

MANAGEMENT OF CONGENITAL URINARY OBSTRUCTION IN NEWBORN CALVES

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ABSTRACT

Congenital urinary tract obstruction is a developmental anomaly which may persist after birth in new born calves. To determine the occurrence of congenital urinary obstruction and to evaluate tube cystostomy for the management of congenital urinary obstruction in neonatal calves two studies were conducted. A retrospective study was performed to observe the occurrence of congenital urinary obstruction in neonatal ruminants from January 2005 to November 2014. Occurrence of congenital urinary obstruction in neonatal calves was also studied in respect to age, sex, breed and season. During the period of 10 years, a total of 42 cases of congenital urinary obstruction were recorded, which constituted an incidence of 2.0%. In this study, maximum incidence was recorded in bovine is 38 (90%). Maximum number of cases (45%) of congenital urinary obstruction in ruminants was recorded from March to June, July to October and November to February as 19 (45%), 9 (22%) and 14 (33%) respectively. Among affected animals, 31 were cross breed (74%) and 11 were local breed (26%). Number of affected males was 29 (69%) clearly ahead than affected female 13 (31%). In another study, tube cystostomy with infusion set was performed in eleven neonatal calves aged 1-6 days old and observed for 1 month. Among 11 calves, 2 died due to severe infection and septicemia and 2 calves needed repeated operation. Seven calves got uneventful recovery and the cured animal showed satisfactory results. Overall successful rate was 63.6%. The results revealed that tube cystostomy seemed to be an effective method. In addition, this study will help not only veterinarian to make them aware about the occurrence of congenital urinary obstruction but also to solve the problem by saving the life of neonatal calves.

Keywords: Oligohydramnios, anomalies, calves, cystostomy, septicemia etc.

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INTRODUCTION

Bangladesh is an agricultural country where livestock plays an important role in its national economy with a direct contribution of around 3% to the agricultural GDP (Bangladesh Economic Review, 2014). About 75% people rely on livestock to some extent for their livelihood, which clearly indicate this poverty reduction potential of the livestock sub sector is high (National livestock development policy, 2007). Livestock production is contributing not only to food but also provide hides, fibers, fertilizer and fuel, as well as a modest, interest-producing capital that can easily be mobile when unforeseen needs arise (Samad, 1998). Agro-climatic condition, religious point of view, social practices and technological aspects support the prospects and potentials of raising animal.

Calf mortality is the major causes of economic losses in livestock production. Calf diseases that cause morbidity and mortality are the results of complex interaction of the management practices and environment, infectious agents and the calf itself. Neonatal calf mortality varied from 8.7-64% throughout the world and the mortality in the first month of age was account to be 84% of total mortality (Jenny *et al.*, 1981). The predominant causes of calf mortality were pneumonia 14.8%, foot and mouth diseases 12.3%, dystocia 11.7%, calf scour 8.6, diarrhea 1.9% and some congenital diseases (Islam *et al.*, 2005). Some reports on the etiology of calf diseases with especial emphasis to parasites (Samad *et al.*, 1977), microbes (Debnath *et al.*, 1987), pathological diseases and conditions and congenital malformation (Hossain *et al.*, 2002) associated with calf morbidity and mortality have been done in Bangladesh. Congenital defects are those with a fetus in born. Major congenital defects affecting calves in Bangladesh are congenital urinary obstruction, umbilical hernia, atresia ani, dermoid cysts, nonfunctional limb joints, embryonic duplications etc. (Hossain *et al.*, 1986; Newman *et al.*, 1999).

Congenital defects, structural or functional abnormalities presented at birth (Nesbitt, 1954) are one of the most challenges facing the clinician in the field because of their nature of complexity (Samad and Hoque, 1986; Rousseaux and Ribbl, 1988). Urethral obstruction in calves is a fatal disease that predisposes to high mortality rate unless the animal is subjected to emergency surgical treatment for correction of the obstruction (Rahman *et al.*, 1972). It

appears uncommon in the general population but with a relatively high incidence in certain cross-breeds (Oehme and Perior, 1974; Das and Hashim, 1996).

In Bangladesh most of the farmers have no facility for modern treatment for their livestock. Moreover, many farmers cannot afford the cost of treatment. So before taking the animal to the veterinarian, the owners try to treat their animals with various local remedies. When choosing a treatment modality, the patient's intended use should be taken into consideration. All treatment modalities have benefits and complications associated with them, so selection is based on long term goals for the individual patient and the owner's ability and willingness to finance and provide after care for the treatment. Surgical tube cystostomy the most commonly used treatment for long term management of obstructive urolithiasis in animals. It redirects urine through a catheter placed from urinary bladder with an exit through the abdominal wall. The success rate of this technique has been reported to be 80% (Fazili *et al.*, 2012). It is important that a hypothetical survey is necessary to bring basic data for further study of surgical affections and thereby solve the problem of ruminant in Bangladesh. A few clinical works on congenital urinary obstruction in ruminants are done in Bangladesh (Samad *et al.*, 2002). This study has been carried out to find out the occurrence of congenital urinary obstruction of animals in Veterinary Teaching Hospital at Mymensingh, to study the relationship of different factors such as species, age, sex and seasons with the occurrence of congenital urinary obstruction in animals in this area and to evaluate tube cystostomy for the management of congenital urinary obstruction to save newborn calves.

MATERIALS AND METHODS

Two studies were conducted at Veterinary Teaching Hospital and the Department of Surgery & Obstetrics, Bangladesh Agricultural University (BAU), Mymensingh, from June 2013 to November, 2014.

Study 1

A retrospective study was carried out on the cases presented with the history and clinical signs suggestive of urinary obstruction in ruminants at Veterinary Teaching Hospital, Faculty of Veterinary Sciences, BAU from January 2005 to November 2014. Cases were recorded and calculated to determine the occurrence of congenital urinary obstruction in neonatal ruminants in that period. The occurrence of congenital urinary obstruction was calculated according to species, age, sex, breed and season.

Study 2

This study was performed to assess tube cystostomy in neonatal calves for the management of congenital urinary obstruction. Surgical intervention was performed in Eleven calves presented to the Veterinary Teaching Hospital, BAU, Mymensingh, with congenital urinary obstruction and distended abdomen (Figure 1 and 2). Age of calves ranged from 1 to 6 days with body weight 10-15 kg. Among 11 calves, 2 were females and 9 were males. All newborn calves were free from other concurrent neurologic, metabolic or infectious diseases.



Figure 1. Animal having no opening for urination.



Figure 2. Animal having distended urinary bladder

Ultrasonographic examination

Abdominal ultrasonography was performed using Magic 5000 digital ultrasound system (VET Eickemeyer®, Germany) to observe the urinary bladder. Uroperitonium characterized by black anechoic structure was found in 6 calves came after 4-6 days after birth with distended abdomen. Bladder could not be seen due to accumulated fluid (Figure 3 a). In three calves, cord like urethral meatus characterized by white echogenic structure was observed with distended bladder (Figure 3 b). Imperforate urinary bladder marked by dense echogenic margin was observed in 2 calves of one day old (Figure 3 c).



Figure 3(a). Black anechoic structure of uroperitoneum.



Figure 3(b). White echogenic cord like urethral meatus.



Figure 3(c). Black anechoic urinary bladder surrounded by dense echogenic margin.



Figure 4(a). Exteriorization and incision on the urinary bladder.

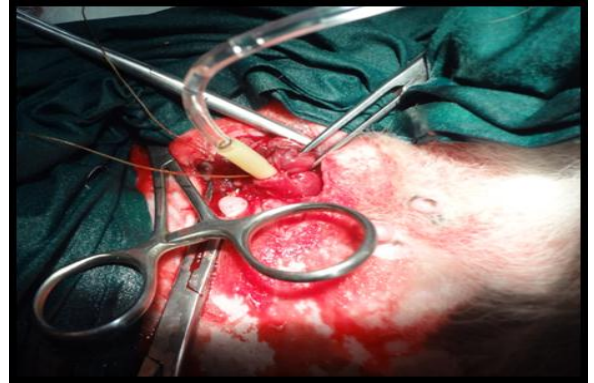


Figure 4(b). Placement of catheter into bladder with purse-string suture.



Figure 4(c). Closure of abdominal muscle and securing of catheter.



Figure 4(d). Animal immediately after the operation.

RESULTS

Study 1: Occurrence of congenital urinary obstruction

Occurrence in different years

A retrospective study was performed to observe the occurrence of urinary obstruction in ruminants (Cattle and goats) at BAU Veterinary Teaching hospital, Mymensingh. Of 2012 surgical cases, about 205 Cases of urinary obstruction were recorded among which 42 cases were congenital urinary obstruction and the percentage was 2%. Data are presented in Figure 5.

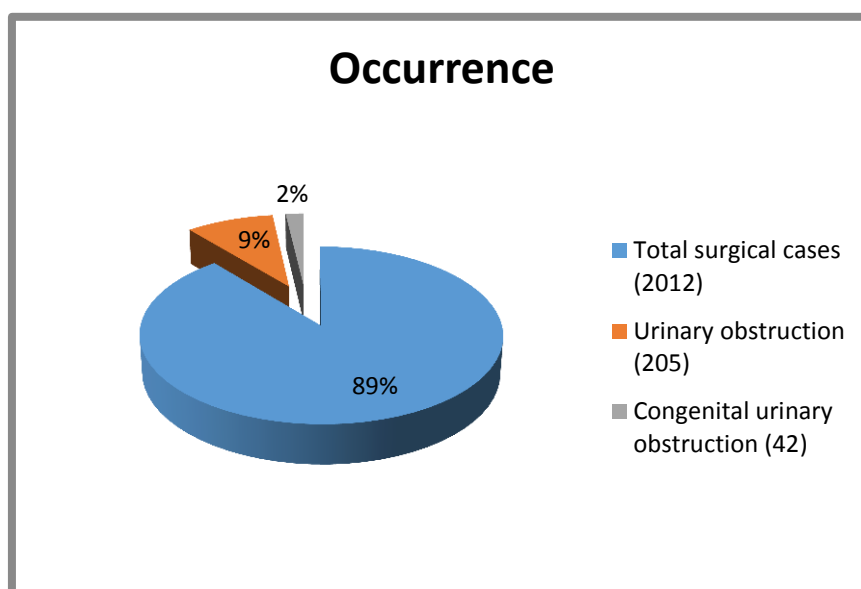


Figure 5: Occurrences of congenital urinary obstruction.

In this study, 42 animals were affected with congenital urinary problem where 4 animals in 2005, 1 animal in 2006, 1 animal in 2007, 2 animals in 2008, 7 animals in 2009, 4 animals in 2010, 4 animals in 2011, 6 animals in 2012, 9 animals in 2013, 4 animals in 2014. Results showed that the occurrence is increasing day by day (Figure 6).

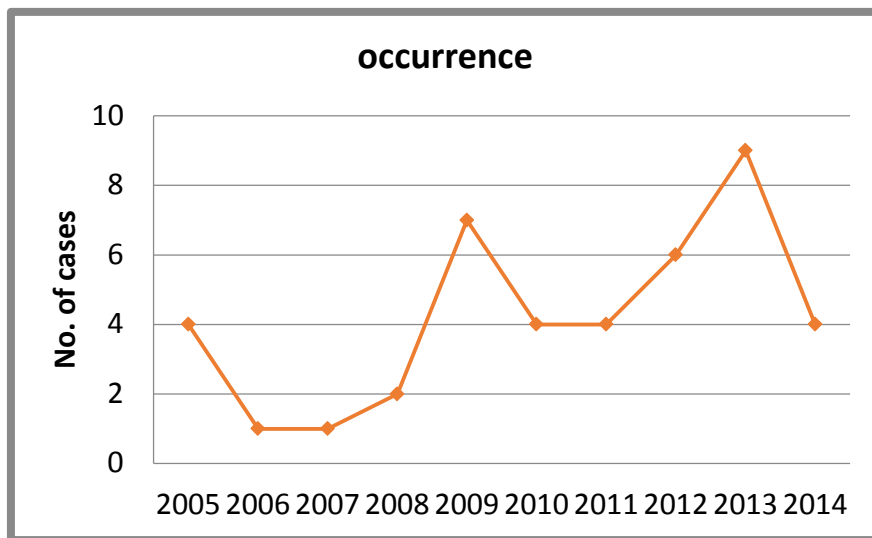


Figure 6: Occurrence of congenital urinary obstruction in different years.

Occurrence in different species

We observed that occurrence of congenital cases was higher in calves in comparison to kids. We found 38 cases (90%) in calves and 4 cases (10%) in kids. In 2005, we found that three calves and one kid were affected. In 2006-2009, the calf was solely affected. We found no record of congenital urinary obstruction in goat. In 2010, 4 cases were observed in 3 calves and 1 kid. In 2011 and 2012, there was no record of congenital urinary obstruction in goat. Seven calves and two kids were affected in 2013. In 2014, only 4 calves were affected. These data are shown in figure 7.

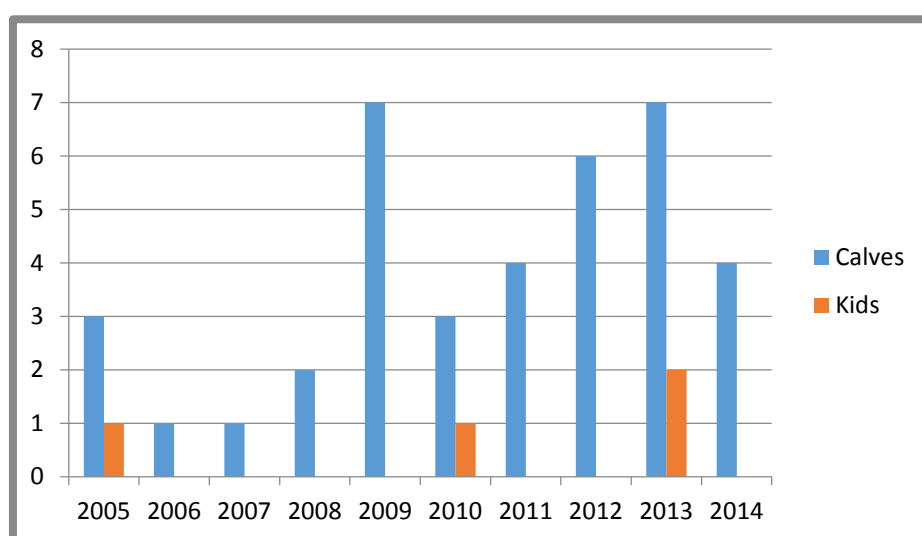


Figure 7: Occurrence of disease in different species.

Occurrence in different seasons

Figure 8 represents the occurrence of congenital urinary obstruction in different season from 2005-2014. It was observed that 19 (45%) animals affected from March to June, 9 (22%) from July to October and 14 (33%) from November to February.

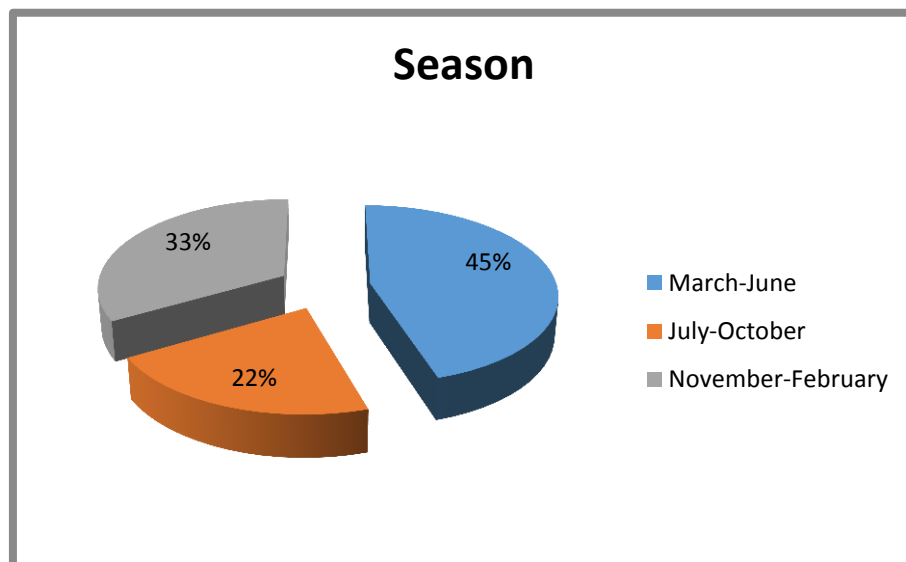


Figure 8: Effects of season on the occurrence of congenital urinary Obstruction.

Occurrence in breed

Among the affected animals 31 was cross breed (74%) and 11 was local breed (26%). Result is presented in Figure 9.

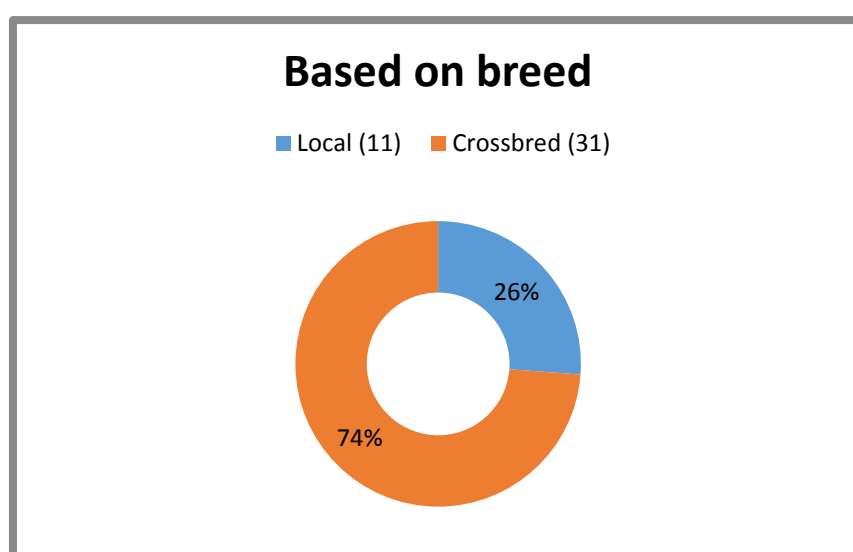


Figure 9: Occurrence in breed.

Occurrence in respect to sex of the animal

The occurrence of congenital urinary obstruction in respect to sex is shown in Figure 10. It was recorded that the number of affected male is 29 (69%) is clearly ahead than affected female 13 (31%).

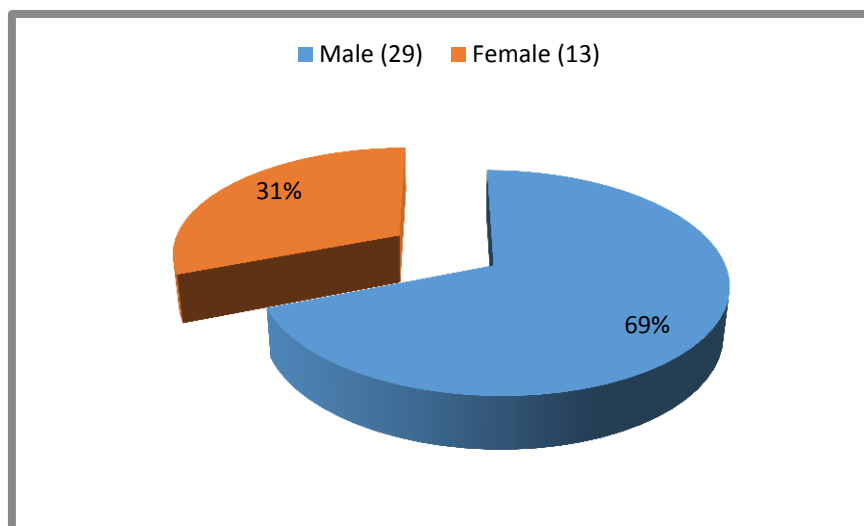


Figure 10: Effects on Sex.

Study 2: Use of tube cystostomy for the treatment of congenital urinary obstruction

Eleven neonatal calves affected with congenital urinary obstruction were corrected with tube cystostomy and infusion saline catheter was used to facilitate continuous flow of urine. Cases and post-operative observations are shown in Table 1.

During the study period, all the cases attained adequate analgesia at surgical site, there was no complication encountered. Catheterization of urinary bladder and positioning of tube were achieved without any difficulties. Continuous flows of urination were noticed immediately after the surgical correction in all the cases. Among 11 calves, 2 died due to severe infection and septicemia. Moreover, 2 calves returned to Veterinary Teaching hospital after 10 days of operation due to dislodgement of the catheter and were subjected to perform tube cystostomy again. Seven calves got uneventful recovery and the cured animal showed satisfactory results. There is no inflammation, no dehiscence, no maggot infestation in the operative area and gradual decreasing wound area. No exudation was observed at surgical site in any animals during removal of suture. The animal can move freely and urinate continuously without any

disruption. All calves showed good prognosis and performance in the immediate post-operative period. Severe pain was noticed for first 2 postoperative days in all animals, which gradually lessened and subsided by 14th postoperative day in almost all calves alive. Among 7 calves, 3 calves resumed normal urination through the natural opening on 15 – 21 post-operative days. Tube was removed after resuming normal urination through the external urethral orifice. Owner complained about tube blockage due to urinary cast. They were advised to make suction of the tube with 10 ml syringe and then urination through catheter was normal.

Overall successful rate was 63.6%. The results showed tube cystostomy as an effective method for the management of congenital urinary obstruction in neonates.

Table 1: The characteristics of congenital cases in calves treated by tube cystostomy and post-operative observation up to one month

Calves	Sex	Age (Day)	Ultrasonographic Findings	Post-operative Observations			
				Cure	Repeat Intervention	Dead	Other Observation
1	Male	5	Uroperitonium	-	-	√ After 10 days	-
2	Male	4	Cord like urethral meatus	√	-	-	Resume Normal urination
3	Male	4	Uroperitonium	-	√	-	Dislodgement of catheter urine dropping
4	Female	1	Cord like urethral meatus	√	-	-	Resume Normal urination
5	Male	1	Imperforate urinary bladder	√	-	-	Tube blockage
6	Male	6	Uroperitonium	-		√ Within 12 hrs	
7	Male	4	Uroperitonium	√	-	-	Tube blockage
8	Male	4	Uroperitonium		√ -	-	Dislodgement of catheter urine dropping
9	Female	4	Uroperitonium	√	-	-	Tube blockage
10	Male	1	Imperforate urinary bladder	√	-	-	Tube blockage
11	Male	6	Cord like urethral meatus, Dribbling of urine Through umbilicus	√	-	-	Resume normal urination

DISCUSSION

The most appropriate information regarding congenital urinary obstruction in animal is very scanty. Therefore, a retrospective study was done in ruminants and to determine the occurrence of congenital urinary obstruction in animals. We found that the occurrence of congenital urinary obstruction in animal is 2% in comparison with other surgical disease. Moreover, occurrence was higher (90%) in calves in comparison to kids. Study showed that the congenital urinary obstruction incidence highest during March-June (45%) where temperature and relative humidity were optimum. In hot and cold seasons the rate is comparatively low (22% and 33%, respectively). Crossbred animal had greater risk of occurrence of congenital deformities, because proper rules are not followed during artificial insemination. Genetics and environmental factors are recognized as major causes (Binns *et al.*, 1972; Hartley *et al.*, 1974; Dennis, 1975). Abnormal development is usually caused either by genotypic or environmental factors, in addition to failure to meet the temporal-spatial requirements (overwhelmed fetal compensatory mechanisms) of development (Bai *et al.*, 2004). It is worthy to point out that autosomal recessive gene has an effect on crossbred animal and animal born with congenital malformation (Samad, 2008).

To date, very little information is available regarding the relative frequency of congenital urinary obstruction in calves and successful rates of treatment. Therefore, the present study was planned with the objectives to evaluate recovery rate after surgical treatment of congenital urinary obstruction cases. Surgical correction is the only way to restore normal function in the urinary system. The aim of the operation was to make the animal urinate in this study. We performed cystostomy with easily available (in sterile pack) and cheap infusion set tubing. Fazili *et al.*, (2010) have also reported the use of infusion set for tube cystostomy for treatment of obstructive urolithiasis in small ruminants.

Urinary catheters are one of the most frequently used tools in the diagnosis and management of urinary tract disorders. Using of catheter facilities the alternative and continuous flow of urination in animal. It maintains the constant and controlled bladder drainage in recumbent, non-ambulatory and incontinent patients. Urinary catheterization is used in the animal emergency setting and critical care for diagnostic, treatment, and monitoring purposes.

Important factor for recovery of diseases includes appropriate surgical approach, proper placement of catheter and post-operative care. Tube cystostomy using infusion set tubing was found to be a useful, easy, quick, cheap, and field-applicable technique for managing tube cystostomy in the neonatal calves. Surgical tube cystostomy is the most promising procedure for obstructive urolithiasis in small ruminants intended for use as breeding animals. The procedure is relatively simple, requiring a short duration of anesthesia and resulting in restoration of full urethral patency in successful cases (Fortier *et al.*, 2004; Ewoldt *et al.*, 2008). Moreover, the incision site healed uneventfully and the cutaneous sutures were removed on the day of catheter withdrawal. During the follow-up period of 1 month in live animal, no complication was reported. The bladder is considered to have a high regenerative capacity and heals readily (Rasmussen, 1967).

Calves presented with the history of no urination and clinical signs suggestive of congenital urinary obstruction were subjected to detailed physical and ultrasonographic examination to confirm congenital urinary obstruction. Sonography is a non-invasive reproducible and inexpensive method for diagnosis of urolithiasis, localization urethral calculi and rupture of urethra or the urinary bladder (Braun, 1993). It is safer for both patient and the operator as it does not involve the use of ionizing radiation. The volume, size and shape of the urinary bladder can be detected by cystosonography (Khan *et al.*, 2011), besides changes in the wall thickness, intraluminal defects and seat of calculi lodgment can be detected. Abdominal sonography is useful to evaluate the bladder but is unrewarding for evaluation of the entire length of the urethra. Scanning of bladder reveals rounded to unevenly hyperechoic shadows with multiple spread tiny hyperechoic patterns (Janene *et al.*, 1995).

In the current study, one animal was found dead after few days of tube cystostomy placement. The cause of death may be attributed to urine leakage, Uroperitoneum, peritonitis and uremia. Ewoldt *et al.* (2008) have revealed that the most common cause of death shortly following the tube cystostomy placement is urine leakage. Fortier *et al.*, (2004) described the catheter obstruction as a common and serious complication requiring careful management to avoid the need for repeat surgery. Tube cystostomy is not free from complications and some complications involved are urine leakage, wound infection or dehiscence problems with the

tube itself such as irritation at the stoma site, obstruction or accidental dislodgment and problems related to ascending infection due to presence of the tube (Bhokre *et al.*, 1985).

In our study, there was no major complication such as significant wound infection, complete dehiscence of sutures, and no obstruction in the artificial opening. Nylon sutures were removed 12- 14 days after operation and Chromic acid suture (e.g. catgut) were left in the surgical site (Bjorling, 2003). The kind of suture materials had no significant effects on occurrence of postoperative complications. Slatter (1985) opined that before specific surgical or medical treatment, the general condition of the patient must be assessed. Shock, anuria, dysuria, uremia, dehydration, electrolyte imbalances and anorexia must be recognized and corrected prior to definitive repair of the urethra or urinary tract.

We could not perform haemato-biochemical study which could be indicative of electrolyte and acid-base abnormalities due retention of urine. Moreover, further study should be directed to implement and evaluate this technique in a sufficient number of cases before recommending its adoption. However, the data collected from this study could help the veterinarian to treat and prevent the affection. Such cheap techniques are particularly advantageous in developing countries. The knowledge derived from this study will increase clinicians understanding about the congenital cases related urinary system of ruminants and identification of risk factors of the cases subsequently will help to take necessary preventive measures of the disorders. Moreover, attempts should be made to save neonatal animals in order to give maximum economic benefit to the farmers of this country.

CONCLUSIONS

Occurrence of congenital urinary obstruction cases was higher in calves and in the season of March-June. The male calves were more affected than female calves. Tube cystostomy with infusion set seemed to be an effective method for the management of congenital urinary obstruction in calves. This technique was the rapid, simple and cost effective. Proper wound management and routine check-up is important for the success of treatment performed with tube cystostomy.

REFERENCES

- Bangladesh Economic Review (2014). Retrieved from [http://www.mof.gov.bd/en/budget/14_15/ber/en/Ch-02%20\(English-2014\)_Final_Draft.pdf](http://www.mof.gov.bd/en/budget/14_15/ber/en/Ch-02%20(English-2014)_Final_Draft.pdf)
- Bai, Y., Chen, H., Yuan, Z. W., & Wang, W. (2004). Normal and abnormal embryonic development of the anorectum in rats. *Journal of Pediatrics Surgery*, 39, 587-590.
- Bhokre, A. P., Kulkarni, P. M., Usturge, S. M., Panchbhai, V. S., & Sarkate, L. B. (1985). Surgical management of urolithiasis in bovines with reference to some blood abnormalities. *Livestock Advisor*, 6, 46-50.
- Binns, W., Keeler, R. F., & Balls, L. D. (1972). Congenital deformities in lambs, calves and goat resulting from maternal ingestion of veratrumcalifornicum harelip, cleft palate, ataxia and hypoplasia of metacarpal and metatarsal bones. *Journal of Clinical Toxicology*, 5, 245-261.
- Bjorling, D. E. (2003). The Urethra. In: *Text Book of Small Animal Surgery* (pp. 1640-1643), Slatter, D. (Ed.) 3rd Edition, WB Saunders Company, Philadelphia, USA.
- Braun, U. (1993). Ultrasonographic examination of the left kidney, the urinary bladder, and the urethra in cows. *ZentralblattfürVeterinärmedizi*, 40, 01-09.
- Das, B. R., & Hashim, M. A. (1996). Studies of surgical affections in calves. Bangladesh Agricultural University, Mymensingh. *Bangladesh Veterinary Journal*, 30, 26-33.
- Debnath, N. C., Huq, M. I., & Rahman, A. (1987). A microbiological investigation of the neonatal calf diarrhoea in Bangladesh. *Indian Journal of Animal Science*, 51, 1035-1038.
- Dennis, S. M. (1975). Perinatal lamb mortality in Western Australia. Seven congenital defects. *Austrelian Veterinary Journal*, 51, 80-82.
- Ewoldt, J. M., Jones, M. L., & Miesner, M. D. (2008). Surgery of Obstructive Urolithiasis in Ruminants. *Veterinary Clinics Food Animal*, 24, 455-465.
- Fazili, M. R., Bhattacharyya, H. K., Buchoo, B. A., Malik, H. U., & Dar, S. H. (2012). Management of obstructive urolithiasis in dairy calves with intact bladder and urethra by Fazili's minimally invasive tube cystotomy technique. *Veterinary Science Development*, 2, 50-53.

- Fazili, M. R., Malik, H. U., Bhattacharyya, H. K., Buchoo, B. A., Moulvi, B. A., & Akhdoomi, D. M. (2010). Minimally invasive tube cystotomy for treatment of obstructive urolithiasis in small ruminants with intact bladder. *Veterinary Records*, 166, 528–531.
- Fortier, L. A., Gregg, A. J., Erb, H. N., & 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.
- Hartley, W. J., & Haughery, K. G. (1974). An outbreak of micrencephaly in lambs in new south wales. *Austrelian Veterinary Journal*, 50, 55-58.
- Hossain, K. M. M., Saha, S., Samad, M. A., & Choudhury, K. A. (2002). Isolation and characterization of enterobacteria from diarrheic calves with their pathogenicity in mice and in-vitro sensitivity to antibiotics. *Bangladesh Veterinary Journal*, 36, 43-49.
- Hossain, M. A., Shahidullah, M., & Ali, M. A. (1986). A report on surgical diseases and reproductive disorder recorded at the Veterinary Teaching Hospital of Bangladesh Agricultural University, Mymensingh. *Bangladesh Veterinary Journal*, 20, 01-05.
- Islam, S. S., Ahmed, A. R., Ashraf, A., Khanam, N., & Ahmed, B. M. (2005). Agrotechnology discipline, Khulna University, Khulna, Bangladesh. *Journal of Animal and Veterinary Advances*, 4, 260-264.
- Janene, K., Kingston, Henry, R., & Staempfli (1995). Silica Urolithiasis in a male Ilama. *Canadian Veterinary Journal*, 36, 767-768.
- Jenny, B. F., Cramling, G. E., & Glaze, T. M. (1981). Management factors associated with calf mortality in South Carolina dairy herds. *Journal of Dairy Science*, 33, 516-518.
- Khan, A. M., Makhdoomi, D. M., & Suhani, B. (2011). Surgical management of obstructive urolithiasis in a crossbred Jersey calf. *Intas Polish Veterinary Journal*, 12, 52-53.
- National livestock development policy, (2007). Retrieved from http://old.dls.gov.bd/files/Livestock_Policy_Final.pdf
- Nesbitt, T. E. (1954). Congenital obstruction and megalourethra. Postgrad. Semin. *America Urology Association of North Centre*, 27, 117-119.

- Newman, S. J., Bailey, T. L., Jones, J. C., Grassie, W. A., & Whittier, W. D. (1999). Multiple congenital anomalies in a calf. *Journal of Veterinary Diagnostic Investigation*, 11, 368-371.
- Oehme, F. W., & Prier, J. E. (1974). Textbook of large animal surgery. Williams and Wilkins, Baltimore, U.S.A. pp. 447-448.
- Rahman, M. A., Ali, K. M., & Rahman, A. (1972). Incidence of disease of cattle in Mymensingh. Bangladesh Agricultural University, Mymensingh. *Bangladesh Veterinary Journal*, 6, 25-30.
- Rasmussen, F. (1967). Biochemical analysis of wound healing in the urinary bladder. *Surgery Gynecology Obstetrics*, 124, 553-561.
- Rousseaux, G. C., & Ribbl, C. S. (1988). Developmental Anomalies in Farm Animals II. Defining Etiology. *Canadian Veterinary Journal*, 28, 30-34.
- Samad, M. A. (1998). Veterinary clinician guide. Bangladesh Agricultural University campus, Mymensingh. Lyric-Epic prokasoni. pp. 23-45.
- Samad, M. A. (2008). Animal Husbandry and Animal Science. Volume-2. Bangladesh Agricultural University, Mymensingh, Bangladesh. *LEP publication*, 11, 17-20.
- Samad, M. A., Haque, A. K. M. F., Rahman, A., & Sen, M. M. (1977). Clinico-pathological report of an acute outbreak of monieziasis in calves. *Bangladesh Veterinary Journal*, 11, 81-84.
- Samad, M. A., Hoque, M. E. (1986). Teratology, congenital hydrocephalus, taillessness and atresia ani in calves. *Veterinary Medical Review*, 86, 01-10.
- Samad, M. A., Islam, M. A., & Hossain, M. A. (2002). Patterns of occurrence of calf diseases in district of Mymensingh in Bangladesh. *Bangladesh Veterinary Journal*, 36, 01-05.
- Slatter, D. H. (1985). Text book of small animal surgery, W.B. Saunders Com., Santiago, California, pp. 1807-1825.