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ULTRASONIC EVALUATION OF THE OVINE KIDNEY

(With 1 Table & 4 Figs.)

By

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(Received at 18/7/1989)

دراسة تقيمية بالموجات الفوق صوتية لكلى الأغنام

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أجريت الدراسة على عشرين كلية لخراف تامة النضج بواسطة الموجات الفوق صوتية وبإستخدام مصدر قوة ٥ مليون ذبذبة / ثانية . وقد تم تحليل النتائج إحصائياً حيث أوضحت الدراسة عدم وجود إختلاف بين قياسات القشره واللب في المناطق المختلفة وذلك في حالة أخذ مقطع موازى لمحور الكلية . بينما وجد إختلاف معنوى بين قياسات اللب في هذه الحالة ومثيلتها في المقطع العرضى للكلية . كما أوضحت الدراسة وجود إرتباط موجب (ر= ٩٣ر٠) بين حجم الكلية ووزنها ، بينما لايوجد إرتباط بين حجم الكلية وأى من قياساتها الأخرى .

SUMMARY

To establish the ultrasonographic appearance and the biometric data of the ovine kidney, B-mode ultrasonography was carried out on one ram in vivo and on 20 ovine kidneys in vitro. The echogenic pattern of the various regions of the ovine kidney was described in both vivo and vitro.

Statistical analysis of the given data showed no difference between the zonal cortical and medullary measurements, when the kidney was sagittaly scanned, while there was a significant difference between the sagittal and transverse medullary measurements. The weight and volume of the kidney were correlated ($r = 0.93$). No correlation was found between the kidney volume and any of the other measured perameters.

INTRODUCTION

Ultrasound began in human medicine in 1947 as a diagnostic aid in obstetrics (KING, 1972, 1974). During the last decade, no part of the human body has escaped sonographic examinsatio (ROUND, 1971; WINSBERG and COLE, 1972). The use of ultrasound in clinical veterinary medicine has also became a valuable part of the clinical

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diagnosis. There are still species and organs which have not been thoroughly described in veterinary medicine.

The application of ultrasonography to urologic diagnosis has previously been discussed in human (HOLMES, 1966; BARNETT and MORLEY, 1971; FERRUCCI, 1979), small animals (CARTEE, 1980; CARTEE, et al. 1980; KONDE, et al. 1984; KONDE, 1985) and horse (RANTANEN, 1986).

The B-mode ultrasonographic evaluation of the normal sheep's kidney has not been previously described. The objective of this study was to describe the B-mode ultrasonographic appearance and size of the ovine kidneys.

MATERIAL and METHODS

An atempt was made on an anesthetized[a] adult ram to scan the kidney in vivo. The kidney could not be scanned through the wool clipped intact skin. A 7 cm sagittal incision was made through the skin of the upper right flank region and a 5 MHz mechanical sector transducer[b] was applied in contact with the subcutaneous muscle after applying contact gel. The animal was then euthmatized[c] and the kidneys were resected for water bath scanning with 18 kidneys of other adult rams. Each kidney was scanned in a sagittal and transverse planes with a 5 MHz mechanical sector transducer in a water bath with an Aquaflex Ultrasound Gel Pad[d] at its base as a deep coupling medium. The cranio-caudal, dorso-ventral and medio-lateral distances as well as circumference and area of each kidney were measured by electronic cursor. The thickness of the cortical and medullary regions were measured in three different zones (Z_1, Z_2, Z_3) from saggital images (Fig. 2) and in one zone from the transverse one (Fig. 3). Each kidney was weighed and its volume was determined by displacement of water in a graduated cylinder.

Descriptive statistics were calculated for each variable. One way analysis of variance was used to compare the cortical and medullary thickness among the four kidney zones. Pearson's correlation analysis was used to compare: 1) volume and weight, 2) volume and medullary/cortical ratios, 3) volume and dorsoventral diameter, and 4) volume and cranio-caudal length.

RESULTS

The ultrasonographic appearance of the ovine kidney in vivo and vitro was comparable with that of the dog and cat. The surface was smooth and the cortex appeared as a homogenous hyperechoic area. The medullary regions appeared as more hypoechoic

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(a) Sodium pentabarbital (65 mg/ml) - Butler Company, Columbus, OH
(b) Diasonics Inc., Milpitas, CA
(c) Evathanosin solution - Schering Corporation, Kenilworth, NJ
(d) Parker Laboratories, Inc., Orange, NJ 07050, USA

areas deep to the cortex (Fig. 1 and 2). The renal pelvis appeared as a hyperechoic region deep and medial to the medullary regions (Fig. 2). A similar appearance was observed on the transverse sections (Fig. 3).

Summary descriptive statistics for kidney measurements are shown in (Table 1). The thickness of the cortex and medulla did not differ among zones when the kidneys were scanned sagittaly. The transverse medullary thickness was significantly different from sagittal medullary thickness. Renal weight and volume were well correlated (r 0.93)(Fig. 4). Kidney volume did not correlate with the medullary/cortical ratio nor with the dorsoventral diameters or craniocaudal length.

DISCUSSION

In vivo, ultrasonographic evaluation of renal disease is a common procedure in human medicine and in veterinary medicine. No reports have been made of the use of this technology in the evaluation of the kidneys of the sheep. We found that in vivo diagnostic ultrasonographic of the ovine kidney was difficult due to the location of the kidney and the thickness of the skin and the extent of the subcutaneous fat. For that reasons, routine transabdominal ultrasonographic evaluation of the ovine kidney appears to be relatively difficult and unproductive. However, it is believed that intraoperative or post mortum ultrasonographic evaluation of the kidneys shows promise in being a rapid method of evaluating ovine kidneys affected by experimental procedures or pathological processes.

The ultrasonographic appearance of the ovine kidney was similar to that of dog and cat (CARTEE, et al., 1980; KNODE et al., 1984; KNODE, 1985). The difference in echogenicity between the cortex and medulla was attributed to the more homogenous density or elasticity of the medullary region (KNODE, et al., 1984). The hyperechogenicity of the pelvis may be due to an increase in collagen in the walls of the pelvis (KNODE et al., 1984; KNODE, 1985).

The data suggests that cortico medullary (C/M) ratio should be about 1:2 in the sheep, and due to the lack of differences in zonal cortical and medullary measurements, it may be taken from any zone of the kidney. Transverse positioning of the probe may result in significantly different C/M ratio than those determined from sagittal scans. The renal weight and volume showed a high correlation (R 0.93), no correlation could be found between renal volume and any other of the ultrasound measured parameters. Unfortunately no physical measurements of these kidneys was performed so that the validity of the ultrasound measurements could not be confirmed. Comparison with previously reported, kidney sizes showed the ultrasound measurements to be within expected limits (SISSON, 1975; NICKEL et al, 1973).

Table (1)

	Number of Kidneys	Mean	+ SD
DVDS	20	3.471	0.213
CCDS	20	7.052	0.837
CIRS	20	20.940	3.155
AS	20	20.750	2.454
Z1C	20	0.955	0.141
Z1M	20	0.632	0.151
Z2C	20	0.863	0.120
Z2M	20	0.606	0.145
Z3C	20	0.909	0.169
Z3M	20	0.640	0.153
MLDT	20	4.227	0.502
DVDT	18	3.452	0.278
CT	18	0.933	0.150
MT	18	0.764	0.242
W	20	70.683	10.103
V	20	71.100	12.013
MED/COR %	20	69.900%	9.990%

Showing the number of the measured kidneys, mean + standard deviation of each parameter. DVDS = dorso-ventral distance (sagittal), CCDS = cranio-caudal distance (sagittal), CIRS = circumference (sagittal), AS = area (sagittal), ZIC, Z2C, Z3C = cortical distance at zone 1,2 and 3 (sagittal) Z1M, Z2M, Z3M=medullary distance at zone 1, 2, and 3 (sagittal), MLDT = medio-lateral distance (transverse), DVDT = dorso-ventral distance (transverse), CT = cortex (transverse), MT = medulla (transverse), W = weight of the kidney, and V = volume of the kidney

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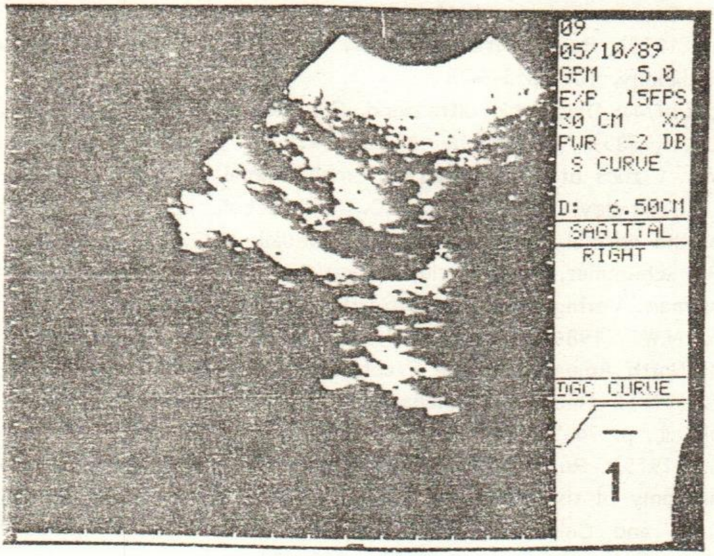
LIST OF FIGURES

Fig. (1): In vivo sagittal sonogram of right kidney from adult ram (5 MHz). It was not possible to obtain this image through the wool covered skin.

Fig. (2): Sagittal sonograms of ovine kidney in water bath. Calipers denote medullary thickness. Cortex (C) and medullary regions (M) were measured in three zones. Renal pelvis (P) is hyperechoic medial region (z_1, z_2, z_3) are the levels of cortico-medullary measurements (5 MHz).

Fig. (3): Transvers sonogram of ovine kidney in water bath. Calipers indicate mediolat-eral measurement. C = cortex, M = medulla, P = pelvis (5 MHz).

Fig. (4): Bar graphs showing relationship between renal weight (gm) and volume (cm^3) for each kidney (right and left) from 10 adult rams.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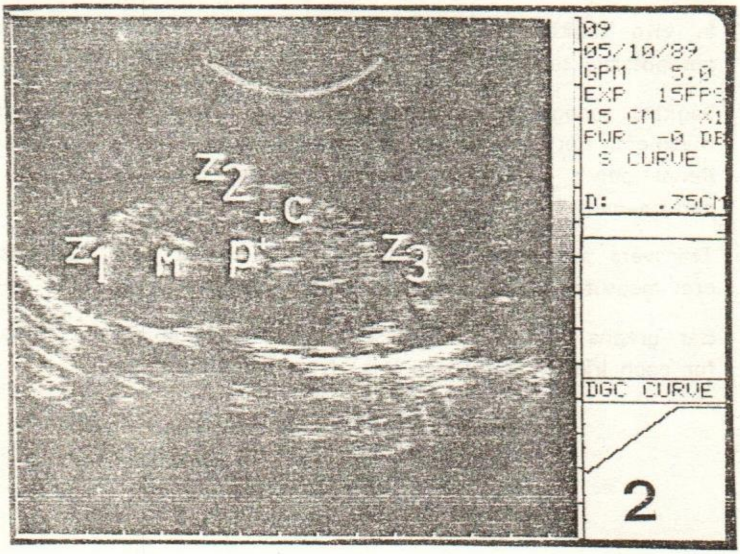
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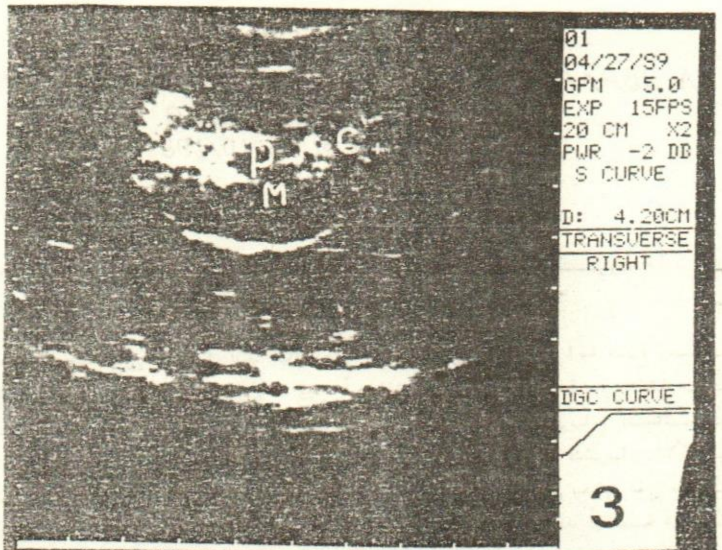
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