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Hysteroscopic and ultrasonographic evaluation of goat (*Capra hircus*) uterus

Pankaj Kumar, Sandeep Dholpuria and GN Purohit

Abstract
Abattoir derived goat (*Capra hircus*) genitalia were examined (n=197) by visual examination, ultrasonography and hysteroscopy and 31 (15.74%) revealed pathologies involving the uterus. For the pathologies detected endometritis showed the highest prevalence (45.16%) followed by hemorrhages on the endometrium (19.35%), hydrometra (16.13%), mucometra (9.86%) and pyometra (9.68%). The sensitivity, specificity, positive and negative predictive values for diagnosing these abnormalities was highest for endoscopy followed by ultrasonography and visual observations or palpation. It was difficult to pass the endoscope used in the present study (5.5 mm) through the cervix in the goat uterus in 55.8% genitalia without a cut on the cervix. It was concluded that hysteroscopy is a better technique for the diagnosis of minor pathologies in the uterus such as endometritis and hemorrhages in goat but the endoscope diameter should be 2 mm.

Keywords: Goat, hysteroscopy, ultrasonography

Introduction
Pathological studies on goat reproductive tract have revealed that the uterus is the organ that was the most affected [1, 2]. A major limitation to the evaluation of goat uterus is its inaccessibility to palpation and visual inspection. With the availability of ultrasonography some of the pathologies of the goat uterus such as hydrometra and mucometra can be identified [3-5] but the most common uterine pathology (endometritis) is still difficult to be evaluated by ultrasonography. In recent years endoscopy has gained popularity for direct visualization of the internal morphology of uterus and other hollow organs adding information on normal and/or abnormal changes in mares [6, 7], cattle [8] and buffaloes [9, 10]. Although Roberts [11] was the first to examine the genitalia of ewes using endoscopy, the technique of hysteroscopy has not gained popularity for clinical use in the small and large domestic ruminants on account of the anatomic structure of the cervix [12]. Hysteroscopy has been reported for the rabbit [13] and in the goat [14, 15] but the hysteroscopic appearance in uterine pathologies was not recorded. The ultrasonographic evaluation of goat uterus has been reported [3] and its use for diagnosis of pathologies such as mucometra and hydrometra has been documented [4, 5]. Endometritis in the goat has been postulated to be a possible cause for further development of mucometra/hydrometra in the goat [16] and these conditions have been diagnosed using ultrasonography in the goat [3]. Ultrasonographic evaluation of uterine pathologies such as endometritis continues to be a difficult approach and minor changes might escape the clinician's diagnosis. It would thus be appropriate to visualize the lumen of the uterus directly. The present study evaluated the usefulness of hysteroscopic and ultrasonographic evaluation of abattoir derived goat genitalia.

Materials and Methods
Goat genitalia were procured from a local abattoir immediately after slaughter and transported to the laboratory in warm normal saline. The study was performed from October 2018 to November 2018. After visual inspection and palpation the genitalia
were immersed in a water bath and examined by real time ultrasonography as described previously [17, 18] using a color Doppler ultrasound system (EDAN, U2 prime, Paul Medical Systems, India) with a dual frequency (8.0-13.4 MHz) linear array transducer and the images were stored in the multimedia kit attached to the ultrasound equipment. The internal structures of the uterus were examined by hysteroscopy using a rigid endoscope (Karl Storz, Germany) as per previously described procedures [9].

The Karl Storz endoscope with HOPKINS telescope (300) 5.5 mm diameter with a C-mount camera connected to the endoscope with light cable was used and the pictures were saved on the computer with AIDA compact. A small cut over the cervix was applied if it was not possible to pass the hysteroscope in the uterine lumen. Once the hysteroscope was inside the uterus a small amount of air was insufflated inside the uterus to visualize the internal structures clearly. Endometritis was considered when the uterine endometrium revealed thickened wall on ultrasonographic examination [17] or disrupted uterine endometrium and/or color changes with thickening on endoscopic examination [19]. The sensitivity and specificity of diagnosis of uterine pathology were calculated using hysteroscopy as the reference method as described previously [19]. The results of visual/palpation or ultrasonography were interpolated with the Hysteroscopic findings to calculate the sensitivity (Se), specificity (Sp), positive predictive value and negative predictive value as described previously [20].

Results

Out of 197 goat genitalia examined by visual, ultrasonographic and hysteroscopic examination (Fig.1), 31 (15.74%) were detected with different uterine abnormalities. For the genitals examined it was not possible to pass the hysteroscope in the uterus without a cut on the cervix (due to extremely smaller size) in 55.8% (110/197) of the goat uteri. Amongst the recorded pathologies the incidence of endometritis was highest (45.16%) followed by hemorrhages on endometrium (19.35%), hydrometra (16.13%), mucometra (9.86%) and pyometra (9.68%). Endometritis and hemorrhages over endometrium could not be detected by visual/palpable examination whereas a thickened uterine wall with moderate to large amount of fluid within the uterine lumen along with snowy patches could be visualized by ultrasonography. Hysteroscopic visualization detected a higher proportion of uteri with endometritis and revealed, grayish discoloration (Fig. 2), fungal plaques or erosion of endometrium (Fig. 3) or corrugated appearance (Fig. 4). Hysteroscopy could also detect mucometra (Fig. 5), pyometra (Fig. 6), hydrometra (Fig.7) and hemorrhages (Fig. 8). Hydrometra could also be detected by ultrasonography by the presence of anechoic fluid (Fig. 9). The Se, Sp, PPV and NPV for prediction of hydrometra, pyometra and mucometra was 100% for both hysteroscopy and ultrasonography while for endometritis the Se and NPV were 57.14% and 96.83% for ultrasonography and the NPV, Se and PPV were 96.95%, 0% and 0% respectively for endometrial hemorrhage detection by ultrasonography. Out of the 6 uteri with hemorrhages the CL was present only in 1 goat genital examined.

Discussion

Hysteroscopic visualization of the goat uterus using a rigid endoscope during the present study is partly similar to reports in cattle (Madoz *et al*., 2010) [19] and buffalo (Purohit *et al*., 2013; Chaudhary *et al*., 2014) [9, 10] that utilized a rigid endoscope for visualization of uterine pathology, however a few reports mentioned the use of flexible endoscopesfor hysteroscopy (Karen *et al*., 2001; Devine and Lindsey, 1984) [21, 22]. The two studies in goat used a specially designed endoscope (Colagross-Schouten *et al*., 2014; Xu *et al*., 2014) [14, 15] of a smaller diameter. Using the 5.5 mm endoscope in the present study it was not possible to pass the scope in 55.8% of the goat uterus without a cut over the cervix. This suggests that a 2mm endoscope should be used in goats as also suggested previously (Colagross-Schouten *et al*., 2014) [14]. The mean cervical diameter in goats varies from 1.07 + 0.17 to 1.75 + 0.04 cm (Adwige and Fayemi, 2005; Gupta *et al*., 2011) [23, 24] (and the cervical canal reveals different anatomic structures with 4.3 cervical folds (Dayan *et al*., 2010) [25]. Thus, the cervical anatomy is an impediment to the easy passage of the endoscope in the goat uterus. Similarly, clinical studies in cattle have pointed out that the cervical anatomy limits the easy passage of hysteroscope in the bovine uterus (Metzner *et al*., 1992; Mordak *et al*., 2008) [26, 27]. Hysteroscopy had a higher sensitivity and specificity for diagnosing endometritis in the present study as also previously mentioned for cattle (Madoz *et al*., 2010) [19]. Hysteroscopic features of endometritis during the present study included corrugated appearance and grayish discoloration which are similar to previous reports in cattle (Madoz *et al*., 2010; Mordak *et al*., 2007) [19, 22] and buffalo (Purohit *et al*., 2013) [9].

Hemorrhages observed by hysteroscopy in the present study have also been observed in previous studies in cattle (Madoz *et al*., 2010) [19] and buffalo (Chaudhary *et al*., 20140 [10] yet they could not be observed by ultrasonography in the present or previous studies (Purohit *et al*., 2013) [9]. Because of accumulation of fluid in pyometra and mucometra they could be diagnosed by both ultrasonography and hysteroscopy and the enlargements were also palpable. It was concluded that hysteroscopy is a better technique for the diagnosis of minor pathologies in the uterus such as endometritis and hemorrhages which can interfere with fertility but the endoscope diameter should be 2mm.

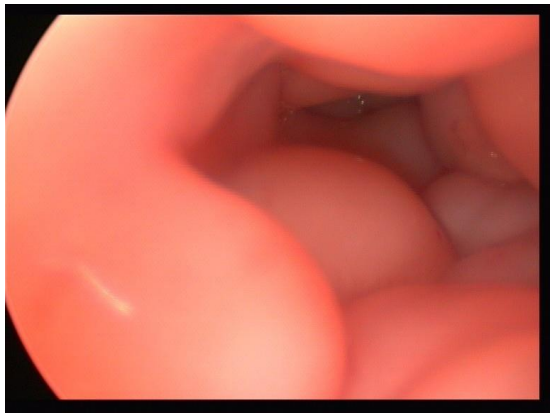

Fig 1: Endoscopic picture of a normal goat uterus

Fig 2: Endoscopic picture of a goat uterus with endometritis showing grayish discoloration

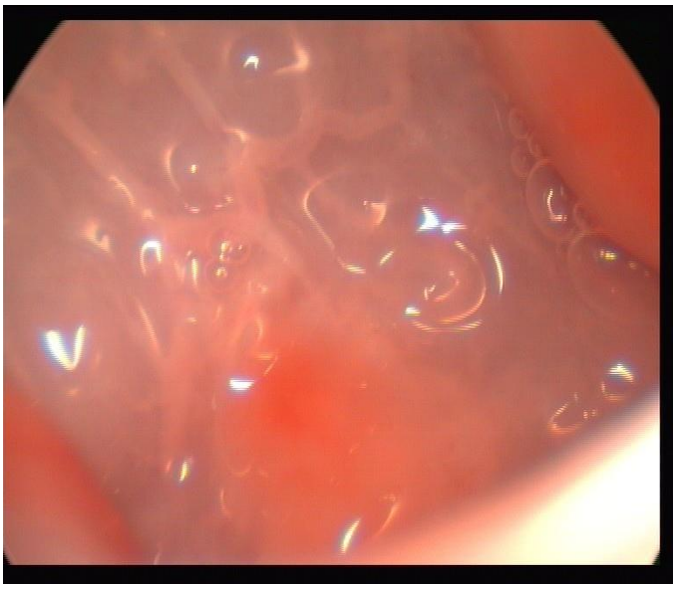

Fig 3: Endoscopic picture of a goat uterus with endometritis showing surface erosion

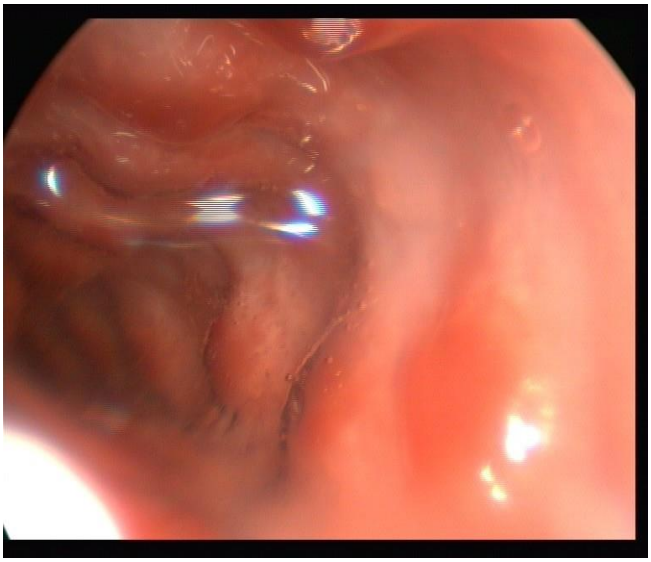

Fig 4: Endoscopic picture of a goat uterus with endometritis showing a corrugated appearance

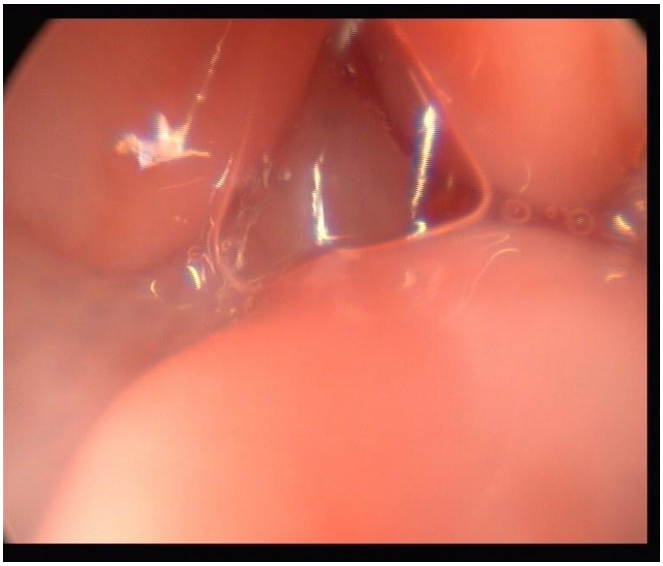

Fig 5: Endoscopic picture of a goat uterus with mucometra

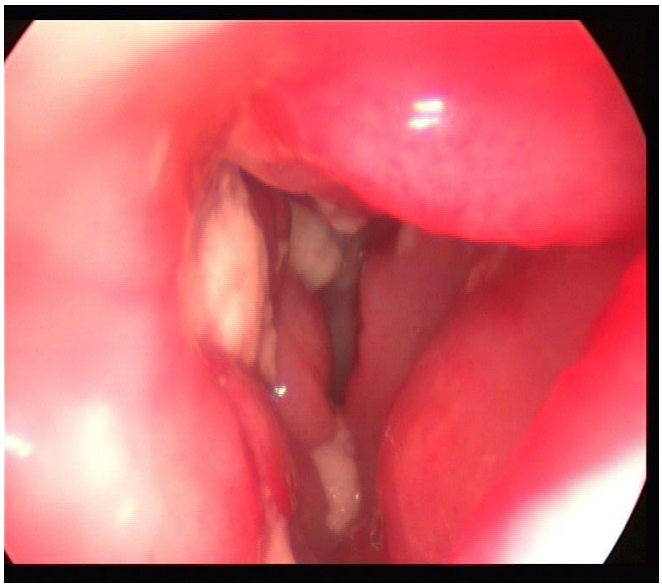

Fig 6: Endoscopic picture of a goat uterus with pyometra. The endometrial congestion and the accumulated pus is visible.

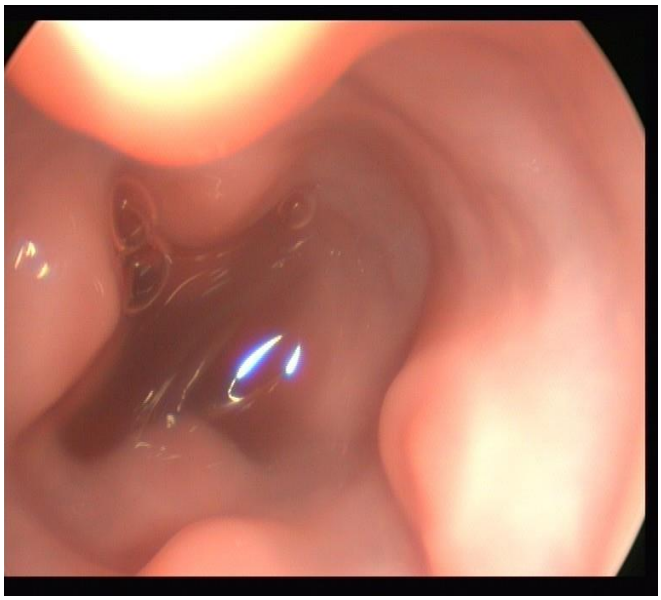

Fig 7: Endoscopic picture of a goat uterus with water accumulation (hydrometra)

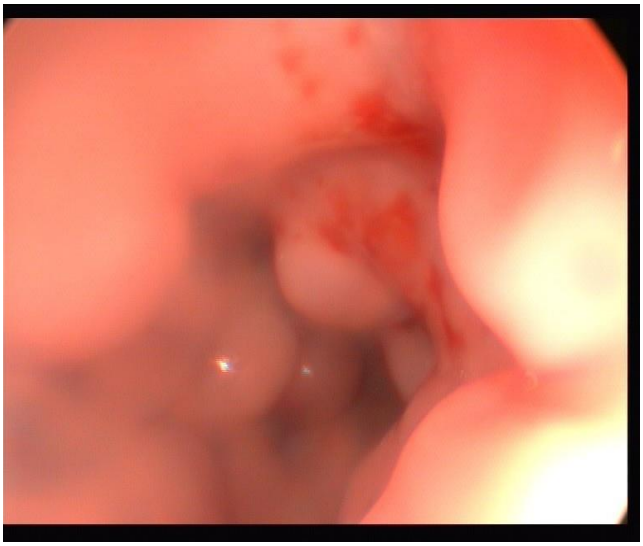

Fig 8: Endoscopic picture of a goat uterus with hemorrhages

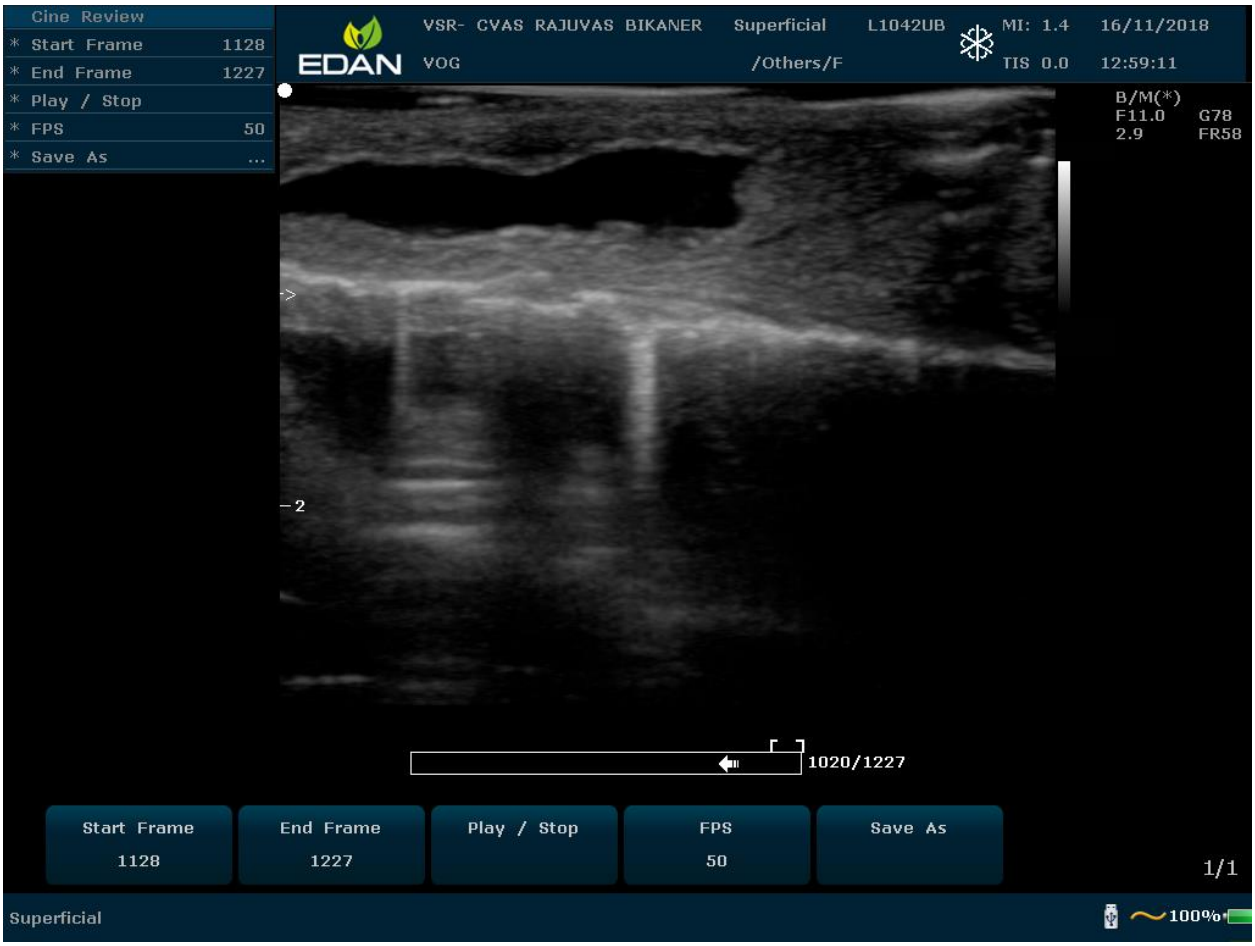

Fig 9: Ultrasound image of a goat uterus with water accumulation (hydrometra)

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