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Animal reproductive physiology, pathology, male gamete preservation and artificial insemination

Tiba Ahmed*

Department of Veterinary Clinical Sciences, Center for Reproductive Biology, Pullman, United States.

BACKGROUND

Reproductive physiology and procreation have always fascinated mankind. Therefore, it is not surprising that scientific research in the field of reproduction is one of the oldest and most established areas of biology. Advances in reproductive science have been made possible by the curiosity of scientists from different backgrounds (biologists, animal scientists, and veterinarians). At the turn of the century, advances in reproductive research were driven primarily by the need to improve animal production and prevent STDs. Knowledge of animal reproduction has grown exponentially over the past 50 years. In recent years, the field of study has expanded beyond laboratory species and farm animals to include the protection and management of wild animals.

As this area of research grew, scientists realized the importance of organizing themselves into international societies dedicated to this area. One of the oldest societies is the Society for the Study of Reproduction. In the veterinary field, reproductive physiology and pathology became known as "theriogenology" thanks to the efforts of the founding members of a veterinary discipline called the American College of Theriogenologists, which was recognized by the American Veterinary Medical Association in 1971 as a part of veterinary studies. Similar universities of applied sciences have also been established in Europe (European College of Animal Reproduction), Australia and New Zealand (College of Veterinary Scientists, Animal Reproduction). In addition to these universities of applied sciences, other international societies have emerged, including the Society for Theriogenology, the International Society for Embryo Transfer, the European Society for the Reproduction of Domestic Animals, and the European Society for the Reproduction of Small Animals. All of these societies have now established regular meetings to provide a forum to communicate the latest research and its application to animal health and welfare.

Tremendous advances have been made in understanding sexual differentiation, testicular differentiation, and function. Early endocrine studies provide information on early testicular development and puberty. Clinical studies in pets led to the development of the field of applied clinical andrology. Studies of clinical methods to predict fertility have been shown to be useful in detecting males for optimal fertility in farm animals and in identifying potential problems in individual animals of high genetic value. Reproductive suitability tests are now standardized procedures used in veterinary practice for almost all domestic animals. However, predicting individual fertility remains a challenge despite the development of a variety of clinical, histological, and molecular techniques.

One of the most important areas of research in male reproduction state the factors that affect spermatogenesis and sperm production. Traditionally, this has been achieved through experimental designs with live animals. The development of techniques such as specific molecular probes and testicular tissue xenotransplantation opened a new era in the study of factors that affect spermatogenesis.

Artificial insemination is considered the reproductive technology with the greatest impact on animal reproduction. Although seed collection and conservation has long been established in some species, challenges persist in others (camelids, wildlife). Storing sperm in liquid (chilled) or frozen (cryopreservation) form remains a challenge due to the huge individual variation in males, especially in some species (eg. horses, camelids). Molecular

techniques have allowed scientists to identify changes during conservation that affect fertility. Recently, attention has been paid to reactive oxygen species and how they alter sperm function.

Advances in sperm technology include the introduction of sperm sex determination for sex selection and preservation of epididymal sperm. The restriction on the use of sperm classified by gender required a re-evaluation of established artificial insemination parameters, such as the required number of sperm per insemination. The preservation of the spermatozoa of the epididymis is one of the most important aspects in the preservation of the genetic material of valuable animals in terminal phase or deceased (wild and domestic species). This new approach to reproduction raises fundamental physiological questions about the role of seminal plasma in fertility.

Other important advancements in sperm technology include cryopreservation by vitrification, re-freezing of sperm, and the production of sperm from frozen testicular tissue. The development in culture of spermatogonia stem cells (SSC) opens a new era in the understanding of testicular function and male fertility. The transmission of SSC will finally revolutionize our breeding strategies and the conservation of genetics.