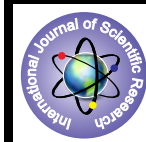


Ultrasonographic Evaluation of Intestinal Lesions in Dogs



Veterinary Science

KEYWORDS : Intestinal lesions, Ultrasonography of intestines and Target sign

Mahesh V.

Assistant Professor, Department of Surgery and Radiology, Veterinary College, KVAFSU, Shimogga-577 204

Chandrasekaran, D.

Assistant Professor, Department of Clinics, Madras Veterinary College, TANUVAS, Chennai- 600 007

Jeyaraja, K.

Associate Professor, Department of Clinics, Madras Veterinary College, TANUVAS, Chennai- 600 007

Ravisundar George

Professor, Department of Clinics, Madras Veterinary College, TANUVAS, Chennai- 600 007

Thirunavukkarasu, SP

Professor and Head, Department of Clinics, Madras Veterinary College, TANUVAS, Chennai - 600 007.

ABSTRACT

A total of 14,580 cases were presented. Of which, 654 (4.49%) dogs had Intestinal problems. out of which, eight (1.23%) dogs were presented with the complaint of intestinal obstruction. The different intestinal lesions observed in 8 cases, of which intussusception was seen in 4 (50%) cases, intestinal obstruction in 3 (37.5%) cases and intestinal stricture in one (12.5%) case. The radiography and ultrasonographic evaluation of the cases in present study suggested that radiography recorded intestinal mechanical obstruction with typical signs of bowel dilatation, abnormal luminal content and pooling of barium suggested intestinal obstruction. The intestinal lesions like intussusception and foreign bodies were not apparent on radiograph, which were diagnosed by using ultrasonography. But even then both radiography and ultrasonography were failed in definitive diagnosis of intestinal lesion. Therefore, present study was concluded that ultrasonography was a superior diagnostic imaging modality than radiography in diagnosis of intestinal lesions in dog.

INTRODUCTION

The gastrointestinal disorder is the most common cause of presentation to clinicians. The intestinal pathologies needs more concentration to detect the cause because it is poorly evaluated by clinical symptoms, physical examination and other techniques *viz.*, Radiography etc. Thus, ultrasonography helps to detect inner lesions, thus observing the location of the gastrointestinal pathological processes.

Investigations were conducted on 36 dogs of different breeds and ages, of whom 12 cases representing 33.33 per cent showed only gastric disorders, 9 subjects representing 25 per cent only intestinal disease and the remaining 15 cases, representing 41.77 per cent showed associated gastric and intestinal disorders. Ultrasound-diagnosed diseases were represented by gastritis (24 cases), pyloric hypertrophy (three patients), enteritis (22 cases) and intussusception (two cases) (Malancus *et al.*, 2010).

Ultrasound and radiological techniques are most often used for observation of gastric and intestinal segments. Advantages of ultrasonography over radiological examination regarding the observation of the gastrointestinal tract are conferred by the fact that ultrasonography is a non-invasive procedure that does not use ionizing radiation. The whole thickness of stomach or intestinal wall can be visualized and measured, as well as adjacent structures such as lymph nodes. Also can be assessed the gastric and intestinal motility observing the peristaltic movements in real time.

With this background, the present study was undertaken to evaluate the intestinal lesions with the following objectives:

- To study the incidence of various intestinal lesions in dogs
- Ultrasonographic evaluation of the intestinal lesions in dogs
- To assess the correlation and accuracy of ultrasound with radiographic findings

MATERIALS AND METHODS

The present study of ultrasonographic evaluation was performed in suspected cases of intestinal lesions in dogs irrespective of breed, age and sex that were presented to the Madras Veteri-

nary College Teaching Hospital, Chennai and Veterinary Colleges of Shimogga / Bangalore (Karnataka) India over a period of 3 months (April - June 2014). The cases were selected based on the history and clinical symptoms. Radiographic and ultrasonographic evaluations were performed to assess the correlation. The selected clinical cases of intestinal obstruction were subjected for the radiography of the lateral abdomen for the assessment of intestinal obstruction in dogs

Ultrasonography examinations were performed as suggested by Nyland *et al.* (2005) using ALOKA SSD 3500 Pro sound system obtain various imaging modes of intestines. Immediately after arrival to the hospital, the patient was taken to a calm and isolated area which aids in the recovery from the stress of transport. The ventral abdomen was prepared by clipping hair coat and liberal amount of acoustic gel was applied over the skin and the ultrasonographic measurements were carried out with the animal lying in dorso-ventral recumbency. Different transducers and frequencies (3.5 MHz, 5MHz and 7.5 MHz) were used depending on animals' weight.

RESULTS AND DISCUSSION

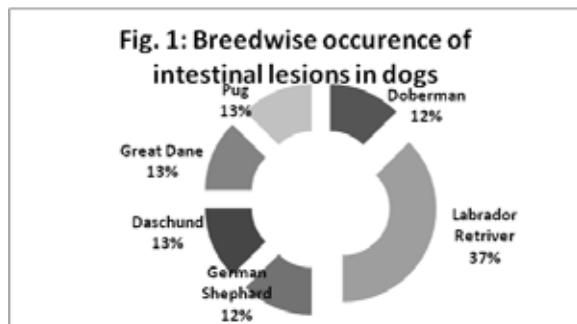
The results of the present study, a total of 14,580 cases were presented over a period of 3 months (April - June 2014). Of which, 654 (4.49%) dogs had Intestinal problems. Out of which, eight (1.23%) dogs were presented with the complaint of intestinal obstruction (Table. 1). The present study was showing 0.05 per cent of intestinal obstruction to the total number of cases but Crha *et al.* (2008) recorded small bowel obstruction of 0.48 per cent of total cases presented to their clinic.

Table 1: Anamnesis of intestinal lesions in dogs

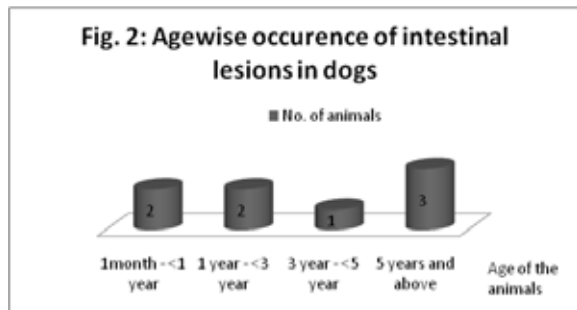
CASE NO.	BREED	AGE	SEX	BODY WEIGHT (KG)	INTESTINAL LESIONS
1	Doberman	3 months	Male	4 kgs	Intussusception
2	Labrador Retriever	8 years	Male	32 kgs	Intestinal obstruction

CASE NO.	BREED	AGE	SEX	BODY WEIGHT (KG)	INTESTINAL LESIONS
3	German Shephard	3 months	Female	5 kgs	Intussusception
4	Labrador Retriever	1year 5 months	Female	25 kgs	Intussusception
5	Labrador Retriever	3 years	Male	38 kgs	Intestinal obstruction
6	Daschund	1 year 5 months	Female	14 kgs	Intussusception
7	Great Dane	5 years	Male	42 kgs	Intestinal obstruction
8	Pug	9 ½ years	Male	12 kgs	Intestinal stricture

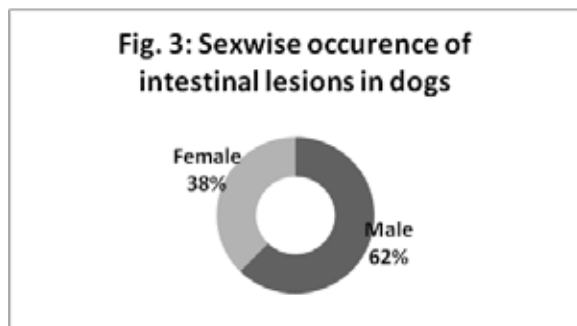
Breedwise occurrence of intestinal lesions included, three (37%) of Labrador Retriever and one each of Doberman (13%), German Shephard (13%), Daschund (13%), Great Dane (13%) and pug (13%) breeds of dogs (Fig. 1). Sharma *et al.* (2011) reported the occurrence of intestinal lesions in different breeds were Labrador Retriever (5); Boxer (3); Beagle (2); German Shepherd (2); mixed-breed (2); Weimaraner (2); Yorkshire Terrier (2); and one each of Alaskan Malamute, Cock-a-Poo, Flat-Coated Retriever, Golden Retriever, Miniature Schnauzer, Miniature Poodle, American Staffordshire Terrier, Standard Poodle, and Vizsla. In the present study more incidence of intestinal lesions were recorded in the Labrador Retriever breed of dog, it may be more population of the same breed in around the survey area.



Agewise occurrence of the intestinal lesions was also recorded. In animals of <1 year of age 2 cases, 1 - < 3 years of age two cases and 3-5 years of age one case and more than 5 years age three cases were recorded (Fig. 2). Capak *et al.* (2001) treated mechanical ileus caused by ingestion of a foreign body in different age groups from 7 weeks to 2 years (n=51) and from 2 to 12 years (n=72) out of 123 dogs. But in the present study suggestive of intestinal obstruction was more common in above 5 years of age in dogs, which might be due to more number of gastrointestinal cases enrolled during shorter duration of study period.

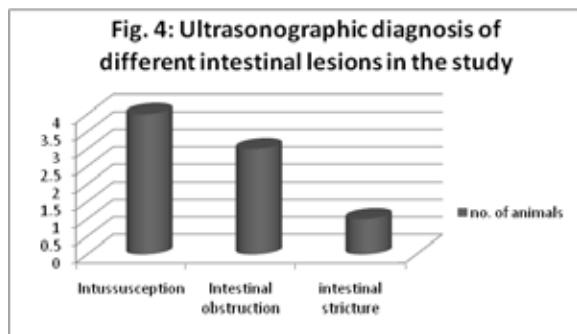


In the present study, 5 (62 %) were males and 3(38%) were females (Fig.3). Sharma *et al.* (2011) reported that 2 (7%) were intact females, 7(26%) were neutered females, 6(44%) were intact males and 12(44%) were neutered males.



The different intestinal lesions observed in 8 cases, of which intussusception was seen in 4 (50%) cases, intestinal obstruction in 3 (37.5%) cases and intestinal stricture in 1 (12.5%) case (Fig. 4). But, Koike *et al.* (1981) recorded in their review 87.23 % were caused by foreign bodies and 12.77% with intussusceptions and Zatloukal *et al.* (2004) also recorded small intestinal obstruction of 53 patients. Out of these patients, simple intraluminal obstruction by foreign bodies, linear foreign bodies, invagination, adhesions, mesenteric hernia, mesenteric volvulus and stricture was found in 40, 4, 4, 2, 1, 1 and 1 cases, respectively. But in the present study incidence of intussusception is more as compared to the above two studies which might be due to more number of such gastrointestinal cases enrolled during shorter duration of study period.

The cases were selected for the present study after thorough clinical examination and only suspected for specific intestinal lesions as reported by various authors *viz.*, Fazio (2006), Tyrrell and Beck (2006), Crha *et al.* (2008), Atray *et al.* (2012) and Lang *et al.* (2013).



Radiographic evaluation

Case 1

A Doberman pup of three months was subjected to plain radiography of lateral abdominal view, the definite diagnosis was not possible except gas filled intestinal loops but 12 hrs barium contrast radiograph (Barium sulphate meal) revealed the pooling of the barium sulphate in the small intestinal loops. Therefore, it may suggestive of intestinal obstruction. The bowel dilatation, abdominal luminal content, abnormal position and appearance of bowel are the indications of intestinal obstruction in dogs was reported by Cairo *et al.*, (1999), Fazio (2006) Riedesel (2007) and Lang *et al.* (2013). But Han *et al.*, (2008) reported that plain radiography may not conclude specific diagnosis for intussusception (Plate 1).

Case 2

The Labrador Retriever dog aged about 8 years underwent plain radiographic evaluation of lateral abdomen it failed to show the abnormality in intestinal tract and even the 12 hr barium contrast radiography of intestines did not reveal any abnormality except pooling of the barium sulphate in the distended intestinal loops cranial to the obstruction. This was in far with the observations made earlier by Cairo *et al.*, (1999), Fazio (2006)

Riedesel (2007) and Lang *et al.* (2013) (Plate 3).

Case 3

The German Shephard dog aged about three months female weighed about five kgs suspected for intestinal lesions was underwent plain radiography and it revealed all intestinal loops are abnormally distended, indicating a distal small intestinal obstruction, this was in similar observation made earlier by Lang *et al.*, (2013) (Plate 5).

Case 4

The Labrador Retriever dog aged about one year five month female weighing about 25 kgs was suspected for intestinal obstruction. The 12 hr barium contrast lateral abdomen radiograph revealed diffused distended, barium pooled small intestinal loops cranial to the obstruction suspected for intestinal lesion. This was in far with the observations made earlier by Cairo *et al.*, (1999), Fazio (2006) Riedesel (2007) and Lang *et al.*, (2013) (Plate 7).

Case 5

The Labrador Retriever Male dog, three years age weighing about 38 kgs was suspected for intestinal obstruction. The 12 hr barium contrast lateral abdomen radiograph revealed diffused distended, barium pooled small intestinal loops cranial to the obstruction suspected for intestinal lesion. The dense foreign body was visible in the caudal part of small intestine and barium was pooled cranial to this. This was in far with the observations made earlier by Fazio (2006) (Plate 9).

Case 6

The Daschund female dog, one year five months of age weighing about 14 kgs was suspected for intestinal lesion and subjected for radiography. The lateral abdomen radiograph revealed no signs of any foreign body except gas filled intestinal loops suspected for intestinal obstruction but it was not a definitive diagnosis. This was in far with the observations made earlier authors *viz.*, Cairo *et al.*, (1999), Fazio (2006) Riedesel (2007) and Lang *et al.*, (2013) (Plate 11).

Case 7

The Great Dane Male dog of five years, weighing about 42 kgs was suspected for intestinal lesion and subjected to radiography. The lateral abdomen radiograph revealed a radiodense foreign body at the dorsal gastric area and colon is gas filled appearance. The dog was showing intestinal related clinical symptoms, therefore it was suspected for intestinal obstruction it was in far with observations of various authors (Fazio, 2006; Riedesel, 2007 and Lang *et al.*, 2013) (Plate 13).

Case 8

The pug breed male dog of nine year and six months, weighing about 12 kgs was suspected for intestinal lesion and subjected to radiography. The 12 hr barium contrast lateral abdomen radiograph revealed abnormal, diffusely distended, barium pooled intestinal loops cranial to the obstruction suspected for intestinal lesion. The similar observations were recorded earlier by Fazio (2006) (Plate 15).

Ultrasonography

Immediately after arrival to the hospital, the patient was taken to a calm and isolated area which aids in the recovery from the stress of transport. Fifteen to twenty minutes were given to the patients to get familiarized to the surroundings. The preparation and Positioning on dorsal recumbency provided excellent examination of the abdominal organs without any complication. Matton (2003) reported that, the patient should be fasted overnight to reduce the interference with gastric contents and intraluminal gas. However, non-fasted dogs may show adequate image quality. The intra-luminal gas causes imaging artifacts, such as reverberation,

comet tail and acoustic shadowing.

The animal is typically placed in dorsal recumbency, although the position may depend on the patient's restlessness, discomfort, or on the operator's preferences was reported by Penninck (2008).

Ultrasonographic evaluation of intestinal lesions

In Case 1, 3, 4 and 6 were shown similar ultrasonographic patterns suggestive of intussusception. In all the cases, the sonographic pattern observed in transverse sections of the bowel was a target-like mass consisting of multiple hyperechoic and hypoechoic concentric rings around a hyperechoic centre that represents the entrapped mesentery and in longitudinal sections, multiple hyperechoic and hypoechoic parallel lines were usually visible suggestive of intussusception. Ultrasonographic patterns may vary with the length of bowel involved, the duration of the process, and the orientation of the scan plane in relation to the axis of the intussusception. Similar observations were earlier recorded by various authors *viz.*, Patsikas *et al.* (2003) Malancus *et al.* (2010) and Lang *et al.* (2013). The intussusception often occur in puppies and kittens secondary to primary intestinal disease such as enteritis from intestinal parasites, bacterial or viral infections and in older patients, the intussusceptions can occur close to pseudocysts, enlarged lymph nodes, foreign bodies or tumor mass was reported by Penninck, 2008 (Plate 2, 6, 8, 12).

The abdominal ultrasonography of case 2, revealed a hypoechoic round shaped foreign body along with acoustic shadowing suggestive of round ping ball used for children's to play. Similar observation was earlier made by Penninck (2008) (Plate 4).

The abdominal ultrasonography of case 5, revealed a triangular hyper echoic mass in the intestinal lumen without acoustic shadowing clearly suggestive of foreign body obstruction(Plate 10).

The abdominal ultrasonography of case 7, revealed an irregular shaped hyper echoic foreign body inside the intestinal lumen along with strong acoustic shadowing suggestive of stone (gravel). Cranial to this mass the intestinal loops were distended with fluid and content. This observation was in far with the observation of Penninck (2008)(Plate 14).

The abdominal ultrasonography of case 8, revealed severely distended intestinal loops in both transverse and longitudinal section along with intestinal content. Other than this no specific diagnostic clue was observed from the ultrasonographic examination but on exploratory laparotomy the case was confirmed as intestinal obstruction due to intestinal stricture at caudal jejunum. Similar description was reported by Penninck (2008) (Plate 16).

Radiography vs ultrasonography in case of intestinal lesions assessment in dogs

The radiography and ultrasonographic evaluation of the cases in present study suggested that radiography recorded intestinal mechanical obstruction with typical signs of bowel dilatation, abnormal luminal content and pooling of barium. The radiodense foreign bodies like Corn cob and stone were diagnosed from Case 5 and Case 7 respectively but soft tissue lesions and radiolucent foreign bodies were missed. The intestinal lesions like intussusception and foreign bodies not apparent on radiograph which were diagnosed by using ultrasonography in cases of Case 1, 2, 3, 6. But the both radiography and ultrasonography were failed in definitive diagnosis of intestinal lesion in case 8. Therefore, present study was suggestive of ultrasonography is superior diagnostic imaging modality than radiography in the diagnosis of intestinal lesions in dog.

Case - 1



Plate 1: Contrast Radiograph (12 hrs barium) of lateral abdomen showing distended barium filled intestinal loops



Plate 2: Ultrasonography of abdomen showing transverse section of intestine as concentric rings (Target sign) suggestive of intussusception

Case 2



Plate 3: Contrast Radiograph (12 hrs barium) of the lateral abdomen showing distended barium filled intestinal loops



Plate 4: Ultrasonography of the abdomen showing anechoic round foreign body in the intestinal loop with acoustic shadowing

Case 3



Plate 5: Radiography of lateral abdomen showing distended and gas filled intestinal loops

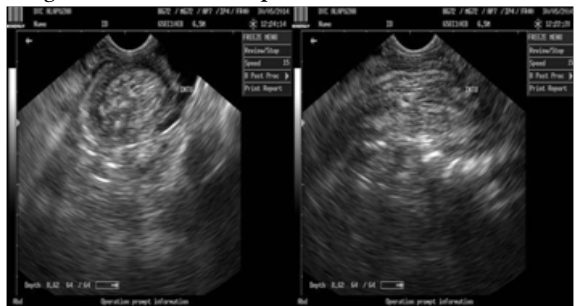


Plate 6: Ultrasonography of abdomen showing transverse section as concentric rings (Target sign) and multi layered in sagittal section of intestines suggestive of intussusception

Case 4

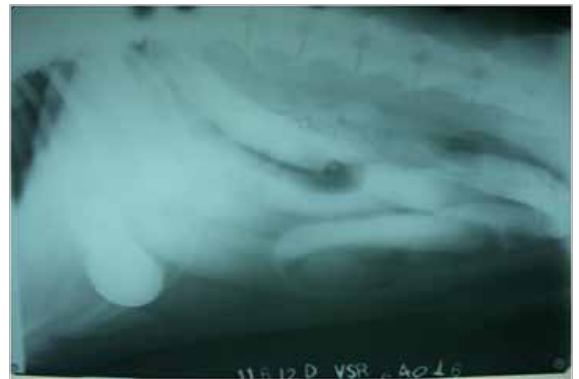


Plate 7: Contrast Radiograph (12 hrs barium) of the lateral abdomen showing distended barium filled intestinal loops

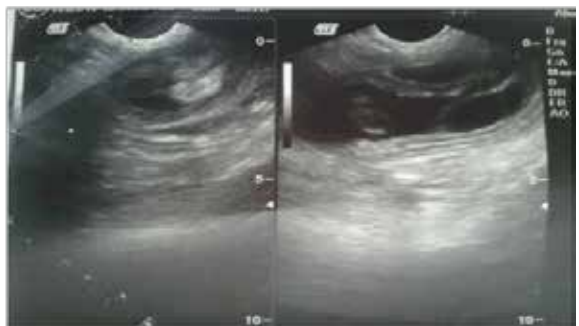


Plate 8: Ultrasonography of abdomen showing distended intestinal loop in transverse section and multi layered appearance in sagittal section suggestive of intussusception

Case 5



Plate 9: Contrast Radiograph (12 hrs barium) of the lateral abdomen showing distended barium filled intestinal loop cranial to the foreign body



Plate 10: Ultrasonography of abdomen showing mass in the intestinal lumen suggestive of intestinal obstruction



Plate 11: Radiograph of lateral abdomen showing gas filled distended intestinal loops



Plate 12: Ultrasonography of abdomen showing distended intestinal loop in transverse section and multi layered appearance in sagittal section suggestive of intussusception

Case 7



Plate 13: Radiograph of lateral abdomen showing radiodense foreign body at the cranial abdominal region



Plate 14: Ultrasonography of the abdomen showing hyper-echoic mass in the intestinal lumen with acoustic shadow suggestive of intestinal foreign body

Case 8

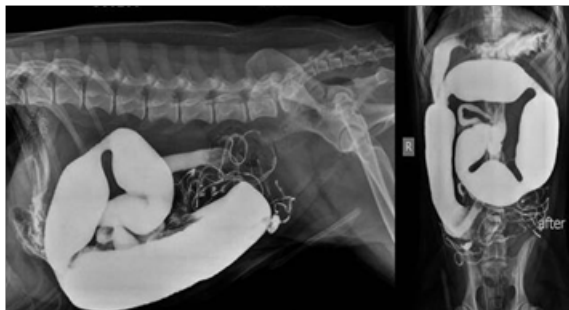


Plate 15: Contrast Radiograph (12 hrs barium) of the lateral and ventrodorsal view of abdomen showing distended barium filled intestinal loop



Plate 16: Ultrasonography of the abdomen showing distended intestinal lumen along with content in both transverse and sagittal sections of intestines

SUMMARY AND CONCLUSION

The present study of ultrasonographic evaluation was performed

in suspected cases of intestinal lesions in dogs presented to the Madras Veterinary College Teaching Hospital, Chennai and Veterinary Colleges of Shimogga / Bangalore (Karnataka) over a period of 3 months (April- June 2014). A total of 14,580 cases were presented. Of which, 654 (4.49%) dogs had Intestinal problems. Out of which, eight (1.23%) dogs were presented with the complaint of intestinal obstruction.

Breedwise occurrence of intestinal lesions included, three (37%) of Labrador Retriever and one each of Doberman (13%), German Shephard (13%), Daschund (13%), Great Dane (13%) and pug (13%) breeds of dogs.

Agewise occurrence of the intestinal lesions were <1 year of age 2 cases, 1 - < 3 years of age two cases and 3-5 years of age one case and more than 5 years age three cases. Out of which, 5 (62%) dogs were males and 3(38%) dogs were females.

The different intestinal lesions observed in 8 cases, of which intussusception was seen in 4 (50%) cases, intestinal obstruction in 3 (37.5%) cases and intestinal stricture in one (12.5%) case.

The ultrasonographic patterns seen in different intestinal lesions from the present study in transverse sections of the bowel was a target-like mass consisting of multiple hyperechoic and hypoechoic concentric rings around a hyperechoic center that represents the entrapped mesentery and in longitudinal sections, multiple hyperechoic and hypoechoic parallel lines were usually visible suggestive of intussusception in case of 1, 3, 4 and 6. In case 2, 5 and 7 the foreign bodies like ball, Corn cob and rocks were easily identified by radiography and in ultrasonography it was easy to diagnose better because of their characteristic shape and the presence of acoustic shadowing.

The radiography and ultrasonographic evaluation of the cases in present study suggested that radiography recorded intestinal mechanical obstruction with typical signs of bowel dilatation, abnormal luminal content and pooling of barium suggested intestinal obstruction. The radiodense foreign bodies like Corn cob and stone were diagnosed from Case 5 and Case 7 respectively but soft tissue lesions and radiolucent foreign bodies were missed. The intestinal lesions like intussusception and foreign bodies in the cases of Case 1, 2, 3 and 6 were not apparent on radiograph, which were diagnosed by using ultrasonography. But even then both radiography and ultrasonography were failed in definitive diagnosis of intestinal lesion in case 8. Therefore, present study was concluded that ultrasonography was a superior diagnostic imaging modality than radiography in diagnosis of intestinal lesions in dog.

List of figures

FIGURE No.	TITLE
	Breedwise occurrence of intestinal lesions in dogs
	Agewise occurrence of intestinal lesions in dogs
	Sexwise occurrence of intestinal lesions in dogs
	Ultrasonographic diagnosis of different intestinal lesions in the study

LIST OF TABLE

Table No.	TITLE
	Anamnesis of intestinal lesions in dogs

LIST OF PLATES

PLATE NO.	CASES	TITLE
1.		Contrast Radiograph (12 hrs barium) of lateral abdomen showing distended barium filled intestinal loops
2.	Case 1	Ultrasonography of abdomen showing transverse section of intestine as concentric rings (Target sign) suggestive of intussusception
3.		Contrast Radiograph (12 hrs barium) of the lateral abdomen showing distended barium filled intestinal loops
4.	Case 2	Ultrasonography of the abdomen showing anechoic round foreign body in the intestinal loop with acoustic shadowing
5.		Radiography of lateral abdomen showing distended and gas filled intestinal loops
6.	Case 3	Ultrasonography of abdomen showing transverse section as concentric rings (Target sign) and multi layered in sagittal section of intestines suggestive of intussusception
7.	Case 4	Contrast Radiograph (12 hrs barium) of the lateral abdomen showing distended barium filled intestinal loops
8.		Ultrasonography of abdomen showing distended intestinal loop in transverse section and multi layered appearance in sagittal section suggestive of intussusception
9.	Case 5	Contrast Radiograph (12 hrs barium) of the lateral abdomen showing distended barium filled intestinal loop cranial to the foreign body
10.		Ultrasonography of abdomen showing mass in the intestinal lumen suggestive of intestinal obstruction
11.		Radiograph of lateral abdomen showing gas filled distended intestinal loops
12.	Case 6	Ultrasonography of abdomen showing distended intestinal loop in transverse section and multi layered appearance in sagittal section suggestive of intussusception
13.		Radiograph of lateral abdomen showing radiodense foreign body at the cranial abdominal region
14.	Case 7	Ultrasonography of the abdomen showing hyperechoic mass in the intestinal lumen with acoustic shadow suggestive of intestinal foreign body
15.		Contrast Radiograph (12 hrs barium) of the lateral and ventrodorsal view of abdomen showing distended barium filled intestinal loop
16.	Case 8	Ultrasonography of the abdomen showing distended intestinal lumen along with content in both transverse and sagittal sections of intestines

REFERENCE

- Atray MM, Raghunath, Singh T and Saini NS (2012). Ultrasonographic diagnosis and surgical management of double intestinal intussusceptions in three dogs. *Can. Vet. J.*, 53: 860-864. | Budras KD, Mc Carthy PH, Fricke W and Richter R (2007). Textbook of Anatomy of dog, Fifth revised edition. Pp. 54-57. | Cairo J, Font J, Gorraiz J, Martin N and Pons C (1999). Intestinal volvulus in dogs: a study of four clinical cases. *J. Small. Anim. Pract.*, 40: 136-140. | Capak D, Brkic A, Harapin I, Maticic D and Radisic B (2001). Treatment of the foreign body induced occlusive ileus in dogs. *Vet. Arhiv.*, 71: 345-359. | Crha M, Lorenzova J, Urbanova L, Fichtel T and Necas A (2008). Effect of selected preoperative factors on postoperative mortality in dogs with small bowel obstruction. *Acta Vet. Brno.*, 77: 257-261. | Fazio KA (2006). Diagnosing gastrointestinal foreign bodies, *Banfield.*, Pp 24-36 | Gibbs C and Pearson H (1986). Localized tumors of the canine small intestine: a report of twenty cases. *J. Small. Anim. Pract.*, 27: 507-519. | Graham JP, Lord PF and Harrison JM (1998). Quantitative estimation of intestinal dilation as a predictor of obstruction in the dog. *J. Small. Anim. Pract.*, 39:521-524. | Han TS, Kim JH, Cho K, Park J, Kim G and Choi SH (2008). Double intussusception in a Shih tzu puppy. *J. Biomed. Res.*, 9: 55-58. | Hayes G (2009). Gastrointestinal foreign bodies in dogs and cats: a retrospective study of 208 cases. *J. Small. Anim. Pract.*, 50: 576-583 | Johansson. J (2011). The use of ultrasound to diagnose intestinal foreign bodies. *Veterinav. radiology and Ultrasound.*, 52(3): 248-255. | Khan MA, Ali MM, Azeem S, Safdar A, Ziaullah IA and Sajjad MT (2011). Ileocolic intussusception in a cocker spaniel dog: a case report. *J. Anim. Plant sci.* 21(3): 635-637. | Koike T, Otomo K, Kudo T and Sakai T (1981). Clinical cases of intestinal obstruction with foreign bodies and intussusception in dogs. *Jpn. J. Vet. Res.*, 29: 8-15. | Lang L, White J and Mattoon J (2013). Imaging of intestinal obstruction. *Clinicians brief.*, Pp 63-67. | Larson MM (2013). Ultrasound of the vomiting dog. *Western Veterinary Conference.* SA 174. | Malancus RN, Tofan C and Gh. Solcan (2010). The use of ultrasonography in diagnosis of gastrointestinal diseases in dogs. *Veterinary Medicine.*, 67(2): 143-149. | Mattoon JS (2003). Gastrointestinal Ultrasonography. In *Proceedings, Western Veterinary Conference, Las Vegas, 2003.* | Meiser G and Meissner K (1987). Ileus and intestinal obstruction—ultrasonographic findings as a guideline to therapy. *Hepatogastroenterol.*, 34: 194-199. | Oakes MG, Lewis DD, Hosgood G and Beale BS (1994). Enteroplication for the prevention of intussusception recurrence in dogs: 31 cases (1978-1992). *J. A., Med. Assoc.*, 205: 72-75. | Paoloni M, Penninck D and Moore A (2002). Ultrasonographic and clinicopathologic findings in 21 dogs with intestinal adenocarcinoma. *Veterinav. radiology and Ultrasound.*, 43(6): 562-567. | Patnaik AK, Hurlvitz AJ and Johnson GF (1977). Canine gastrointestinal neoplasms. *Vet. Pathol.*, 14:547-555. | Patsikas MN, Jakovljevic S, Moustardas N, et al., (2003). Ultrasonographic signs of intestinal intussusceptions associated with acute enteritis or gastroenteritis in 19 young dogs. *J Am Anim Hosp Assoc.*, 39: 57-66. | Penninck D (2008). Gastrointestinal tract. In: Penninck D and Anjou MA, *Atlas of Small Animal Ultrasonography.* Blackwell Publishing, Iowa. Pp. 281-318. | Riedesel EA (2007). The small-intestine. In: Thrall DE (ed): *Textbook of veterinary diagnostic radiology*, 5th ed. St. Louis, MO: Saunders-Elsevier; Pp.770-791. | Sharma A, Thampson MS, Scrivani PV, Dykes NL, Freer SR and Erb HN (2011). Comparison of radiography and ultrasonography for diagnosing small intestinal mechanical obstruction in vomiting dogs. *Vet. Radiol. Ultrasound.*, 52(3): 248-255. | Tyrrell D and Beck C (2006). Survey of the use of radiography vs. ultrasonography in the investigation of gastrointestinal foreign bodies in small animals. *Vet. Radiol. Ultrasound.*, 47: 404-408. | Zatloukal J, Crha M, Lorenzova J, Husnik R, Kohout P and Necas A (2004). The comparative advantage of plain radiography in diagnosis of obstruction of the small intestine in dogs. *Acta. Vet. Brno.*, 73: 365-374.