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Original Research

Ultrasonographic Reference Values of Kidney Dimensions and Clinicopathological Findings Associating the Transcutaneous Ultrasound-Guided Renal Biopsy in Donkeys (*Equus asinus*)

Hussein Awad Hussein [a,*], Ahmed Ibrahim [b], Marwa F. Ali [c]

[a] Internal Veterinary Medicine, Department of Animal Medicine, Faculty of Veterinary Medicine, Assiut University, Assiut, Egypt
[b] Department of Surgery, Anesthesiology, and Radiology, The Veterinary Teaching Hospital, Faculty of Veterinary Medicine, Assiut University, Assiut, Egypt
[c] Department of Veterinary Pathology and Clinical Pathology, Faculty of Veterinary Medicine, Assiut University, Assiut, Egypt

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ABSTRACT

This study aimed to establish normal ultrasonographic reference values of kidney dimensions in donkeys (*Equus asinus*) and to describe and evaluate the clinicopathological variations associated with ultrasound-guided renal biopsy. The ultrasonographic dimensions of the right and left kidneys were conducted on 16 donkeys, which were then divided into two groups; eight each for biopsy of the right kidney (RK) and left kidney (LK). Three ultrasonographic cineloops were obtained at 17th intercostal space daily for 3 consecutive days. Renal length, width, and dimensions of the cortex, medulla, and pelvis for both the kidneys in each donkey were recorded. Maximal dimensions were obtained for the RK (length 10 ± 8 cm, width 4.9 ± 1 cm, thickness 4.2 ± 0.4 cm) and LK (length 8.9 ± 0.9 cm, width 4.7 ± 0.8 cm, thickness 3.5 ± 0.7 cm) with good-to-excellent repeatability for all measurements. Follow-up ultrasonography revealed development of postbiopsy subcapsular hematomas, which were confirmed postmortem, of mild (volume < 20 mL), moderate (volume from 20 to 40 mL), and severe degrees (volume > 40 mL). Gross hematuria had been observed till 24 hours after biopsy, and then microscopic hematuria was noticed thereafter. Variable clinicopathological changes were noticed in blood and urine. All the biopsy specimens were adequate for histopathological assessment. Postmortem histopathological examination revealed various kidney changes. In conclusion, kidney dimensions can be used by veterinarians for accurate diagnosis and management of renal diseases. Ultrasound-guided renal biopsy is a relatively safe procedure; however, some complications may develop. Renal biopsy is commonly associated with clinicopathological variations; thus, caution should be taken during interpretation of these variables.

1. Introduction

Donkeys are extensively used as a mean of transportation and play an important role in agricultural development and draught purposes [1]. The kidney is especially susceptible to be diseased; this is because the kidneys acquire 20% of the cardiac output and thereby receive a relatively high proportion of blood-borne hazards leading to renal insufficiency or even renal failure [2]. In donkeys, kidney diseases involved subacute tubulointerstitial nephritis, renal fibrosis, renal cysts, membranous and proliferative glomerulonephritis, glomerulosclerosis, hemorrhage, nephrolithiasis, and chronic pyelonephritis had been recorded [3].

Establishment of normal reference ranges of kidneys may be helpful in the diagnosis of some renal abnormalities. These renal values may be increased in cases of acute renal failure, obstructive nephrolithiasis, and kidney tumors or decreased as in cases of chronic renal failure [4].

Renal biopsy is one of the most important diagnostic procedures used in the identification of kidney diseases in both human and animals [5,6]. Histopathological information obtained from renal biopsy specimens has a clinical relevance in confirmation of some

Animal Welfare/ethical statement: The present study was ethically approved by the scientific committee of Faculty of Veterinary Medicine, Assiut University, Assiut, Egypt.
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* Corresponding author at: Hussein Awad Hussein, Department of Animal Medicine, Faculty of Veterinary Medicine, Assiut University, Assiut 71526, Egypt.
E-mail addresses: hhussein@aun.edu.eg, hussein-vet@lycos.com (H.A. Hussein).

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obscure renal problems [7]. Renal biopsy results can provide useful diagnostic and prognostic information about the type of renal disease in horses with acute renal failure, and they may be used more often to document the presence of chronic diseases in horses with chronic renal failure [8].

The ultrasonographic reference features of kidneys and renal biopsy techniques in horses were reported in several studies [7,9–12]. However, to the best of the authors' knowledge, there are no literature studies reporting the normal ultrasonographic dimensions of the kidneys in donkeys or describing the technique and the consequent clinicopathological findings associated with ultrasound-guided renal biopsy. Therefore, the objectives of this study were as follows: (1) determine the reference ranges of ultrasonographic renal dimensions in clinically healthy adult donkeys (*Equus asinus*); (2) determine the possible clinicopathological changes following ultrasound-guided renal biopsy.

2. Materials and Methods

2.1. Animals and Study Design

The present study was ethically approved by the scientific committee of Faculty of Veterinary Medicine, Assiut University, Assiut, Egypt. The present study was conducted on 16 adult clinically healthy donkeys (*Equus asinus*), of both sexes (8 males, and 8 nonlactating and nonpregnant females), and with no history of urinary tract disorders. The mean ± standard deviation (SD) of age was 3.2 ± 3.0.3 years and weight was 150 ± 2.8 kg. All animals were housed in a standard stable with food and water provision ad libitum. Donkeys identified by biochemical analysis to have any indication of renal dysfunction or coagulopathy were excluded from the study.

2.2. Ultrasonographic Kidney Dimensions

Before the renal dimension measurements, all animals (16 donkeys) underwent kidney ultrasonography for determination of any hidden renal affections, and information about the kidneys and their adjacent organs was obtained, as well as the expropriate sites for kidney biopsy which was carried out later on were selected. A 3.3- to 5 MHz microconvex ultrasound transducer (MyLabOne VET, Esaote, Italy) was used to image the kidneys and their adjacent organs. All ultrasonographic examinations were carried out with donkeys restrained manually within a handling box. In preparation for renal ultrasonography, the area from 14th intercostal space (ICS) to the flanks of both sides was clipped, shaved, and a coupling gel was applied. For each donkey, three ultrasonographic cineloops of 5 seconds each were taken of each ICS (16th–17th) of the left kidney (LK) and right kidney (RK) and left paralumbar fossa. Ultrasonographic examinations were carried out by one experienced operator. Ultrasonographic renal dimensions were measured for each donkey three times daily, for 3 consecutive days. For each longitudinal plane images, six dimensions were taken including: (1) longest craniocaudal axis of the kidney (maximal length), (2) longest lateromedial axis of the kidney (maximal width), (3) thickness of the renal cortex (cortex), (4) thickness of the renal medulla (medulla), (5) length of the renal pelvis (pelvis length), and (6) width of the renal pelvis (pelvis width) (Figs. 1A and 1B). For each transverse plane images, the largest measure of the kidney (renal thickness) (Fig. 1C) was obtained. Each measurement was repeated on three occasions, providing an indicator for assessment of the repeatability.

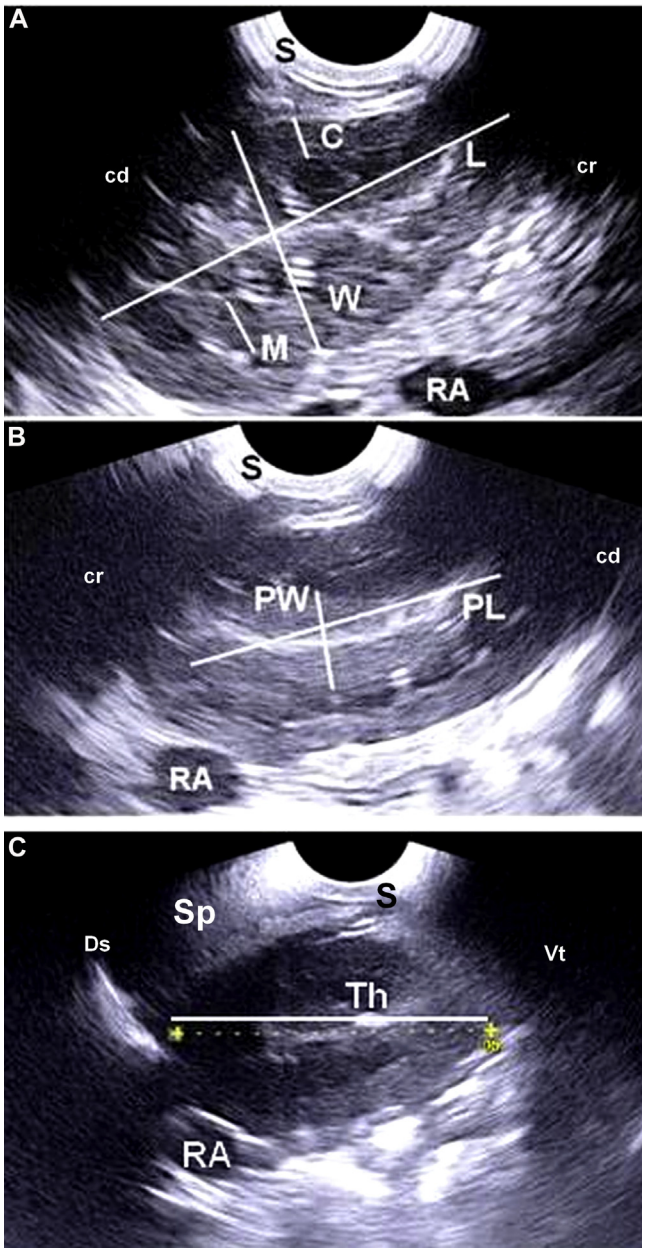

Fig. 1. (A) Transabdominal ultrasonographic image in the longitudinal plane of a normal right kidney in a donkey at 17th ICS shows the maximal renal length (L) and width (W) and cortex (C) and medulla (M) lengths; (B) Transabdominal ultrasonographic image in the longitudinal view of a normal left kidney at 17th ICS shows the pelvis length (PL) and width (PW); (C) Transabdominal ultrasonographic image in the transverse axis from a normal left kidney at the 17th ICS shows the renal thickness (Th). S, skin; Cd, caudal; Cr, cranial; Ds, dorsal; Vt, ventral; Sp, spleen; RA, renal artery.

2.3. Ultrasound-Guided Renal Biopsy Technique

2.3.1. Animal Preparation

First, all animals were divided randomly and equally into two groups: the RK biopsy group (number = 8 donkeys; 4 males and 4 females) and the LK biopsy group (number = 8 donkeys; 4 males and 4 females). Each donkey was sedated intravenously by xylazine hydrochloride 2% (dose 1 mg/kg b.wt, ADWIA Co., SAE, Egypt). The area from 14th ICS to the flanks of both sides was clipped, shaved, and disinfected by 70% alcohol and povidone iodine (Betadine, the Nile Co. for pharmaceutical and chemical industries, Egypt). After ultrasonographic examination of both the kidneys, the position of