

ARTIFICIAL INSEMINATION IN CERVIDAE



OVERVIEW

- The members of the cervidae family where artificial insemination has been used extensively include the deer- red deer (*Cervus elaphus*), fallow deer (*Dama dama*), white-tailed deer (*Odocoileus virginianus texanus*) and the elk or wapiti (*Cervus elaphus*).
- Artificial insemination has been developed for most of these species with the purpose of timed vaginal or uterine deposition of semen in estrus synchronized females.
- Semen used for artificial insemination can be fresh, cooled or frozen. Frozen-thawed semen offers the best return on investment.
- AI allows use of elite sires, maintenance of a closed herd and hybridization amongst some species of cervidae.

INCIDENCE/PREVALENCE

- Relatively common procedure

GEOGRAPHIC DISTRIBUTION

- Potentially worldwide depending on species and environment

SYSTEMS AFFECTED

- Reproductive

PATHOPHYSIOLOGY

- Development of a successful AI program requires a good knowledge of the reproductive physiology patterns of the species including seasonality, estrus cycle and pregnancy.
- *Seasonality*
 - Cervids display a highly seasonal pattern of reproduction regulated by photoperiod and nutrition.
 - Sexual activity takes place in fall; calves and fawns are born during the summer months.
 - Seasonality is characterized by intense aggressive behavior in males (Stags, bucks or bulls).
 - Because of the high fertility, the breeding season generally does not last more than 2 or 3 cycles.
- *Estrous cycle*
 - The estrous cycle length is 18 days in the red deer and 21 days in the fallow deer and elk
 - Duration of estrus is very short. Most females tend to ovulate within 36 to 48 hours after the beginning of estrus.
 - Estrus signs (restlessness, change in activity) are very discrete in absence of a rutting male.
 - Estrus detection aids such as marking harness, paint may help detecting receptive females but are not reliable enough for use in conjunction with artificial insemination.
 - Electronic heat detection devices seem to be less reliable than crayons markers.
 - Double ovulation is common in some species but twinning is relatively uncommon (< 1%)

- *Fertilization and Pregnancy*
 - Studies on the physiology of fertilization are scarce. Fertilization patterns is assumed to be similar to other ruminant.
 - Placentation is “oligocotyledonary” (only 3 to 5 placentomes per uterine horn)
 - Pregnancy diagnosis can be reliably done by transrectal ultrasonography starting at 28 days after conception
 - Pregnancy associated protein can be used of diagnosis of pregnancy at 30 days
 - Length of gestation averages 233 days in red deer (range 226-238), 229 days in fallow deer (range 225-234) and 250 days for elk.
- Artificial insemination success depends on a timely deposition of an adequate number of morphologically normal motile spermatozoa in the uterus.
- Lack of success of AI is primarily due to inadequate sperm number, poor timing in relationship to ovulation or early embryonic.

HISTORICAL DATA

- Estrus synchronization

SIGNALMENT

- Female from the Cervidae family including the deer- red deer (*Cervus elaphus*), fallow deer (*Dama dama*) and the elk or wapiti (*Cervus elaphus*).

PHYSICAL EXAMINATION FINDINGS

- Females in estrus

GENETICS

- The primary purpose of artificial insemination is the introduction of new genetics and genetic improvement of the herd.
- Male selection is important to avoid introduction on potentially hereditary defects

CAUSES AND RISK FACTORS

- N/A



DIAGNOSIS

DIFFERENTIAL DIAGNOSES

- N/A

CBC/BIOCHEMISTRY/URINALYSIS

- N/A

OTHER LABORATORY TESTS

- Semen collection and processing

- Electroejaculation (ovine equipment for deer, bovine equipment for elk) under sedation/anesthesia or in a padded squeeze chute.
 - Artificial vagina mounted on the hind legs of a docile estrogen-treated female has been used successfully in deer.
 - Semen collected under anesthesia may be of lesser quality
 - The best semen quality is obtained during the rutting season
 - Ejaculates are generally 0.5 to 5 ml in volume, with concentration ranging from 0.5 to 4 billion spermatozoa per ml.
 - Semen is frozen successfully in the same manner as for other ruminants in glycerolated fructose-yolk citrate or other commercial bull or ram semen freezing extenders.
 - Acceptable pregnancy rates have been obtained with fresh semen at doses as low as 12.5 million spermatozoa. Frozen-thawed semen is generally used at a dose of 25 to 40 millions spermatozoa.
- Pregnancy diagnosis after insemination using PSPB

IMAGING

- Ultrasonography for pregnancy diagnosis after insemination

OTHER DIAGNOSTIC PROCEDURES

- Disease testing on males used for artificial insemination

PATHOLOGIC FINDINGS

- Cauda epididymis sperm has been collected, frozen and used for artificial insemination successfully in several species of cervids



TREATMENT

THERAPEUTIC APPROACH

- Estrus synchronization and timing of artificial insemination
 - Insemination is generally performed 12 hours after first detection of estrus.
 - Most commonly insemination is performed at a fixed time after synchronization
 - Synchronization of estrus in female cervidae uses the combination of progestagen (vaginal delivery, sponges or CIDR) and eCG (PMSG).
 - Intravaginal sponge (medroxyprogesterone 100 mg) as well as CIDR (progesterone 0.3 g for deer and 0.9 or 1.3 g for elk) have been used for 12 to 14 days followed at the time of sponge withdrawal by an injection of PGF2 α and eCG (200 to 250 IU for deer, 250 to 400 IU in Elk)
 - Insemination should be performed 55 to 60 hours and 60 to 64 hours after CIDR removal in deer and elk, respectively.

SURGICAL CONSIDERATION AND TECHNIQUE

- Laparoscopic AI is used under general anesthesia in deer because of the difficulty in bypassing the cervix. The technique is similar to that described for sheep.



MEDICATIONS

DRUGS OF CHOICE

- Synchronization of estrus
 - CIDR: Progesterone 0.3 gr for deer, 1.3gr for elk
 - PGF2 α : Cloprostenol 500 μ g IM
 - eCG: IM, 200-250 IU deer, 250-400 IU elk
- Anesthesia for laparoscopic AI
 - Xylazine (2 mg/kg) and ketamine (4mg/kg) IM
 - Yohimbin (0.4 mg/kg, IV) to reverse anesthesia
- Long acting antibiotics following laparoscopic AI

CONTRAINDICATIONS

- Appropriate milk and meat withdrawal times must be followed.

PRECAUTIONS

- Use of high doses of eCG may induce a high rate of double ovulation and twinning

POSSIBLE INTERACTIONS

- N/A



FOLLOW-UP

EXPECTED COURSE AND PROGNOSIS

Insemination techniques and conception rates

- Vaginoscope-guided or Gourley scope cervical-vaginal insemination similar to the technique used in sheep has been used in deer but pregnancy rates are generally lower than laparoscopic technique.
- This reduced fertility is probably due to difficulty in depositing semen in utero and length manipulation of the cervix.
- Laparoscopic technique, similar to that used in sheep AI, is used primarily in deer with conception rates surpassing 70%.

- Trans-cervical via recto-vaginal manipulation technique (as in the bovine) is the preferred method for elk insemination and may be used in large-pelvis deer. This technique requires special training due to anatomical difficulties including small pelvis diameter and the small diameter elongated cervix. (Figures 1, 2)



Figure 1: Typical restraint system for Elk artificial insemination.



Figure 2: Collection of cervical mucus during AI in elk.

- The cervix has 5 to 7 cervical rings but is easy to penetrate if the female is in estrus. (Figure 3)

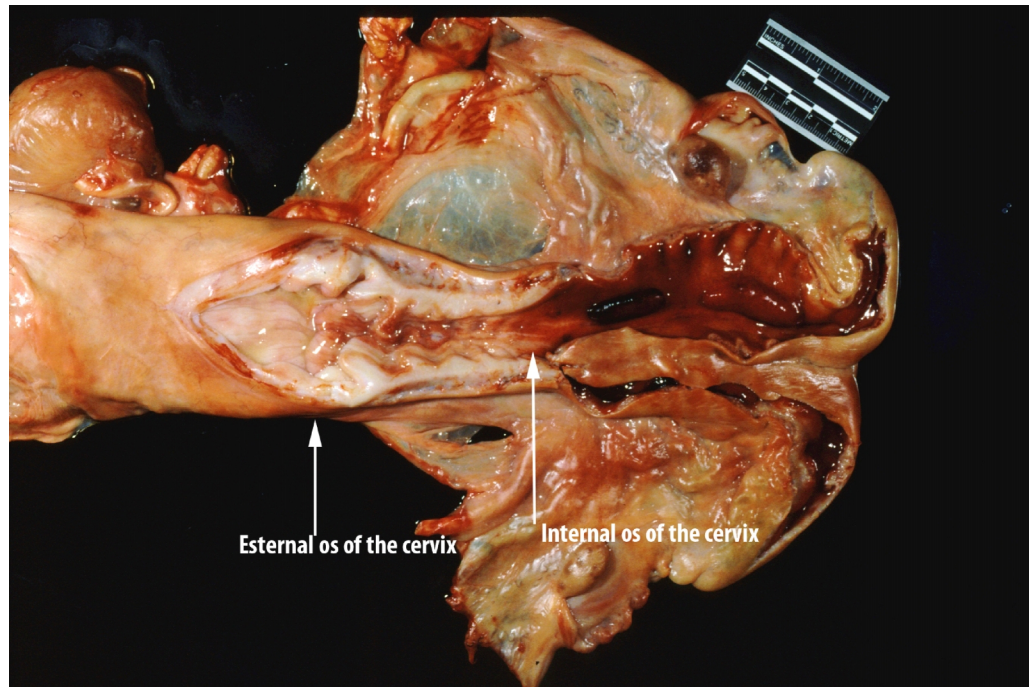


Figure 3: Reproductive tract of an Elk. Note the long cervix with 5 cervical rings.

- Successful insemination using this technique requires:
 - Excellent restraint is necessary, ideally a pneumatic padded squeeze chute is used
 - The perineal area is cleaned and a “plastic cannula” inserted in the vagina
 - The artificial insemination gun is inserted through the “cannula” to prevent it from being trapped in the vaginal folds
 - The author prefers to inseminate half of each dose deep into each uterine horn
- Transcervical uterine insemination results in a pregnancy rate of 65 to 85% in adult animals and 30 to 40% in yearlings.

Factors affecting success of artificial insemination

- Herd management and management of the synchronization program
- Semen quality: There is a significant variation amongst males in quality and freezability of semen
- Semen handling: Adequate transport, maintenance of liquid nitrogen tanks, straw handling at the time of thawing, thawing process and interval of time from thawing to insemination all can affect conception rate
- Catheterization of the cervix: For adequate fertilization rate frozen-thawed semen should be deposited into the uterine lumen. Blind vaginal insemination is only used with fresh semen with very high number of sperm. Cervical deposition of semen results in a reduction of pregnancy rate by half compared to intrauterine deposition.
- No difference was found in pregnancy rate between transcervical AI, laparoscopic AI and natural mating in white-tailed deer

POSSIBLE COMPLICATIONS

- Animals should be handled quietly to avoid any stress or accidents
- Complications associated with laparoscopy include anesthesia risk and peritonitis

- There is a risk of cervical/uterine perforation during manipulation if the operator is not experienced.

CLIENT EDUCATION

- Success of AI depends on adequate nutritional management, proper handling of animals and preparation for synchronization

PATIENT CARE

- N/A

PREVENTION

- N/A

MISCELLANEOUS

ASSOCIATED CONDITIONS

- Infertility and early pregnancy loss may occur in poorly managed herds

AGE-RELATED FACTORS

- Conception rate is lower in maiden females compared to adult multiparous females

ZOONOTIC POTENTIAL

- Care should be taken in handling semen collection and estrus mucus. Brucellosis, chlamydiosis, leptospirosis are a risk where they exit.

PREGNANCY

- Pregnancy diagnosis should be scheduled early in order to determine conception rate from AI

BIOSECURITY

- Use only semen from males that have been tested for common infectious diseases

PRODUCTION MANAGEMENT

Guidelines to improve fertility

- *Selection of females before synchronization*
 - Good identification
 - Use only multiparous females
 - Females should be used to the handling facility to reduce stress
 - Do not use late calvers
 - Good conformation and body condition score (3 to 3.5 out of 5)
 - Select females that can be palpated trans-rectally
 - No history of reproductive problems
 - If the group is very large, insertion of CIDRs should be staggered to allow the inseminator to respect the timing of insemination. Two hour run batches of 50 females deer and 30 elk cows seems to be adequate for most experienced inseminators using good facilities.
 - Observe strict rules of hygiene in placing the CIDR devices minimizing trauma to the vagina and cervix

- *Selection of females at the time of insemination*
 - Do not inseminate females that have no mucous discharge
 - Do not inseminate females with abnormal discharge
 - Examine vulva for pustular lesions
 - Do not inseminate females that have abnormal cervical conformation
- *Critical management areas*
 - Keep group size within a number that is easy to control
 - Observe hormonal treatment timing; the author prefers setup such that timed AI can be done at night (reduced stress)
 - Observe strict hygienic measures for preparation of females and semen
 - Follow recommended semen handling procedures (thawing temperature and time, interval from thawing to insemination)
 - Record amount and nature of mucus and ease of insemination for each female
 - Record site of semen deposition for each female
 - Join females with male 10 days after insemination
 - Use early pregnancy diagnosis methodology (ultrasonography or PSP) or DNA testing to differential pregnancies from AI and those from natural mating

SYNONYMS

- N/A

SEE ALSO

- Abortion: Farmed Cervidae
- Artificial Insemination: Bovine
- Artificial Insemination: Small Ruminant
- Biosecurity: Cervidae
- Cervidae: Reproduction
- Breeding Soundness Examination: Cervidae
- Cervidae: Captive Management
- Nutrition and Metabolic Disease: Cervidae (www.fiveminutevet.com/ruminant)
- Vaccination Programs: Cervidae

ABBREVIATIONS

- PSP= pregnant specific proteins
- DNA= deoxyribonucleic acid
- AI= artificial insemination

SUGGESTED READING

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