

# Transcutaneous ultrasonographic examination of the left kidney in healthy cows

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**ABSTRACT:** The aim of this study was to assess the feasibility of a new technique for transcutaneous ultrasonographic imaging coupled with transrectal manoeuvring for the examination of the left kidney using 10 clinically healthy Jersey/Red Sindhi crossbred cows. The areas extending caudally from the tuber-coxae, cranially up to the 11<sup>th</sup> intercostal space, dorsally from the lumbar transverse processes, and ventrally up to the midflank on both sides (left and right) were shaved. The transducer was placed in the right and left paralumbar fossae, the 3<sup>rd</sup> (between vertebrae L3 and L4) and the 4<sup>th</sup> (between vertebrae L4 and L5) lumbar spaces, respectively. For transrectal manoeuvring of the left kidney, the arm was inserted in to the rectum beyond the elbow to palpate and push the left kidney gently towards the right abdominal wall. The left kidney was imaged in its entirety from the right paralumbar fossa in all of the cows. However, it could not be imaged with clarity without a gentle transrectal push towards the right abdominal wall at the time of imaging. The left kidney was also imaged via the 3<sup>rd</sup> (between vertebrae L3 and L4) and the 4<sup>th</sup> (between vertebrae L4 and L5) lumbar spaces in only eight of 10 cows, but the quality of imaging was poor in comparison to the transflank imaging. Moreover, in four of ten cows, the right and left kidneys were imaged together in one ultrasonographic image. On the basis of our results we consider transcutaneous ultrasonography, simultaneously supported with transrectal manoeuvring, to be suitable for evaluation of the left kidney in cows. The findings reported in this study may be of assistance to veterinary surgeons by providing a basis for use in clinical procedures such as transcutaneous ultrasonography-guided renal biopsies.

**Keywords:** ultrasonography; cow; kidney; rumen

Knowledge of the topographic relations of the bovine left kidney to the body wall is essential to the veterinary surgeon for its clinical examination, which includes transrectal palpation/ultrasonography, diagnostic laparotomy, and laparoscopy/ultrasonography-guided biopsy. Ultrasonographic examination and determination of the anatomy of the urinary system in cattle has been carried out previously. It has been reported that the right kidney could be examined transabdominally through lumbar and paralumbar regions; in contrast, the left kidney, bladder, and urethra should be approached transrectally (Braun 1991, 1993; Pekkaya et al. 2005). Ultrasonography has also been successfully used for the diagnosis of various urinary disorders in bovines (Hoque et al. 2002; Durgut et al. 2003; Magda 2006; Floeck 2007, 2009; Braun et al. 2008). However, in the peer-reviewed literature, there is no reference to transcutaneous ultrasonographic

examination of the bovine left kidney simultaneously supported with transrectal manoeuvring. This study describes a new technique for the ultrasonographic examination of the left kidney in healthy Jersey/Red Sindhi crossbred cows.

## MATERIAL AND METHODS

The transcutaneous ultrasonographic examinations were performed on 10 non-pregnant clinically healthy Jersey/Red Sindhi crossbred cows that had been kept off feed for 12 h, using a 3.5 MHz curvilinear transducer (BPL US 9101 Ultrasound Scanner, BPL Health Management Solutions Limited, Bangalore, India). The cows were four to twelve years old and weighed approximately 300 to 450 kg. The animals were secured in a standing position in a cattle crate without any chemical restraint. The cows were con-

sidered to be clinically healthy based on the results of routine physical examination, complete blood count, observation of spontaneous or induced urination, and also general examination and physico-chemical testing of the urine (Grunder 1979). The areas extending caudally from the tuber-coxae, cranially up to the 11<sup>th</sup> intercostal space, dorsally from the lumbar transverse processes, and ventrally up to the midflank on both sides (left and right) were shaved. The transducer was placed in the right and left paralumbar fossae, the 3<sup>rd</sup> (between vertebrae L3 and L4) and the 4<sup>th</sup> (between vertebrae L4 and L5) lumbar spaces, respectively. For transrectal palpation of the left kidney, faeces were cleaned out without taking the hand out of the rectum in order to avoid pneumorectum. If the cow had pneumorectum, the most cranial rectal ring was grasped and teased to expel the air. An arm was inserted into the rectum beyond the elbow to palpate and push the left kidney gently towards the right abdominal wall.

## RESULTS

The left kidney could not be seen from the left paralumbar fossa, but it was imaged in its entirety from the right paralumbar fossa in all of the cows. However, it could not be imaged with clarity without a gentle transrectal push towards the right abdominal wall at the time of imaging. The motile wall of the

rumen was also seen medial to the left kidney from the right flank (Figure 1). The left kidney was also imaged via the 3<sup>rd</sup> (between vertebrae L3 and L4) and the 4<sup>th</sup> (between vertebrae L4 and L5) lumbar spaces in only eight of ten cows, but the quality of imaging was poor in comparison to the transflank imaging. Moreover, in four of ten cows, the right and left kidneys were imaged together in one ultrasonographic image (Figure 2). Other organs seen contiguous with the left kidney included the medial wall of the rumen, and the colon. The various structures of the left kidney had differing echogenicities in the ultrasonographic images. The renal cortex was echoic in comparison to the relative hypoechoic renal medullary pyramids, which contrasted sharply with the hyperechoic renal sinus.

## DISCUSSION

To observe the left kidney, a transcutaneous ultrasonographic approach was successfully performed in this study. Braun (1991) suggested that the left kidney could probably not be examined by transcutaneous ultrasonography. Floeck (2009) reported that, occasionally, in calves and small or thin adult cattle, the left kidney can be visible ultrasonographically from the right caudal paralumbar fossa, but it is frequently covered by gas-filled large intestine. Furthermore, it has also been mentioned that

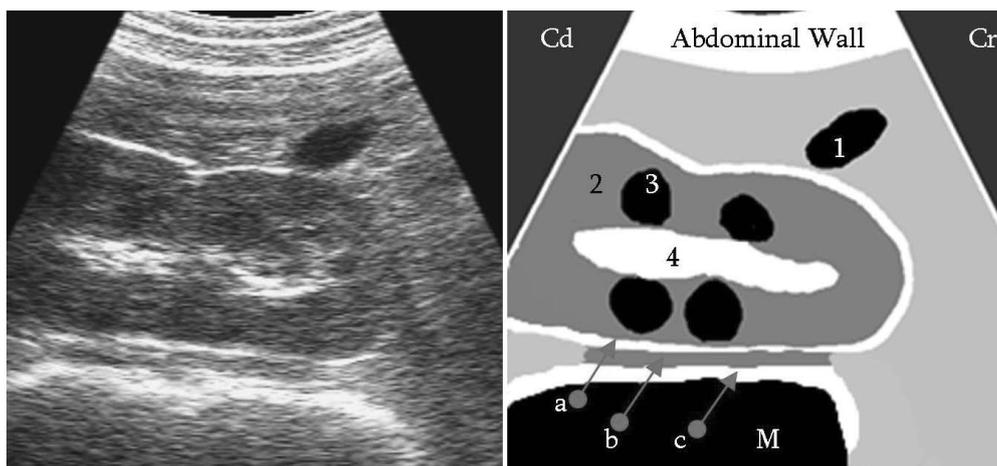


Figure 1. Ultrasonographic image of the left kidney imaged from the right paralumbar fossa obtained by placing the transducer parallel to the longitudinal axis of the cow just below the transverse processes of the lumbar vertebrae 3–5. 1 = caudal vena cava, 2 = renal cortex, 3 = medullary pyramid, 4 = renal sinus; a = hyperechoic line representing the peri-renal fat, b = hypoechoic line representing the medial wall of the rumen, c = hyperechoic line (internal reverberation artefact) reflecting from the tissue-gas interphase superimposed on the image of the medial wall of the rumen; Cr = cranial, Cd = caudal, M = medial

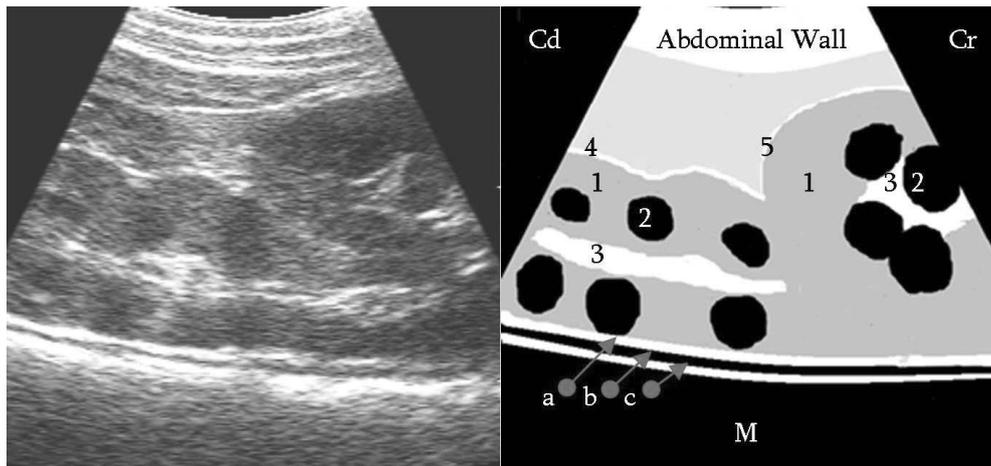


Figure 2. Ultrasonographic image of the left and right kidneys imaged together from the dorsal right paralumbar fossa obtained by placing the transducer parallel to the longitudinal axis of the cow just below the transverse processes of the lumbar vertebrae 2–4. 1 = renal cortex, 2 = medullary pyramid, 3 = renal sinus, 4 = left kidney, 5 = right kidney; a = hyperechoic line representing the peri-renal fat, b = hypoechoic line representing the medial wall of the rumen, c = hyperechoic line (internal reverberation artefact) reflecting from the tissue-gas interphase superimposed on the image of the medial wall of the rumen; Cr = cranial, Cd = caudal, M = medial

evaluation of the entire left kidney is not possible by transrectal ultrasonography, because the cranial pole cannot be reached, especially in large cattle, and with a transcutaneous approach the cranial pole of the left kidney is visible, in contrast to transrectal ultrasonographic examination. However, the image obtained from the left kidney scanned transrectally may be superior to the transcutaneous examination because the kidney is closer to the focal zone of the transducer and a higher frequency transducer improves the resolution of the image (Floeck 2009).

In this study, the left kidney was imaged transabdominally with good resolution in its entirety from the right flank lateral to the motile wall of the rumen in all of the cows. This was made possible after the left kidney was grasped transrectally and pushed towards the right abdominal wall. Transrectal manoeuvring localised the appropriate transflank position for ultrasonographic imaging of the left kidney, and also helped in differentiating it from the right kidney. The left kidney was usually palpated at the midline of the abdominal cavity, but depending on the fullness of the rumen, it was found either in the right or in the left dorsal quadrant. The position of the left kidney below and behind the right kidney is determined by the developmental expansion of the rumen. The left kidney is thus within easy reach on rectal exploration, but contact with the right one is not usually attainable. Transrectal palpation of the left kidney reveals a blunt caudal pole, a pointed

cranial pole, and a flattened surface where it meets the rumen. The left kidney hangs in a loop of mesentery and can be displaced to the right by a distended rumen (Grunder 1979). It is almost completely surrounded by peritoneum and therefore pendulous, and lies ventral to lumbar vertebrae two to five, and caudal to the right kidney, from which it is separated by the descending mesocolon. Medially, it joins the rumen, and laterally, the intestinal mass (Budras and Wunsche 2003). Unsuccessful imaging of the left kidney in two of 10 cows and poor imaging resolution through the lumbar acoustic window could be attributed to attenuation of the ultrasound waves during transmission through the lumbar roof and/or interference by the gas-filled colon.

In conclusion, transcutaneous ultrasonography, simultaneously supported by transrectal manoeuvring, was found to be suitable for evaluation of the left kidney in cows that had been kept off feed for 12 h. The findings reported in this study may be of assistance to veterinary surgeons by providing a basis for use in clinical procedures such as transcutaneous ultrasonography-guided renal biopsies.

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Received: 2012–10–12

Accepted after revision: 2013–12–26

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