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Research Article

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Gross and ultrasonographic morphometry of female reproductive tract in small ruminants

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Abstract

Understanding the anatomy of female reproductive organs is very much important to identify any variation in disease condition. Therefore, this study was conducted to determine the gross and ultrasonographic morphometry of female reproductive tract in small ruminants. The reproductive tracts of 21 does and 20 ewes were collected from slaughter house and both gross and ultrasonographic image measurements were performed to study morphometry of cervix, body of uterus, horn of uterus and ovary. Water bath ultrasonography technique was used with trans-abdominal linear probe for image measurement. Results revealed significant ($P<0.001$) variation between gross and image measurements of cervix, body of uterus and ovaries in does. In ewes, the significant ($P<0.001$) variation was observed between gross and image measurements in diameter of ovaries. Gross measurements were proportionately higher than image measurements in both species. The mean length, width and diameters of right ovaries were found higher than those of left ovaries. Pearson's correlation revealed a positive relation between two measurements. Moreover, it was found that echogenicity varied with reproductive organs. This is a model study, which may help to identify female reproductive structures in small ruminants when trans-abdominal probe is used.

Keywords: Ultrasonography, Morphometry, Female reproductive tracts, small ruminants

INTRODUCTION

Ultrasonography has become an important diagnostic tool for evaluating the female reproductive system in the bovine practice, where it is possible to view the entire reproductive system in a non-invasive manner (Carriere *et al.*, 2002). Interest in ultrasonography among veterinarians and animal scientists began to grow in the early eighties, following reports on the usefulness of the technique in studying the reproductive organs of the cow (Chaffaux *et al.*, 1982; Reeves *et al.*, 1984; Pierson *et al.*, 1988). Ultrasonography can be used efficiently for diagnosing reproductive disorders and the response to treatment thereafter (Kumar und Purohit, 2009). The non-invasive nature of ultrasonography makes it an excellent clinical and research tool in the bovine reproduction (Carriere *et al.*, 2002; Kumar und Purohit, 2009) and this technology was demonstrated to be an effective method of choice to evaluate reproductive cycle in the zebu cows (Akter *et al.*, 2010). Ovarian cyclicity as well as evaluation of ovarian follicles and corpus luteum, changes in uterus and cervix was examined in Bangladeshi zebu cows by this technique with the purpose to improve reproductive efficiency (Akter *et al.*, 2010). Post-partum anoestrus cows and buffaloes were diagnosed and treated effectively where ultrasonography was used as diagnostic tool (Rahman, 2010; Shohag, 2011). In spite of its immense use in supplementing diagnosis during physiological states, its use in delineating different anatomical and pathological conditions of small ruminants genital tract is hardly described, which is necessary to justify for implementation of modern reproductive technology. In Bangladesh, very few efforts were undertaken to conduct gross and image morphometric study of reproductive organs in small ruminants using ultrasonography. Therefore, this study was performed, to study the morphometry (slice measurement with gross and ultrasonography machine) of different parts (cervix, body of uterus, horn of uterus, uterine tube and ovary) of reproductive system of does and ewes collected from local slaughter house. The size proportions between two measurements were also studied.

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MATERIALS AND METHODS

Procedure for collection of specimen

Reproductive organs of does (n=21) and ewes (n=20) were collected from Municipal slaughter house at Mymensingh Sadar upazila from November, 2013 to May, 2014. After slaughtering, the female reproductive tract was separated from the pelvic viscera by dissection. After sawing through the pelvic symphysis, the broad ligaments, the lose connective tissue and fat surrounding the vulva and the retroperitoneal part of the vagina were removed as far as possible for a better examination. The flexures of the fallopian tubes were straightened out by freeing them from the masosalpinx. After processing, samples were taken to the laboratory of Department of Surgery and Obstetrics, BAU for detail study. Only normal (lesions free) and non-gravid specimens were included in this study.

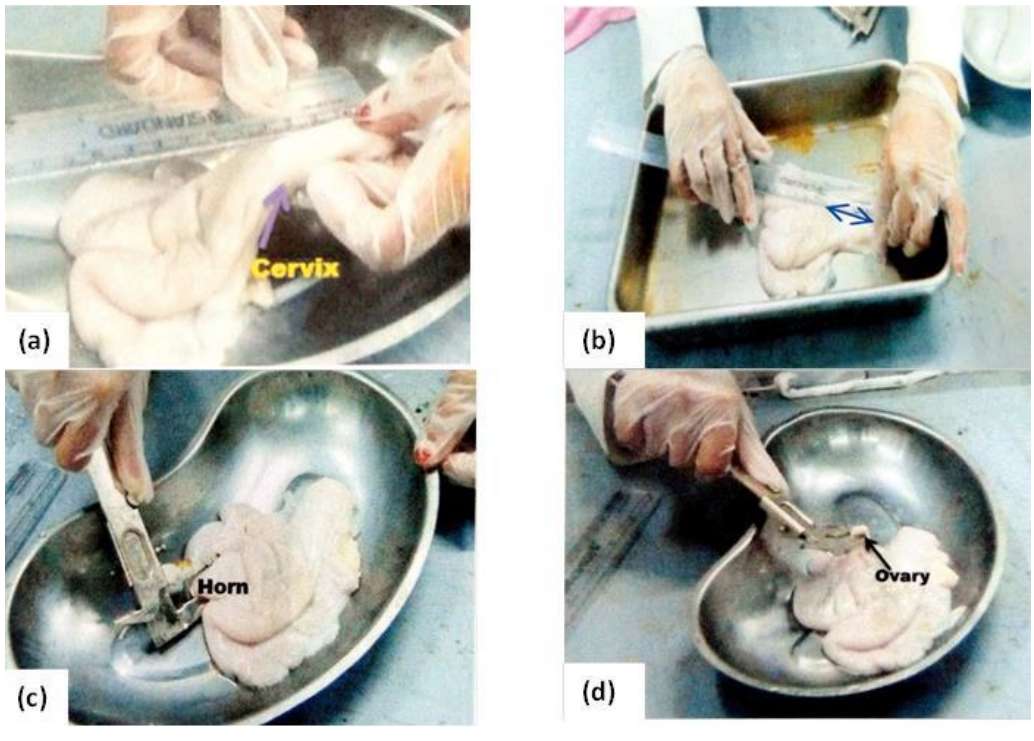

Figure 1: Gross measurements of (a) cervix, (b) body of uterus, (c) horn of uterus and (d) ovary

Methods of gross image measurement of reproductive organs

The measurements of various parts of the reproductive tract were performed according to the techniques described by McEntee (1983). For gross sample, the length and width of the ovaries were measured and converted to diameter.

Cervix

Cervix was checked to record the length and width. The length was measured from the os-externum to the os-internum and the width at the external diameter at the mid-cervix using a measuring ruler (Figure 1a).

Body of Uterus

The length of the uterine body was taken as the distance between the internal cervical os and the bifurcation of two horns using a measuring ruler. Width was measured at the middle of uterine body (Figure 1b).

Horn of Uterus

The width of both right and left uterine horns was measured with a slide caliper just after the bifurcation of two horns (Figure 1c).

Ovaries

Diameter of the ovaries was considered. The length was measured from the anterior to the posterior extremity with the help of a slide caliper. The greatest diameter between the lateral and medial surface was measured as width (Figure 1d).

Methods of ultrasonographic image measurement of reproductive organs

B-mode digital Ultrasound system (Vet Eickemeyer Magic 5000, Germany) with transrectal probe 5 MHz, Probe type: C20615S) was used for ultrasonographic scanning. For ultrasonography image, water bath method was followed and image was measured by machine setup. In ultrasonographic

image, cervix was visible as hyper echoic structure in both species (Figure 1a). Echogenic structure similar to grey was observed for both body and horns of uterus (Figure 1b & c). Hypoechogenic ovarian round structure was selected and measured for diameter in ultrsonographic image. Cervix was visible as hyperechoic structure, echogenic structure similar to grey was observed for both body and horns of uterus; ovary was visible as hypo echogenic structure in both species (Figure 1d). Generally, the ultrasonic findings of the non-gravid uterus were the same for ewes and does.

Statistical analysis

Data was presented as mean±SEM. 'T' test was performed to observe significant differences between gross and image measurement. Pearson's correlation test was also performed. All analyses were performed using Statistical Package for Social Science software version 20. $P<0.05$ was considered as significant.

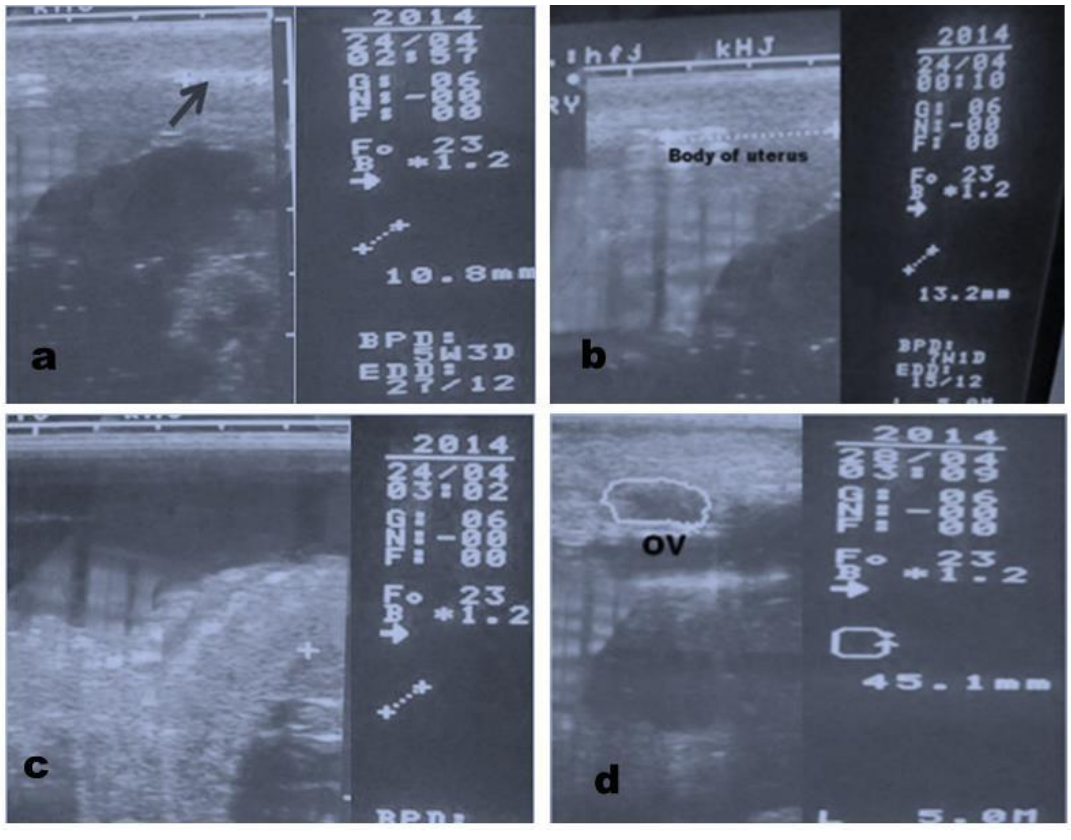

Figure 2: Ultrasonographic image of (a) cervix-black arrow; (b) body of uterus (BU); (c) horn of uterus; (d) ovary (OV)

RESULTS

The study was conducted to observe both gross and image morphometry of some parts of reproductive organs of does and ewes. Gross morphometry was used as baseline parameter to study the efficacy of ultrasonography of female reproductive tract in small ruminants using linear trans-abdominal probe. The organs only visible in ultrasonography such as cervix, body of uterus, horn of uterus and ovary were taken into consideration for this study and measurements are demonstrated in Table 1 and Table 2.

Morphometry of female reproductive tract in small ruminants

Cervix

In gross examination the cervix appeared comparatively firm in relation to the body of uterus in the does and ewes. The mean gross length of the cervix was 1.9±0.2 cm and image length was 0.8±0.1 cm in does and significant ($P\leq0.05$) variation was found between two measurements in goat (Table 1). Whereas, no significant variation was there between gross (1.1±0.2 cm) and image (0.9±0.1 cm) measurements in ewes (Table 2).

Table 1: Morphometric parameters of some parts of reproductive organs in does

Organs	**Parameters**	**Mean±SE (cm)**		
		Gross	US	P-value
Cervix	Length	1.9 ± 0.2	0.8 ± 0.1	0.04
Body of uterus	Length	1.9 ± 0.1	2.7 ± 0.1	0.00
	Wide	1.0 ± 0.1	0.8 ± 0.03	0.00
Horn of uterus				
Right	Wide	1.1 ± 0.1	1.1 ± 0.1	0.6
Left	Wide	1.1 ± 0.1	1.1 ± 0.1	0.6
Ovary				
Right	Diameter	4.0 ± 0.1	3.3 ± 0.2	0.00
Left	Diameter	4.7 ± 0.2	3.3 ± 0.2	0.00

Uterus

The uterus was bicornuate and the horns were joined posteriorly forming a short body of uterus. The mean length of the uterus was 1.9±0.1 cm and 2.7±0.1 cm in gross and image measurements respectively in does and the difference between two measurements was strongly significant ($p \leq 0.001$) (Table 1). Similarly, significant ($P < 0.001$) variation was observed in the width of body of uterus in both gross (1.0±0.1 cm) and image (0.8±0.03 cm) in this species. In contrast, there was no significant ($P > 0.05$) variation between gross (2.5±0.3 and 1.4±0.1 cm) and image (3.0±0.1 and 0.8±0.03 cm) measurements of length and width of body of uterus respectively in ewes. Only the width of both right and left horns was measured. Because, the length of horn could not be visible in ultrsonographic image. No significant variation was observed between gross and image measurements of width of both horns (Table 1 and Table 2).

Ovary

The ovary of the does appeared ovoid or spherical in shape. It was found that significant ($P < 0.001$) variation existed between gross and image diameter and gross diameter was higher in comparison to image diameter in does and ewes (Table 1 and Table 2).

Table 2: Morphometric parameters of some parts of reproductive organs in ewes

Organs	**Parameters**	**Mean±SE (cm)**		
		Gross	US	P-value
Cervix	Length	1.1 ± 0.2	0.9 ± 0.1	0.08
Body of uterus	Length	2.5 ± 0.3	3.0 ± 0.1	0.06
	Width	1.4 ± 0.1	0.8 ± 0.03	0.08
Horn of uterus				
Right	Width	1.3 ± 0.1	1.1 ± 0.1	0.06
Left	Width	1.4 ± 0.1	1.1 ± 0.1	0.08
Ovary				
Right	Diameter	3.9 ± 0.1	2.9 ± 0.1	0.00
Left	Diameter	4.5 ± 0.2	2.9 ± 0.1	0.00

Table 3: Correlation between gross and ultrasonographic morphometric values recorded in does and ewes

Reproductive Organs	Parameters	DOES			EWES		
		Proportion#	R-value	P-value	Proportion#	R-value	P-value
Cervix	Length	2.4	0.784	0.05	1.2	0.293	0.210
Body of uterus	Length	0.7	0.306	0.177	0.83	0.079	0.742
	Width	1.3	0.572	0.007	1.6	0.175	0.459
Horn of uterus							
Right	Width	1	0.761	0.03	1.2	0.081	0.734
Left	Width	1	0.557	0.009	1.3	0.104	0.662
Ovary							
Right	Diameter	1.2	0.049	0.834	1.3	0.365	0.114
Left	Diameter	1.4	0.404	0.07	1.46	0.426	0.061

for proportion, image value was condiered as 1

Correlation among the measurements

Relation and proportion were analyzed among gross and image measurements to understand the resolution of image using trans-abdominal probe of 5.5-6.5 Hz and results are shown in Table 3. Ultrasonographic image measurements were comparatively lower in comparison to gross measurements. Strong positive correlation between two morphometric measurements of different parts of uterus was observed in case of does, no significant positive correlation was observed among parameters in ewes (Table 3).

DISCUSSION

Regular and successful reproduction is the key to profitable animal production. High reproductive efficiency is very much important for achieving the maximum return from animals. Small ruminants, sheep and goat are highly proliferative in nature. But the production is hampered due to various reproductive disorders. Any structural and functional abnormalities in reproductive system may interrupt animal production. Therefore, proper monitoring and screening of female productive systems of small ruminants is the need of the hour to increase its economic gain. According to above perception, the study was conducted to determine the morphometry of female reproductive tract of small ruminants. Now-a-days, ultrasonography has become an important diagnostic tool for evaluating the female reproductive system in cattle (Carriere *et al.*, 2002). But in small ruminants ultrsonographic image study is limited only to diagnosis pregnancy, monitoring and sexing fetus. Different anatomical and pathological conditions of small ruminants' genital tract are hardly described. Therefore, image morphometry using transabdominal transducer was studied to evaluate the efficacy of ultrasonograph in comparison to gross anatomical measurements.

It was found that the mean gross length of the cervix was 1.9±0.2 cm in does and 1.1±0.2 cm in ewes. Adigwe und Fayemi (2005) observed the mean gross length of cervix as 2.6±0.61 cm in Black Bengal does. Whereas, Mohsen und Abbasi (2010) reported the mean length of cervix is 5.6 cm in indigenous ewes. The gross length and width of body of the uterus were 1.9±0.1 & 1.0±0.1 cm respectively in does and 2.5±0.3 & 1.4±0.1 cm respectively in ewes in this study. Adigwe und Fayemi (2005) observed the mean length of the uterine body in ewes was 3.8±1.7 cm which is higher in comparison to our study. The gross diameter was 4.7±0.2 & 4.0±0.1 cm in does and 4.5±0.2 & 3.9±0.1 cm in ewes. However, this variation among different studies might be resulted from the variation in breeds of does and ewes. Image measurements of all parts were proportionately lower except in body of the uterus in both species. Moreover, results revealed significant ($P<0.001$) variation among gross and image measurements of cervix, body of uterus and ovaries in does. Whereas, significant ($P<0.001$) variation was found between gross and image measurements of ovaries diameter in ewes. In addition, strong positive ($P<0.001$) correlation between two morphometric measurements of different parts of uterus was observed in case of does, but correlation was not significant among the parameters in ewes. Data regarding ultrasonographic image morphometry of these structures was scanty and there is no "standard" with which to compare measurements.

The ability to visualize changes in structure in a serial fashion, without interruption or distortion of function, has revitalized the study of reproduction in many species, but most notably in cattle. It is worth to be noted that inaccurate measurements may be present during ultrasonic investigations, and this may be attributed to many factors related to the operator, the ultrasonic apparatus and factors related to animals. During this study the sample size was small. Therefore, fur-

ther study should be directed to measure reproductive organs precisely and to observe the relation between gross and US study of ovarian structure, which could enable us to determine the precise stage of the estrous cycle based on a single examination, and the health status of individual follicles and their contained egg in small ruminants.

In conclusion, there was variation among data recorded on gross and US image morphometry. Echogenicity varies with reproductive organs. Cervix showed hyperechogenicty, ovary hypo echoic and uterus normal echogenic structure. The values were proportionately higher in gross morphometry in most of the cases. Positive correlation was observed among gross and US image values. This is a model study and it may help to identify female reproductive structures when trans-abdominal probe with 5 to 7 Hz frequency is used.

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