

## Selected studies on foreign body impaction in goats with special reference to ultrasonography

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**Received:** 15-05-2014, **Revised:** 17-06-2014, **Accepted:** 21-06-2014, **Published online:** 24-07-2014

doi: 10.14202/vetworld.2014.522-527

**How to cite this article:** Abdelaal AM and EL-Maghawry S (2014) Selected studies on foreign body impaction in goats with special reference to ultrasonography, *Veterinary World* 7(7): 522-527.

### Abstract

**Background and Aim:** Diagnosis of foreign body impaction in ruminant is still of interest in most clinical studies. The main purpose of this study was to evaluate this condition using B-mode ultrasonography in addition to evaluation of clinical, hemato-biochemical and ruminal parameters in healthy and affected goats.

**Materials and Methods:** Fifteen clinically normal goats and 15 goats with foreign body impaction were recruited in Menia El-Kamh abattoir. All animals were selected only when revealed negative for internal and external parasite. Thorough clinical, ultrasonographic examination and blood analysis were applied before slaughtering. Meanwhile, ruminal fluid and necropsy findings were assessed after slaughtering.

**Results:** The prominent clinical signs in diseased group were inappetence, dullness, emaciation, weakness, scanty hard feces and tympany. Ultrasonographic examination of diseased goats revealed the presence of foreign body at left 11<sup>th</sup>-12<sup>th</sup> ICS. Foreign body in rumen appeared as hyperechoic band with acoustic shadowing. Significant reduction in ruminal wall thickness and biphasic reticular motility along with significant increase in monophasic reticular contraction and relaxation period were recorded in diseased goats when compared with control one. The erythrocytes count, hemoglobin content, hematocrit percent and albumin were significantly decreased in diseased goats when compared with healthy one. Moreover, ruminal fluid analysis of affected goats revealed significant decrease in ruminal pH and prolonged Methylene blue reduction time.

**Conclusions:** Findings indicated that B-mode ultrasonography is a relatively simple and objective method for diagnosis of foreign body impaction in goats.

**Keywords:** foreign body, goats, haemato-biochemistry, ruminal fluid, ultrasonography.

### Introduction

Foreign body impaction has been recorded in bovine [1, 2] and ovine [3] specifically in developing countries due to lack of recycling industries wastes. Additionally, malnutrition and unbalanced dietary habits lead to a variety of nutritional deficiencies which result in pica and ingestion of materials other than normal food including wastes [4]. Most of these wastes are indigestible and their accumulation in the rumen of grazing animals may lead to adverse effect on health [5]. Ingestion of indigestible materials hinders the process of fermentation and mixing of contents leading to indigestion. They also obstruct the orifice between reticulum and omasum and if not removed through surgery, may become fatal. These foreign bodies cannot be digested or passed as such through feces by an animal. In most cases with foreign body impaction there were no or less abnormalities on hematological and biochemical examination [6].

Although, the diagnosis of foreign body impaction

in small ruminant based on palpation of abdomen [7], it was difficult to distinguish pregnancy from foreign body impaction. Therefore a further aid is required to reach a definitive diagnosis. Radiography is currently the reference standard method in diagnosis [8], but it has a disadvantage in that both the patient and staff are exposed to radiation and difficulty of its application under field condition. Ultrasonographic examination was considered also important for differential diagnosis between pregnancy and rumino-reticular foreign materials without risk of radiation.

To our knowledge there are very scarce reports in the context of using ultrasonography to attain the definite diagnosis of foreign body impaction in ovine. The results of this paper describe the ultrasonographic feature of foreign body as well as the feature of rumen and reticulum in healthy and diseased goats. Additionally, haemato-biochemical, ruminal juice and necropsy findings were reported.

### Materials and Methods

**Ethical approval:** All study procedures were approved by and in accordance with the local law and regulation of animal use and care ethical committee of Egyptian abattoir.

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**Table-1:** Vital parameter differences between healthy control and foreign body impacted goats.

Items	Control group	Affected group
Respiratory rate/ minute	16.7±1.65	15.7±1.5
Pulse rate/ minute	81.2±5.76	77.9±3.7
Rectal temperature (°C)	39.16±0.32	39.3±0.23
Ruminal motility/ 2 minutes	3.1±0.55	1.1±0.5*

\* Significant difference at  $p \leq 0.05$ .

**Study area and animals:** Fifteen clinically healthy male goats and 15 diseased male goats were selected from Menia El Kamh Abattoir between August, 2012 and August, 2013. Their ages were ranged from 1-3 years and weighted 25-35 kg body weight. Clinically, healthy goats were defined as those with no history or clinical signs of any disease. All 30 animals were selected based on negative fecal, blood and external parasitological examination.

**Clinical examination:** Clinical examination of the goats include history, careful abdominal examination with restriction to deep palpation, pulse, respiration, ruminal motility and body temperature were applied by the method adopted from Jackson and Cockcroft [7].

**Fecal analysis:** About 10 gm of pellets were taken directly from the rectum of all goats under investigation in a clean plastic bags for parasitological examination by direct smear technique and concentration, flotation technique as described by Pugh [9].

**Ultrasonographic examination:** For better ultrasonographic imaging, administration of 1.5-2 liter of water via stomach tube was applied to all animals. A real-time B-mode ultrasound apparatus and a convex 3.5 - 5.0-MHz transducer were used to scan the standing non-sedated goats. The rumen was examined on the left side from the 8<sup>th</sup> intercostal space to the flank and on the right side from the 10<sup>th</sup> ICS to the flank. The visibility of the rumen at each intercostal space was determined. The stratification of the ingesta, thickness of wall and the distance between rumen and abdominal wall were assessed on the left at the 12<sup>th</sup> intercostal space and the flank. The rumen was examined from dorsal to ventral according to the method described by [10]. Moreover, reticulum was examined at ventral abdomen behind xiphoid cartilage as well as left and right paramedian [11]. Shape, contour, thickness of reticular wall, distance between reticulum and abdominal wall, reticular motility and relaxation period were assessed.

**Blood analysis:** Blood films from ear vein and two blood samples from jugular vein were collected. Blood films used for examination of blood parasite, first sample was taken in EDTA coated tubes for leucocytes (WBCs) and erythrocytes (RBCs) count, hemoglobin content (Hb) and packed cell volume (PCV) using CBC counter, while second one was taken in tubes without anticoagulant for serum analysis. Serum protein, albumin, urea nitrogen, creatinine, AST and ALT were determined using test kits according to the method described by Baure [12]. Serum globulin was calculated by subtraction of the amount of serum

albumin from the amount of total serum protein. Serum sodium and potassium were determined by flame photometry using a Perkin-Elmer spectrophotometer equipped with a direct intensity reading flame attached [13].

**Ruminal fluid analysis:** Rumen fluid samples obtained immediately from rumen after slaughtering, then strained with gauze to remove a raw dietary residue to be suitable for analysis using the method described by Pugh [9]. Briefly, analysis of ruminal juice samples included; assessment of the physical properties of ruminal juice (color, odor and consistency), hydrogen ion concentration (pH) by pH indicator paper and Methylene blue reduction time (MBR) using methylene blue 0.03%.

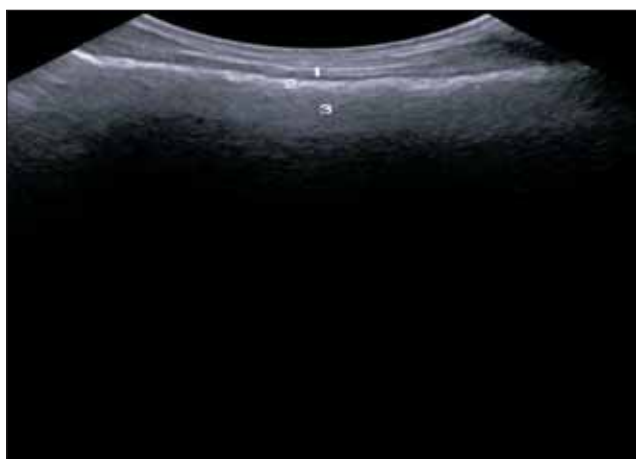
**Statistical analysis:** The statistical significance between means was compared using Student's t-test; and ( $p \leq 0.05$ ) was considered significant. All data are presented as means  $\pm$  standard deviation (SD) of the means. All tests were performed using computer package of the statistical analysis system SPSS.

## Results

**Clinical findings:** Depression, weakness, inappetence and ruminal atony was reported in all the diseased goats. Furthermore, a hard mass was detected by deep palpation of abdomen from both sides. Tympany and hard pellet mucous coated feces were recorded in 12 (80%) goats. Moreover, Pale mucous membrane and sunken eye were observed in 8 (53.3%) and 9 (60%) goats respectively. Meanwhile, vital parameters including temperature, pulse and respiratory rates weren't affected when compared with control group (Table-1).

**Ultrasonographic findings:** In healthy goats, the rumen was seen by ultrasound from 9<sup>th</sup> to 12<sup>th</sup> ICS and the flank on the left side in all goats and at 8<sup>th</sup> ICS in 8 goats. Ruminal wall appeared hyperechoic with hypoechoic content and its thickness ranged from 0.2-0.7 (0.46±0.18) cm (Figure-1). The distance between rumen and abdominal wall was 0.02-0.05 (0.03±0.01) cm.

The reticulum appeared as a crescent shaped structure and located immediately behind diaphragm (Figure-2) and had biphasic and monophasic contractions. In a biphasic contraction, an incomplete primary contraction followed by complete contraction while in a monophasic one characterized by one incomplete contraction followed by complete relaxation. Number of biphasic, monophasic and total



**Figure-1:** Ultrasonography of healthy goat's rumen imaged at left 12<sup>th</sup> ICS shows abdominal wall (1) hyperechoic ruminal wall (2) and hypoechoic ruminal content (3).



**Figure-2:** Ultrasonography of healthy goat's reticulum imaged at point just behind xiphoid cartilage shows abdominal wall (1), crescent shaped reticulum (2) cranial sac of rumen (3).

**Table-2:** Ultrasonographic differences between healthy control and foreign body impacted goats.

Items	Control group	Affected group
Ruminal wall thickness/ cm	0.46±0.18	0.22±0.9*
Distance between rumen and abdominal wall/ cm	0.03±0.01	0.01±0.01*
Reticular wall thickness/ cm	0.5±0.09	0.46±0.0.8
Distance between reticulum and abdominal wall/ cm	0.04±0.01	0.03±0.02
Number of biphasic contractions/ 5 minutes	4.2±0.65	0.73±.6*
Number of monophasic contractions/ 5 minutes	0.86±.6	1.8±1.28*
Number of total contractions/ 5 minutes	5.06±0.67	2.5±1.6*
Number of contractions/ minute	1.01±0.13	0.5±0.3*
A biphasic contraction period/ seconds	6.44±0.8	6.02±0.6
A monophasic contraction period/ seconds	3.8±1.0	3.15±1.45
Relaxation period between 2 contraction/ seconds	49.07±2.6	57.46±1.6*

\* Significant difference at  $p \leq 0.05$ .

**Table-3:** Hematological and biochemical differences between healthy control and foreign body impacted goats.

Items	Control group	Affected group
RBCs $10^{12}/L$	7.5±0.38	6.9±0.41*
Hb g/dl	8.93±1.3	7.70±0.87*
Hematocrit %	33.0±0.6	27.83±0.5*
WBCs $\times 10^9/L$	12.6±4.1	13.8±1.2
Total Protein mg/dl	65.3±1.5	63.6±4.0
Albumin mg/dl	30.3±6.6	24.0±2.5*
Globulin mg/dl	35.0±5.2	39.6±6.5
AST U/L	87.66±2.7	89.3±2.0
ALT U/L	21.9±6.0	22.54±2.8
BUN mmol/L	3.24±0.12	3.3±0.06
Creatinine $\mu\text{mol}/L$	74.0±2.0	76.0±3.0
Sodium mmol/L	154.6±6.1	152.1±11.9
Potassium mmol/L	5.26±0.49	5.47±0.62

\* Significant difference at  $p \leq 0.05$ .

contractions/5 minutes was 3-5 ( $4.2 \pm 0.65$ ), 0-2 ( $0.86 \pm .6$ ) and 4-6 ( $5.06 \pm 0.67$ ), respectively. It means that reticulum contracted  $1.01 \pm 0.13$  every minutes. The duration of an individual biphasic contraction was  $6.44 \pm 0.8$  seconds, while a monophasic contraction period was  $3.8 \pm 1.0$  seconds. Moreover, relaxation period between two successive contractions was  $49.07 \pm 2.6$  seconds. The thickness of reticular wall and the distance between reticulum and abdominal wall were  $0.4-0.7$  cm ( $0.5 \pm 0.09$ ),  $0.03-0.06$  cm ( $0.04 \pm 0.01$ ), respectively.

Sonographic examination of rumen in diseased group revealed appearance of the foreign body as hyperechoic band with acoustic shadowing at 11<sup>th</sup> and 12<sup>th</sup> ICS from left side (Figure-3). Significant decrease

in ruminal wall thickness at area of foreign body and biphasic reticular motility along with significant increase in monophasic reticular contraction and relaxation period were reported in diseased goats when compared with healthy one (Table-2).

**Blood analysis:** As shown in Table- 3, only significant decrease in erythrocytes count, hemoglobin content, hematocrit percent and serum albumin were reported in diseased group when compared with control one. Other biochemical parameters showed no significant changes.

**Ruminal fluid analysis:** The ruminal fluid of healthy group appeared with brownish to deep green color, aromatic odor and had slightly viscous consistency. All



**Figure-3:** Ultrasonography of diseased goat's rumen imaged at left 12 ICS. Noticed that it was difficult to distinguish abdominal and ruminal wall. 1: ruminal wall, 2: ruminal content, 3: foreign body, 4: acoustic shadowing.



**Figure-5:** Necropsy finding of affected rumen shows stunted and sloughed ruminal papillae.

these parameters were nearly similar in diseased group. Moreover, the results revealed significant reduction in ruminal pH in diseased group ( $5.08 \pm 0.09$ ) when compared with healthy one ( $6.50 \pm 0.50$ ) and significant prolongation in methylene blue reduction time in diseased group ( $25.00 \pm 3.82$  minutes) when compared with healthy group ( $4.00 \pm 1.00$  minutes).

**Necropsy findings:** Accumulation of plastic bags and other undigested materials weighing about 1.5- 4.5 kg, partially occluding the rumen (Figure- 4) was observed and mixed with ruminal ingesta. Stunted and sloughed ruminal papillae were also observed (Figure-5).

### Discussion

The ingestion of materials other than normal feed gets lodged in the rumen and compromising the ruminal space and interfering with the normal physiological functions of the rumen. The current study was conducted only in Menia El- Kamh abattoir. In Egypt the abattoir laws prohibit slaughtering female animals and thereby, it wasn't suitable for a prevalence study.

**Clinical findings:** In the present study, all the diseased goats manifested by depression, weakness, inappetence and ruminal atony. This result is in agreement to Vanitha *et al.* [1] in cattle. These manifestations might be due to the interference of foreign body with the process of fermentation and absorption of volatile fatty



**Figure-4:** Different undigested foreign bodies found in rumen of diseased goat after slaughtering. A: Plastic bags with cloths, B: Plastic bags, C: Plastic bags and phytobezoar, D: plastic bags and robes.

acids leading to poor body condition [14]. Additionally, decreased appetite may have been due to the physical presence of the foreign body mass and stretch of the cranial sac of the rumen which could stimulate ventro-medial hypothalamus and satiety center leading to loss of appetite [4]. A hard mass was detected by deep palpation of abdomen from both sides. This result is in concurrence by Raofi *et al.* [6]. Tympany and hard pellet mucous coated feces were recorded in 12 (80%) goats. Accumulation of the indigestible materials in rumen leads to distension of the rumen and passing of scanty or no feces [15, 16]. Additionally, Meyer *et al.* and Kumar and Dhar [17, 18] stated that most of impacted materials in the rumen do not cause clinical impaction except where the rumino-reticular orifices were partially or completely blocked. Moreover, pale mucous membrane and sunken eye were observed in 8 (53.3%) and 9 (60%), respectively. The ingestion of foreign body is mainly related with nutritional deficiencies and affected animals manifested by nutritional anemia [14]. Similar to Mozaffari *et al.* [19], it seems that the presence of the impaction in the rumen of the goats did not affect on vital parameters including temperature, pulse, respiratory rate and heart rates significantly.

**Ultrasonographic findings:** In the present study, the rumen was visualized by ultrasound from the 9<sup>th</sup> to 12<sup>th</sup>

intercostal space as well as at the flank region of left side in all healthy goats. This finding was similar to that reported by Braun *et al.* [10]. Moreover, the ruminal content appeared hypoechoic and the wall appeared hyperechoic. Unlike Braun *et al.* [10] findings, it was difficult to distinguish between different layers of ruminal content. The reticulum appeared as a crescent shape and located immediately behind the diaphragm. This finding is in agreement with Braun and Jacquat [11]. Biphasic contractions, have also been observed in cattle [20, 21] while monophasic one was observed only in goats [11] and never seen in other species.

In the current study, the total number of reticular contractions was with a mean of  $5.06 \pm 0.67$  contractions/5min or  $1.01 \pm 0.13$  contractions/min. These results are nearly similar to that reported previously by Kaske *et al.* [20] in cattle, goats and sheep. Every biphasic contraction lasted with a mean of  $6.44 \pm 0.8$  seconds in our study, which was nearly similar to that reported in goats [11] and in cattle [22]. The average monophasic reticular contraction was shorter than a biphasic contraction and the frequency of mono-phasic contractions was lesser than that of biphasic contractions. This result was similar to that reported in goats [11]. The thickness of reticular wall  $0.4\text{-}0.7$  cm ( $0.5 \pm 0.09$ ) and the distance between reticulum and abdominal wall  $0.03\text{-}0.06$  cm ( $0.04 \pm 0.01$ ) were in agreement with Braun and Jacquat [11].

In the present study, the foreign body appeared as hyperechoic band with acoustic shadowing imaged at 11<sup>th</sup> and 12<sup>th</sup> ICS from left side. Acoustic shadowing results from reflection of the ultrasound pulse upon striking the foreign materials [23]. The most important findings in this study was the significant decrease in ruminal wall thickness at area of foreign body and biphasic reticular motility along with significant increase in monophasic reticular contractions and relaxation period when compared with healthy one. To the authors' knowledge, this result was never evaluated before. The reduction in ruminal thickness and distance between rumen and abdominal wall could be due to presence of heavy foreign bodies which compress and stretch the ruminal wall pushing it toward the abdominal wall. Moreover, due to location foreign bodies in rumen results in retardation in reticulo-ruminal contraction and prolongation in relaxation period.

**Blood analysis:** In the present study the diseased goats showed significant reduction in RBCs count, HB content, PCV and albumin when compared with control group. These results are in concurrence with those obtained by [24] in goats and [17] in cattle. This observation may be due to inadequate dietary intake or reduced absorption as a result of presence of foreign materials in the rumen.

**Ruminal fluid analysis:** Physical examination of ruminal juice including color, odor and consistency showed no changes between control and diseased goats. Meanwhile, the methylene blue reduction time

was significantly increased when compared with control group. This prolongation indicates poor anaerobic fermentation in the rumen [9]. In this study, ruminal fluid analysis of goats revealed a significant decrease in the pH. Presence of foreign body inside the rumen gives a picture of sub-acute ruminal acidosis leading to reduction of pH [25].

**Necropsy findings:** Plastic bags and other undigested materials were observed, which was mixed with ruminal ingesta. The physical effect of large sized foreign bodies leads to stunted and sloughed ruminal papillae. This result is in accordance to Kumar and Dhar [18] in a captive Sambar (*Rusa unicolor*).

## Conclusion

Foreign body impaction in the rumen lead to some clinical signs, but vital signs and biochemical parameters were unchanged. Findings indicated that B-mode ultrasonography is a relatively simple and objective method for diagnosis of foreign body impaction in goats. This research is a preliminary study; a further investigation is recommended specially in uses of ultrasonography in goats with foreign bodies' impaction and has no clinical signs. This method could serve as an alert and allow implementing preventive measures and avoiding the worsening of the general condition of the animal and early cull.

## Authors' contributions

AMA made available relevant literatures and conducted examinations. ES supervised the research. Both authors participated in draft and revision of the manuscript. Both authors read and approved the final manuscript.

## Acknowledgments

Special thanks to Menia El Kamh abattoir staff members for the help provided during this research. This study was funded by authors and no outside fund was received.

## Competing interests

The authors declare that they have no competing interests.

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