around basis for prevention and better care. In this article, we would like to discuss some of the more recent changes in the world of veterinary medicine.

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1. **Stem cell therapy**

The clinical use of stem cells in veterinary medicine is clearly in its early stages. Applications for bone marrow-derived mesenchymal stem cells (BM-MSC) and adipose-derived stromal vascular fraction (AD-SVF) cells in the treatment of musculoskeletal pathologies are currently in use in several species, although the differential efficacies of various approaches are still being investigated. Optimization of these stem cell-based therapies will focus on the cellular origin, isolation, enrichment, and processing as well as on the timing, route of administration, formulation, and dosing of those therapies. Development of confirmed embryonic stem or induced pluripotent stem cells in domestic species would greatly facilitate the development of a wider range of clinical applications. Use of stem cell-based approaches in attempts to preserve the germplasm of threatened species could begin on an opportunistic basis in the form of xenografting of testis tissue obtained quickly after the death of pre-pubertal individuals (Fortier and Travis, 2011). However, this must still be considered a research endeavor given the largely unknown causes of species differences in the success of spermatogenesis as well as the need to perform subsequent techniques of assisted reproduction which have themselves not yet been determined for most species.

2. **Fiber optics**

One of the most exciting developments in veterinary medicine in the last few years is fiber optic technology. Briefly, fiber optics involves the use of small plastic fibers that carry light along their entire length. In veterinary medicine, bundles of these fibers are put together in an endoscope. These scopes, which resemble black cables or hoses, are useful for many procedures. For example, to aid in the diagnosis of vomiting or diarrhea, the veterinarian can pass an endoscope into a sedated or anesthetized animal and look at or take biopsies of the gastrointestinal tract. Optical fibers can assess animal behavior using both optical imaging/recording and the manipulation of neural activity (Miyamoto and Murayama, 2016).

Smaller versions of these scopes can be used for diagnosing bladder disorders, urethral problems, and for looking at the internal female reproductive tract. Endoscopes are also useful in emergencies when an animal has swallowed a foreign object. For the coughing companion, a small version of an endoscope called a bronchoscope can be placed into the animal’s airway for visualization and biopsy. Formerly, these procedures could only be done through surgery. Endoscopic examination, diagnosis and treatment are much less expensive. There are also fewer complications than an animal would potentially experience through surgery (e.g. infections, bleeding and disruption of the surgical wound).

3. Anesthesia and anesthetic monitoring

Since the introduction of anesthesia hundreds of years ago, the agents used to provide sedation, induction, and maintenance of anesthesia have become profoundly safer. Although the drugs we use today are much safer, there still exists no perfect anesthetic agent. Since propofol came to the market, it has been the most widely used, and arguably one of the safest anesthetic induction agents used in both human and veterinary anesthesia. Alfaxalone, brand name Alfaxan, is the newest anesthetic induction agent to enter the United States market after approval by the FDA (Rodríguez et al., 2012). Other newer anesthetics such as isoluorane and sevoluorane anesthetize animals more safely than the older ones. These new gases quickly induce anesthesia, have minimal negative effects on your animal's internal systems, such as the cardiovascular, and allow the animal to recover quickly when the procedure is terminated.

The statement "there are no safe anesthetic agents, there are no safe anesthetic procedures, there are only safe anesthetists" should be the dictum for the entire anesthetic process in every practice (Smith, 1959). Anesthesia is typically maintained using inhalant anesthetics delivered in O_2 and dosed "to effect" (Lerche et al., 2000). Monitoring can be of following types:

Physiologic Monitoring:

Regardless of the drugs used for anesthesia maintenance (i.e., inhalant or injectable), vigilant monitoring, interpretation of physiologic changes, and response to patient physiologic status by well-trained and attentive staff is critical. Monitoring decreases the odds of anesthetic death, whereas a lack of monitoring increases the odds of anesthetic death by a factor of 5–35 (Matthews et al., 2017). Both multiparameter electronic monitors and hands-on assessment of the patient by the anesthetist should be used. Treatment decisions should be made based on information from both the electronic monitors and the anesthetist's assessment. Monitoring respiratory function includes respiratory rate, oxygenation (percentage of hemoglobin saturated with oxygen (SPO_2), and ventilation ($ETCO_2$). BP, heart rate (HR) and rhythm (ECG), capillary refill time, mucous membrane color, and pulse oximetry (SpO2) provide the best indices of cardiovascular function. Anesthetic depth is monitored, and a surgical plane of anesthesia is typically defined as a patient with absent palpebral reflex, mild jaw tone (i.e., muscle relaxation), and lack of purposeful movement. Body temperature monitoring is critical, with heat supplementation starting early.

Physiologic Support:

Regardless of the drugs used for anesthesia maintenance (i.e., inhalant or injectable), O_2 should be delivered to the patient. The O_2 flow rates depend on the breathing circuit. Use a relatively high flow rate (2–3 L/min) when rapid changes in anesthetic depth are needed, such as during the transition from injectables to inhalants (induction) or when discontinuing inhalants at the end of the procedure. Because of the high oxygen flow, increased flow at induction and after discontinuing inhalants is not necessary. Following induction and intubation, the patient may be apneic or have a low or shallow respiratory rate, requiring intermittent (1-4 breaths/min) PPV breaths delivered by the anesthetist to maintain anesthesia until the respiratory depression of the induction drugs subsides. If PPV is excessive, $ETCO_2$ levels will decrease below the level that stimulates ventilation and the patient may not begin spontaneously breathing. Balanced crystalloid fluids should be administered for most patients undergoing anesthesia.

4. **Laser surgery**

The past two decades have seen incredible progress in the development of laser technologies for the veterinary profession, and there is every indication this will continue. In keeping with the consensus of today's veterinary laser practitioners that higher power equates to improved results in surgical outcomes, the latest generations of surgical lasers have been developed with power outputs of up to 45W at a continuous wave, and up to 30W at SuperPulse. With such units, laser surgery may now be conducted at the same hand speed as that performed with a scalpel blade, with the added benefits of no hemorrhage, with reduced collateral thermal injury, and with sealed nerve endings and lymphatics. Such innovation is an extraordinarily useful tool to possess for soft tissue surgery (Mushaben et al., 2018). Laser surgical innovations include: Laser-Tissue Welding, Smaller Handheld Laser Units, etc. An examination of today's technologies offers an opportunity for speculation on how the veterinary profession might integrate them with surgical lasers to enhance the operating room experience.

This is just a partial list of major veterinary advances. Many additional new therapies and technologies are becoming available all the time, continually improving the health and longevity of animals.

Conclusion

Technological advancements have helped improve the quality of not just human life but also that of the animals dear to them. The field of veterinary medicine has witnessed transformations in leaps and bounds, enabling veterinary practitioners to make faster

diagnoses, more accurate prognoses, and ultimately save animal lives. The use of technology has also ensured better care outcomes - not just for the pets, but also for their owners.

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