Ultrasonographic examination of kidneys and urinary bladder of normal adult Spiti horses and Himalayan hill mules of India

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Received: 23-09-2017 Accepted: 22-12-2017 DOI: 10.18805/ijar.B-3498

ABSTRACT

The objective of this study was to develop baseline topographical data of landmarks for locating kidneys and urinary bladder and to generate sonographic calliper measurements along with dynamic parameters of these organs. Ultrasonography was performed on 50 native adult (Spiti horses and Himalayan hill mules) healthy unsedated equines of either sex. The thickness, character and echo-architecture of these organs were recorded. The right kidney was found from 15th (±1) intercostal space (ICS) extending upto first lumbar vertebra, both in horses as well as in mules. The height of right kidney varied from 112.7 to 118.3 mm (Mean± SE= 115.6±1.01 mm) and its thickness varied from 58.4 to 71.2 mm (Mean± SE= 64.3±2.37 mm). While in mules height of right kidney varied from 90.7 to 109.2 mm (Mean± SE= of 101.1±3.14 mm) and its thickness varied from 47.3 to 56.8 mm (Mean± SE= 52.3±1.57 mm). The left kidney in horses was found between 16th ICS to 2nd lumbar vertebra, while in mules it was found from 16th ICS to 3rd lumbar vertebra. The height of left kidney varied from 87 to 107.8 mm (Mean± SE= 99.0±3.67 mm) and its thickness varied from 49.5 to 53.8 mm (Mean± SE= 51.8±2.53 mm). In mules the height of left kidney varied from 85.5 to 111.4 mm (Mean± SE= 95.3±2.36 mm) and its thickness varied from 43.4 to 55.7 mm (Mean± SE= 50.6±2.53 mm). During transrectal ultrasonography urinary bladder was observed as an oval to round structure in the caudal ventral abdomen, the wall thickness of urinary bladder varied from 2.7 to 2.8 mm (Mean± SE= 2.74±0.02 mm), 2.4 to 2.7 mm (Mean± SE= 2.62±0.05 mm) in horses and mules respectively. Hence detailed ultrasonographic examination of these organs helped us to compile baseline data, which will be helpful in future in management of the affections of these organs.

Key words: Horses, Kidneys, Mules, Ultrasonography, Urinary bladder.

INTRODUCTION

Soft tissue organs like kidneys, liver and spleen are not easily accessible for clinical examination by palpation or percussion because of their topographic location under costal part of the abdominal wall. Usually exploratory laparotomy confirms the diagnosis of disease conditions of Kidneys, liver spleen and urinary bladder, although its invasiveness may not be suitable in already compromised patients. Clinical diagnosis of the urinary tract diseases is difficult in equines, since even severe diseases may not always be accompanied by specific signs and one can easily misinterpret it with gastrointestinal tract colic. In these circumstances ultrasonography, a non invasive procedure can be used to diagnose the affections.

Sonographic assessment of abdominal organs in different equine breeds has already been described (Reef, 1998; Freeman, 2002; Hendrickson et. al., 2007; Epstein et. al., 2008 and Barton, 2011), but no such study has been conducted on native breeds of India. Hence, it is envisaged to perform the detailed ultrasonographic examination of kidneys and urinary bladder and to compile baseline data of Spiti horses and Himalayan hill mules. This will be useful in future to delineate normal and abnormal conditions and to distinguish between true and false colic which will provide an important diagnostic lead in management of affections of these organs.

MATERIALS AND METHODS

Standardization was carried out on 50 clinically healthy adult native animals of either sex (25 Spiti horses and 25 Himalayan hill mules). The horses were between 8-17 years of age and weighed between 120-165 kg, whereas mules were between 8-15 years of age and weighed between 90-110 kg. The normal equine abdomen was subjected to ultrasonographic examination for standardizing the technique and machine settings. Ultrasonography was performed to scan and document images of kidneys and urinary bladder to delineate their topographical anatomy in different planes, to define their echotexture and to determine the thickness
and site for placement of the transducer at various locations. Ultrasonography was carried out using Siemens Acuson X300 ultrasound system, premium edition, a grey scale B + M-mode, 4D scanners and Sonosite M-Turbo ultrasound system. The standing animals were restrained in a crate without any sedation. The topographic regions of all animals were shaved and cleaned with tap water. Contact gel was applied and animals were examined using three different transducers: i) 5.3-10 MHz linear transducer with a maximum depth of field of 13 cm. ii) 2-5 MHz volumetric (4D) transducer with a maximum depth of field of 30 cm and iii) 5-10 MHz sonosite M-turbo L52 rectal transducer with a maximum depth of field of 15 cm. Care was taken to record ultrasonograms at the peak of inspirations. The organ echotexture, wall thickness, size, optimal topographical locations as well as associated structures were studied with photographic recordings.

RESULTS AND DISCUSSION

Kidneys: The right kidney was found from 15th (±1) ICS extending up to right paralumbar fossa almost reaching the level of first lumbar vertebra, caudal to liver, dorsal to descending duodenum and ventral to lumbar transverse processes, both in horses as well as in mules. The renal capsule appeared as echogenic structure surrounding the kidney (Fig-1.1(a, b)). The duodenum courses ventrally around the caudal pole of right kidney and caecum was imaged ventral and caudal to right kidney. The right kidney appeared as a triangular curvilinear or heart shaped. The height (in slightly oblique transverse plane) of right kidney varied from 112.7 to 118.3 mm (Mean ± SE = 115.6 ± 1.01 mm) and thickness varied from 58.4 to 71.2 mm (Mean ± SE = 64.3 ± 2.37 mm). However, length was difficult to obtain in its long axis (dorsal plane i.e. parallel to the spine) because of interference from the ribs both in horses as well as in mules. Whereas, in mules height of right kidney varied from 90.7 to 109.2 mm (Mean ± SE = 101.1 ± 3.14 mm) and thickness varied from 47.3 to 56.8 mm (Mean ± SE = 52.3 ± 1.57 mm), (Fig-1.2(a, b)).

The left kidney was found between 16th to 17th ICS and first to 2nd lumbar vertebra, whereas, in mules it was

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**Fig 1.1(a, b):** Ultrasonogram of Right kidney (Mule) at 16th ICS. The image was obtained with volumetric (4D) transducer at 5.0 MHz at a depth of 13 cm. (ICM= intercostal muscle).

**Fig 1.2(a, b):** Ultrasonogram of Right kidney (Mule) at 16th ICS. The image was obtained with volumetric (4D) transducer at 5.0 MHz at a depth of 13 cm.
found from 16th ICS to 3rd lumbar vertebra medial or deep to the spleen between the level of the tuber coxae and tuber ischii. The height of left kidney varied from 87 to 107.8 mm (Mean ± SE = 99.0 ± 3.67 mm) and thickness varied from 49.5 to 53.8 mm (Mean ± SE = 51.8 ± 0.72 mm). In mules the height of left kidney varied from 85.5 to 111.4 mm (Mean ± SE = 95.3 ± 2.36 mm) and thickness varied from 43.4 to 55.7 mm (Mean ± SE = 50.6 ± 2.53 mm). The thickness of cortex varied from 8.1 to 8.6 mm in horses and 8.0 to 8.1 mm in mules. The renal cortex was found hypoechoic compared to the surrounding tissues but more echogenic than the adjacent medulla. Renal pyramids appeared as distinct hypoechoic circles separated from each other by renal column. Renal pelvis was found in the centre and was most echogenic structure in each kidney (Fig-1.1[a, b] and Fig-1.2[a, b]). The observations of present study were in agreement with other studies (Kiper et al., 1990; Hoffman et al., 1995 and Reef, 1998) except for that in their studies left kidney was found upto 3rd lumbar vertebra in horses and thickness of cortex was reported to be 1 to 2 cm thick, which was higher than the findings of present study. Similarly, height and thickness of both kidneys in the present study varied from Hoffman et al., (1995) who reported that height of right kidney varied from 13 to 18 cm, with a length of 13 to 15 cm and thickness of 5 cm, whereas height of left kidney varied from 11 to 15 cm, length 15 to 18 cm and thickness of 5 to 6 cm. Freeman (2002) suggested that transrectal ultrasonography produced higher quality images, allowing visualization of the renal vasculature and ureters, however the transrectal technique is limited by the size of the horse, but in the present study none of the kidneys could be imaged through transrectal ultrasonography due to small size of the animals. This difference in measurements of both the kidneys and topographic anatomical variation obtained in the current study in spiti horses and himalayan hill mules may be possibly attributed to the variations in body weight/size, breed type, and/or hybrid (interspecies variation) nature of mules.

**Urinary Bladder:** On transrectal ultrasonography urinary bladder was observed as an oval to round structure in caudal ventral abdomen (Fig-2.1[a, b]). The urinary bladder
appeared as anechoic with hyperechoic particles swirling inside the urine and sometimes these particles settled at the ventral portion of bladder forming sludge and caused strong acoustic shadowing. Due to presence of mucous and calcium, urine appeared highly echogenic (Fig-2.2[a, b]). Schmidt (1989) reported that hyperechogenicity of urine depends on the degree of urine, mucus and crystals present in it. Barton (2011) also reported this hyperechogenicity of urine is due to mucous and calcium in urine in adult horses. The urinary bladder was not imaged from transcutaneous ventral window, due to the presence of gas within the large intestine. The ureters and urethra could not be visualized in the present study. However urethra was seen only when the catheter was passed through the urethra. Reef (1998) also reported that urethra and ureters cannot be imaged unless abnormally distended. Diaz et al., (2005) reported that opening of ureters into the urinary bladder can be imaged transrectally in adult horse and normal urine flow into bladder can be imaged. The ureters appear as small echoic collapsed tubular structures with pluses of anechoic urine entering the dorsal aspect of the bladder.

However, none of these features could be appreciated in present study and the reason possibly may be continuous straining of the animal on transrectal ultrasonography and highly echogenic urine which masked the details of the urinary bladder. In the present study the wall thickness of urinary bladder in horses varied from 2.7 to 2.8 mm (Mean ± SE = 2.74 ± 0.02 mm (Fig-2.2[a, b]), whereas in mules it varied from 2.4 to 2.7 mm (Mean± SE = 2.62 ± 0.05 mm (Figure-2.3[a, b]). However Reef (1998) reported that the normal wall thickness of bladder should measure between 0.3 to 0.6 cm. These differences regarding the wall thickness of urinary bladder in local horses and mules may be possibly attributed to the variations in the body weight/size, breed type, and/or hybrid (interspecies variation) nature of mules.

CONCLUSION

Based on the sonographic evaluation of the abdomen of equids, the surgeon/clinician can be able to differentiate the true and false colic, which will help in accurate diagnosis and formulation of a precise and efficient therapeutic plan.
ACKNOWLEDGEMENT

The authors would like to thank faculty members and support staff of the department of veterinary surgery and radiology, college of veterinary and animal sciences CSKHPKV Palampur for their suggestions and cooperation.

REFERENCES


