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Semi-open Herniorrhaphy Reduces Postoperative Complications of Umbilical Hernia in Male Calves

Bibek Chandra Sutradhar, Sreekanta Biswas, Sabiha Zarin Tasnim Bristi, Tuli Dey, Thomby Paul, Debashish Sarker, and Mohammad Farhad Hossain

ABSTRACT

Umbilical hernia is the most common birth defect in calves, especially in the male. The aim of this study was to justify the semi-open herniorrhaphy compared with other techniques for the treatment of umbilical hernia in male calves. This research included 54 clinical cases of reducible umbilical hernia (11 indigenous, 43 crossbred calves). The ages of 54 calves ranged from less than 1 month to 6 months. Sizes of the hernial ring ranged from 2-6 cm. Out of the 54 hernias, 20 were treated with open herniorrhaphy, 16 with closed herniorrhaphy, and 18 with semi-open herniorrhaphy. Among the three correction methods of umbilical hernia in calves, the semi-open herniorrhaphy was the best with a 96.65% recovery rate without any complication, followed by the closed method (93.3%) and open method (66.67%) of herniorrhaphy. The average recovery period was also the best in semi-open herniorrhaphy (10.27 days), followed by the open method (12.44 days) and the close method (21.01 days). These findings suggest that semi-open herniorrhaphy is the best method to correct umbilical hernia in calves, especially in the male.

Keywords: Calves, semi-open herniorrhaphy, umbilical hernia.

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I. Introduction

A hernia is a bulge of skin containing material of a body cavity pass through a weak spot of the body wall. It possibly will occur by accident or a normal anatomical opening, which does not completely fulfill its function [1], [2]. An umbilical hernia is the most common form of congenital hernia in calves. However, many umbilical hernias are secondary to umbilical sepsis and hereditary due to multiple births and reduced gestation length [3], [4]. The failure of normal development and closure of the umbilicus, infection at the site of the umbilicus, manual breakage of the umbilicus, clamping or ligation of the umbilical cord, potentially excessive straining, heritable factors, inflammation and sepsis of the umbilicus, post-calving infection of umbilical infection, breakage of the umbilicus during manual traction of the fetus, external trauma to the umbilicus, excessive straining, hypoplasia of the abdominal musculature, and multiple births (twins, triplets) are considered the most common causes of umbilical hernia in calves [3]. Umbilical hernia occurred predominantly in male calves compared to their female counterparts [4], [5]. The results from the surgery of open

herniorrhaphy are complicated due to the proximity of the penis to the umbilicus in the male calves, which made it harder to maintain the post-operative bandage than in female calves [5].

Higher prevalence in males may be due to large swelling at the umbilical region for the preputial sheath. During the development of such a large preputial sheath, the ventral abdominal wall may not be properly developed and leading to forming a hernial ring before birth [6]. Navel infection in the male is also more frequent due to continuous moistening by urine. Surgical management of umbilical hernia is always a significant problem for male calves. Hernial sac ligation, use of clamps, suturing of the hernial sac, and radical operation are frequently performed methods to correct the umbilical hernia, although open herniorrhaphy is the most common method for correction of umbilical hernia [7]. However, the open method of herniorrhaphy has many disadvantages, especially bacterial infection that might cause recurrence of the hernia, and closed herniorrhaphy can minimize these post-operative complications, if there is any irreducible complicated umbilical hernia, there is no choice other than open herniorrhaphy [5]. To reduce post-operative complications in male calves due to their anatomical configuration, the authors decided to modify the incision site mentioned as a semi-open herniorrhaphy. This surgical approach is a simple and quick method with minimum complications. To the best of our knowledge, this is the newest method than open and closed methods for the correction of umbilical hernia, which reduces some common post-operative complications in male bovine calves.

This research aimed to evaluate the post-operative efficacy of open, closed, and semi-open methods of herniorrhaphy for the correction of umbilical hernia in bovine male calves.

II. Materials and Methods

A. Animals

The study was carried out on 54 clinical cases of umbilical hernia in bovine male calves from July 2016 to July 2020. The calves having umbilical hernia were randomly classified into three groups; group-A (n=20), group-B (n=16), and group-C (n=18), which were surgically managed with open (group-A), closed (group-B), and semi-open (group-C) herniorrhaphy. Out of 54 calves affected with umbilical hernia, 11 were indigenous and 43 were cross-bred. Ages ranged from less than 1 month to 6 months and body weights were from 22 to 50 kg. All detailing included the history of the cases, ring diameter, and swelling measurements recorded before surgery. The type of surgical repair, surgical complications, postoperative care, and follow-up of the patients were monitored by a direct phone call with owners or occasional visits.

B. Clinical Examination of Calves

The condition can be easily diagnosed by history, clinical signs, external digital palpation on a standing position, and by ultrasonography also. Detection of the hernial ring with the index finger was also assisted for diagnosis. The affected calves were placed in dorsal recumbency and the contents were pushed back into the abdomen. The contents went back to the abdominal cavity in case of a reducible hernia. The hernial swelling had the length from its neck to the fundus and was measured in cm with a measuring scale. The border of the swelling was taken at the level of its body and measured in cm with a measuring tape. The diameter of the hernial ring was measured after blunt dissection of the abdominal muscle during the operation. The calf was selected to perform closed herniorrhaphy if the measurement of the hernial ring was below 3 cm in diameter.

C. Surgical Management

Food was withheld for 24-hours and water for 12-hours before surgery. All calves were restrained and sedated with Diazepam (Sedil 0.5%; Square Pharmaceuticals, Bangladesh) at a 0.4 mg/kg dose rate intravenously. After proper sedation, the surgical site (umbilical area) was aseptically prepared by clipping, shaving, scrubbing, and washing with water and 70% alcohol spray. Then the calves were positioned in dorsal recumbency (group-A and group B) and lateral recumbency (group-C) with both forelegs and both hind legs tied separately. After that, the ring block anesthesia at the umbilical region was achieved by local anesthetic 2% lidocaine hydrochloride (Jasocaine; Jayson Pharmaceuticals, Bangladesh) at the dose rate of 6 mg/kg body weight.

D. Open Herniorrhaphy

After proper restraining in dorsal recumbency, an elliptical incision was made at the middle of the swelling. The skin and subcutaneous tissues were detached from the internal hernial sac using both blunt and sharp dissection. The incision was continued with a combination of direct and sharp dissection before reaching the hernial ring. If any adhesion was found in the hernial cavity, it was carefully separated and placed back in the abdominal cavity. The surgeon freshened the edges of hernial rings to facilitate the healing process and closed them by interrupted horizontal mattress sutures using polypropylene monofilament suture (Prolene 1-0, Ethicon Inc, India) materials. Then the subcutaneous tissues were continuously sutured with chromic catgut (Orichrome 1-0; India). Excess skin was removed for better apposition and sutured with a simple interrupted suture pattern using silk (Mersilk, India).

E. Closed Herniorrhaphy

The patient was positioned in dorsal recumbency, and then the hernial contents were pushed back into the abdominal cavity. After confirming that there was no adhesion of any content into the hernial sac, the hernial ring was detected and interrupted vertical mattress sutures were placed using polyamide monofilament (Nylon, India) suture materials to close the hernial ring from the outside of the skin.

F. Semi-open Herniorrhaphy

In this method, all patients were positioned in the right lateral recumbency. A line incision was made just proximal to the edge of the hernial ring (Fig. 2). The skin and subcutaneous tissue were detached through blunt dissection, and the incision was continued through the hernial sac. Then muscle layers were held together with the skin to expose the hernial ring. After examination of the hernia, gently pressed to detach if there were any adhesion. The hernial ring edges were freshened and closed by interrupted horizontal mattress sutures using a polypropylene monofilament suture (Prolene

No1 Ethicon Inc) material. The subcutaneous tissue was continuously sutured with chromic catgut (Orichrome 1-0; India). Excess skin was removed for better apposition and sutured in a simple interrupted suture pattern with No. 2 silk (Mersilk, India).

G. Postoperative Management

The skin sutures were removed within 10-12 days after the operation in open herniorrhaphy and after 2 weeks in case of closed herniorrhaphy. The animals were kept under supervision for a month to observe any complications. Each animal was treated postoperatively with parenteral antibiotic streptopenicillin (streptopen, Reneta Pharmaceuuticals Ltd.) @ 1 ml/10 kg body weight intramuscularly at 24 hours interval for 7 days, antihistaminic pheniramine maleate (Astavet, Acme laboratories, Bangladesh) @ 0.5 mg/kg body weight administered intramuscularly at 24 hours interval for 7 days and ketoprofen (Kop-vet, Square Pharmaceuticals, Ltd.) @ 3 mg/kg body weight intramuscularly at 24 hours interval for 3 days as non-steroidal anti-inflammatory was prescribed.

H. Statistical Analysis

All values of hernia operation related to age and outcomes of herniorrhaphy with or without complication and recurrence were reported as a percentage for each group. Fisher's exact test was used for comparisons between groups. Differences between groups were considered significant, whether $p<0.05$. Data analysis was performed using SPSS 11.5 software (SPSS, USA).

III. Results

Cross-bred calves were more prone to developing umbilical hernia (79.6%) than indigenous calves (20.37%). The effect of age and breed on the occurrence of umbilical hernia in calves is presented in Table I. Calves within 1-3 months (62.96%) were at higher risk of having umbilical hernia than in 1 month or 3-6 months of age. Additionally, calves having 1-3 months, the percentage of umbilical hernia was higher in crossbred calves (51.85%) than in the indigenous breed (11.11%). The highest incidence of the hernia occurred in calves of 1-3 months old while the lowest incidence was observed in calves of 3-6 months.

TABLE I: Effects of Age and Breed on the Occurrence of Umbilical Hernia in Male Calves

Age	Occurrence of umbilical hernia		
	Indigenous (11)	Cross (43)	Total (54)
< 1 month (n=12)	3 (5.55%)	9 (16.66%)	22.22%
1-3 months (n=34)	6 (11.11%)	28 (51.85%)	62.96%
3-6 months (n=8)	2 (3.70%)	6 (11.11%)	14.81%
Total (n=54)	(20.37%)	79.63%	100%
P & Level of significance		0.63 NS	

In our study, all hernia in male calves was treated by closed herniorrhaphy, open herniorrhaphy or semi-open herniorrhaphy (Fig. 1).

The physical measurements of the umbilical swelling are presented in Table II. Mean body circumferences of the umbilical swelling in group-A, group-B, and group-C were 16.91 cm, 13.99 cm, and 17.32 cm respectively.

The average swellings of the umbilicus were lowest in the G-B (14 cm), followed by the G-A (16.91 cm) and G-C (17.32 cm) groups. However, the diameters of the hernial ring were less in group-B (2.31 cm) in comparison to other groups. The diameters of the hernial ring in group-A, group-B, and group-C were 5.54 cm, 2.31 cm, and 6.12 cm respectively. All values were statistically significant ($p<0.05$).

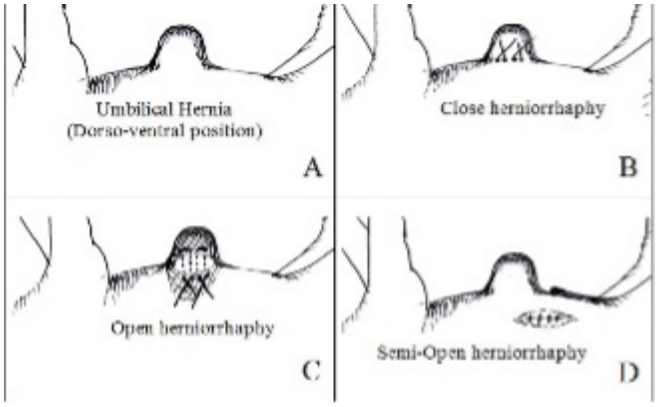

Fig. 1. (A) a schematic diagram of an umbilical hernia in a calf in dorsal recumbency, (B) vertical mattress in a closed herniorrhaphy, (C) incision given at the swollen site of hernia in case of open herniorrhaphy, (D) incision given at the proximal to the hernia ring in case of semi-open herniorrhaphy.

TABLE II: Physical Measurements of Umbilical Hernia in Calves

Group	Swelling size (cm)	Ring diameter (cm)
Group-A (n=20) Open method	16.91 ±0.61	5.54 ±0.16
Group-B (n=16) Closed method	13.99±0.33	2.31±0.18
Group-C (n=18) Semi-open method	17.32 ±0.66	6.12 ±0.06
Level of significance	P<0.05	P<0.05

Umbilical hernia was corrected by open, closed, and semi-open methods of herniorrhaphy in calves. Horizontal mattress sutures were used to close the hernial ring in open herniorrhaphy after exposing the skin. Vertical mattress sutures were used in closed methods of herniorrhaphy in calves. However, horizontal mattress sutures were used to close the hernial ring in semi-open herniorrhaphy with a side incision of umbilical swelling (Fig. 2).

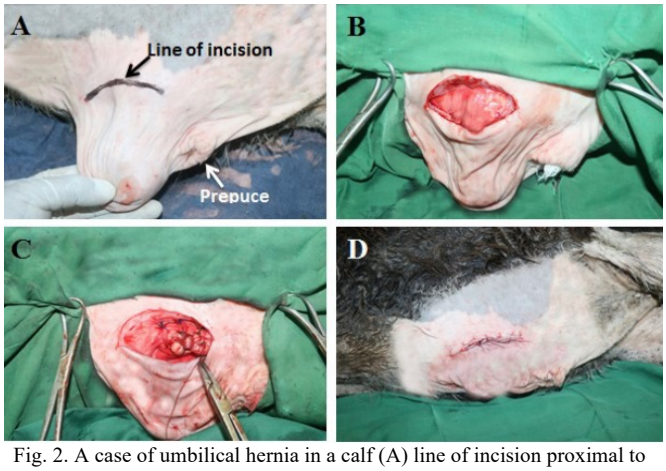

Fig. 2. A case of umbilical hernia in a calf (A) line of incision proximal to the hernia ring (semi-open method), (B) hernia sac, (C) closure of hernial ring with horizontal mattress sutures by Prolene, (D) suture after operation.

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TABLE III: COMPARISON AMONG THE OPEN, CLOSED, AND SEMI-OPEN METHODS OF HERNIORRHAPHY IN MALE CALVES

Techniques	Recovery without complication (%)	Recovery with complication (%)	Recurrence (%)	Average recovery period (day)
Open herniorrhaphy (Group-A)	66.67±0.15	26.67±0.22	6.67±0.13	12.44±0.31
Closed herniorrhaphy (Group-B)	93.33±0.07	6.67±0.22	0.00±0.01	21.01±0.33
Semi-Open herniorrhaphy (Group-C)	96.65±0.16	3.27±0.21	0.00±0.03	10.27±0.11

Out of 54 clinical cases, 20 were treated by the open method of herniorrhaphy (Group-A), 16 were treated by the closed method (group-B) and 18 were treated by the semi-open method (group-C) of herniorrhaphy. Complications were more in the open method of herniorrhaphy group compared to the other groups. The recurrence rate of hernia in group-A animals was 6.67%. Hernia recurred in one calf treated with open herniorrhaphy within 2 weeks with swelling and muscular weakness at the site of operation. In group A, complications occurred in four calves after one week with swelling, myiasis, and stitch abscess at the site of the operation.

Other complications included abscess, inflammatory swelling, seroma accumulation, and secondary bacterial infection, which were higher in group- A than in group-B and group C. Best healing rate with minimum complications was found in group-C than in group-A and group-B. In the case of semi-open method herniorrhaphy (group-C), healing was completed within 2 weeks of surgery without any recurrence (Fig. 3).

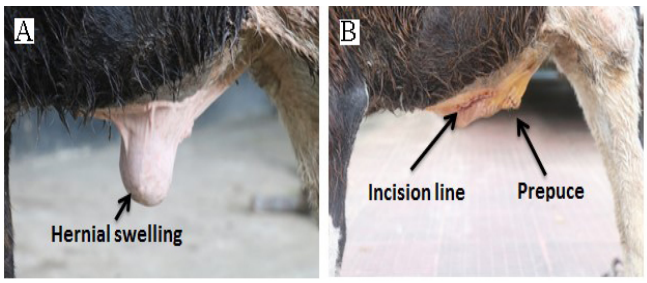

Fig. 3. A case of umbilical hernia in a calf (A) hernial swelling, (B) after surgery by semi-open method.

The healing was smoother and shorter in semi-open method herniorrhaphy (group-C) than in the other groups of surgery. Delayed healing was common in closed herniorrhaphy (group-B) compared to the other surgery groups.

IV. DISCUSSION

Umbilical hernia is the most common birth defect in calves, which can occur in any breed and is frequent in both males and females [8]-[10]. Surgical repair is often indicated to correct hernia either by closed or open methods of herniorrhaphy described in our previous study [9]. The results of an open herniorrhaphy were reported to be more complicated in the male calves because of the proximity of the penis to the umbilicus, which made it harder to maintain the postoperative bandage than in female calves. Contamination by urine may also contribute a postoperative complications [5]. Therefore, our study selected hernias only in male calves to justify a new surgical technique named semi-open herniorrhaphy compared with other techniques.

Cross-bred calves were more prone to developing umbilical hernia (79.6%) than indigenous calves (20.37%) have summarized in Table I. This is due to the hereditary in origin and occurs due to one or more pairs of autosomal recessive genes [11].

Umbilical hernias occur when the umbilical ring fails to close after birth common in Holstein-Friesians calves available in our country [8], [12], [13]. The etiology of umbilical hernias likely has a genetic component [14]-[16]. However, excess traction on an oversized fetus or cutting the umbilical cord too close to the abdominal wall are other possible causes. Many umbilical hernias are secondary to umbilical sepsis [8]. They may occur as isolated defects or may be associated with defects of other parts of the body [17]. The highest incidence of the hernia occurred in calves of 1-3 months in our study which is supported by other research [4]. Umbilical hernia occurred at an average age of 6-7 weeks after birth which is the highest at 5 weeks of age having a similarity to our study [12], [15].

The size of an umbilical hernia can differ greatly, based on the size of the opening of the umbilical ring and the number of abdominal contents that have protruded through this opening. It can be managed using different treatment options depending on the size of the hernial ring. There are various methods have been described in the literature for the treatment of umbilical hernia including counter irritation, clamping, transfixation sutures, and even safety pins and commercially-available rubber bands. The most popular technique among them is the wooden or metal clamp technique. This method may result in infection, loss of clamp or premature necrosis of the hernial sac. If the hernia is less than one to three cm in diameter, and/or if the contents of the hernia are easily reducible, it is likely that the hernia is not severe and will heal spontaneously. If the hernial ring is more than one finger in size or persists for more than 2 to 3 weeks suggest surgical intervention [3], [18]-[20].

Herniorrhaphy can be done by simply closing the abdominal wall with horizontal mattress stitches using absorbable or non-absorbable sutures [18], [21]. In the current study, the sizes of the hernial rings were more than 2 cm in each case. Both open and semi-open herniorrhaphy were carried out using horizontally interrupted mattress sutures with prolene. Treatment by semi-open herniorrhaphy appeared the most satisfactory (96.65%) regimen for the correction of umbilical hernia in calves. The complications were very low compared to the other surgical techniques. In open herniorrhaphy, direct floor contact and licking by the cows might be the causes to increase the susceptibility of infection and in closed herniorrhaphy, accumulation of seroma and chances of abomasal tearing is not uncommon already described in our previous research [9]. The healing was very much satisfactory in semi-open herniorrhaphy probably due to the lack of chance for direct contact to the surgical site. Additionally, there was no chance of seroma accumulation due to the gravitational force and less chance of

urine contamination that were common in open method of herniorrhaphy. The suture area was dry and less dirty in the group of semi-open herniorrhaphy which favors prompt better healing without any complications.

Local, regional, and spinal anesthesia are safe, effective, and often more desirable procedures for ruminants than general anesthesia. Many procedures can be performed safely and humanely in ruminants using a combination of physical restraint, mild sedation, and local, regional, or spinal anesthesia [22]. Local infiltration anesthesia with or without tranquilization was used in this study with a satisfactory result for hernia repair. Diazepam (0.4 mg/kg) was used intravenously as a tranquilizer in this study, which was economic in comparison with xylazine producing a satisfactory result. Infiltration anesthesia with 2% lidocaine was also satisfactory for umbilical region. Positioning the animal on a surgical table was found to be important to facilitate the reduction of the hernial contents and herniorrhaphy.

In this study, only nonabsorbable (prolene) suture materials were used to correct hernia. Prolene suture was used for both open and semi-open methods of herniorrhaphy, whether the nylon was used in closed herniorrhaphy considering as cheaper price and availability in the field. Early healing and less complication were found in a group of calves that were treated with semi-open method of herniorrhaphy. Therefore, the results of this study suggest that semi-open herniorrhaphy is the most suitable and satisfactory choice of surgical treatment for umbilical hernia in the bovine, especially in male calves.

V. Conclusion

In this study, we found a higher incidence of umbilical hernia encountered in cross-bred calves in contrast to indigenous calves. Better healing and less complications were found in bovine calves which were treated with the newest method named as semi-open herniorrhaphy. Therefore, the authors suggest that semi-open herniorrhaphy is the most effective, feasible, and reliable method for field veterinarians compared to the other methods.

Conflict of Interest

The authors declare that they do not have any conflict of interest.

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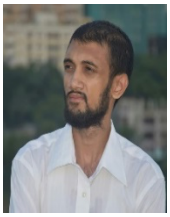

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List of articles published:

1. Akter S, Biswas S, Paul P, Hasan T. Study on prevalence, diagnosis and treatment of dermatological disorders in hospitalized dogs at Madras Veterinary College (MVC), Chennai, India. *Asian Australas. J. Biosci. Biotechnol*. 2018;3 (1): 1-6.

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List of articles published:

1. Rana EA, Chowdhury NS, Islam MS, Ara J, Nasrin SS, Dutta P, Bristi SZT, Nizami TA, Chakraborty P and Siddiki AZ. Molecular detection and prevalence of SARS-CoV-2 during the early outbreak in southern Bangladesh. *International Journal of One Health*, 2020;6(2):153-159.

2. Das BC, Bristi SZT, Biswas S, Dey T and Sutradhar BC. Successful surgical management of unilateral diaphyseal femoral and tibial fracture in a cat. *International Journal of Natural Sciences*, 2019;9(2):5-8.

3. Sutradhar BC, Biswas S, Datta A, Chowdhury J and Bristi SZT. Management of septic arthritis in a calf–a case report. *Bangladesh Journal of Veterinary and Animal Sciences*, 2019;7(2).

Dr. Bristi is a member of Bangladesh Veterinary Association (BVA) which helps work for the betterment of veterinary profession. Registered veterinary member of Bangladesh Veterinary Council (BVC).

T. Dey was born in Chattogram district of Bangladesh in 1992. She passed the secondary school certificate (SSC) in 2007 and then the higher secondary certificate (HSC) examination in 2009. She obtained her Doctor of Veterinary Medicine (DVM) degree in 2014 (held in 2015) from Chattogram veterinary and animal sciences university (CVASU), Bangladesh. She completed her MS degree (surgery) in 2018 from the department of medicine and surgery, CVASU, Bangladesh. During her undergraduate period, she received clinical training in veterinary medicine from Tamilnadu Veterinary and Animal Sciences University, India, and Tufts Cummings School of Veterinary Medicine, USA, to work as a short-term scholar.

Now she is serving as an assistant professor (surgery) at the department of medicine and surgery in CVASU, Bangladesh. Previously, she worked as a lecturer from 2016 to 2019 in the surgery unit of CVASU. She achieved Dean's award in 2015 for her academic excellence. She is a member of the Bangladesh veterinary association (BVA), which helps work for the veterinary profession.

She has published several scientific articles in national (5) and international journals (13). She is interested in working on transfusion medicine and veterinary imaging techniques.

List of the published articles

1. Das BC, Bostami MB, Dey T and Sutradhar BC. Comparative pattern of fracture in different animals. *Bangladesh Journal of Veterinary and Animal Sciences*, 2020;8(1):66-73.

2. Dey T, Poddar S, Sultana J, Akter S. Gross anatomical investigation of the posterolateral aspect of the forearm for ulnar posterolateral aspect of the forearm for ulnar nerve block in Black Bengal goat (Capra hircus). *Anatomy*, 2018;12 (3):115-117.

T. Paul was born in Cox's Bazar district of Bangladesh in 1994. He passed the secondary school certificate (SSC) in 2010 and then the higher secondary certificate (HSC) examination in 2012. He obtained a Doctor of Veterinary Medicine (DVM) degree in 2019 from Chattogram veterinary and animal sciences university (CVASU), Bangladesh. During his undergraduate period, he received clinical training in veterinary medicine from Tamilnadu Veterinary and Animal Sciences University, India. He achieved Dean's awards in 2015 and 2018 for his academic excellence. He also achieved "Best Clinical Awards" in 2018 for his practical excellence at Teaching Veterinary Hospital, Chattogram veterinary and animal sciences university (CVASU), Bangladesh.

He is a member of Bangladesh Veterinary Association (BVA) which helps work for the betterment of the veterinary profession. He is a registered veterinarian of Bangladesh Veterinary Council (BVC), Bangladesh.

D. Sarker was born on 14th October 1996 in Rajshahi, Bangladesh. He completed SSC in 2011 and HSC in 2013 from Rajshahi Education Board. He also completed his DVM degree from Chattogram veterinary and animal sciences University in 2019. Now he is enrolling in his Master's degree in surgery at the department of medicine and surgery, Chattogram veterinary and animal sciences university. During his undergraduate period, he received clinical training in veterinary medicine from Tamilnadu Veterinary and Animal Sciences University, India, and University of Putra Malaysia.

He is skilled in soft tissue and orthopedic surgery and diagnostic imaging, especially in endoscopy of small animals.

Dr. Sarker is an extraordinary performer. He is currently working as a Theater executive director of a cultural organization 'Prangon' of the residence university. His hobbies include photography, digital illustration and painting. He achieved "Clinical Awards" in 2018 for his practical excellence in Teaching Veterinary Hospital, Chattogram veterinary and animal sciences university (CVASU), Bangladesh.

M. F. Hossain DVM, MS is the owner of a Veterinary Clinic (CVRT) in Chittagong, Bangladesh. He graduated as a veterinarian from Bangladesh Agricultural University in 1985. Farhad Hossain is the immediate past director in the Directorate of Livestock, Bangladesh and is a renowned dairy practitioner in this country. He has a specialization in dairy reproduction and herd health management.