Theriogenology to enhance animal well-being
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Abstract
Veterinarians practicing the discipline of theriogenology enhance animal well-being in numerous ways. By utilizing reproductive counseling for breeders about genetic selection, and utilizing appropriate techniques to manage breeding, pregnancy and births, reproduction can be optimized such that neonates and their dams have a maximal chance for survival. Additionally, sound breeding management techniques can prevent diseases and injuries that may occur to male or female animals during breeding. Alternatively, veterinarians may utilize techniques to prevent unwanted pregnancies and other conditions that may be associated with reproduction in animals maintained for companionship or work and improve their safety and well-being.

Keywords: Theriogenology, animal well-being, breeding injury, birthing injury

Introduction
Dorland’s Medical Dictionary defines health as... “a state of optimal physical, mental, and social wellbeing, and not merely the absence of disease and infirmity”.¹ Webster’s New World Dictionary defines well-being as well, happy or prosperous.² Well-being has been described to involve activities that provide for the physical and psychological needs of animals.³ The reader is referred to a discussion of animal welfare in relation to feelings, its ability to cope with its environment, stress and health for elaboration of the relationships between animal well-being and animal welfare.⁴

This manuscript provides an overview of procedures and techniques utilized by veterinarians to enhance animal well-being. This paper will review common or potential diseases and injury that animals may incur during various phases of the reproductive process from selection of parents for breeding to the act of breeding, through gestation and parturition and the early postpartum period.

Veterinarians have a myriad of opportunities and skills to reduce or avoid diseases and injuries that may occur during animal breeding. Veterinarians also utilize numerous techniques to confirm pregnancy, to monitor maternal and fetal health during gestation, and procedures to minimize risk for the dam and fetus during parturition and during the early postpartum period.

Male breeding soundness examinations
Breeding soundness examinations are a safe, repeatable systematic method of identifying males that are subfertile or infertile. While the technique of the male breeding soundness examination varies among the species the outcome for utilizing males that are not fertile is the same. Using subfertile or infertile males subjects females to the trauma of repeated breeding and enhances the risk of disease or injury.⁵⁻⁷

Injuries in male animals associated with breeding
Numerous injuries may occur to males during breeding.⁸⁻⁹ Males tend to become aggressive toward other males and protective of females that may be sexually receptive. Stallions, boars, toms and dogs may bite other males and serious fighting may occur, especially in animals that tend to develop pack behavior such as dogs. Additionally, kicking and/or butting are common aggressive acts among stallions, bulls, rams and bucks.¹⁰⁻¹¹ These behaviors may lead to musculoskeletal or genital injuries that may be life threatening or render the male temporarily or permanently incapable of breeding.

Males may suffer an array of injuries during breeding if there is mismatch between male and female size such that the penis or prepuce may become bruised, develop contusions or minor to severe preputial lacerations. Overly aggressive males or males that are not athletically gifted may suffer rupture of the tunica albuginea of the penis during breeding. Dogs and stallions may additionally suffer severe
genital bite wounds from an unreceptive female during attempted mating. Unreceptive mares may kick the stallion causing minor to severe musculoskeletal injuries or blunt force trauma to the sheath, penis, prepuce or scrotum. Hind limb, pelvic or spinal injuries may occur if the attempted breeding occurs on surfaces that allow slipping or falling during coitus.

Techniques to minimize male injuries associated with breeding

Numerous breeding techniques are utilized to prevent injuries to the male during breeding. Hand mating horses so that both the stallion and the mare are managed by a halter and an assistant may prevent attempted breeding when the mare or stallion is overly aggressive. Mares may be hobbled to prevent them from kicking the stallion. Mares, stallions, and dogs may be muzzled to prevent biting from aggression during breeding.

Maintaining males in single sire units where there is not contact with other males in the breeding area will prevent many injuries. Ensuring environmental protection and sound footing may also alleviate the risk of injury during coitus. Appropriate vaccination prior to breeding can reduce the risk of transmission of some infectious disease from the female to the breeding male.

Diseases and injuries in female animals associated with breeding

Females may suffer numerous musculoskeletal injuries during breeding. These injuries are often related to size disproportion between the female and the male such that females may not be able to adequately support the weight of the larger males during coitus. Resultant injuries may include fractures of the hind limbs, pelvis, spine or soft tissue injuries to joints or nerves. Females may incur genital soft tissue injuries due to size disproportion wherein the penis causes bruising or lacerations to the perineum, vagina or cervix. In severe cases the penis may perforate the cranial vagina with potential fatal results from peritonitis. Less commonly misalignment of the penis with the vulva leads to perforation of the rectum of the female with potentially fatal outcomes. Mares may suffer mild to severe bite wounds from the stallion when he bites her neck or withers during mating.11

There are numerous sexually transmitted diseases in animals. Breeding females may contract those diseases either through natural service or in some instances through artificial insemination. A number of heritable diseases that affect different species of animals are due to undesirable genetic defects that affect fetal formation, development and well-being.

Techniques to minimize female injuries associated with breeding

Female breeding soundness examinations allow assessment for normal reproductive tract and skeletal development along with body condition scoring and determination of fitness for breeding. Females that are not considered to be optimal breeders may be withheld from breeding thereby avoiding the risk of diseases or injury due to breeding, gestation or parturition. Part of the breeding soundness examination may include testing for equine infectious anemia or other diseases that may be appropriate for the species.

There are numerous sexually transmitted diseases in animals such as brucellosis and equine contagious metritis and females should be appropriately tested to ensure they are free from those diseases prior to breeding. Breeding sires are also capable of spreading venereal diseases and they should be determined to be free of those diseases prior to breeding or semen collection for artificial insemination.

Females should be appropriately immunized against those infectious agents that pose significant risk of fertilization failure, embryonic or fetal mortality, or fetal infections and for which vaccines are available. The vaccines should be administered sufficiently before breeding to allow an optimal immune response by the female.12-17

Pedigree analysis and genetic tests are available for a number of heritable diseases in animals. It is wise to screen females and potential sires for those genetic diseases that affect that particular species and breed of animal. In cattle utilization of genetic selection tools such as Expected Progeny Differences (EPD) allows selection of sires that produce calves of low to moderate birth weights or high calving ease in first calf heifers.18,20
One of the most powerful tools to prevent female injury during breeding is the use of artificial insemination. Either using natural estrus or estrus management techniques to schedule ovulation allows females to become pregnant without the physical presence of a male or without coitus. Consequently there is no opportunity for female injury due breeding accidents.

Timing of insemination relative to ovulation may reduce the number of attempted matings to achieve pregnancy. Breeding rolls may prevent excessive penetration of the stallion penis into the vaginal vault of the mare. Additionally shoulder or wither pads or bite pads may prevent injury to mares while being covered by an aggressive stallion. Pharmacological management of the sire may reduce aggressiveness while maintaining libido which may reduce trauma caused by the male during copulation.

Inadequate nutrition during pregnancy is associated with development of a weak or undersized fetus and increased neonatal mortality. Nutritional counseling to ensure that pregnant females are fed to maintain optimal body condition scores during pregnancy may reduce dystocia, prevent pregnancy toxemia, enhance neonatal survival, optimize milk production and hasten return to cyclicity following parturition.

**Diseases and injuries in female animals associated with pregnancy and parturition**

Metabolic diseases such as hypocalcemia in cows, mares and bitches are associated with advanced gestation and the early postpartum period. A large number of infectious agents are associated with early embryonic death or abortion in different domestic species of animals. Dropsical conditions may occur in pregnant cows, sheep or pigs.

Pregnancy toxemia is usually associated with females pregnant with two or more fetuses in late gestation. This condition may be prevented with early recognition of the presence of twins or triplets, usually with the aid of ultrasound examination, or rectal or ultrasound assessment of an oversized fetus. Vaginal or cervical prolapse in late pregnancy are considered to be heritable conditions in certain breeds of cattle as well as occasionally in ewes and may prevent normal cervical dilation and Stage II labor. The risk of ascending placentitis due to vaginal vault contamination may be minor surgical techniques such as the Caslick’s procedure in mares.

**Techniques to reduce disease or injuries associated with pregnancy or parturition in female animals**

Early pregnancy recognition and termination of an unwanted fetus due to unplanned matings or the presence of twins in mares can eliminate diseases and injuries that the female may experience during pregnancy or parturition. Infections occurring during pregnancy may be detected with physical examinations, routine laboratory testing and perhaps ultrasonography or other imaging modalities. Normal development of the fetus can also be monitored with non-invasive imaging techniques.24-27

Appropriate nutrition during pregnancy can generally prevent hypocalcemia and hypomagnesemia which most commonly occur in the last trimester of pregnancy. Pregnancy toxemia due to metabolic energy imbalance is usually associated with the presence of twins or triplets in ewes, does and cows may be avoided by appropriate nutritional support. Additionally, the pregnancy may be terminated early by parturition induction or cesarean section with the goal of preserving fetal viability and the health and well-being of the female. Maternal malnutrition has been associated with the birth of weak puppies and decreased neonatal survival as well as reduced development of abdominal viscera in calves born to undernourished cows.

Females may suffer mild to severe injury during parturition when an overlarge fetus is delivered or the fetus is delivered despite an abnormal posture, presentation or position. Such injuries may include uterine rupture and cervical, vaginal, vulvar or perineal lacerations.

Cervical or vaginal prolapse should be promptly replaced within the vaginal vault and secured such that contamination, contusion, laceration, sepsis, fibrosis or necrosis does not occur that may prevent cervical and vaginal relaxation at the time of parturition. Owners should be offered genetic counseling concerning the potential heritability of these conditions and should be advised to remove affected females and their female offspring in order to reduce the likelihood of the prolapse happening in future generations of their herds or flocks.
Fetal injuries occurring during parturition
Most fetal injuries that occur during parturition are due to relative fetal oversize wherein the fetus is too large to easily pass through the maternal birth canal. Additional injuries may occur when more than one fetus may enter the birth canal simultaneously such as with twins or triplets. Fetal injury may occur due to malpresentation wherein the fetus does not enter the birth canal with the normal presentation, posture, and position. Forceful uterine and abdominal contractions may apply sufficient pressures to cause fetal injury. Weak or absent uterine contractions resulting in prolonged Stage I or Stage II labor may result in fetal stress, hypoxia or acidosis. Excessive traction on the fetus by over-zealous or inexperienced obstetricians may injure the fetus. These injuries range from soft tissue trauma including bruising or nerve injury to fractures of the ribs, vertebrae or limbs.

Increased morbidity and mortality of newborns is associated with inadequate protein and energy intake by the gravid female. Additionally, fetal rumen and omasal development has been shown to be less in calves born to cows that were nutrient restricted during early to mid-gestation than in cows fed appropriate diets. These conditions can be avoided by appropriate maternal nutrition throughout pregnancy.

Techniques to reduce fetal injuries occurring during parturition
Peripartum females should be provided with adequate housing and environmental protection suitable to the species prior to parturition. These females should be monitored frequently to ensure that parturition proceeds in normal fashion. Technologies such as monitoring the calcium content of milk in mares, body temperature in dogs, ultrasound examination for fetal viability or stress or programs such as WhelpWise™ may assist with assessment of fetal and maternal well-being.

Induction of parturition may be initiated to ensure that assistance is immediately available to correct fetal malpresentation, position or posture. Epidural anesthesia may facilitate correction of fetal malpresentation. Episiotomy may be utilized to reduce soft tissue pressure from the vulva or vestibule on the fetus during delivery. Cesarean section may prevent trauma through the birth canal and avoid excessive traction for females with relative fetal oversize, fetal malpresentations not readily correctable per vagina, or for females with pregnancy toxemia, uterine inertia, incomplete cervical dilation, uterine torsion, fibrosis or tumor within the vaginal vault or fibrosis of the vestibule or labia.

Through obstetrical intervention veterinarians are often the first to recognize teratogenic or heritable defects that affect fetal viability. Numerous infectious agents cause detectable anomalies in the fetus or alter gestational length. Fescue toxicosis in mares is an example that causes prolonged gestation and dystocia often with edematous fetal membranes that do not rupture in a timely fashion with accompanying fetal asphyxia and agalactia in the mare. Proper nutritional management of the mare along with timely induction of parturition could result in less fetal wastage due to this plant toxin.

Summary
The veterinarian is uniquely qualified to provide a holistic approach to reproductive management to enhance animal well-being. This plan includes ensuring that appropriate housing to protect animals from environmental stresses and the availability of appropriate nutrition sources for the animals. Active management of all facets of breeding, pregnancy determination, monitoring of fetal and maternal health during gestation are essential. Provision of an appropriate environment and available assistance at parturition are key components for optimal well-being of the female and her offspring.

Sterilization of male and female animals not destined for breeding can ensure their well-being by altering their behavior to avoid aggression, roaming or territoriality. Sterilization at an appropriate age may also reduce the risk of such diseases as mammary neoplasia, mastitis or pyometra as well as such metabolic diseases as hypocalcemia, hypomagnesemia, pregnancy toxemia.

Finally, by early recognition of abnormal conditions veterinarians may select appropriate testing to confirm the etiology of an abnormality. Veterinarians routinely consult with geneticists, toxicologists,
pathologists, nutritionists and other animal scientists to ensure that owners are appropriately counseled to provide optimal care for the well-being of their animals.

References