



Minimally Invasive Surgical Versus Ultrasound Guided Inguinal Tube Cystostomy for Management of Obstructive Urolithiasis in Cattle

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ABSTRACT

Background: Tube cystostomy, though a popular technique to relieve obstructive urolithiasis in ruminants with advantages of lower recurrences, preservation of the reproductive function of the animal and restoration of full urethral patency in successful cases, is time consuming and invasive. Tube cystostomy performed under ultrasound guidance is hypothesized to be technically easier, safer and quicker.

Methods: Twelve bovine intact male calves of 3-9 months age with obstructive urolithiasis were divided into two groups of six animals each. One group was subjected to surgical and another ultrasound guided minimally invasive tube cystostomy through the inguinal approach. In group A animals, after exposing the bladder through the grid incision, the catheter was placed in the bladder lumen, using teat tumor extractor fixed in the eye of the Foley's catheter. In group B animals tube cystostomy under ultrasound guidance was performed through in the skin. Incision was closed as per routine. Techniques were evaluated on the basis of various parameters like, technical feasibility, use of anesthesia, use of suture material, time taken for surgery, haematobiochemical parameters, time taken for normal urination, survival rate and intra and postoperative complications.

Result: Ultrasound guided minimally invasive inguinal tube cystostomy technique was not only technically easier to perform but also required lesser time, lesser suture material with quicker onset of normal urination. Obstruction of catheter occurred in one animal of each group. Survival rate of 67% without any complication was recorded in both groups.

Key words: Calves, Foley's catheter, Inguinal tube cystostomy, Ultrasound guided.

INTRODUCTION

Tube cystostomy is a technique in which catheter placed in urinary bladder through abdominal wall diverts the urine from urethra, allowing the inflammation around the urolith to subside (Rakestraw *et al.*, 1995; Cockcroft, 1993; Van Metre *et al.*, 1996). It is now a popular technique to relieve obstructive urolithiasis in ruminants. Advantages of the technique include a relatively simple technique, lower recurrences, preservation of the reproductive function of the animal and restoration of full urethral patency in successful cases. Disadvantages of tube cystostomy include increased hospitalization costs and intensive case management (Ewoldt *et al.*, 2008; Palmer *et al.*, 1998). Tube cystostomy has been made simple, economical and easy to suit the field conditions by replacing the Foleys catheter with polyvinylchloride tubing (Parrah *et al.*, 2011b). Continuing with the advancement, the technique was further simplified by adopting minimally invasive flank approach for bovine obstructive urolithiasis cases with intact urinary bladder only (Fazili *et al.*, 2012). Drawback with the technique, besides having limited applicability for cases with intact urinary bladder only, is blind with catheter placement made by bladder palpation approach. Refining the technique further, minimally invasive inguinal tube cystostomy was expected to facilitate rapid tube placement with minimal soft tissue dissection through grid incision approach under direct

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visualization particularly in metabolically compromised patients (Bray *et al.*, 2009), making it more field applicable as minimum equipment shall be required to carry out the procedure. Ultrasonography is an inexpensive and non-invasive diagnostic technique that allows identification of

urinary tract obstruction and thus allowing immediate treatment without delay that might adversely influence the prognosis (Scott and Sargison, 2000). We hypothesized that minimally invasive tube cystostomy performed under ultrasound guidance would be technically easier and require lesser time to perform. The present study was therefore designed to compare surgical minimally invasive inguinal tube cystostomy with ultrasound guided tube cystostomy.

MATERIALS AND METHODS

The study was conducted at Division of Veterinary Surgery and Radiology, Faculty of Veterinary Sciences and Animal Husbandry (F. V. Sc. and A. H.), Sher e Kashmir University of Agricultural Sciences and Technology of Kashmir (SKUAST-K). Twelve clinical cases of obstructive urolithiasis in non-castrated male cattle calves of 3-9 months age with intact urinary bladders, brought to Veterinary Clinical Complex, F. V. Sc. and A.H., SKUAST-K for treatment during 2017, formed the material of the study. These calves were divided into two equal groups A and B. Group A calves were subjected to surgical minimally invasive inguinal tube cystostomy under direct visualization of urinary bladder and group B calves to ultrasound guided minimally invasive tube cystostomy using Foley's catheter.

Restraining of animals was similar in both the groups. The animals were positioned in lateral recumbency with the uppermost pelvic limb retracted laterally and secured to facilitate direct access to the inguinal region. In animals of group A, an oblique 2-3 cm skin incision was made directly at inguinal region starting 1-2 cm away from external inguinal ring at an acute angle to the midline of the body (Fig 1). After sequential incision of the subcutaneous fat and the aponeurosis of the external abdominal oblique muscle (external fascia), a grid approach was used for entering the peritoneal cavity. The exposed portions of the internal abdominal oblique muscle and the underlying transverse abdominis muscle were separated in the direction of their fibers to expose the peritoneum, which was incised. The intact urinary bladders were easily visible in inguinal approach (Fig 2). To facilitate catheter entry into the bladder, the tip of a teat tumor extractor was inserted into the eye of Foley's catheter to act as a stylet. The Foley's catheter 14FG was pulled taut (Fig 3) and the tip of the Foley's catheter introduced into the peritoneal cavity. After stabilization with left hand the urinary bladder was stabbed at an avascular area under direct visualization. Outlet of the catheter was clamped beforehand to avoid the abrupt collapsing of bladder due to drainage of urine. Catheter bulb was inflated with 15 ml sterile normal saline solution for its retention in lumen of urinary bladder. Foley's catheter was then declamped to allow the drainage of urine. The urinary bladder was irrigated with normal saline solution many a times to flush out small uroliths. The peritoneum, muscles and skin was closed routinely. The catheter was then anchored with ventral abdominal wall by the application of simple interrupted sutures.

In the animals of Group B, the location of the intact urinary bladder was determined by ultrasonography in inguinal region. The intact urinary bladders, viewed on screen as an anechoic fluid surrounded by hyper echoic bladder wall with no fluid in the peritoneal cavity; were selected for performing the ultrasound guided tube cystostomy. Taking the guidance from viewing the intact bladder on the screen, approach to the peritoneal cavity was decided at a proper location. A stab incision to the skin was made to pass the Foley's catheter with close proximity of the urinary bladder wall confirm on the USG screen and thrust into the cystic lumen. Rest of the procedure of inflating the bulb of Foley's catheter, clamping and declamping it and flushing the urinary bladder and closing the skin incision was same as in group A animals. Correct placement of catheter into the urinary bladder was depicted on ultrasonographic screen as hyper echoic bulb wall within the cystic lumen (Fig 4) and reduction in the size of cystic lumen after drainage of urine. The purse string suture was given and tightened and catheter anchored with abdominal wall as in group A animals.

Postoperatively animals were given broad spectrum antibiotics and anti-inflammatory analgesics for 3 days, urinary acidifier (Ammonium chloride @ 8gm/animal/day for 1 week), herbal litholitic drug (Tab.cystone @ 2tabs per day for 15 days) and aseptic dressing of wound on alternate days for a period of 10 days.

Intraoperatively following parameters were recorded:

1. Size of incision.
2. Requirement of anesthetics and suture materials.
3. Ease of access to urinary bladder.
4. Time taken for surgical procedure: duration of surgery was considered from skin incision to completion of skin sutures. The total time required in each case was recorded and compared between the groups.
5. Intraoperative complications encountered, if any, were recorded.

Postoperatively following observations were recorded:

1. Hematological parameters viz. hemoglobin, packed cell volume and total leukocyte count using automatic blood analyzer.
2. BUN, Creatinine and total protein using commercially available kits.
3. Urine pH by pocket pH meter.
Haematobiochemical and urine pH were recorded at the time of admission in animals (0 hour) and at 24, 48, 96 and 168 hours post-operatively.
4. Time taken for normal urination: Cystostomy tube was plugged/clamped for at least one hour daily after 3rd post-operative day to determine if the urethra had become patent. If signs of discomfort (repetitive posturing to urinate, stranguria) were observed, the plug or tie was removed and the animal was allowed to urinate through the catheter. The time at which dribbling of urine and normal urination took place was recorded in each case.

5. Survival rate.
6. Postoperative complications if any were recorded till resumption of normal urination.
7. The animals were followed up to at least for a period for 2 months to record their survivability.

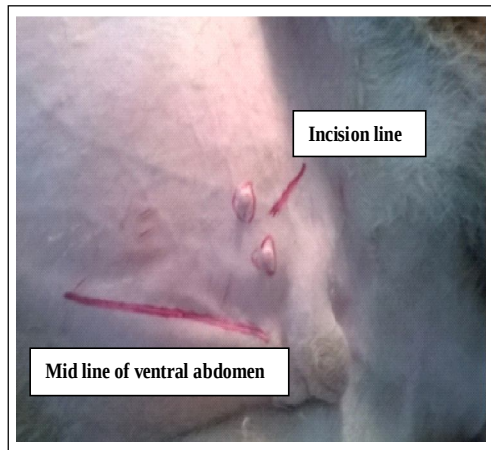


Fig 1: Site of incision in inguinal tube cystostomy.

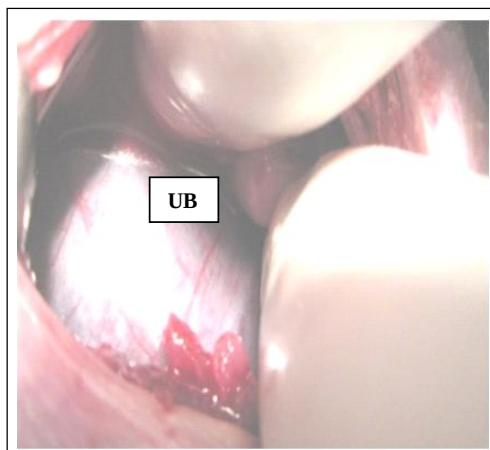


Fig 2: Intact urinary bladder visible in minimally invasive inguinal approach.

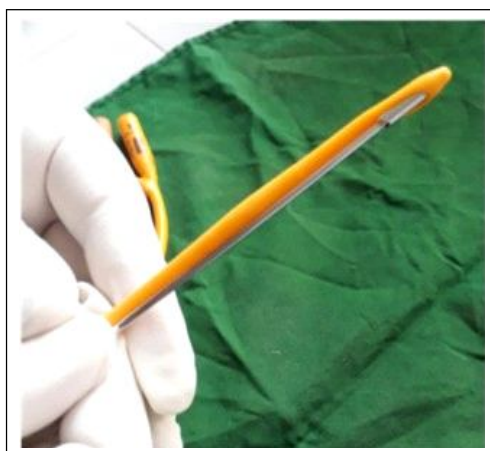


Fig 3: Foley's catheter with teat tumour extractor pulled taut for insertion.



Fig 4: Cystosonogram showing Foley's catheter balloon fixation under ultrasound guided tube cystostomy in calves.

Statistical analysis

The quantitative data were compared between the two groups using unpaired t-test ($P < 0.05$) by standard statistical procedure (Snedecor and Cochran, 1989).

RESULTS AND DISCUSSION

Two techniques viz. surgical minimally invasive inguinal tube cystostomy under direct visualization and ultrasound-guided minimally invasive inguinal tube cystostomy using Foley's catheter, were evaluated for their comparative efficacy in the management of obstructive urolithiasis in calves with intact urinary bladders.

The cost of surgical tube cystostomy has been identified as a major disadvantage (Fortier *et al.*, 2004; Streeter *et al.*, 2002). Minimally invasive tube cystostomy via inguinal approach facilitates rapid tube placement with minimal soft tissue dissection particularly in metabolically compromised patients (Bray *et al.*, 2009). This makes this technique more field applicable as minimum equipment is required to carry out the procedure. However, this technique may result in perforation of intestines or organ or tearing of the bladder wall leading to uroabdomen (Holmes, 2015). This can be prevented by usage of fluoroscopy or ultrasound. These things prompted us to undertake the study.

Ultrasound guided inguinal tube cystostomy required lesser volume of local anesthetic for smaller size of incision, median size of 1.5 cm with a range of 1-2 cm as compared to 2.5 cm median incision size in another group. Also, lesser quantity of non-absorbable suture material silk No. 1 with no absorbable suture material was used in this technique as compared to median 10 cm catgut No.1 in the unguided technique. This could be attributed to the fact that only a nick in skin was given as bladder location was accurately predicted in the animals of group B, while in the animals of group A grid incision was performed to gain access to the intact urinary bladder.

Intact urinary bladders were clearly visible to naked eye in group A animals and appeared smooth and dark brownish

in colour, which could be due to stretching of the urinary bladder wall and rupture of capillaries (Parrah *et al.*, 2012). In group B animals the intact urinary bladders were easily scanned for their status and location and appeared as hyper echoic urinary bladder wall surrounding anechoic urine with no evidence of any kind of pathology. These observations pointed towards the fact that these cases were fresh with no intervention or treatment given in the field. These observations authenticated the history revealed by the owners. Parrah *et al.* (2011a) has reported many lower urinary tract affections like, cystitis, uroperitoneum, serosal erosion of cystic wall, rupture in urinary bladder, urethritis and rupture in urethra in calves suffering from obstructive urolithiasis from the same study area.

The median (range) duration of surgery (min) recorded in group A and B animals was 12(10-15) and 9(6-12) respectively. The duration of surgery was less in group B as compared to group A indicating it as short duration surgical technique for management of obstructive urolithiasis in calves with intact urinary bladders. Tube cystostomy with Foley's catheter is less time-consuming procedure as compared to one being performed with simple polyvinyl chloride tubing (Parrah *et al.*, 2013a). Median time taken for completion of tube cystostomy with Foleys catheter in calves with intact urinary bladder from the same study area is reported 29 minutes (Parrah *et al.*, 2013a). This clearly vindicates the hypothesis that both the techniques of minimally invasive and ultrasound guided are least time consuming.

Parrah *et al.*, (2010c) encountered prolapse of intestine during handling of ruptured urinary bladders, while performing traditional tube cystostomy for management of obstructive urolithiasis in calves from the same study area. However, no intraoperative complication, whatsoever, except minimal bleeding was observed in the animals of both the groups. Inguinal approach thus proved convenient for performing tube cystostomy for management of obstructive urolithiasis in calves.

At the time of admission Haemoglobin (Hb g%; A, 12.13±0.68 and B, 10.98±0.43), Packed cell volume (PCV%; A, 39.83±1.14 and B, 39.50±0.67) and Total Leukocyte Count (TLC ×10³/cu mm; A, 39.50±0.67 and B, 7.78±0.41) values in the animals of both groups were within the normal reference range. Postoperatively, the values decreased steadily but remained within the normal reference range throughout the study period in the animals of both the groups. Significant (p<0.05) difference in the values of TLC (×10³/cu mm) was observed at 96 and 48 hours onwards till the end of the study period in groups A(6.18±0.54) and B (6.58±0.37) respectively from their corresponding base values. Comparison between the groups did not exhibit any significant difference in the values of haemoglobin, PCV and TLC at any observation interval. Decrease in postoperative values towards normalcy in both the groups could be attributed to the onset of rehydration due to fluid therapy, bypassing of urine through catheter, administration

of antibiotics and anti-inflammatory drugs in the animals and normal intake of food and water (Parrah *et al.*, 2010b). Again a significant decrease in total leucocyte count was observed earlier in the animal of group A indicating the superiority of USG guided tube cystostomy technique over non guided technique.

The mean±SE value of Blood urea nitrogen (BUN mmol/L; A, 43.67±3.71 and B, 43.83±2.40) and Creatinine (A, 405.00±63.04 and B, 461.00±39.45) at 0 hour interval were above the normal reference range (14.28-21.42 mmol/L: 88.4-176.8 µmol/L) in the animals of both groups A and B without any significant differences between the two. Postoperatively, the BUN and Creatinine values decreased significantly (p<0.05) as compared to corresponding base values from 24 hours interval onwards till the end of the study period (168 hours) in both the groups. The BUN values returned to normal reference range by 48 hours in the animals of group B(20.56±0.29 mmol/L) and by 96 hours in the animals of group A (20.73±0.24 mmol/L), however Creatinine values (µmol/L) returned to normal by 48 hours (A, 199.50±33.84 and B, 179.16±12.27) in both the groups. Comparison between the groups didn't reveal any significant difference at any observation interval. Return of significantly higher than the normal reference range base values of BUN and Creatinine in the animals of both groups to normal values could be attributed to relief of obstruction, rehydration as a result of fluid therapy and return of normal appetite in animals (Parrah. *et al.*, 2010b). Early return in the animals of group B could be attributed to the superiority of USG guided technique over the non-guided one in the management of obstructive urolithiasis in calves.

Total plasma protein values (g/L) were within the normal reference range (67.4-74.68) in the animals of both groups A and B at 0 hour interval with no significant difference between the groups. Post operatively total plasma protein decreased continuously and non-significantly from the corresponding base value at all the observation intervals in both the groups, which could be attributed to haemodilution through administration of fluid therapy. Comparison between the groups revealed no significant difference in the values of total plasma protein at any observation interval.

The median (range) time of initiation of urination (dribbling) from the external urethral orifice was 7(4-10) and 5(3-9) days in the animals of groups A and B respectively. The median time of onset of free flow of urine from the external urethral orifice in the animals of group A was 9(7-15) days while as in the animals of group B it was 8 (6-14) days. The median time for removal of tube cystostomy catheter in animals of group A and B was 11 (9-17) days and 10 (8-16) days respectively. Initiation and free flow of urine along with catheter removal was earlier in the animals subjected to ultrasound guided tube cystostomy technique, vindicating its superiority over the other technique.

Phosphate calculi are formed rapidly in alkaline urine and are more soluble in acidic urine. Parrah *et al.*, (2011c) reported that magnesium ammonium phosphate was

present in every urinary calculus alone or in combination with other chemicals, while studying chemical composition of 30 bovine calculi from the same study area (Parrah *et al.*, 2010a). Urine pH in both groups A and B were alkaline on the day of presentation. Postoperatively there was decline in pH towards acidic side probably due to the intravenous administration of normal saline, oral administration of ammonium chloride and by incorporation of salt in feed and drinking water (Parrah *et al.*, 2013b). Urine pH became acidic by 48 hours in both the groups.

Both, these innovative surgical techniques adopted in groups A and B animals for management of obstructive urolithiasis in calves were observed having similar postoperative complications. Catheter blockade was observed in one animal in each group which could be due to occlusion of catheter lumen with urinary sludge. Kinking of catheter could be one of the reasons for catheter blockade (Van Metre, 2004). Dislodgement of catheter was observed as complication in one animal in both groups A and B. This could be attributed to deflation of Foley's catheter possibly because of catheter chewing onto the by dam or calf. These observations match with those of Parrah *et al.* (2010c).

The survival rate of 100% was observed in both groups as no mortality was reported in any group. Survival rate of 67% without any complication was recorded in both groups.

With mobile ultrasound equipment availability at the field level, not only early diagnosis of obstructive urolithiasis but also its rapid management via ultrasound guidance is possible. Ultrasound makes accurate positioning of the surgical incision in the inguinal area possible which is crucial to ensure the bladder is readily accessible through the small surgical access and to minimize muscle dissection during surgery. Without ultrasound the incision could be made more dorsal or cranial, this might make access to the bladder wall difficult, necessitating a more extensive dissection. Placement of Foley's catheter under ultrasound guidance can be performed rapidly as even an inexperienced clinician can easily locate bladder.

CONCLUSION

Ultrasound guided inguinal tube cystostomy is not only technically easier and requires lesser time to perform but is also economical as well for the livestock owners, as the USG machine is now commonly available at every institute for diagnostic and other purposes.

Conflict of interest

All authors declare that they have no conflict of interest.

REFERENCES

Bray, J.P., Doyle, R.S. and Burton, C.A. (2009). Minimally invasive inguinal approach for tube cystostomy. *Veterinary Surgery*. **38(3)**: 411-416.

Cockcroft, P.D. (1993). Dissolution of obstructive urethral uroliths in a ram. *Veterinary Record*. **132(19)**: 486-488.

Ewoldt, J.M., Jones, M.L. and Miesner, M.D. (2008). Surgery of obstructive urolithiasis in ruminants. *Veterinary Clinics North America, Food Animal Practice*. **24(3)**: 455-465.

Fazili, M.R., Bhattacharya, H.K., Buchoo, B.A., Malik, H.U. and Dar, S.H. (2012). Management of obstructive urolithiasis in dairy calves with intact bladder and urethra by Fazilis minimillay invasive tube cystostomy technique. *Veterinary Science Development*. **2(1)**: 50-53.

Fortier, L.A., Gregg, A.J., Erb, H.N. and Fubini, S.L. (2004). Caprine obstructive urolithiasis: Requirement for 2nd surgical intervention and mortality after percutaneous tube cystostomy, surgical tube cystostomy, or urinary bladder marsupialization. *Veterinary Surgery*. **33**: 661-667.

Holmes, E. (2015). Percutaneous Cystostomy Tube. In: *Veterinary Image-Guided Interventions*. [Weisse, C., Berent, A., (eds.)], Hoboken, NJ: John Wiley and Sons, Inc. pp. 423-426.

Palmer, J.L., Dykes, N.L., Love, K. and Fubini, S.L. (1998). Contrast radiography of the lower urinary tract in the management of obstructive urolithiasis in small ruminants and swine. *Veterinary Radiology*. **39(3)**: 175-180.

Parrah, J.D., Hussain, S.S., Moulvi, B.A., Singh, M. and Athar, H. (2010a). Bovine uroliths analysis: A review of 30 cases. *Israel Journal of Veterinary Medicine*. **65(3)**: 103-107.

Parrah, J.D., Hussain, S.S., Moulvi, B.A., Makhdoomi, D.M., Buchoo, B.A. and Malik, H.U. (2011a). Ultrasonographic diagnosis of obstructive urolithiasis in calves. *Indian Journal of Veterinary Surgery*. **32(2)**: 117-120.

Parrah, J.D., Moulvi, B.A., Athar, H., Bhat, M.I. and Handoo, N. (2012). Perioperative observations during surgical management of bovine obstructive urolithiasis. *Journal of Research and Development*. **12**: 95-104.

Parrah, J.D., Moulvi, B.A., Hussain, S.S. and Bilal, S. (2011b). Innovative tube cystostomy for the management of bovine clinical cases of obstructive urolithiasis. *Veterinarski Arhiv*. **81(3)**: 321-337.

Parrah, J.D., Moulvi, B.A., Hussain, S.S., Makhdoomi, D.M., Athar, H., Dedmari, F.H. and Hamdani, H. (2013a). Evaluation of different surgical techniques for the management of bovine obstructive urolithiasis. *Veterinary Practitioner*. **14(2)**: 515-522.

Parrah, J.D., Moulvi, B.A., Mohsin, G.A., Makhdoomi, D.M., Athar, H., Dar, M., Dar, S.H. and Mir, A. Q. (2013b). Importance of urinalysis in veterinary practice- A review. *Veterinary World*. **6(9)**: 640-646.

Parrah, J.D., Moulvi, B.A., Bhat, J.I.A., Hussain, S.S., Bilal, S. and Hussain, I. (2010b). Haematology of bovine obstructive urolithiasis. *Online Journal of Veterinary Research*. **15(1)**: 1-13.

Parrah, J.D., Moulvi, B.A., Hussain, S.S., Bilal, S. and Athar, H. (2011c). Aetiopathogenesis of bovine obstructive urolithiasis. *Indian Journal of Animal Research*. **45(1)**: 1-13.

Parrah, J.D., Moulvi, B.A., Hussain, S.S., Bilal, S. and Ridwana (2010c). Comparative efficacy of tube cystostomy and cystostomy with indwelling urethral catheterization in the management of obstructive urolithiasis in bovines. *Indian Journal of Veterinary Surgery*. **31(2)**: 1-13.

Rakestaw, P.C., Fubini, S.L., Gilbert, R.O. and Ward, J.O. (1995). Tube cystostomy for treatment of obstructive urolithiasis in small ruminants. *Veterinary Surgery*. **24**: 498-505.

- Scott, P.R. and Sargison, N.D. (2010). Ultrasonography as an adjunct to clinical examination in sheep. *Small Ruminant Research*. **92(1)**: 108-119.
- Snedecor, G.W. and Cochran, W.G. (1989). Statistical Methods. 8th Edition, Iowa State University Press, Ames.
- Streeter, R.N., Washburn, K.E. and McCauley C.T. (2002). Percutaneous tube cystostomy and vesicular irrigation for treatment of obstructive urolithiasis in a goat. *Journal of American Veterinary Medical Association*. **221(4)**: 546-549.
- Van Metre, D. (2004). Urolithiasis. In: Farm Animal Surgery, [Susan L., Fubini, N.G. Ducharme, (Eds.)], W.B. Saunders, New York. pp. 534-547.
- Van Metre, D.C., House, J.K., Smith, B.P., George, L.W., Angelos, S.M., Angelos, J.A. and Fecteau, G. (1996). Obstructive urolithiasis in ruminants, medical treatment and urethral surgery. *Compendium Continuing Education Practice Veterinarian*. **18(3)**: 317-328.