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Development of a Course in Embryo Transfer and Related Technologies

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Summary and Implications

Embryo transfer is a reproductive technology that many livestock producers utilize as a part of their genetic improvement programs. Global use of embryo transfer technologies is increasing, and a need existed to modernize the animal science curriculum so that progressive livestock breeders would understand the intricacies of these technologies. During fall semester 1995, a two-credit lecture course in embryo transfer and related technologies was offered for the first time through the animal science department. In the fall of 1996, a 1-credit laboratory course was added to the animal science curriculum to provide meaningful hands-on training in embryo transfer technologies. These two courses have provided hundreds of animal science and veterinary medicine students with theoretical and practical training in embryo transfer and related technologies in cattle, horses, pigs, sheep, and goats.

Introduction

Embryo transfer is a set of procedures involving the production and collection of preimplantation embryos from genetically outstanding donor females and the subsequent transfer of harvested embryos to the reproductive tract of recipient females whose estrous cycles have been synchronized with those of the donors. The first successful mammalian embryo transfer was performed in rabbits more than a century ago (in 1890), and today more than 1 million bovine, equine, and small ruminant embryos are transferred each year throughout the world.

Livestock producers in the United States are facing increasing global competition for the economical production of animal-derived products such as meat, milk, and hides. To remain at the forefront of animal agriculture it is important for American livestock producers to learn about and adopt technologies that can increase the economic efficiency of their operations. Embryo transfer is one such technology.

The animal science curriculum has historically required broad-based instruction in courses such as anatomy & physiology, animal nutrition, animal genetics, and animal reproduction. Although reproductive technologies such as artificial insemination have been taught for decades, embryo transfer has received little more than a cursory overview in most courses due to the relatively small percentage of livestock farmers who utilized this technology. However, as non-surgical methods for embryo transfer evolved and further refinements in the technology were made, embryo transfer was transformed into a routine technology in which students should be trained.

Materials and Methods

A decision was made to develop a stand-alone course in embryo transfer and related technologies for undergraduate students in animal science. A set of specific student learner outcomes was written for the new course. The junior-level three-credit lecture course in animal reproduction (AnS 331) required of all animal science undergraduate students was designated as a prerequisite course for this new two-credit lecture course entitled "Embryo Transfer and Related Technologies" (AnS 333). This prerequisite was implemented to ensure that students taking the new course had adequate background in animal reproduction. The cow was used as the "model species" throughout the course, but species differences and similarities (with pigs, horses, and sheep and goats) were also incorporated into the course.

The new course was structured to teach students about procedures in the order in which they would be performed by persons who adopted embryo transfer technologies. After providing students with an overview of embryo transfer (including a brief description of the global and national commercial embryo transfer industries), the following topics were discussed: principles of genetic improvement and the role that embryo transfer can play; genetic selection of donor females; laws governing use of veterinary prescription products; estrous cycle and follicular waves; synchronization of estrus; superovulation; detection of estrus; artificial insemination of superovulated donors; preimplantation embryonic development; embryo collection; embryo evaluation; recipient selection; embryo transfer. The following technologies related to embryo transfer were also discussed: embryo cryopreservation; media for the embryo transfer industry; embryo washing procedures; sex determination [fetal, embryo, sperm]; in vitro fertilization; embryo splitting; nuclear transfer ["cloning"]. Lectures specific to embryo transfer in pigs, horses, and sheep and goats were also included, as were discussions of the economics of embryo transfer.

The lectures often incorporated data from studies published in the scientific literature to illustrate to students how current industry practices evolved. For veterinary students, such data are the major foundation of "evidence based medicine". Results of controlled studies were used instead of relying solely on the instructor's personal experiences and/or clinical impressions of those employed in the embryo transfer industry.

The lecture course was taught initially in fall semester 1995. It was the unanimous opinion of the students enrolled in AnS 333 that the course could be enhanced if hands-on activities/demonstrations were included. As a result, a one-credit hands-on course entitled "Embryo Transfer Laboratory" (AnS 334) was developed and taught for the first time during fall semester 1996. This laboratory course focused only on cattle, and topics in the course included: female reproductive anatomy; synchronization of estrus, ultrasonographic detection of ovarian structures; estrus detection; microscopy for embryo transfer; embryo handling; embryo grading and classification; artificial insemination and semen handling; embryo collection; embryo transfer; embryo cryopreservation; embryo sexing. The course also included a field trip to a commercial bovine embryo transfer company. An enrollment limit of 10 students was placed on this course to enable a tremendous level of instructor-student interaction.

Beginning in spring semester 1998, at the request of the associate dean of resident instruction of the Iowa State University college of veterinary medicine, AnS 333 and AnS 334 were offered as elective courses to second-year veterinary students. These courses were taught at no expense to the college of veterinary medicine, and this instruction served as a model of cooperation between the colleges of agriculture and veterinary medicine.

Results

Enrollment in AnS 333 during fall semesters (1995-2009) averaged 28 undergraduate students, with a range from 9 students (the first semester) to 43 students. Most students enrolled were animal science and dairy science majors, but students majoring in agricultural business, agricultural education, agricultural studies, zoology, and biology also took the course. Enrollment in AnS 333 for spring semesters averaged 36 veterinary students from spring 2002 through spring 2009.

Enrollment in AnS 334 was nearly always at capacity of 10 students, and during some spring semesters two lab sections were taught to accommodate student demand.

Discussion

The development and implementation of two new courses in embryo transfer and related technologies was highly successful. Although these courses are elective courses, student enrollment has been quite good. More than 800 students have been trained through these courses since their inception, and numerous students are now employed in the embryo transfer industry. Some graduates have also gained employment in the human assisted reproductive technology field.

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