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Prospects of hysteroscopy in large domestic animals: A mini review

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Abstract
Hysteroscopy has been used to a limited extent in large domestic animals to evaluate uterine health and institute therapy. On account of the anatomic formation of bovine cervix it is difficult to pass the endoscope inside the uterus whereas the ease with which the equine cervix can be passed has stimulated interest in the use of hysteroscopy in the equine species. In equines hysteroscopy is currently utilized to evaluate and treat endometrial growths, adhesions, cysts and low dose artificial insemination. The basic principle, instrumentation, anesthesia and indications of hysteroscopy in large domestic animals are mentioned in this review.

Keywords: Hysteroscopy, bovine, equine, endometritis, endometrial cysts, goats

1. Introduction
Even though hysteroscopy has been available since 1869 when Pantaleoni visualized and treated an endometrial polyp, it has struggled to be widely adapted as a gynecological surgical tool in medical practice. In 1970s the possibility of trans-cervical sterilizations caused the first real spurt of interest and growth among general medical gynecologists to learn hysteroscopy [1]. Reports on the Hysteroscopic visualization of the large animal uterus are not very old [2, 3]. However, the interest in use of hysteroscopy has gained popularity in equine reproductive medicine on account of easier introduction of the scope in the equine uterus and possibly the cost of the species. Thus hysteroscopy has been used in the equine species for evaluation of normal fertile [4] and sub-fertile mares [5], identification of growths or adhesions [6,7], collection of biopsies [8], low dose insemination with normal [9, 10] or sex selected semen [11-13]. In cattle and buffalo however, the use has been limited to evaluation of endometritis [14, 15] or visualization of endometrial hemorrhages or fluid accumulations [16, 17]. Compared to mares the anatomic formation of the cervix of cattle has prevented the more frequent use of this technique in cattle. In this manuscript the approaches and indications of hysteroscopy in large domestic animal species are described.

2. Basic Instrumentation and principle
The basic instrumentation includes either a rigid [3] or a flexible fiber-optic endoscope to which video-camera and light sources are attached. Flexible scopes are commonly used both in cattle [2, 18] and mares [19, 20]. The preparation of the mare and the instrument, instrument assembly has been described previously [19, 20]. A fiber optic endoscope system is based on transmission of light and images through long thin fibers of optical glass. The fiber optic image is made up of thousands of tiny fibers that are made of coated glass. The coating acts as a mirror that reflects light through the fiber into the eyepiece. The eyepiece magnifies the group of fibers into an image that can be visualized with eye. If one looks closely, he can observe what appears to be a screen or spider web. This screen is actually all the fibers lined up next to one another [20].

3. Restraint and Anesthesia
Cows and mares restrained in a chute and tranquilizers can be administered if required [20]. The tail should be wrapped and tied out of the way and the perineal area carefully washed and dried. The examination should be carried out in an aseptic manner.

4. Procedures

The procedure of endoscopy has been well described [20]. The endoscope should be prepared by sterilization in glutaraldehyde solution, thoroughly rinsed with copious amounts of sterile water (including the internal biopsy channels), and placed within a sterile sleeve until used. It should be noted that only disinfectants approved by the manufacturer of the endoscope being used should be employed because endoscopes can be damaged by the use of certain harsh chemicals. To visualize the uterine lumen, it must be distended. This can be accomplished by the use of sterile saline or lactated Ringer's solution or by the use of an inert gas such as carbon dioxide or air. The use of air appears to be more irritating to the endometrium. The drawback to the use of fluid to distend the uterus is the presence of mucopurulent material or exudates in the uterus. These may cause the fluid to become quite cloudy and make viewing of the uterus very difficult. An advantage to the use of fluid is that it has some therapeutic value after the procedure is over and the fluid is evacuated from the uterus. Generally, fluid (1 to 2 liters) is infused into the uterus using an equine embryo flushing catheter with an 80-ml inflatable cuff to seal up the cervix and keep the fluid from leaking out. The fluid is instilled by gravity flow. When the uterus is distended, the operator, wearing a sterile sleeve, passes the endoscope into the distended uterus. If the uterus is not sufficiently distended, more fluid can be infused. In addition, if the fluid is cloudy, it can be expelled and new fluid infused. After the procedure is completed, the fluid or air is evacuated. A luteolytic agent (prostaglandin) is administered to return the mare to estrus. In addition, uterine lavage is encouraged for the next 1 to 2 days to minimize any inflammation or contamination of the uterus. Antibiotics given either systemically or intrauterine are used as deemed necessary by the practitioner but are generally not needed.

When the endoscope is first introduced vaginally, the vaginal vault and cervix can be visualized. Vaginal abnormalities may be viewed at this time. The endoscope is passed through the cervix and the previously dilated uterus can now be viewed [20]. If there is evidence of endometritis or other inflammatory the fluid used to distend the uterus should be changed as it may be clouded by flocculent material [20].

The horns of the uterus may be visualized by passing the scope anteriorly down each distended horn. The distal portion of the uterine horn can be visualized with the uterotubal junction (UTJ) (oviductal papilla).

When the uterus is viewed endoscopically, one of the most common findings, especially in older mares, is the presence of endometrial cysts [5]. These cysts originate from lymphatic tissue or glandular tissue. Lymphatic cysts are caused by obstruction to lymphatic channels and appear as single or multi-lobulated structures, which may be pedunculated or more tightly adhered to the endometrium. Most lymphatic cysts are located in the body of the uterus, at the bifurcation of the uterus or just within the uterine horn itself [20]. Less commonly, these cysts are located mid-horn or further anteriorly.

5. Indications

5.1 Equines

The relative ease with which the endoscope can be introduced in the mare's uterus has stimulated the use of this technique in this species for reproductive examination [4, 5]. For the examination the mares are restrained in stocks and tranquillized with an iv injection of 3-5 mg detomidine hydrochloride, followed ***5*** min. later by an iv injection of 7-10 mg of butorphanol [20]**.** Passage of filtered air allows the visualization of uterine cavity as the endoscope is passed inside. Samples for cytology can also be obtained during visualization [4]. The presence of intra-luminal uterine fluid, intra-luminal adhesions, endometrial cysts or scarring of the endometrial lining can be determined by such an examination [5, 6].

By far, the more frequent use of hysteroscopy in mares has been for low dose artificial insemination [10, 21-24]. When$10x10^6$ motile freshly collected spermatozoa were deposited (32 hrs after IM administration of an hCG) at the utero-tubal junction using an endoscope 6 of the ten mares conceived [22]. Similarly, deposition of $14x10^6$ frozen spermatozoa 32 hrs after an hCG at the utero-tubal junction using an endoscope resulted in pregnancy in 9 of the 14 mares inseminated [22]. However Brinsko *et al*. [25] found no difference in the pregnancy rates when a low number of sperms were placed directly on to the oviductal papilla using hysteroscopy or placed in the tip of the uterine horn using a trans-rectally guided uterine pipette. The low number of sperm as well as the small volume of the inseminate require more careful handling and loading sperm for this procedure [10, 25]. This is particularly true if cryopreserved sperm are used as these cells are much more susceptible to cold shock and the small volumes used make heat transfer and thermal shock more likely. Prior to the insemination, catheters and lab-ware used for semen handling should be prewarmed to body temperature. Once the endoscope is in place and the UTJ is identified, the inseminate should be drawn into the distal end of the insemination catheter by aspirating it carefully much as an embryo would be aspirated into a transfer pipette. Insemination should be accomplished rapidly after the catheter is loaded [10]. The volume of inseminate deposited at the UTJ by hysteroscopy typically varies between 20 to 200 µl. When frozen-thawed sperm are inseminated directly, a volume of 250 to 500 µl (corresponding to a single 0.25- or 0.5-ml straw) is typically inseminated [10].

Operative hysteroscopy is primarily performed for the minimal invasive resection of endometrial cysts. Further indications are intrauterine adhesiolysis and surgical therapy of uterine tumors
[26-29]. Endometrial cysts and fibrous adhesions resulting from injudicious infusion of irritant solutions into the uterus can be assessed and sight directed endometrial biopsies recovered using either the flexible biopsy forceps passed down the working channel of the scope, or the much larger, rigid biopsy forceps passed through the cervix alongside the endoscope and, under visual control, manipulated further to the area of interest [4, 5]. The subsequent development of flexible NdYAG laser technology added an extra dimension to video-endoscopy by allowing minor surgical repairs and ablations to be performed in utero, including the destruction and virtual ablation of large, fluid-filled endometrial cysts sited where they might impede free movement of the young embryo throughout the uterine lumen between Days 10 and 16 after ovulation, or ablate intrauterine fibrous adhesions [27].

5.2 Cattle and buffalo

Hysteroscopy has been used in cattle to diagnose uterine diseases [3] including clinical and endometritis [14] and post partum metritis [18]. The earliest report on the use of a flexible scope for uterine evaluation of bovine uterus is that of Devine

and Lindsay, [2]. Reports evidence the use of flexible scopes of 6-10 mm [14, 18, 30]. In one report Sacral epidural anesthesia was carried out by 2 ml of 2% Novocain before introduction of the hysteroscope [30]. Endoscope is introduced into the reproductive tract of a cow by vaginal control. After the cervix had been passed through, air is pumped until it enables carrying out the visualization of the uterus (Fig. 1). In one study the cattle uterus obtained from abattoir was found to be a useful model to train medical gynecologists on hysteroscopy [31].

In buffalo hysteroscopy has been evaluated as a diagnostic tool utilizing abattoir derived material [16, 17]. Hysteroscopy was found to be more efficient technique for visualizing minor uterine pathologies such as hemorrhages (Fig. 2), mucus accumulation and endometritis [17]. Hysteroscopic visualization of the dromedary camel uterus was mentioned in one report [32].

Fig 1: Hysteroscopy view of the uterine lumen of a buffalo

Fig 2: Hysteroscopic view of a buffalo uterus showing hemorrhages

5.3 Goats

A small number of studies have been performed in goats [33, 34]. The technique of endoscopic trans cervical cannulation in goats suggested the use of a smaller diameter scope (2.5mm) in goats and similar findings were recorded in a recent study using a 5 mm hysteroscope for examination of abattoir derived goat genitalia [35]. Xu *et al*. [34] reported that conventional hysteroscopy is feasible in goats. Minor pathologies such as endometrial hemorrhages and mild endometritis that cannot be evaluated by ultrasonography can be easily visualized using a hysteroscope [35].

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