



ISSN 1810-3030 (Print) 2408-8684 (Online)

Journal of Bangladesh Agricultural UniversityJournal home page: <http://baures.bau.edu.bd/jbau>, www.banglajol.info/index.php/JBAU

Clinical and laboratory investigation on the recurrence of the umbilical hernia after herniorrhaphy in bovine calves

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ARTICLE INFO

**Abstract****Article history:**

Received: 16 July 2018

Accepted: 05 December 2018

Published: 31 December 2018

Keywords:Umbilical hernia; Herniorrhaphy;
Recurrence; Infection**Correspondence:**

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This study was performed to investigate the recurrence of the umbilical hernia in bovine calves at Veterinary Teaching Hospital (VTH), Bangladesh Agricultural University, Mymensingh. A total of 34 animals were admitted to VTH diagnosed to have the umbilical hernia, among them 13 were recurrent cases. The diagnosis of umbilical hernia was based on the disease history, clinical signs, palpation, needle exploration, and auscultation. The risk factors like age, sex, breed, body weight, the season of affection, size of the hernial ring, suture materials, error in suture patterns and involvement of infections in the recurrence were considered. Infected samples were collected from recurrent patients with infected umbilicus region, and subjected to bacteriological analysis. We found the recurrence percentage was higher in the crossbred (44%) than that in the indigenous (22.22%) calves. It was also observed that recurrence percentage was higher in male (42.11%) than those in female (33.33%) patients. The recurrence percentage was also higher in calves aged below three months (40.74%) than the calves of above three months (28.57%). It was found that recurrence percentage was most frequent in summer (46.15%) and the least in the winter (30%). Among 13 recurrent bovine calves after herniorrhaphy, three calves returned to VTH with umbilical abscess, six calves recurred due to non-infectious causes like failure of suture materials, errors in suture pattern or management fault and 4 calves recurred with both umbilical abscess and non-infectious causes. From this study, it may be concluded that synthetic absorbable suture materials with secured suture pattern and good postoperative management may help in reducing the recurrence of an umbilical hernia.

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Introduction

Congenital disorders in calves have been increasing alarmingly with the increase of crossbred animals. Umbilical hernia is one of the major congenital disorders causing mortality in calves (Nath *et al.*, 2016). Herniorrhaphy is the best acceptable treatment of this congenital anomaly. Recently, recurrence of umbilical hernia after herniorrhaphy has appeared as a common event (Rahman *et al.*, 2017). The recurrence of umbilical hernia causes irreparable loss to the farmers. Further, operational and medicinal cost is more than first time. Moreover, recur patient is ineligible for calving and draught purpose on the eye of farmers. So, the recurrent calf is either culled or sold.

Recurrent calf may be infected or non-infected (Roger and David, 2011). In case of infection, there is presence of pus on the affected site. Infection of the umbilicus or umbilical cord remnants often occurs in the neonatal period as a result of environmental contamination, but the umbilicus may also be seeded with bacteria from a generalized septicemia/bacteremia (Fubini, 2016). In case of non-infected calf, suture materials may play a vital role for recurrence because of premature absorption of the thread leading to the disruption of hernia ring.

A lot of research works regarding correction of umbilical hernia have been documented (Rahman *et al.*, 2017; Salim *et al.*, 2015; Sutradhar *et al.*, 2009) but the researches on the recurrence of umbilical hernia are rarely found in Bangladesh. Considering the above facts, the present study was undertaken to investigate the incidence of the recurrence of umbilical hernia and the etiological factors involved in the recurrence of umbilical hernia in bovine calves after surgical intervention. Besides, finding out the pathogenic organisms associated with the infection and the choice of appropriate suture materials and suture patterns for the prevention of the recurrence of umbilical hernia are also our research goals.

Materials and Methods

The animals with umbilical hernia brought to the Veterinary Teaching Hospital (VTH), Bangladesh Agricultural University (BAU) were considered as the experimental animal.

This study was undertaken during the period from December 2016 to November 2017.

Once the patient arrived at VTH, BAU, the parameters like age, sex, breed, bodyweight, season (time) of

Cite this article

Jaman M.M., Mishra P., Rahman M. and Alam M.M. 2018. Clinical and laboratory investigation on the recurrence of the umbilical hernia after herniorrhaphy in bovine calves. *Journal of Bangladesh Agricultural University*, 16(3): 464–470.

Recurrence of umbilical hernia in calves

affection, size of hernia ring and new or recurrent patient were recorded carefully.

Treatment of the new patient

In new patient, herniorrhaphy was performed with the following procedure:

After 24 hours of fasting the animal was controlled in dorsal recumbence and the operative area was prepared with routine aseptic procedure. Diazepam (Sedil[®] 2%; Square Pharmaceuticals, Bangladesh) at a dose rate of 0.4 mg/kg was administered intramuscularly to sedate the patient. Later, infiltration anaesthesia was followed using 2% lignocaine hydrochloride (Jasocaine[®], Jayson Pharmaceuticals Ltd., Dhaka, Bangladesh) in an inverted 'V' shaped manner from cranial to caudal aspect of hernial ring. An elliptical incision was made through the skin and each side of the swelling. After blunt dissection, incision was made on the sac to check for internal adhesion if any. Then the sac was incised just above the ring and contents were pushed back to the abdomen. The ring was scratched and closed by placing a series of overlapping mattress sutures through its edges. Muscles were sutured layer by layer using chromic catgut with simple continuous suture pattern. The skin flaps were apposed by simple interrupted mattress sutures using non-absorbable material.

Approach to recurrent patient

In case of recurrent animal, history was taken regarding treatment protocol, management of the patient, suture

material and suture pattern by interviewing the owner or from the register book at VTH, BAU. The site was inspected carefully whether there was any infection like abscess formation, oozing of pus from umbilicus etc. In our study, we found both infected and non-infected recurrent calves. In case of non-infected calves, the patient was only corrected through further surgical operation by myomattress suture pattern with chromic catgut or Vicryl[®]. Following surgery, advices were given to the owner for careful management. But in case of infected patient, pus was collected from the site of infection to identify pathogen involved in the infection. After a course of systemic antibiotic, hernia was repaired using routine procedure as stated above.

Culture of the sample

a) Spread plate method

In these steps, samples were subjected to 10-fold serial dilutions and a small aliquot was poured to an agar plate. The samples were then distributed evenly over the surface of Mannitol-salt agar media, MacConkey agar media and Blood agar media with a bent glass rod. Glass rod was sterilized by dipping into 70% alcohol solution and then passed it quickly through the Bunsen burner flame. When all alcohol was burned off and rod was air cooled, the plate was streaked up and down several times. Then the plates were inoculated at 37 °C for 24 hours (overnight). After incubation, the plate was examined for the growth of bacteria as colonies on the surface of culture medium (Fig. 1. A, B, C, D, E).

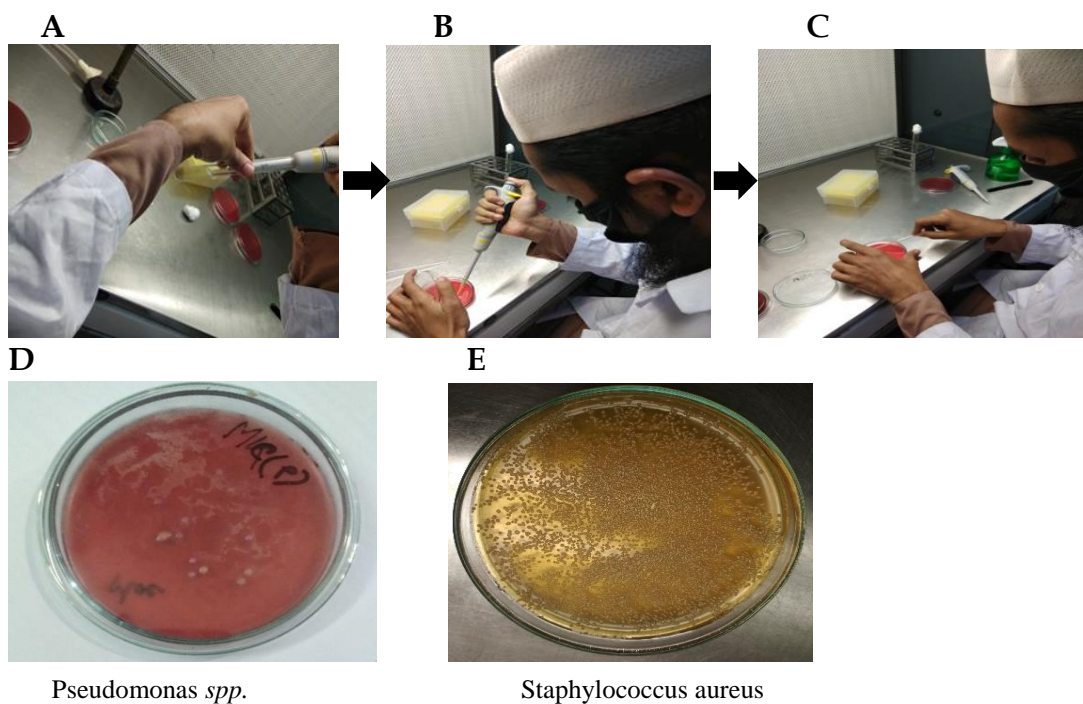


Fig. 1. Culture of the samples according to spread plate method (A, B, C) and Colony of *Pseudomonas* and *Staphylococcus* (D, E) in the Mannitol-salt agar and MacConkey agar media respectively

b) Streak plate method

It was the method of culturing aerobic bacteria by streaking the surface of a solid medium in a petri dish with an inoculating loop. This inoculating loop was sterilized by heat then cooled. Sample was taken with a sterilized loop. The sample was placed at one point on solid surface of Mannitol-salt agar media, MacConkey

agar media and Blood agar media. The samples were streaked several times on the surface. The culture media were inoculated at 37°C for 24 hours (overnight) in anaerobic condition. After incubation, the plate was examined for the growth of bacteria as colonies on the surface of culture medium (Fig. 2. A, B, C, D, E).

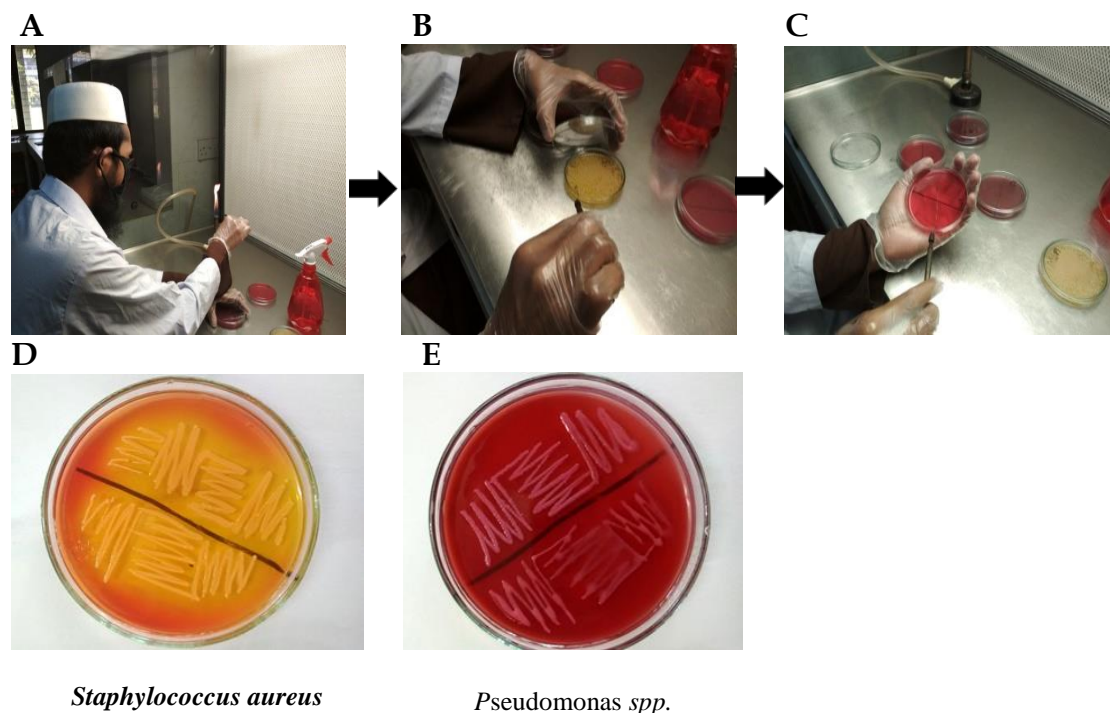


Fig. 2. Culture of the samples according to streak plate method (A, B, C) and Colony of *Staphylococcus* and *Pseudomonas* (D, E) in the Mannitol-salt agar and MacConkey agar media respectively.

Staining of the bacterial agent

Gram’s staining

Gram’s staining was performed according to the method described by (Cheesbrough, 2006). One or two drops of distilled water were taken on a dry grease free clean slide. The colony of the test bacteria was taken with an inoculating loop and mixed with the water to make smear. Smear was fixed by gentle heat. The smear was flooded with crystal violet for two minutes and then washed with water. Then Gram’s iodine was added to act as mordant for one minute and washed with water. Acetone alcohol was used to decolorize the stain and allowed for few seconds. After washing with water, safranin was added as counter stain and allowed to stain for 2 minutes. Finally, smear was washed with water, blotted and dried in air and then examined under microscope under 100X objective using immersion oil.

Analysis of data

All values of umbilical hernial occurrence and recurrence percentages of umbilical hernia after herniorrhaphy related to risk factors like age, sex, breed, body weight, the season of affection, size of the hernial ring, suture materials, error in suture patterns and infections involvement in the recurrence were reported as numeric forms and calculated as a percentage for each group.

Results and Discussion

Total recurrence percentage

A total 34 surgically corrected umbilical hernia patients were investigated during the study period (one year) where 13 patients were found with the recurrence of umbilical hernia. So, the total recurrence percentage of umbilical hernia during the study period was 38.24% (Fig. 3).

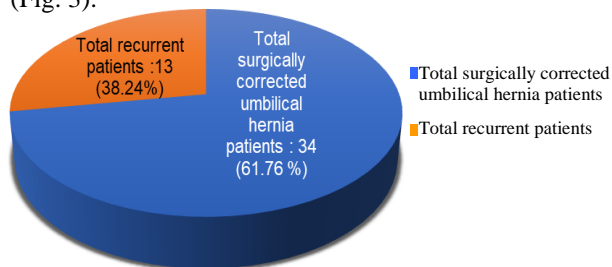


Fig. 3. Graphical representation of total recurrence rate of umbilical hernia

The umbilicus in newborn calves consists of the urachus and the remnants of the umbilical vessels that transport blood between the fetus and its mother. Normally, just after birth these structures shrink until only tiny remnants remain within the abdomen. If the area in the body wall through which these structures passed remains

open, abdominal contents can protrude through the defect resulting in an umbilical hernia (Dennis *et al.*, 1997). Many umbilical hernias are secondary to umbilical sepsis. This may occur as isolated defects or may be associated with defects of other parts of the body (Steenhold *et al.*, 2004). In the study area, the overall recurrence of umbilical hernia was as high as 38.24% (13 calves out of 34) after herniorrhaphy.

Recurrence based on breed

The hernia has been reported to be hereditary in origin (Herrmann, 2001). In this study, we found higher recurrence rate in the crossbred than that in the indigenous breed following surgery. The breed predisposition on the recurrence of umbilical hernia in calves is shown in Table 1. Among the 34 affected calves, 2 out of 9 affected indigenous calves were recurrent and 11 patients were returned to the hospital with reformation of umbilical hernia out of 25 crossbred calves. Breed difference in the recurrence of umbilical hernia was evident. The recurrence percentage was 22.22% and 44% in indigenous and crossbred calves, respectively.

Table 1. Recurrence of umbilical hernia following surgery based on breed in bovine calves

Breed	Hernia operated patients	Recurrent animals	Recurrence percentage (%)
Indigenous breed	9	2	22.22
Crossbred	25	11	44
Total	34	13	38.24

This finding is similar to the occurrence of umbilical hernia observed by Rings (1995), Steenhood and Hernandez (2004), who stated that umbilical hernias were the most common birth defects in calves especially in Holstein Frisian breeds indicating genetic in nature.

Recurrence based on sex

In our study, the recurrent rate was higher in male than in female calves (Table 2). Among 34 surgically treated calves, 9 male calves out of 19 and 3 female calves out of 15 were recurrent; the recurrence percentage in male and female were 42.11% and 33.33% respectively.

Table 2. Recurrence of umbilical hernia based on sex in bovine calves

Sex	Surgically treated hernial patients	Recurrent animals	Recurrence percentage (%)
Male	19	8	42.11
Female	15	5	33.33
Total	34	13	38.24

This finding disagrees with the finding of Mazakazu (2005), who observed that gender had effect on occurrence of umbilical hernia and female showed a higher incidence than male. In our study, higher recurrence in male may be due to the contamination of

operated site with urine during urination or become wet due to improper management. But, female may be free from this sort of danger due to anatomical location.

Recurrence based on age

Generally, umbilical hernia is mostly occurred between 1 and 3 months of age while calves below 1 month and those above 3 months are less commonly affected (Gadre *et al.*, 1989). In our study, the recurrence rate was higher in the calves aged three months and bellow three months than calves aged above three months (Table 3). Among the 34 surgically corrected hernial calves, 2 out of 7 calves (28.57%) aged above three months were recurrent and 11 out of 28 calves (40.74%) were between 1 to 3 months of age.

Table 3. Recurrence of umbilical hernia based on age in bovine calves

Age of the animal	Surgically corrected umbilical hernial patients	Recurrent animals	Recurrence percentage (%)
≤ 3months	27	11	40.74
>3-6months	7	2	28.57
Total	34	13	38.24

In this connection, Jettennavar *et al.*, (2010) conducted a study in 18 commercial dairy farms in New York, 15% of heifer calves had umbilical hernias during the first 3 months of age.

Recurrence based on season

We studied if there was any effect of season on the recurrence of umbilical hernia and found that the recurrence was higher in the summer (46.15%) than in the rainy (36.36%) and winter (30%) seasons (Table 4).

Table 4. Recurrence of umbilical hernia based on season in bovine calves

Season	Surgically corrected umbilical hernial patients	Recurrent animals	Recurrence percentage (%)
Winter (October–January)	10	3	30
Summer (February–May)	13	6	46.15
Rainy (June–September)	11	4	36.36

The recurrence of umbilical hernia has been found to occur throughout the year (Nath, 2016). In our study, recurrence of umbilical hernia was higher (46.15%) in the summer (February–May) whereas the lower incidence (30%) was recorded in the winter season (June–September). This observation was agreeable with earlier reports of occurrence of umbilical hernia (Dehoux, 1992; Samad *et al.*, 2002). This may have happened because the occurrence of surgical site infection (SSI) is greater in summer season than other seasons. According to Durkin *et al.* (2016), the rates of SSI remained higher during the summer after stratification by pathogen. Specifically, SSI due to either

Gram-positive cocci like *Staphylococcus aureus* or Gram-negative bacilli which were more common during the summer season.

Recurrence based on suture and suture patterns

Suture pattern plays an important role in the success of hernia repair. The recurrence of umbilical hernia based on suture and suture patterns in bovine calves is shown in Table 5.

Table 5. Recurrence of umbilical hernia based on suture and suture patterns in bovine calves

Suture patterns	Surgically corrected umbilical hernial patients	Recurrent animals	Recurrence percentage (%)
Myomattress suture pattern with chromic catgut	18	4	22.22
Unknown suture pattern with chromic catgut	16	9	56.25
Total	34	13	38.24

Recurrence percentage was 38.24% in both suture repair groups whereas it was higher in animal treated with unknown suture pattern with chromic catgut (56.25%) than animal treated with myomattress suture pattern with chromic catgut (22.22%). Very similar results have been reported by Venclauskas (2008), that recurrence rate was up to 19–54% with horizontal suture pattern used to repair the ring. In our study, we found that failure of umbilical suture as chromic catgut was more frequent. According to Mosbah, and Karrouf (2006), the recurrent recorded cases may be due to the decrease in the tensile strength of the synthetic absorbable suture material (chromic catgut) before complete healing of the hernial ring. Ritchie (1990) said that chromic catgut should be avoided in avian surgery because of developed a marked granulocytic inflammatory response due to catgut that diminished the strength of the suture during the period of healing and possible to recur.

We used Vicryl® in one case and obtained good result that there was no recurrence (data not shown). It may be due to excellent properties of Vicryl® as it is non-antigenic, does not swell when wet, causes minimal tissue reaction, ensures good handling and knot security (Hendrickson, 2013). In case of suture patterns, recurrence was lower in myomattress suture pattern than others. This observation is agreed with Ghalot *et al* (1995), who stated that about 8.33% umbilical hernia were recurrent after treatment with myomattress pattern using catgut, whereas 50% recurrence were found in horizontal mattress pattern. Relatively, higher incidence of recurrence in horizontal mattress pattern is due to direct pressure of bowel on suture line during healing process (Ghalot *et al*, 1995).

Relationship between hernial ring diameter and weight of bovine calves

In the study, it was found that the hernial ring's size of recurrent animals were 2 to 4.5 cm. A relationship exists between diameter of hernial ring's size and bodyweight of calves and the hernial diameter increases with the bodyweight of calves. In the Pearson's product-moment correlation test with 5% level of confidence, the p-value = 0.0001356. So, according to hypothesis, we can say that the relation between hernial ring diameters and weight of bovine calves is significant. The relationship between hernial ring diameters and weight of bovine calves is shown in Fig. 4.

In the current study, we found that the recurrent hernial ring diameters were between 2 to 4 cm and there was a relationship between hernial ring diameter and weight of bovine calves that the hernial diameter increases according to the weight of calves. The study is similar to Venclauskas (2008), that recurrence rate was higher in patients whose hernia size was >2 cm and patient's bodyweight was >30 kg comparing with hernia size of <2 cm and <30 kg bodyweight.

Bacterial invasion

We found the recurrent calves with infected state as well. There was presence of pus in operation site. Among 13 recurrent calves, 3 calves were recurrent with hernial abscess. To identify bacterial involvement, samples were collected and cultured in microbiological laboratory in the Department of Microbiology and Hygiene, BAU. Pathogenic bacteria were identified based on cultural characteristics and Gram's staining reaction and these were Gram positive *Staphylococcus aureus* and Gram negative rods like *Pseudomonas* spp. (Fig. 5).

Recurrent calf may be infected or non-infected. In our study, we found recurrence with infection (23.08%) and recurrence without infection (46.15%) and both infected and non-infected recurrence (30.77%). We used suture materials such chromic catgut (32 calves), prosthetic mesh (one calf, data not shown), only Vicryl® (one calf) and found that patient treated with Vicryl® was free from infection. This finding is similar to Hendrickson (2013), who stated that Vicryl® reduces bacterial attachment to the suture material and act as an antimicrobial impregnated suture. In case of infected recurrent calves, pathogenic agents were isolated from the lesion through microbiological culture namely *Staphylococcus aureus* and *Pseudomonas* spp. This observation was agreed with Fubini (2016) in case of umbilical infections, who stated that common bacteria isolate from umbilical infections in calves included *Staphylococcus aureus*, *Pseudomonas* spp. and *Escherichia coli* etc.

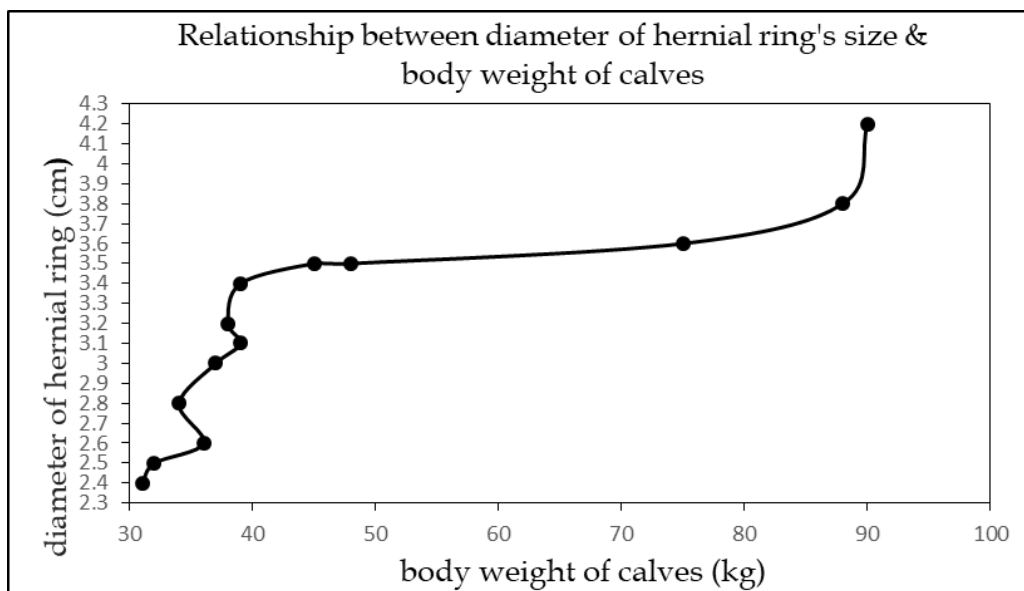


Fig. 4. Graphical representation on the relationship between diameters of hernial ring and body weight of bovine calves on the recurrence of umbilical hernia

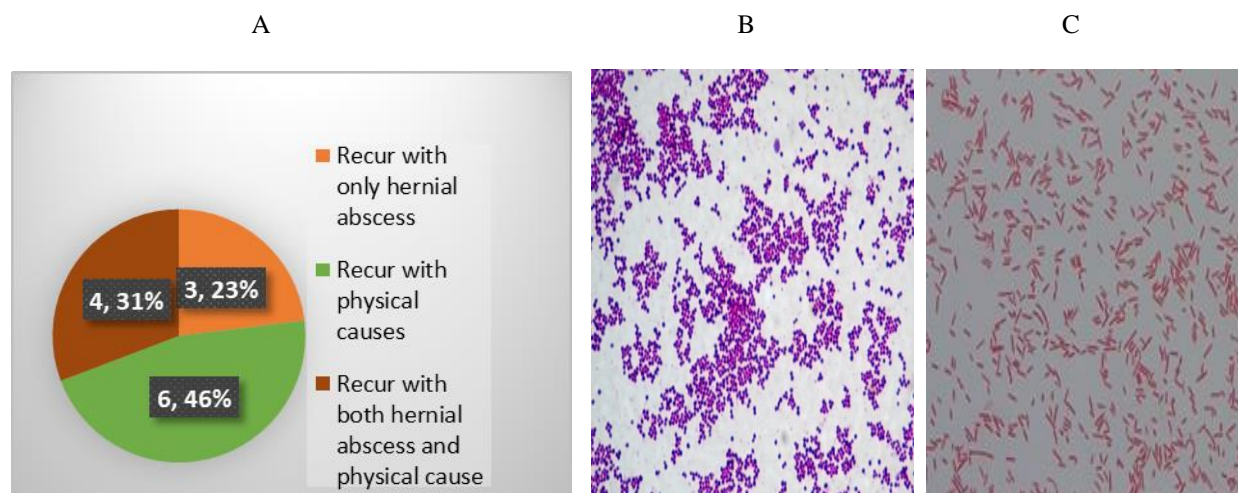


Fig. 5. Pathogenic involvement in the recurrence of umbilical hernia. (A) Percentage of recurrence associated with infection; (B, C) Result of Gram's staining reaction. (B) is showing Gram positive *Staphylococcus aureus* arranged in cluster and (C) is showing Gram negative small rod-shaped organisms arranged in single under light microscope (100X)

Conclusion

From investigation on recurrence of umbilical hernia of bovine calves after herniorrhaphy, the following conclusions can be made:

- 1) Anti-microbial impregnated and strong tensile strength suture (e.g. Vicryl®) should be used to reduce both infection and recurrence of umbilical hernia.
- 2) Good suture pattern like overlapping myomattress suture should be chosen by surgeon to overcome error of suture pattern.
- 3) Awareness should be created among the farmers about calf management after herniorrhaphy and timely reference of recurrent cases of umbilical

hernia to the respective veterinarian near the veterinary hospital for herniorrhaphy.

Acknowledgements

We thank National Science and Technology (NST) for providing financial support to conduct the research.

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