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Endoscopic Transcervical Insemination in the Bitch (12-Dec-2003)

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Introduction

Intrauterine semen deposition is an essential part of the successful use of frozen canine semen [1-3]. Although transcervical insemination is routine in the cattle industry, it was thought to be impossible in the bitch so until relatively recently most veterinarians have used surgery to deposit the semen into the uterus. In the early seventies, Fougner et al., developed a transcervical insemination technique for the fox fur industry in Norway [1]. This technique was later shown to be equally feasible in the bitch [2-4]. The technique involves palpation of the cervix through the abdominal wall and passage of a rigid metal catheter through the cervical canal. It is possible to inseminate a wide range of breeds using this method, though large breeds and overweight bitches can present a significant challenge.

Endoscopic transcervical insemination (TCI) was developed as an alternative technique to the Norwegian catheter [5,6]. The technique provides visualization of the cervix, using a rigid endoscope, and passage of a plastic catheter through the cervical canal. The beauty of the technique is that both veterinarian and client can observe and confirm the intrauterine deposition of the semen. Many people find the technique easier to learn because they can see what they are doing; large or fat bitches are not a problem with this method.

Anatomy

There are several features in the bitch reproductive tract which are particularly important to the performance of transcervical insemination. The position of the clitoris within the ventral commisure of the vulva and the position of the urethral orifice must be recognized in order to avoid them (Fig.1). The longitudinal vaginal folds change as estrus progresses and affect the ease with which the endoscope can be advanced (Fig.2).

Figure 1. Post-mortem specimen from a bitch showing the ventral surface of the vaginal vestibule. Important landmarks visible in this view are the clitoral fossa (CL) and the urethral orifice or urinary meatus (U). - To view this image in full size go to the IVIS website at www.ivis.org . -

Figure 2. The mucosal surface of the body of the vagina is made up of longitudinal folds which increase in size under the influence of rising oestrogen levels during oestrus. - To view this image in full size go to the IVIS website at www.ivis.org . -

The cranial portion of the vagina, or paracervix, [7] presents the most significant features relative to transcervical insemination (Fig.3 and Fig.4). The dorsal median fold is a well-developed fold suspended from the dorsal wall of the vagina, which significantly reduces the vaginal lumen in the approach to the cervix. The next important landmark is the cervical tubercle, which is the vaginal portion of the cervix, including the cervical canal and external cervical os. The cervical tubercle is located at the cranial end of the dorsal median fold and is separated from it by an obvious transverse fold. The cervix lies diagonally across the uterovaginal junction with the cervical os positioned almost ventrally and the cervical canal directed craniodorsally from vagina to uterus. The cervical canal can be catheterized at all stages of the reproductive cycle of the bitch; the ease with which this can be done varies with the stage of the cycle and operator

experience [8]. The fornix is the final landmark in this area it is a slit like space cranioventral to the cervical tubercle and represents the cranial limit of the vagina.

Figure 3. The relationship of the features of the paracervix are illustrated. - To view this image in full size go to the IVIS website at www.ivis.org . -

Figure 4. The dorsal median fold (DMF), cervical tubercle (CT), os (O) and fornix (F) in an anestrous bitch. - To view this image in full size go to the IVIS website at www.ivis.org . -

Equipment

There is little choice of endoscopic equipment, which meets the exacting specifications required for transcervical insemination. The requirements result from the significantly reduced space through the paracervix caused by the dorsal median fold and the particularly long vagina, which can be up to 29 cm.

Karl Storz manufactures an extended length cystourethroscope which best meets the requirements, having a 29 cm working length and 22 fr diameter (Fig.5). An alternative smaller diameter sheath is currently being developed to enable passage in bitches where the paracervical lumen is particularly narrow. Many endoscopes can be purchased or found within practices which will work in some bitches but if they do not have the specific dimensions indicated then problems will be encountered in more bitches than with the recommended endoscope. The endoscope consists of a rigid telescope with a 30 degree viewing angle together with a sheath and bridge; a cold light source and cable complete the essential equipment. The endoscope can be used without a camera but there is no doubt that the addition of a camera makes the whole technique easier and more client friendly. catheterization is achieved using a urinary catheter - in most cases an 8 Fr is suitable but occasionally a 6 fr may be necessary. A catheter with a terminal hole is preferable to the standard urinary catheter with side holes but these are currently not available (Fig.6).

Figure 5. The extended length cystourethroscope assembled ready for use; the plastic urinary catheter is in place in the instrument channel and the video camera is attached. - To view this image in full size go to the IVIS website at www.ivis.org . -

Figure 6. Urinary catheters with a single terminal hole are preferable to models with 2 side holes but they are difficult to obtain. - To view this image in full size go to the IVIS website at www.ivis.org . -

Effective restraint of the bitch is essential to safeguard both the bitch and the equipment and allow the procedure to be performed easily. Bitches in standing estrous can be simply restrained on a specially designed stand which provides a tie point to the collar and an abdominal band to limit sideways movement and attempts to sit (Fig.7). The stand is placed on a hydraulic table to ensure bitches can be examined at the optimum height - after all there is wide variation in size of bitches.

Figure 7. Restraint of the bitch on this stand limits sideways movement and attempts to sit providing a safe handling system. - To view this image in full size go to the IVIS website at www.ivis.org . -

Technique

The endoscope is introduced through the dorsal commisure of the lips of the vulva in order to avoid the sensitive clitoris located within the ventral commisure (Fig.8). The angle of introduction must take account of the slope of the vestibule and ensure smooth passage up over the pelvic brim, avoiding the urethral orifice (Fig.9). It is surprisingly easy to pass the scope into the urethra. This can be avoided by lifting the scope slightly dorsally as it is moved to the horizontal plane.

Figure 8. The endoscope is introduced through the dorsal commisure of the vulva taking account of the angle of the vestibule. The index finger placed behind the endoscope is used to help "lift" the scope clear of the urethral orifice as the scope is moved to the horizontal plane. - To view this image in full size go to the IVIS website at www.ivis.org . -

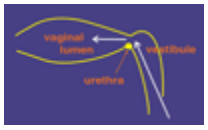

Figure 9. Diagram emphasizing the fact that the endoscope is introduced through the dorsal commisure of the vulva at an angle that takes into account the angle of the vestibule and location of the urethral orifice. The index finger should be placed behind the endoscope and used to help "lift" the scope clear of the urethral orifice as the scope is moved to the horizontal plane. - To view this image in full size go to the IVIS website at www.ivis.org . -

The distinctive vaginal folds confirm the position of the endoscope within the vagina (Fig.10). The endoscope is advanced by applying gentle pressure, observing and following the vaginal lumen. It is important to keep the tip of the scope in the lumen, as it is easier to advance the scope and minimises any discomfort to the bitch. Any folds obscuring scope vision can be moved out of the way using the tip of the catheter. The distinctive paracervical area can be clearly identified by the large dorsal median fold and crescentic vaginal lumen (Fig.11). The reduction in the vaginal lumen at this point may make it more difficult to advance the scope and it is usually preferable to proceed down the side of the dorsal median fold, using the catheter tip to keep the fold off the endoscope. In small or some maiden bitches it can be impossible to pass the scope through this area.

Figure 10. Typical appearance of the vaginal folds as the endoscope is advanced through through the lumen. - To view this image in full size go to the IVIS website at www.ivis.org . -

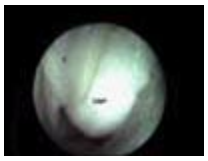

Figure 11. Paracervix with the large dorsal median fold (DMF) and crescentic vaginal lumen (VL). The catheter (C) is used to keep the fold off the endoscope lens. - To view this image in full size go to the IVIS website at www.ivis.org . -

The cervical tubercle appears as a distinct entity at the cranial end of the dorsal median fold, separated from it by an obvious transverse fold (Fig.12). The cervical os is often not immediately obvious because of its ventral location. The scope is manipulated under the tubercle until the os can be identified. The os is usually located in the center of a rosette of furrows but sometimes its location can only be identified by the presence of fluid issuing from it. Once located the tip of the catheter is advanced into the os by manipulation of the endoscope and catheter together. The catheter is gently advanced using a twisting movement to aid its passage through the cervical canal (Fig.13). For insemination it is advanced as far as it will go. The semen is inseminated slowly observing all the time to ensure there is no significant backflow, if this happens the catheter is repositioned slightly and insemination recommenced.

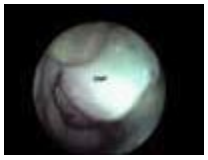

Figure 12. The cervical tubercle (CT) can be seen in the distance below the dorsal median fold (DMF). - To view this image in full size go to the IVIS website at www.ivis.org . -

Figure 13. The catheter is advanced through the cervical os and the semen can be seen within the catheter during insemination. - To view this image in full size go to the IVIS website at www.ivis.org . -

It is essential to keep one hand on the endoscope and the other hand on the catheter at all times and learn to use both the endoscope and catheter for manipulation. Bitches in estrus, exhibiting standing behavior show excellent tolerance to the technique, without the need for any sedation.
For the technique to be widely adopted it is essential that it can be successfully applied to all, or at least, most bitches and it is important that the majority of bitches can be inseminated using the same endoscope. Looking at the vast array of breeds presented with regard to size and shape this would appear unlikely but is in fact for the most part possible.

Learning
The technique is theoretically very simple but the significant variation between bitches means that expertise in the technique only comes with examining many different bitches. Medium sized bitches that have previously had a litter and are well in estrus make the best practice subjects. When confident with these then every possible estrus bitch should be examined to learn all the variations. The endoscope should be used on every possible occasion - not kept only for frozen semen inseminations.
A thorough knowledge of the anatomy of the reproductive tract cannot be over emphasized. Training by an experienced operator is helpful but it is possible to teach yourself - a full training video [a] is available to help people wishing to learn the technique.

Problems and Solutions
Endoscopic transcervical insemination is really straightforward and easy in many bitches but this is not always the case. A logical approach is needed to solve the problems encountered and ensure successful catheterization of the cervix. There are several main problems that need to be considered.
Unable to locate the cervical os - This can occur because the endoscope is not far enough in or because the operator is not familiar with the appearance or location of the cervix.

1. The maximum length of the vagina is a critical dimension. However, if the correct equipment is purchased this is not an issue as no bitch has so far been examined where the cervix is beyond the reach of the equipment described.
2. The one limiting factor identified is the amount of space in the paracervix, as in a small percentage of bitches it is impossible to advance the endoscope through this area. This occurs in some maiden bitches of small or medium sized breeds and in some toy breeds. The standard endoscope described here has been used successfully on many small and toy breeds, so is suitable for the majority of bitches and the new sheath will hopefully further reduce this problem.
   With the very small toy breeds, restraint of the bitch is a large part of the problem and sedation may be the answer [8].
3. The cervical tubercle varies significantly in size and shape in different bitches and at different stage of the estrus cycle (Fig.14). In addition to this, the appearance of the folds surrounding the os can vary, making the os difficult to identify.
4. At times the os is not found in its expected ventral position in the center of the tubercle but can appear to be on one side.

Figure 14. The size, shape and surface appearance of the cervical tubercle varies between bitches. - To view this image in full size go to the IVIS website at www.ivis.org . -

In order to overcome these issues it is important to be familiar with the anatomy so that you can logically identify where you are and know where you need to be and what it looks like.
It is essential to have a planned approach to find the cervix and not just hope you will stumble across it. In order to find the cervix advance the endoscope well in to the fornix then move it under the ventral surface and withdraw the endoscope slowly watching for the furrows and fluid issuing from the os, repeat from the other side.
Unable to catheterize the cervix - Having located the os, the ability to catheterize the cervix depends on following some basic principles:

1. The os must be positioned directly in front of the endoscope (Fig.15) which means lining up the whole tubercle in front of the endoscope.
2. It must be remembered that the cervical canal is directed craniodorsally from the os and the slope of the bitch vagina is extremely variable. This may result in them being almost at right angles to each other making catheterization difficult (Fig.16). Ensuring the catheter advances once the tip is in the os depends on applying pressure at a complimentary angle. This is achieved by changing the angle of presentation of the catheter by lowering the camera end of the endoscope to a more horizontal position or lower (Fig.17).
3. It is essential to use a catheter that will go through the canal which means resorting to a 6 fr catheter in some bitches, in preference to the usual 8 fr catheter.

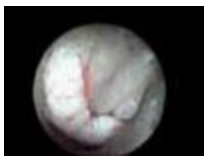

Figure 15. Optimum positioning of cervical os relative to the endoscope for catheterization. - To view this image in full size go to the IVIS website at www.ivis.org . -

Figure 16. The angle of the endoscope (red) during passage to the cervix is frequently almost at right angles to the cervical canal (yellow). Once the tip of the catheter is in the os, the angle of approach must be changed to facilitate catheterization (white). - To view this image in full size go to the IVIS website at www.ivis.org . -

Figure 17. This is achieved by lowering the camera end of the endoscope to a more horizontal position. - To view this image in full size go to the IVIS website at www.ivis.org . -

Unable to see - When using the endoscope it is essential to be able to see the vagina clearly.

Loss of vision has 3 main causes:

1. Fogging as the endoscope is introduced occurs regularly, it may clear as the endoscope is advanced or it can sometimes be cleared by deliberately touching the lens onto a vaginal fold (Fig.18). If neither of these options work it may be necessary to remove the telescope, rinse it and replace it.
2. Excessive amounts of vaginal discharges causing poor visibility can be a major problem, particularly in the learning phase (Fig.19). As oestrus progresses the amount of discharge usually diminishes, which coincides with the time inseminations are normally performed. However, in some bitches, significant volumes of fluid are present throughout estrus. In many cases just continuing through the fluid works, as it tends to be in pockets and it is still possible to locate the cervix for insemination but very occasionally it may be necessary to draw off the fluid through the catheter.
3. Discharges vary in type and thick discharges cause problems by collecting in the end of the sheath and covering the lens (Fig.20). Removing and washing the telescope may work but as soon as the endoscope is advanced further, the problem is likely to recur as more discharge is picked up. The discharge is too thick to draw off so the solution in this case is to introduce the endoscope sheath with obturator in place and advance it as far forward as possible, hopefully all the way to the cervix. When the obturator is replaced with the telescope it should be possible to view the cervix without the presence of discharge in the sheath.

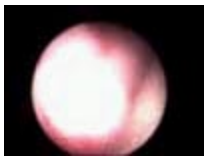

Figure 18. Fogging of the endoscope lens. - To view this image in full size go to the IVIS website at www.ivis.org . -

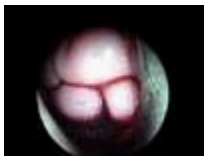

Figure 19. Excessive amounts of blood stained discharge cause visibility problems. - To view this image in full size go to the IVIS website at www.ivis.org . -

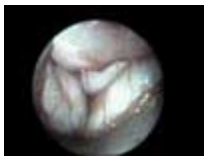

Figure 20. Thick vaginal discharges like this, can collect in the sheath and cover the lens. - To view this image in full size go to the IVIS website at www.ivis.org . -

Semen backflow - Semen backflow can be a problem for 3 reasons (Fig.21):

1. If the catheter is not advanced far enough into the uterine body then some of the semen will flow back into the vagina. It is essential that the tip of the catheter passes through the cervical canal and well into the body of the uterus to ensure semen is deposited in the cranial part of the uterine body or even in one horn.
2. Using a standard urinary catheter with 2 side holes can make semen backflow more likely. With the walls of the uterus in close contact with the catheter, semen from a catheter with a terminal hole will naturally go forward. However, with side holes there will be more of a tendency for it to come back along the catheter so it is essential it is well into the uterus. Also, the catheter has to be advanced further into the uterus to ensure the 2nd hole on the catheter is well within the uterine body.
3. If large volumes of semen are inseminated some backflow will occur so insemination volumes should be limited to a 2 to 3 ml. When clearing semen out of the catheter use only a small amount of air and watch what is happening so that the air does not cause backflow.

Figure 21. The position of the catheter within the uterus is important in minimizing backflow of semen. The back hole of catheter must be well within the uterus. - To view this image in full size go to the IVIS website at www.ivis.org . -

Safety

The risk of trauma or infection resulting from the procedure is an important consideration. It is difficult to imagine that the plastic urinary catheter could ever perforate the vaginal or uterine wall during estrus unless a pathological condition already existed. However, the paracervical area can be traumatized by the endoscope by the use of inappropriate force; if advancing the endoscope causes obvious discomfort to the bitch then the procedure should be stopped.

It has been suggested that TCI could introduce infection to the uterine environment. During pro-estrus and estrus, bacteria are routinely isolated from uterus and vagina without apparently causing any problems perhaps due to a greater resistance to infection at this time [8]. Therefore, it is reasonable to assume that advancing a catheter from vagina to uterus at this time will not cause any problems. However, care must be taken to ensure no new infections are introduced as a result of inadequately cleaned equipment or from the environment through poor technique. Equipment should be cleaned and disinfected following the manufacturer's recommendations.

Uses

Frozen semen insemination - This technique provides intrauterine deposition of semen, which is a vital part of frozen semen technology, but equally important to the successful use of frozen semen are the timing of insemination, semen quality and bitch fertility. Endoscopic TCI, like any other intrauterine insemination method will only be successful if all these factors are taken into account. Intrauterine insemination using a surgical procedure exposes the bitch to risks associated with general anaesthesia and surgery and allows for only a single insemination. Although easy to perform and with no major learning curve, the surgical option is considered by many veterinarians and clients to be ethically unacceptable.
Insemination using the endoscopic TCI technique involves minimal stress to the bitch and repeat inseminations are possible. The ability to do repeat inseminations has been reported to increase conception rates or litter size [3,5,9]. Where the semen is of lower quality, repeat inseminations allow more semen to be inseminated over an extended period and repeat inseminations are also useful where the bitch is difficult to time.

Chilled and fresh semen insemination - It is easy to think only in terms of frozen semen use in conjunction with transcervical insemination but when used for chilled and fresh semen inseminations it is possible to achieve much better results than from vaginal deposition. Any technique which enables more sperm to achieve an intrauterine situation must be beneficial to the success rate. Although chilled semen is not compromised to anything like the extent of frozen semen, it is reasonable to assume it is not equivalent to fresh semen. TCI allows intrauterine deposition of the semen without resorting to surgical insemination which may not be an acceptable option to the client for a non-frozen semen breeding.
The same considerations apply to fresh semen insemination. It is particularly advantageous where fresh semen quality is compromised, resulting in litters which would not otherwise be possible.
Using TCI for fresh and chilled inseminations not only results in excellent conception rates and litter sizes but provides the opportunity to develop experience and expertise in many more situations. The endoscope should not be treated as something special for frozen semen insemination but should be used at every opportunity.

Other TCI Applications

Transcervical catheterization has been used to study the intrauterine environment with respect to microbiology and cytology throughout the reproductive cycle of the bitch giving valuable research information [8,10,11]. When examinations are performed during anestrus and diestrus the vaginal walls are thinner and more susceptible to trauma so extreme care must be taken in these situations. Bitches do not tolerate the endoscope well when not in standing heat so sedation is usually required which also means they will not react to inappropriate manipulation of the endoscope, further emphasizing the need for extreme care. Air insufflation is helpful during anestrus and diestrus, as the vaginal wall tends to cling to the endoscope [7]. The uterus is likely to be more susceptible to infection during diestrus when under the influence of high progesterone levels, requiring particular attention to aseptic technique at this stage. With the ability to catheterize the cervix comes the possibility of developing new diagnostic procedures and perhaps therapy.

Other Uses for Endoscope

In addition to cervical catheterization, the endoscope can be used for routine vaginoscopy to determine the progression through the reproductive cycle as well as for diagnostic vaginoscopy, and cystoscopy [7,12].

Summary

The benefits of using endoscopic transcervical insemination for frozen semen insemination come from being able to achieve the same or better results without the need and risks of general anaesthesia and surgery. The ability to do all fresh and chilled inseminations this way will certainly improve conception rates, as well as extending a dog's stud life in the face of declining semen quality. Above all the client response to the technique is overwhelmingly positive. At times the learning process will be discouraging but the end result is worth the effort.

[a] If you would like to purchase the video mentioned in the text, please write to Dr. Wilson at marion.glenbred@xtra.co.nz. You can also place an order by phone (64 6 328 6881) or by fax (64 6 328 6870) or you can write to Dr. Wilson at: The Glen, RD 9, Feilding, New Zealand.

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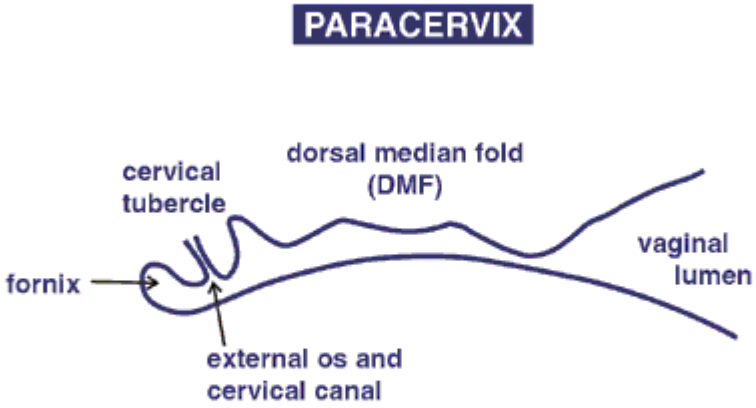

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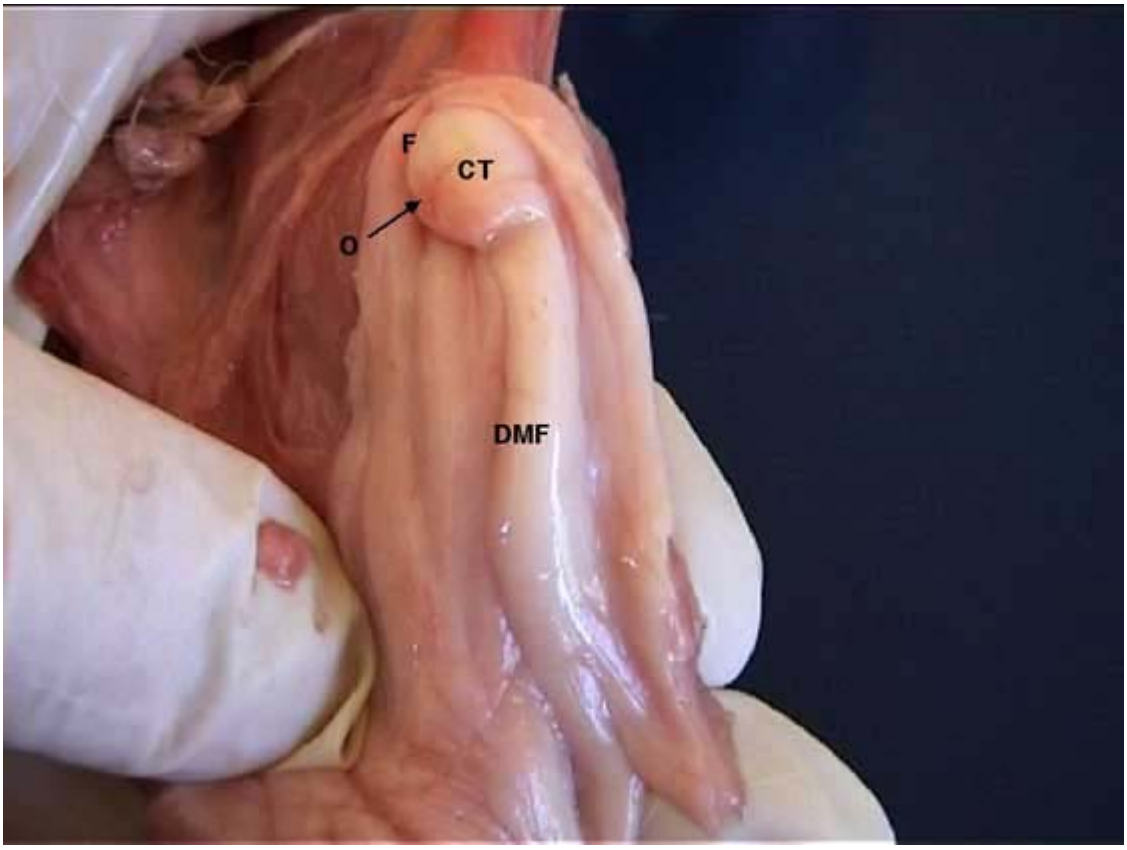

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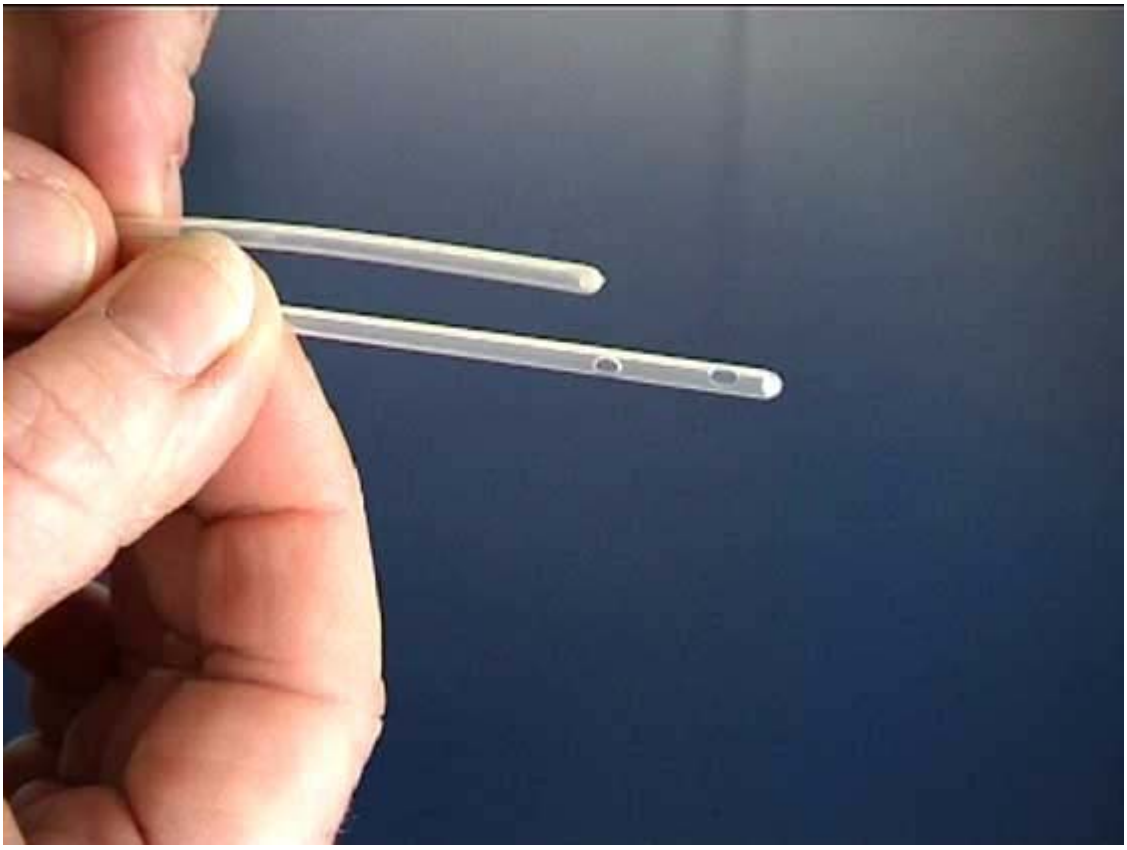

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Figure 7. Restraint of the bitch on this stand limits sideways movement and attempts to sit providing a safe handling system.

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Figure 8. The endoscope is introduced through the dorsal commisure of the vulva taking account of the angle of the vestibule. The index finger placed behind the endoscope is used to help "lift" the scope clear of the urethral orifice as the scope is moved to the horizontal plane.

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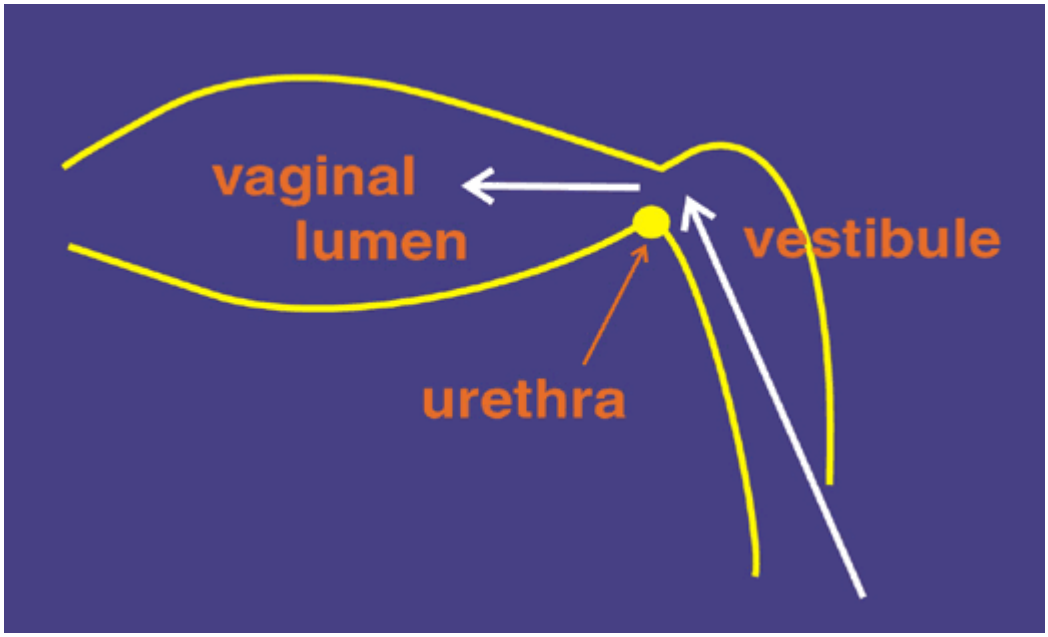

Figure 9. Diagram emphasizing the fact that the endoscope is introduced through the dorsal commisure of the vulva at an angle that takes into account the angle of the vestibule and location of the urethral orifice. The index finger should be placed behind the endoscope and used to help "lift" the scope clear of the urethral orifice as the scope is moved to the horizontal plane.

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Figure 10. Typical appearance of the vaginal folds as the endoscope is advanced through the lumen.

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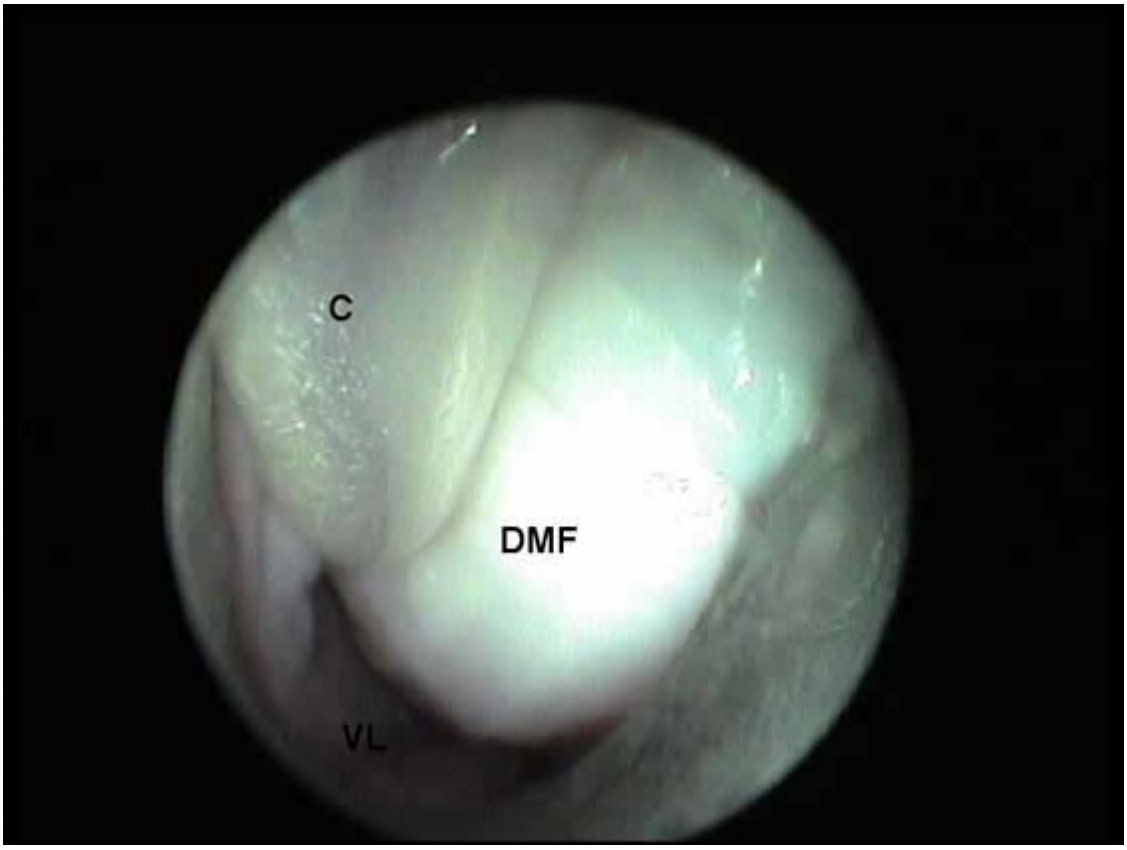

Figure 11. Paracervix with the large dorsal median fold (DMF) and crescentic vaginal lumen (VL). The catheter (C) is used to keep the fold off the endoscope lens.

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Figure 12. The cervical tubercle (CT) can be seen in the distance below the dorsal median fold (DMF).

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Figure 13. The catheter is advanced through the cervical os and the semen can be seen within the catheter during insemination.

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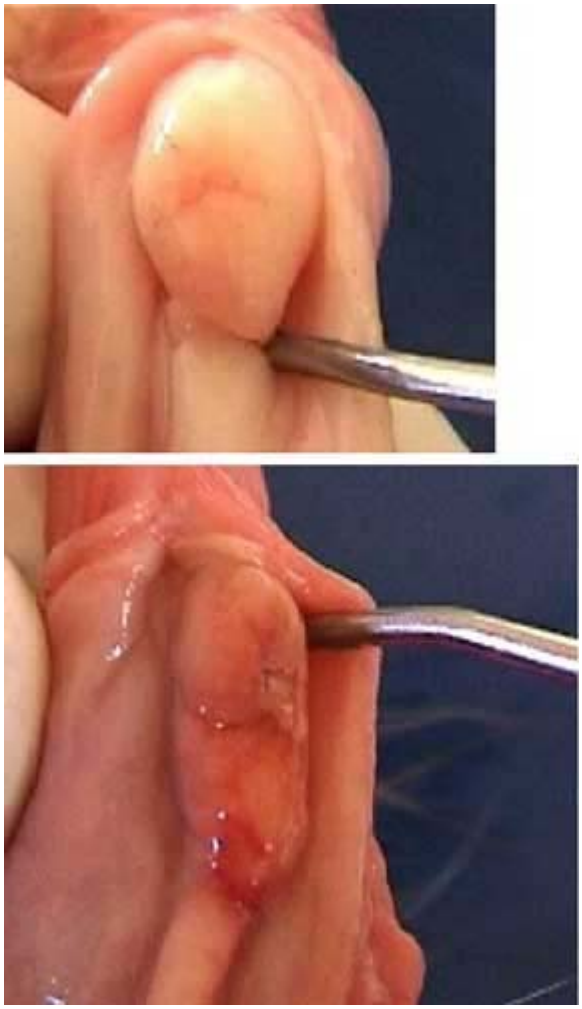

Figure 14. The size, shape and surface appearance of the cervical tubercle varies between bitches.

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Figure 15. Optimum positioning of cervical os relative to the endoscope for catheterization.

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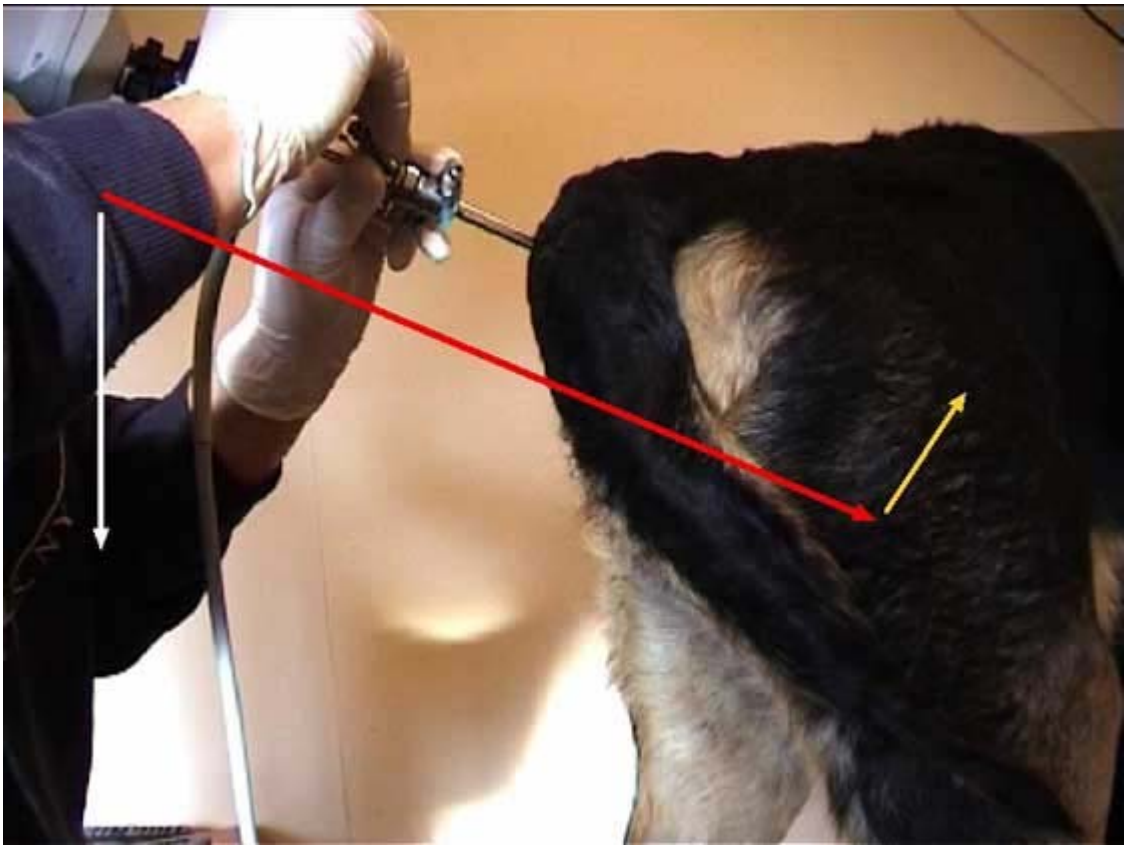

Figure 16. The angle of the endoscope (red) during passage to the cervix is frequently almost at right angles to the cervical canal (yellow). Once the tip of the catheter is in the os, the angle of approach must be changed to facilitate catheterisation (white).

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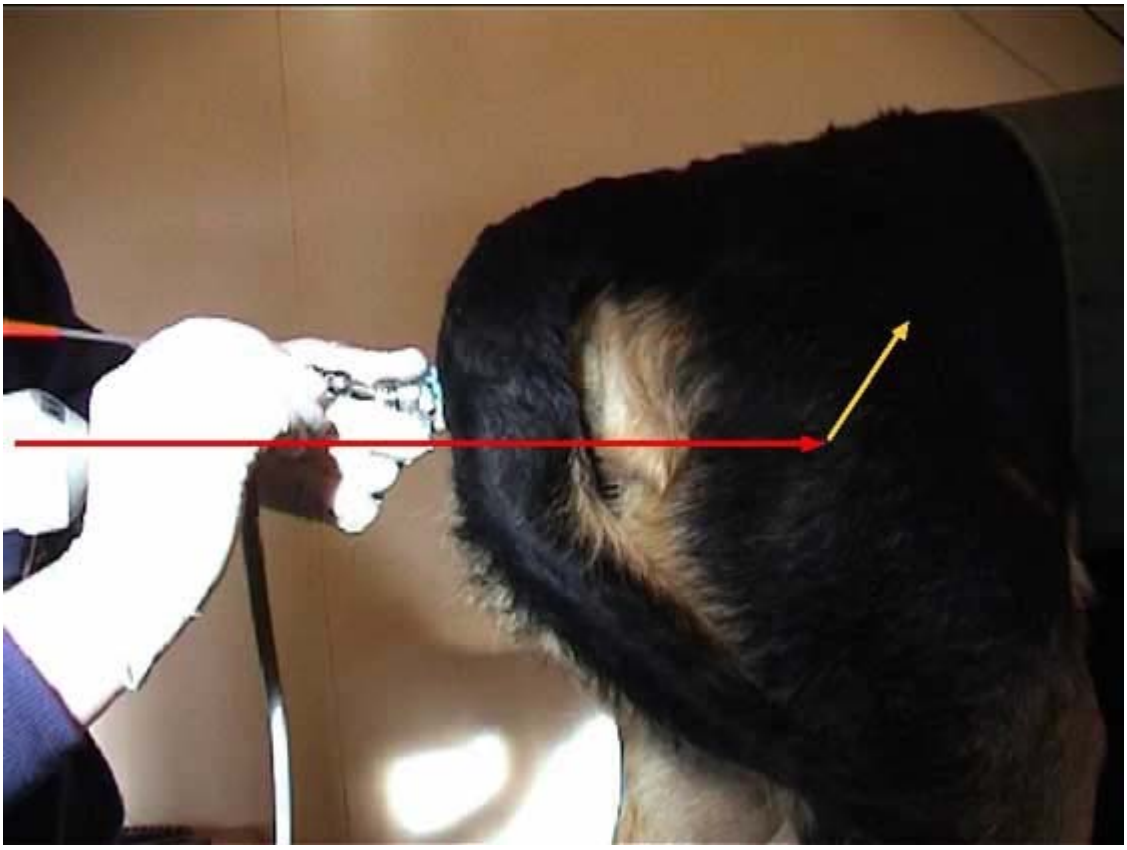

Figure 17. This is achieved by lowering the camera end of the endoscope to a more horizontal position.

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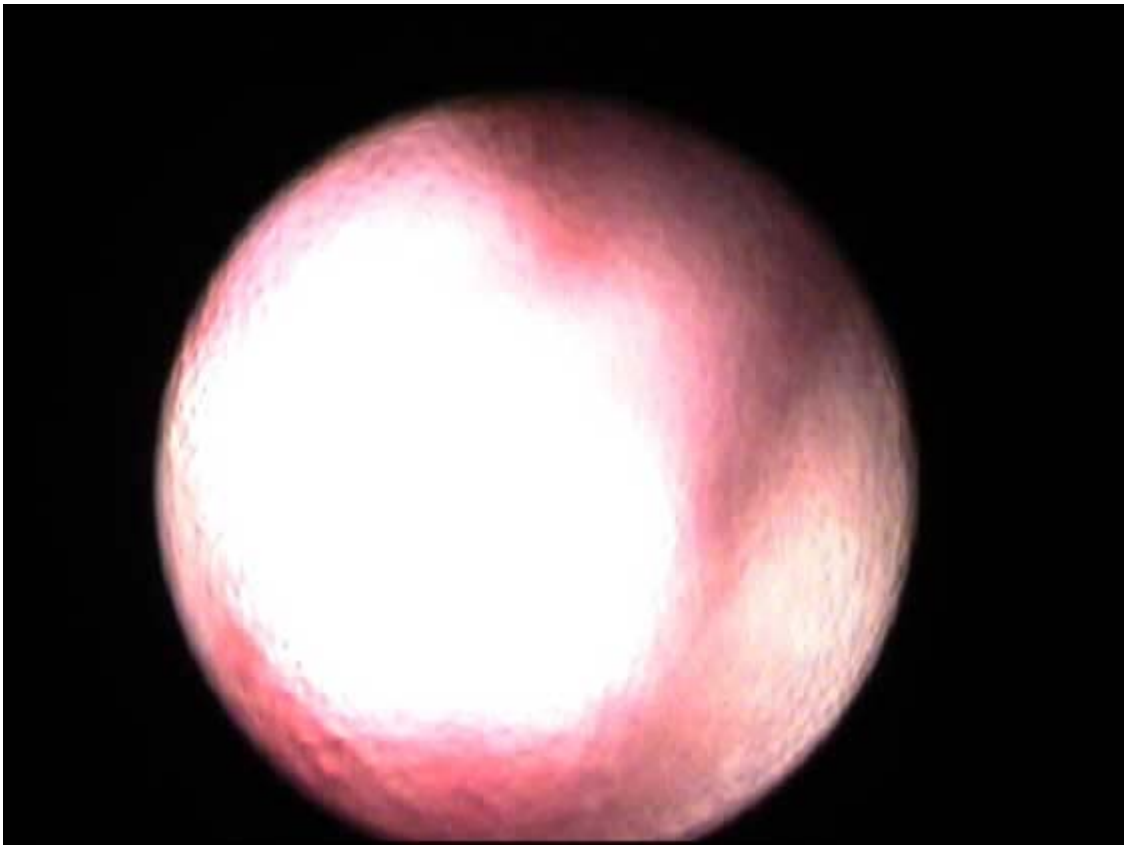

Figure 18. Fogging of the endoscope lens.

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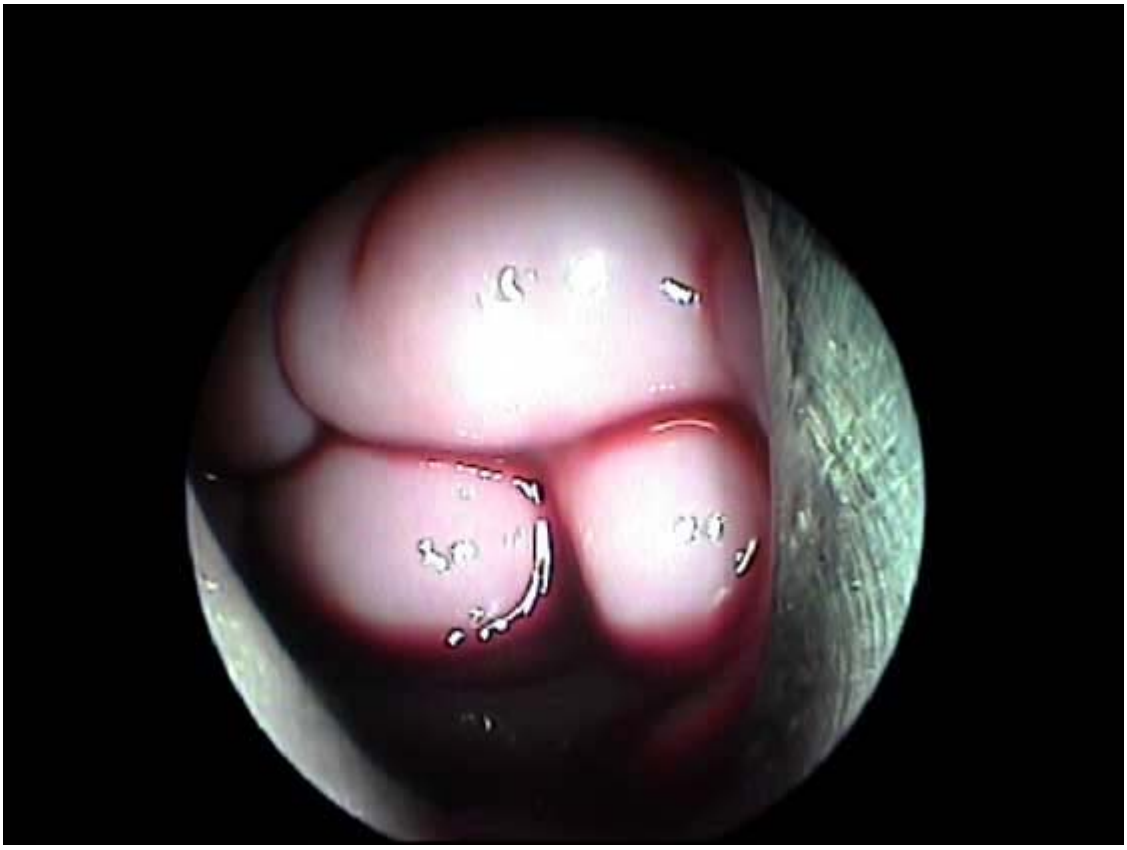

Figure 19. Excessive amounts of blood stained discharge cause visibility problems.

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Figure 20. Thick vaginal discharges like this, can collect in the sheath and cover the lens.

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Figure 21. The position of the catheter within the uterus is important in minimizing backflow of semen. The back hole of catheter must be well within the uterus.

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