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Ultrasonographic examination of the abdomen of the goat. II. Liver, spleen, urinary tract and greater omentum

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Summary

This review article describes the ultrasonographic findings of the liver, spleen, urinary tract and greater omentum that were previously obtained in studies of healthy female Saanen goats. Real-time B-mode ultrasonography and a linear or convex 5.0 to 7.5 MHz transducer are used to scan standing goats from both sides. The urinary bladder and urethra are also examined transrectally. The liver is scanned from the intercostal spaces (ICSs) on the right from dorsal to ventral. The parenchymal pattern consists of numerous fine echoes that are homogenously distributed across the entire organ. The dorsal visible margin of the liver runs parallel to the lung in a cranioventral to caudodorsal direction. The visible extent of the liver is largest in the 7th and 8th ICSs and the maximum thickness is measured in the 10th ICS. The caudal vena cava has a triangular shape in cross section and is seen only at the 11th or 12th ICS. The portal vein is oval to circular in cross section with stellate ramifications into the liver parenchyma. The gallbladder is pear-shaped and sometimes extends beyond the ventral margin of the liver depending on the amount of bile. In most goats, the gallbladder is only seen from the 9th or 10th ICS. The spleen is scanned from the left where it is almost always seen from the 11th and 12th ICSs. The parenchymal ultrasonographic pattern is similar to that of the liver. The splenic vessels are embedded in the parenchyma and are seen in longitudinal or cross section. The kidneys are best visualized from the flank and last two ICSs on the right. The ultrasonographic appearance varies with the sectional plane. In a sagittal plane through the hilus, the parenchyma is homogenous with fine, evenly distributed echoes. The medullary pyramids are seen near the sinus as oval to circular hypoechoic structures. The hyperechoic sinus is at the centre of the kidney. The urinary bladder is best visualized transrectally but can also be seen in many goats from either inguinal region. The content of the bladder is usually anechoic and the diameter ranges from 1.0 to 4.8 cm. The urethra is seen transrectally as

Sonographische Untersuchung des Abdomens der Ziege. II. Leber, Milz, Harnapparat und Netz

In dieser Arbeit werden die ultrasonographischen Befunde an Leber, Milz, Harnapparat und Netz der Ziege beschrieben. Die ultrasonographische Untersuchung dieser Organe erfolgt am stehenden Tier von beiden Körperseiten aus mit einem Linear- oder Convex-Schallkopf und einer Frequenz zwischen 5.0 und 7.5 MHz. Die Harnblase und die Urethra werden zudem transrektal untersucht. Die Leber wird in den Interkostalräumen der rechten Körperseite von dorsal nach ventral untersucht. Das Binnenstrukturmuster der normalen Leber besteht aus zahlreichen feinen Echos, die in gleichmässigem Abstand zueinander stehen und die Leberkontur ausfüllen. Die dorsale Begrenzung der Leber verläuft parallel mit der Ausdehnung der Lunge von kranioventral nach kaudodorsal. Die Leberausdehnung ist in den Interkostalräumen 7 und 8 am grössten. Am dicksten ist die Leber im 10. Interkostalraum. Die V. cava caudalis zeigt im Querschnitt eine dreieckige Form. Sie kann nur im 11. oder 12. Interkostalraum dargestellt werden. Die Portalvene ist im Querschnitt rund bis oval und weist eine sternförmige Verzweigung der Portalvenenäste ins Innere des Leberparenchyms auf. Die Gallenblase stellt sich birnenförmig dar und überragt den Ventralrand der Leber je nach Füllungszustand unterschiedlich stark. Sie ist meist nur in einem, im 9. oder 10. Interkostalraum, darstellbar. Die Milz wird in den Interkostalräumen der linken Körperseite untersucht, wo sie in den Interkostalräumen 11 und 12 praktisch immer gesehen werden kann. Die Milzpulpa weist ein ähnliches Parenchymmuster wie die Leber auf. In die Milzpulpa eingebettet sind die Milzgefässe, welche im Längs- und Querschnitt zu sehen sind. Die Nieren können am besten von der rechten Flanke und den letzten beiden Interkostalräume rechts dargestellt werden. Die Nieren stellen sich je nach Schnittebene unterschiedlich dar. Im sagittalen Längsschnitt durch den Hilus stellt sich das Nierenparenchym homogen und mit regelmässigen, fein verteilten Binnenechos dar. Sinusnah sind die

two adjacent parallel echoic lines without an apparent lumen.

Keywords: ultrasonography, goat, liver, spleen, urinary tract, greater omentum

Markpyramiden als runde bis ovale, echoarme Strukturen zu sehen. Im Zentrum der Niere befindet sich der Sinus renalis als hyperechogene Struktur. Die Harnblase kann am besten transrektal, bei vielen Ziegen jedoch auch von der rechten oder linken Inguinalgegend dargestellt werden. Ihr Inhalt ist normalerweise echoarm und ihr Durchmesser liegt zwischen 1.0 und 4.8 cm. Die Urethra ist transrektal als zwei parallel aneinanderliegende echogene Linien ohne offensichtliches Lumen zu sehen.

Schlüsselwörter: Sonographie, Ziege, Leber, Milz, Harnapparat, grosses Netz

Introduction

This review describes the indications, technique and findings of the ultrasonographic examination of the liver, spleen, urinary tract and greater omentum of female Saanen goats. Real-time B-mode ultrasonography and a linear or convex 5.0 to 7.5 MHz transducer are used to examine standing goats. This article also provides brief information and literature sources on the ultrasonographic examination of the female reproductive tract.

Liver

Indications for ultrasonography of the liver

Indications include the diagnosis of liver abscesses and tumours, hepatomegaly, fascioliasis and other diseases. Ultrasonography has also been used as a screening technique for the detection of hydatid cysts of *Echinococcus granulosus* (canine tapeworm) in the liver and lung of sheep and goats (Maxson et al., 1996; Sage et al., 1998; Njoroge et al., 2000).

Technique of ultrasonography of the liver

In goats, the liver is examined on the right side in the intercostal spaces (ICSs) from dorsal to ventral (Steininger, 2009; Braun and Steininger, 2011) analogous to the technique used in cattle (Braun 2009b). First the different organ structures are assessed subjectively and then they are measured. The position of the liver, the texture of the parenchyma, the surfaces that are in contact with the diaphragm (facies hepatica) and the various abdominal viscera (facies visceralis), the angle of the liver (angle between the diaphragmatic and visceral surfaces), the caudal vena cava and adjoining hepatic veins, the portal vein with its stellate ramifications into the parenchyma, the gallbladder and bile ducts are evaluated. The location and size of the liver and its blood vessels are determined via measuring various variables in each ICS. These variables include the dorsal and ventral visible margins and size of the liver, the diameter of the caudal vena cava and portal vein, the thickness of the liver at the level of these two veins, the angle of the liver and others. The measurements are made as described in detail elsewhere (Braun and Steininger, 2011). The dorsal and ventral visible margins and size of the liver are determined by measuring the distances of the margins from the dorsal midline analogous to the method described for the rumen (Fig. 1). The

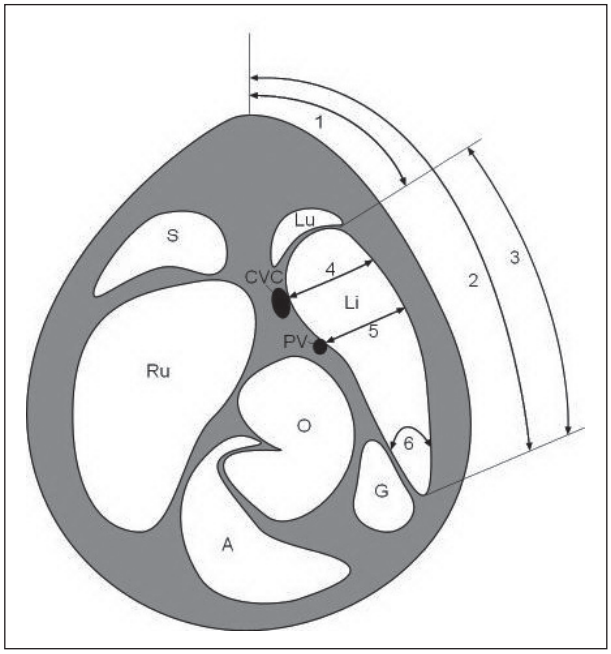

Figure 1: Schematic representation of determination of the position and size of the liver in goats on a cross section in the 11th intercostal space. Lu Lung, Li Liver, G Gallbladder, S Spleen, Ru Rumen, O Omasum, A Abomasum, CVC Caudal vena cava, PV Portal vein, 1 Distance between midline of the back and dorsal limit of liver, 2 Distance between ventral limit of liver, 3 Size of liver, 4 Depth of caudal vena cava, 5 Depth of portal vein, 6 Angle of liver. (Reproduced from Braun and Steininger, 2011).

diameters of the caudal vena cava and portal vein and the thickness of the liver were measured electronically by means of the two electronic calipers on frozen images.
Depending on the case, centesis of the gallbladder may be carried out under ultrasonographic guidance and the aspirated bile examined microscopically, as described in cattle. A liver biopsy may be carried out and if a liver abscess is suspected, the lesion can be aspirated and the sample examined microscopically.

Ultrasonographic findings of the liver

The liver can always be imaged on the right side, and in Saanen goats it was always visible from the 7th to the 9th ICS (Steininger, 2009; Braun and Steininger, 2011). From the 5th and 6th and the 10th to the 12th ICS the liver is seen only in some of the goats. The parenchymal pattern of the normal liver consists of numerous fine echoes homogeneously distributed over the entire area of the organ (Fig. 2). The dorsal visible margin of the liver runs parallel to the border of the lung in a cranioventral to caudodorsal direction (Fig. 3). In adult Saanen goats, the distance between the dorsal visible margin of the liver and the dorsal midline is largest at the 5th ICS measuring 29 to 33 cm (31.4 ± 1.52 cm) and progressively decreases in a caudal direction because the liver becomes less obscured by the lungs (Braun and Steininger, 2011) (Tab. 1). At the 12th ICS the dorsal margin is only 7 to 10 cm (7.9 ± 1.28 cm) from the dorsal midline. The distance between the ventral margin of the liver and the dorsal midline is largest at the 5th ICS and shortest at the 12th ICS. The visible extent of the liver is largest at the 7th and 8th ICSs measuring on average 15.9 cm and progressively decreases cranially and caudally. The mean thickness of the liver is smallest in the 6th ICS (3.9 ± 0.94 cm) and greatest in the 10th ICS (5.2 ± 0.79 cm). The angle of the liver, formed in the ventral portion of the liver by the diaphragmatic and visceral surfaces, ranges from 27.5 to 47.4° at the different ICSs.
The caudal vena cava has a triangular shape in cross section because it is embedded in the sulcus of the vena cava in the liver (Fig. 4). The vein is seen in about 75 % of all goats, usually limited to the 11 or 12th ICS. Further cranially the caudal vena cava can usually not be seen because of superimposition of the lungs. The distance between the vein and the parietal surface of the liver ranges from 4 to 9 cm and the diameter of the vein ranges from 0.8 to 2.5 cm. The vessels that are seen in cross section medial to the caudal vena cava outside of the liver parenchyma are the common trunk of the left gastric and splenic veins or veins that individually drain those two organs before their junction as a common trunk. These veins are usually circular in cross section.
The portal vein always has a more ventral position and is closer to the liver surface than the caudal vena cava. It is circular to oval in cross section with stellate ramifications into the liver parenchyma (Fig. 5). In contrast to the caudal vena cava, the portal vein is seen in all ICSs in which liver parenchyma is visible except for the 5th ICS. The mean diameter increases from 0.8 cm cranially to 1.7 cm caudally. The mean distance between the portal vein and the peritoneum ranges from 2.8 to 4.9 cm.
The gallbladder is pear-shaped and sometimes extends beyond the ventral margin of the liver depending on the amount of bile (Fig. 6). The gallbladder is seen in 90 % of all goats and usually only from the 9th or 10th ICS.

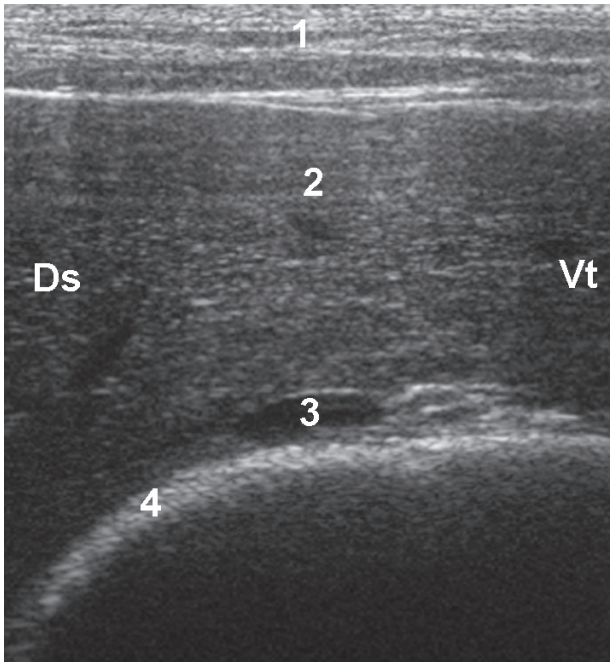

Figure 2: Ultrasonogram of the liver parenchyma viewed from the 10th intercostal space on the right side in a 3.5-year-old Saanen goat. 1 Lateral abdominal wall, 2 Liver parenchyma, 3 Portal vein, 4 Omasum, Ds Dorsal, Vt Ventral, Md Medial. (Reproduced from Braun and Steininger, 2011).

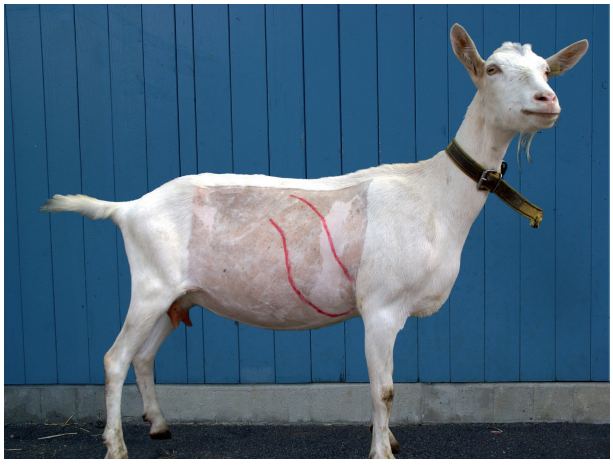

Figure 3: Saanen goat showing the dorsal and ventral margins of the liver between the 5th and 12th intercostal spaces. The drawing corresponds to the mean values for the dorsal and ventral margins of the liver of 27 Saanen goats. (Reproduced from Braun and Steininger, 2011).

Table 1: Results of ultrasonographic examination of the liver in 27 female Saanen goats (mean ± SD, range in brackets) (reproduced from Braun and Steininger, 2011).

Variable	Intercostal space							
	5 (n = 5)	6 (n = 24)	7 (n = 27)	8 (n = 27)	9 (n = 27)	10 (n = 25)	11 (n = 19)	12 (n = 6)
Dorsal liver margin (cm)	31.4 ± 1.52 (29.0–33.0)	28.8 ± 2.80 (22.0–33.0)	25.1 ± 2.91 (19.0–29.5)	20.9 ± 2.94 (15.5–27.5)	17.0 ± 2.59 (11.0–20.5)	13.5 ± 2.79 (7.0–18.0)	9.7 ± 2.10 (6.0–14.0)	7.9 ± 1.28 (7.0–10.0)
Ventral liver margin (cm)	39.1 ± 6.28 (33.5–49.0)	41.3 ± 4.98 (29.5–51.0)	41.0 ± 4.23 (30.5–50.0)	36.8 ± 4.81 (28.0–46.0)	32.1 ± 4.53 (24.0–41.0)	27.0 ± 5.37 (18.0–43.0)	20.9 ± 4.61 (15.5–35.0)	18.5 ± 3.78 (13.5–23.0)
Size of liver (cm)	7.7 ± 6.66 (0.5–17.0)	12.9 ± 4.18 (6.5–22.5)	15.9 ± 3.72 (10.0- 23.5)	15.9 ± 4.74 (9.0–28.5)	15.2 ± 4.13 (6.0–22.0)	13.5 ± 3.98 (7.0–25.0)	11.2 ± 4.21 (4.0–22.0)	10.6 ± 3.35 (6.5–15.5)
Thickness of liver (cm)	NE	3.9 ± 0.94 (1.9–5.5)	4.6 ± 1.00 (3.3–7.0)	5.0 ± 0.95 (3.5–6.7)	5.0 ± 0.91 (3.5–6.7)	5.2 ± 0.79 (3.5–6.7)	5.0 ± 1.30 (1.4–6.4)	4.5[1]
Angle of liver (degree)	29.0 ± 6.56 (22.0–35.0)	27.5 ± 5.62 (17.0–40.0)	28.8 ± 5.96 (15.0–40.0)	32.6 ± 5.91 (19.0–43.0)	30.5 ± 6.68 (15.0–40.0)	33.5 ± 8.26 (20.0–53.0)	35.8 ± 10.56 (20.0–64.0)	47.4 ± 6.03 (40.0–55.0)
Hemi circumference of abdomen (cm)	44.4 ± 4.93 (38.0–50.0)	44.6 ± 6.50 (17.5–51.0)	45.2 ± 6.01 (18.0–52.0)	46.0 ± 5.59 (22.0–53.0)	47.4 ± 5.44 (26.0–55.0)	48.3 ± 5.69 (27.0–58.0)	49.8 ± 6.35 (29.0–59.0)	52.6 ± 5.08 (43.0–59.0)

NE Not examined because the portal vein could not be seen
[1] In the 12th intercostal space the thickness of the liver could be determined only in one goat, because the portal vein was visible only in one goat.

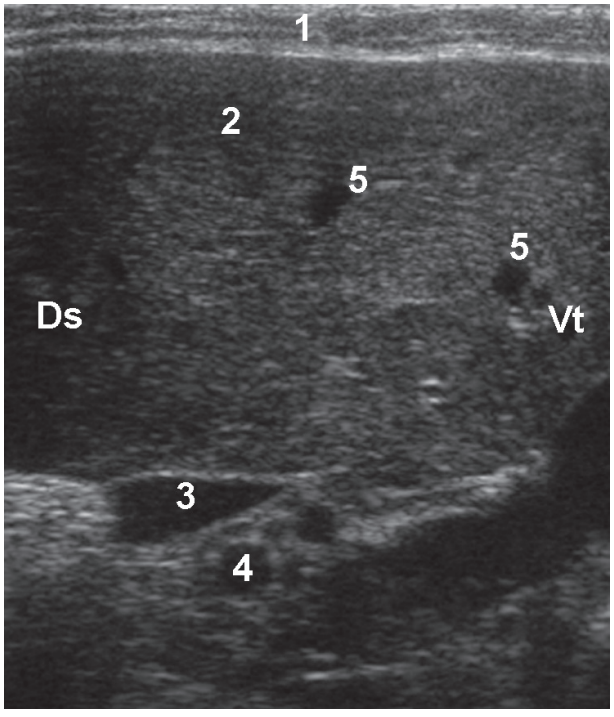

Figure 4: Ultrasonogram of the caudal vena cava viewed from the 12th intercostal space on the right side in a four-year-old Saanen goat. The caudal vena cava has a triangular shape on cross section. 1 Lateral abdominal wall, 2 Liver parenchyma, 3 Caudal vena cava, 4 Common trunk of left gastric vein and splenic vein, 5 Liver veins, Ds Dorsal, Vt Ventral. (Reproduced from Braun and Steininger, 2011).

Its size depends on the amount of bile. The width ranges from 0.8 to 3.0 cm and the length from 2.3 to 6.2 cm. The content is hypo- or anechoic. The intrahepatic bile ducts, the common hepatic duct and the common bile duct cannot usually be seen.

Spleen

Indications for ultrasonography of the spleen

Indications include goats suspected of having a splenic tumour or abscess; however, in contrast to cattle the latter is very uncommon in goats because traumatic reticuloperitonitis is rare.

Technique of ultrasonography of the spleen

For the ultrasonographic examination of the spleen, the goat is scanned from the ICSs on the left from dorsal to ventral with the linear transducer held parallel to the ribs (Steininger, 2009; Braun and Steininger, 2010), analogous to the technique described in cattle (Braun and Sicher, 2006). First the appearance of the splenic capsule and the parenchymal pattern are assessed subjectively. This is followed by measuring the extent of the spleen in each ICS and the overall size and thickness of the spleen. To determine the extent, the distances between the dorsal and ventral visible margins of the spleen and the dorsal midline are measured in each ICS, and the former is subtracted from the latter, as described in cattle (Braun and Steininger, 2010).

Results of ultrasonography of the spleen

The spleen can almost always be visualized from the 11th and 12th ICSs and very often also from the 8th to 10th ICSs and immediately caudal to the last rib. It is situated between the rumen and the abdominal wall and in the 8th ICS is also adjacent to the cranial blind sac of the rumen. Dorsally the parietal surface of the spleen is in direct contact with the lungs. The spleen is surrounded by an echoic capsule, and the parenchymal pattern consists of numer-

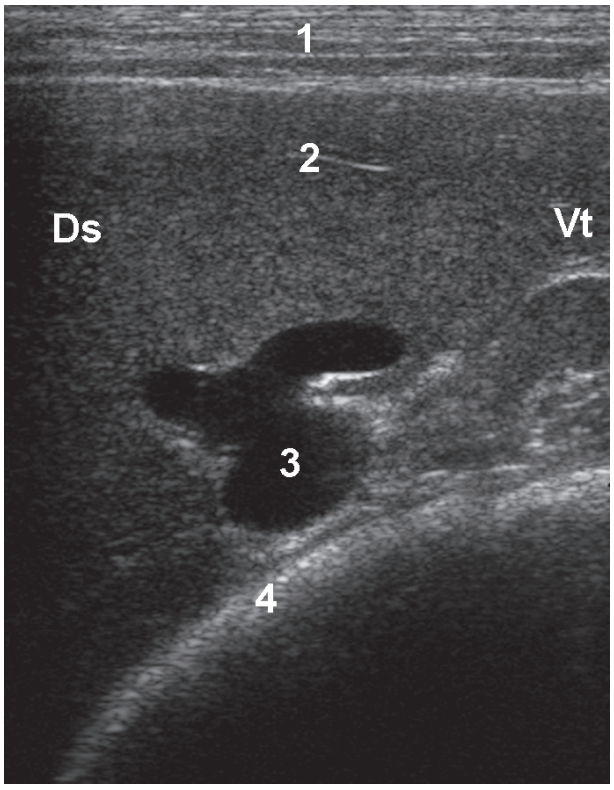

Figure 5: Ultrasonogram of the portal vein viewed from the 9th intercostal space on the right side in a three-year-old Saanen goat. The portal vein is circular on cross section with two ramifications branching into the liver parenchyma. 1 Lateral abdominal wall, 2 Liver parenchyma, 3 Portal vein, 4 Omasum, Ds Dorsal, Vt Ventral. (Reproduced from Braun and Steininger, 2011).

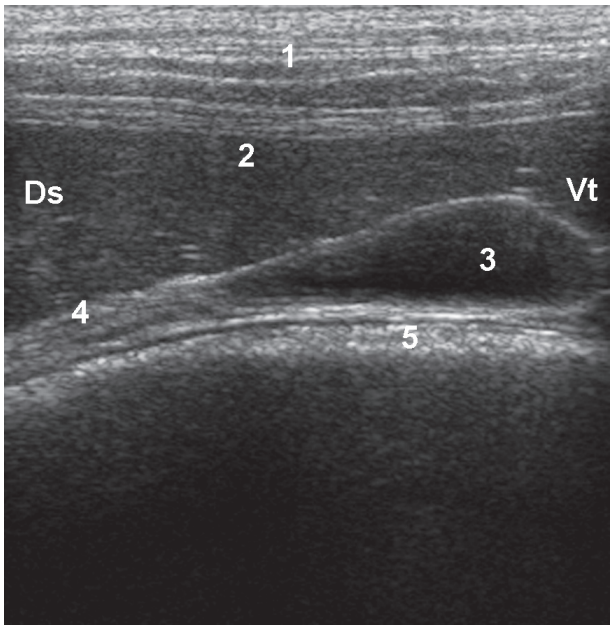

Figure 6: Ultrasonogram of the gallbladder viewed from the 9th intercostal space on the right side in a three-year-old Saanen goat. The gallbladder is located on the visceral surface of the liver and appears pear-shaped. The cystic duct appears as an echoic structure with a narrow lumen. 1 Lateral abdominal wall, 2 Liver parenchyma, 3 Gallbladder, 4 Cystic duct, 5 Omasum, Ds Dorsal, Vt Ventral, Md Medial. (Reproduced from Braun and Steininger, 2011).

ous weak echoes distributed homogeneously through the entire organ (Fig. 7). The splenic vessels are embedded in the parenchyma and are seen in longitudinal or cross section and have a diameter ranging from 0.07 to 0.57 cm (Braun and Steininger, 2010). The dorsal visible margin of the spleen runs from cranioventral to caudodorsal because of superimposition of the lungs (Fig. 8), analogous to the liver. The distance between the dorsal visible margin of the spleen and the dorsal midline was therefore greatest at the 8th ICS and smallest immediately caudal to the last rib. The ventral margin has a similar course. The dorsoventral extent of the spleen is smallest in the 8th ICS measuring from 2 to 5 cm and largest in the 11th ICS measuring up to 15 cm (Braun and Steininger, 2010). The thickness of the spleen ranges from 0.5 to 9.5 cm.

Urinary tract

Indications for ultrasonography of the urinary tract

There have been numerous reports on ultrasonography of the urinary tract in healthy and diseased cattle and sheep

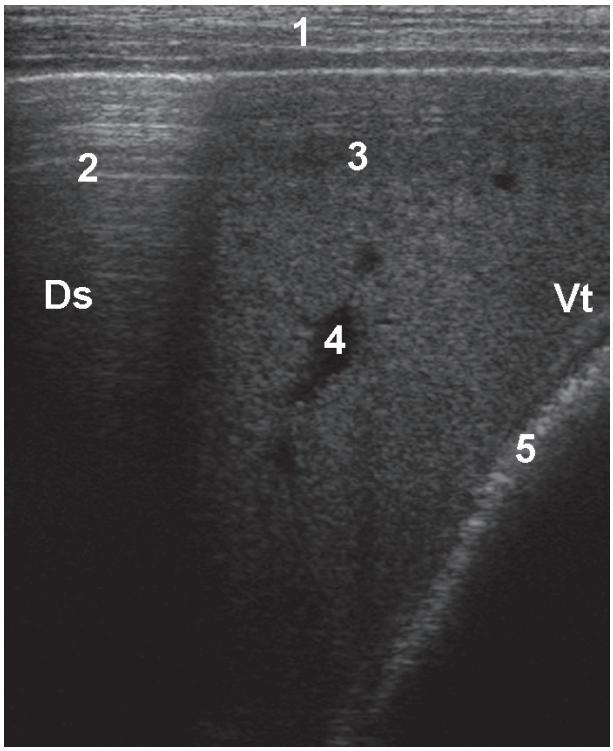

Figure 7: Ultrasonogram of the splenic parenchyma of a 3.5-year-old Saanen goat viewed from the 11th intercostal space. 1 Lateral abdominal wall, 2 Lung, 3 Splenic parenchyma, 4 Spleen vessel, 5 Rumen, Ds Dorsal, Vt Ventral. (Reproduced from Braun and Steininger, 2010).

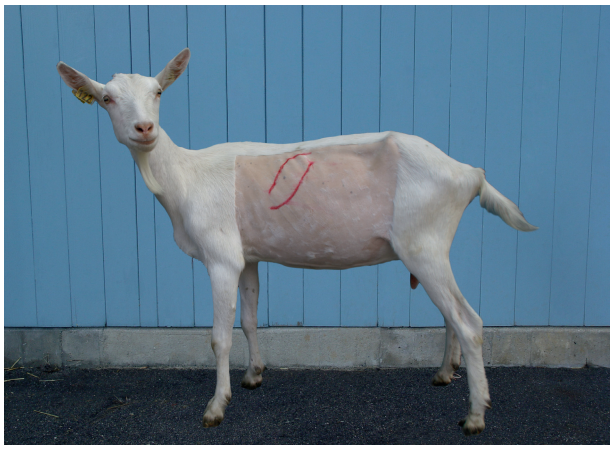

Figure 8: The dorsal and ventral margins of the spleen have been drawn from the 8th intercostal space to just caudal to the last rib on a Saanen goat. The outline corresponds to the mean positions of the dorsal margins of the spleen and ventral margins of the spleen in 30 goats. (Reproduced from Braun and Steininger, 2010).

(cited in Steininger and Braun, 2012) but this technique has only recently been described in goats (Steininger, 2010; Steininger and Braun, 2012). Analogous to reports in cattle and sheep, indications for urinary tract sonography include animals suspected of suffering from diseases of the kidneys, ureters, urinary bladder and urethra. Analogous to rams, the principal urinary tract disorder in the buck is obstructive urolithiasis.

Technique of ultrasonography of the urinary tract

As described previously in detail (Steininger and Braun, 2012), examination of the urinary tract is carried out from a number of locations, most importantly from the flank and the last two ICSs on the right. From these locations, the right kidney and in most goats also the left kidney can be seen. The urinary bladder and the urethra can be visualized transrectally but also from the left or right inguinal region. The same equipment that is used for other organs is used for the transcutaneous examinations, but the transrectal examinations is best carried out using a 5.0 to 7.5-MHz bar-shaped endocavity probe. The kidneys are first examined in various longitudinal planes with the transducer held parallel to the longitudinal axis of the organ and then in different cross sectional planes with the transducer held accordingly. The last two ICSs and the area immediately caudal to the last rib are scanned for the right kidney, and the right as well as the left dorsal flanks are scanned to locate the left kidney. The location and appearance of the surface of the kidney and the echogenicity of the renal cortex, medulla and sinus are assessed subjectively and the visualisation of the renal hilus and ureter are evaluated. The kidneys are then measured longitudinally and transversely on the frozen sonographic image by means of the electronic calipers. The thickness of the kidney between the renal capsule and medulla is measured in the longitudinal plane in the region of the medullary pyramids. The diameter of the three largest medullary pyramids is also measured. Using frozen images of cross sections of the kidney, the thickness (distance between dorsal and ventral surfaces) and width (distance between medial and lateral surfaces) of the kidney, the thickness of the renal tissue (distance between renal sinus and capsule measured from dorsal to ventral) and the dimension of the renal sinus are determined. An attempt is made to visualize the ureters from the right flank and the junction of the ureters with the bladder transrectally.

The urinary bladder is examined transrectally using a 5.0-MHz endocavity probe and from the inguinal regions using a 5.0-MHz linear transducer. The lumen, content and bladder wall are assessed subjectively and the length, maximum diameter and wall thickness are measured by means of the electronic cursors. The visualisation of the urethra is examined transrectally.

Ultrasonographic findings of the urinary tract

A study of Saanen goats has shown that the right kidney can only be seen from the right (Steininger and Braun, 2012). The best site is the dorsal region of the 12th ICS but in about 25 % of goats the right kidney can also be seen from the 11th ICS and from the craniodorsal flank. The right kidney is almost always oriented with its long axis parallel to the ribs and only rarely perpendicular to the ribs. The left kidney is also seen in most goats from the right and only rarely from the left; occasionally it cannot be seen from either side. From the right, the left kidney is most often seen from the dorsal flank and very rarely also in the last ICS. From the left, the left kidney may rarely be seen from the dorsal flank. The longitudinal axis of the left kidney is usually parallel to the vertebral column. The renal capsule may appear as a delicate echoic line but it is not always distinct. The ultrasonographic appearance of the kidneys varies with the sectional plane. In a sagittal plane through the hilus, the kidney has an oblong oval shape and the parenchyma is homogeneous with fine, evenly-distributed echoes (Fig. 9). The medullary pyramids are seen near the sinus as oval to circular hypoechoic structures. The sinus is at the centre of the kidney and is hyperechoic. In longitudinal section through the medullary pyramids, the kidney also has an oblong oval shape, and the renal cortex is distinct and easily differentiated from the renal medulla and the medullary pyramids (Fig. 10). The latter are arranged at the centre and have an echoic border and a hypoechoic to anechoic centre surrounded by echoic renal columns (*columnae renales*). The interlobar veins and arteries are seen as elongated hypoechoic filamentous structures between the medullary pyramids. In cross section, the kidneys appear as oval to circular structures with an echoic capsule (Fig. 11). The renal sinus is represented on ultrasonograms by a hyperechoic band. Oblong hypoechoic structures within the re-

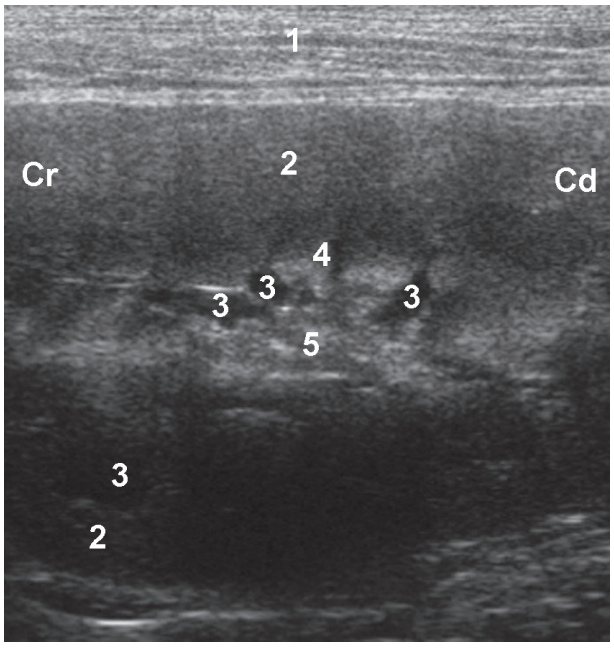

Figure 9: Ultrasonogram of the left kidney in longitudinal section through the hilus in the sagittal plane viewed from the right craniodorsal flank in a three-year-old female Saanen goat. 1 Lateral abdominal wall, 2 Renal cortex, 3 Medullary pyramids, 4 Interlobar vessels, 5 Renal sinus, Cr Cranial, Cd Caudal. (Reproduced from Steininger and Braun, 2012).

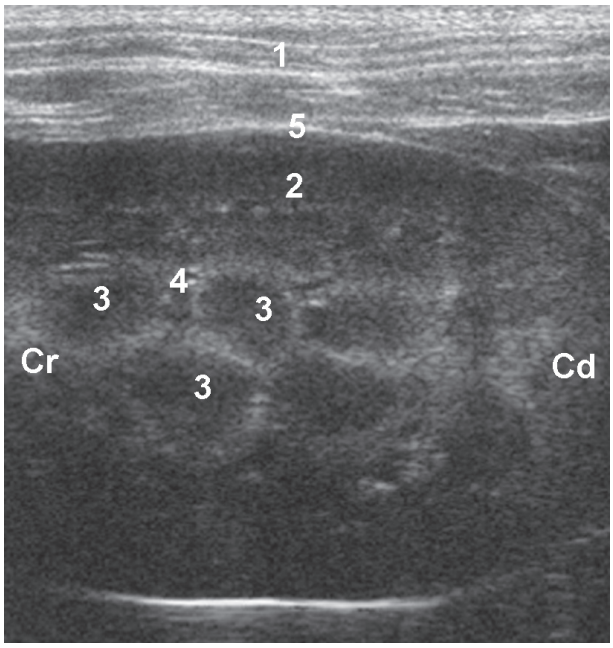

Figure 10: Ultrasonogram of the left kidney in longitudinal section through the region of the medullary pyramides viewed from the right craniodorsal flank in a three-year-old female Saanen goat. 1 Lateral abdominal wall, 2 Renal cortex, 3 Medullary pyramids, 4 Interlobar vessels, 5 Renal capsule, Cr Cranial, Cd Caudal. (Reproduced from Steininger and Braun, 2012).

nal sinus correspond to the renal artery and vein and the ureter. The parenchyma is homogeneous and echogenic.
The length of the right kidney ranges from 6.6 to 9.4 cm (8.0 ± 0.67 cm), the width from 3.9 to 6.4 cm (5.2 ± 0.75 cm) and the thickness from 3.2 to 5.5 cm (4.3 ± 0.63 cm) (Tab. 2). The thickness of the cortex varies from 0.4 to 1.3 cm (0.9 ± 0.21 cm), the thickness of the renal parenchyma from 1.0 to 3.6 cm (1.8 ± 0.53 cm) and the length of the renal sinus from 0.5 to 1.2 cm (0.9 ± 0.19 cm). The diameter of the medullary pyramids ranges from 0.7 to 2.0 cm (1.2 ± 0.24 cm). The left and right kidneys have similar dimensions (Tab. 2).
Normal non-dilated ureters cannot be visualised from the flanks or transrectally. The urinary bladder is best visualised transrectally but can also be seen in many goats from either inguinal region (Fig. 12). The wall of the bladder is seen as an echoic line that is smooth on both sides and between 0.8 and 2.3 mm (1.4 ± 0.38 mm) thick. The bladder is between 2.4 and 7.2 cm long and has a diameter ranging from 1.0 to 4.8 cm. The content of the bladder is normally anechoic. In about 80 % of goats, the urethra is seen transrectally as two adjacent parallel echoic lines, but the lumen cannot normally be seen.

Greater omentum

The greater omentum can be seen in all goats and appears as a homogenously echoic structure with small hypoecho-

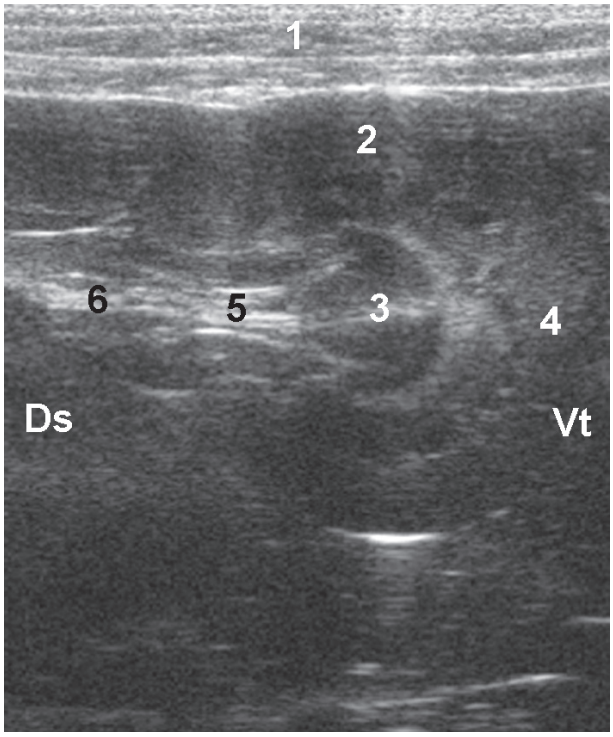

Figure 11: Ultrasonogram of the left kidney in cross section viewed from the right craniodorsal flank in a three-year-old female Saanen goat. 1 Lateral abdominal wall, 2 Renal cortex, 3 Renal medulla 4 Arcuate artery and vein, 5 Renal sinus, 6 Renal hilus, Ds Dorsal, Vt Ventral, Md Medial. (Reproduced from Steininger and Braun, 2012).

Table 2: Measurements of the kidneys in 29 female Saanen goats ($\bar{x} \pm s$, range in brackets) (reproduced from Steininger and Braun, 2012).

Variable	Right kidney	Left kidney
Length of kidney (cm)	n = 28 8.0 ± 0.67 (6.6 – 9.4)	n = 27 8.4 ± 0.64 (6.4 – 9.7)
Width of kidney (cm)	n = 26 5.2 ± 0.75 (3.9 – 6.4)	n = 25 5.0 ± 0.64 (3.9 – 6.3)
Thickness of kidney (cm)	n = 26 4.3 ± 0.63 (3.2 – 5.5)	n = 25 4.4 ± 0.55 (3.1 – 5.6)
Thickness of renal cortex (cm)	n = 28 0.9 ± 0.21 (0.4 – 1.3)	n = 27 1.0 ± 0.22 (0.6 – 1.4)
Thickness of renal parenchyma (cm)	n = 25 1.8 ± 0.53 (1.0 – 3.6)	n = 25 1.7 ± 0.41 (1.1 – 3.2)
Thickness of renal sinus (cm)	n = 25 0.9 ± 0.19 (0.5 – 1.2)	n = 25 0.9 ± 0.25 (0.4 – 1.5)
Diameter of medullary pyramid 1 (cm)	n = 28 1.2 ± 0.27 (0.7 – 1.8)	n = 25 1.2 ± 0.18 (0.9 – 1.5)
Diameter of medullary pyramid 2 (cm)	n = 27 1.2 ± 0.21 (0.8 – 1.7)	n = 25 1.2 ± 0.24 (0.9 – 1.8)
Diameter of medullary pyramid 3 (cm)	n = 27 1.3 ± 0.24 (0.9 – 2.0)	n = 25 1.2 ± 0.24 (0.8 – 1.8)

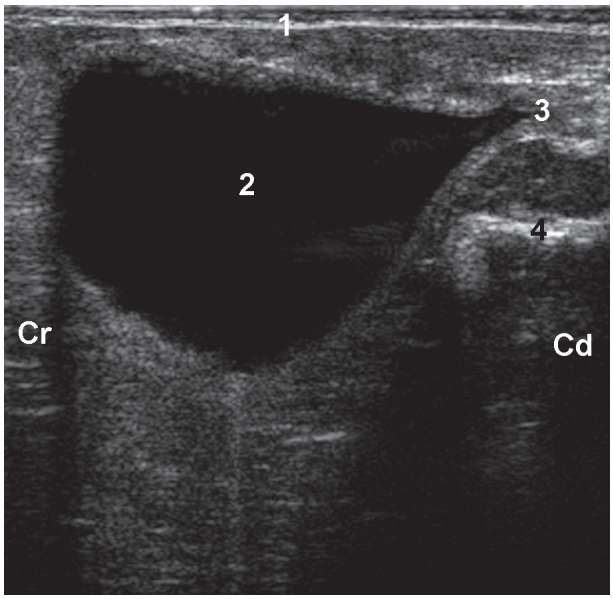

Figure 12: Ultrasonogram of the urinary bladder and urethra of a three-year-old Saanen goat viewed transrectally. 1 Rectal mucosa, 2 Urinary bladder, 3 Neck of bladder, 4 Brim of pelvis, Ds Dorsal, Vt Ventral, Cr Cranial, Cd Caudal. (Reproduced from Steininger and Braun, 2012).

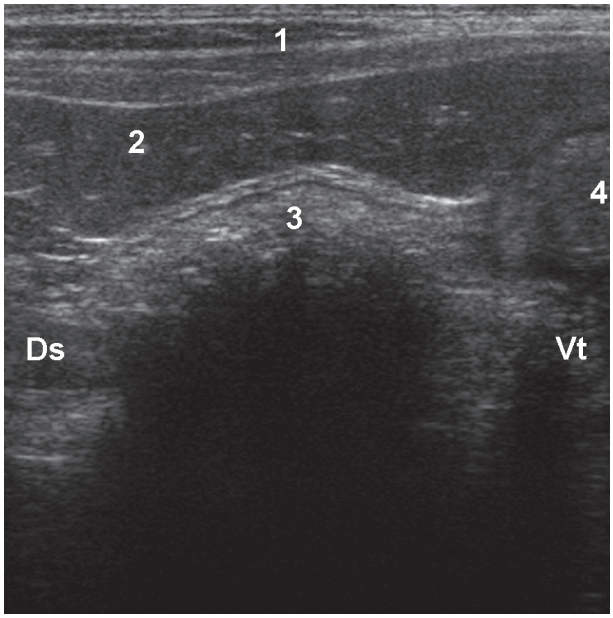

Figure 13: Ultrasonogram of the greater omentum viewed from the right flank in a female Saanen goat. 1 Lateral abdominal wall, 2 Greater omentum, 3 Large intestine, 4 Small intestine, Ds Dorsal, Vt Ventral.

ic foci, which correspond to blood vessels (Fig. 13). The greater omentum is situated immediately adjacent to the abdominal wall, and visualisation increases from cranial to caudal. The thickness of the greater omentum ranges from 0.2 to 2.9 cm (1.0 ± 0.51 cm).

Reproductive tract

Numerous publications have dealt with the ultrasonographic examination of the reproductive tract of goats. This chapter is limited to a brief synopsis. Indications for uterine sonography include pregnancy diagnosis, estimation of the duration of pregnancy and fetal sexing (Karen et al., 2009; Amer, 2010; Gonzales-Bulnes et al., 2010; Neto et al., 2010; Erdogan, 2012). Ultrasonography has been used to monitor uterine involution (Ababneh and Degefa, 2005) and to diagnose uterine diseases such as hydrometra (Waldow, 1999; Batista et al., 2001, 2006) and hydrallantois (Morin et al., 1994). Ultrasonography is ideal for monitoring ovarian activity in relation to various zootechnical procedures (Haruna et al., 2009; Wang et al., 2009; Bedos et al., 2010; Zabuli et al., 2010; de Sousa et al., 2011; Holtz et al., 2012). One report described the distribution of corpora lutea and follicular dynamics in pregnant goats (Schwarz and Wierzchoś, 2009) and another the diagnosis of ovarian follicular cysts (Medan et al., 2004). Ultrasonography was also used to document a case of hydrosalpinx in a goat (Janett et al., 2001).

Examen échographique de l'abdomen de la chèvre: II. foie, rate, appareil urinaire, omentum

On décrit dans cette revue les images échographiques du foie, de la rate, de l'appareil urinaire et de l'omentum chez la chèvre. L'examen de ces organes a lieu sur l'animal debout, depuis les deux côtés du corps, au moyen d'une sonde linéaire ou convexe avec une fréquence comprise entre 5 et 7.5 MHz. La vessie et l'urètre sont en outre examinés par voie transrectale. Le foie est examiné par les espaces intercostaux du côté droit, de dorsalement à ventralement. Le type de structure du foie normal se compose de nombreux échos fins, situés à intervalle régulier les uns des autres et qui remplissent les contours du foie. La limite dorsale du foie est parallèle à l'extension des poumons de cranioventral à caudodorsal. L'extension maximale du foie se situe au niveau des espaces intercostaux 7 et 8. C'est dans le 10ème espace intercostal qu'il est le plus épais. La veine cave inférieure présente en coupe une forme triangulaire. Elle ne peut être vue que dans le 11ème ou le 12ème espace intercostal. La veine porte est ronde à ovale en coupe et présente une ramification en étoile de ses rameaux dans le parenchyme hépatique. La vésicule biliaire à une forme de poire et dépasse, de façon variable suivant son remplissage, le bord ventral du foie. Elle n'est la plupart du temps visible que par un seul espace intercostal, le 9ème ou le 10ème. La rate est examinée par les espaces intercostaux gauches, où elle peut pratiquement être toujours vue dans le 11ème et le 12ème. La pulpa splénique se présente de façon similaire à celle du foie. A l'intérieur de cette pulpe on trouve les vaisseaux spléniques, visibles en coupes longitudinales et transverses. Les reins sont visible au mieux depuis le flanc droit et par les deux derniers espaces intercostaux droits. Ils se présentent, selon le plan de coupe, de façon variable. Dans une coupe longitudinale sagittale par le hile, le parenchyme rénal est homogène avec des échos réguliers, répartis finement. Près du sinus, on voit les pyramides médullaires comme des structures peu échogènes, rondes à ovales. Au centre du rein se trouve le sinus renalis, structure hyperéchogène. La vessie peut être visualisée au mieux par voie transrectale; elle peut cependant être également vue chez beaucoup de chèvres par la région inguinale gauche ou droite. Son contenu est normalement peu échogène et son diamètre de 1.0 à 4.8 cm. L'urètre est visible par voie transrectale comme deux lignes échogènes parallèles proches l'une de l'autre, sans lumière visible.

Esame ecografico dell'addome della capra. II. fegato, milza, sistema urinario, circolazione

In questo studio vengono descritti i risultati ecografici di fegato, milza, sistema urinario e circolazione nella capra. L'esame ecografico di questi organi avviene con l'animale in piedi, da entrambi i lati del corpo con un trasduttore lineare o convesso e con una frequenza compresa tra 5.0 e 7.5 MHz. La vescica e dell'uretra sono esaminate per via transrettale. Il fegato viene esaminato negli spazi intercostali del lato destro del corpo da dorsale a ventrale. La struttura interna tipica del fegato normale consiste di numerosi echi sottili, a distanza uniforme l'uno dall'altro e che riempiono il profilo del fegato. Il limite posteriore del fegato è parallelo all'espansione dei polmoni da cranioventrale in direzione caudodorsale. L'espansione del fegato è maggiore negli spazi intercostali 7 e 8. Il fegato è il più spesso nel 10 spazio intercostale. La vena cava caudale nella sezione trasversale è di forma triangolare. È riconoscibile solo nel 11 o 12 spazio intercostale. La vena portale è, nella sezione trasversale, da tonda a ovale e presenta una forma a stella ramificata dei rami della vena portale all'interno del parenchima epatico. La cistifellea è a forma di pera e sporge oltre il margine ventrale del fegato in misura diversa a seconda dello stato di riempimento. Di solito è visibile solo in uno, il 9 o il 10 spazio intercostale. La milza è esaminata negli spazi intercostali sul lato sinistro del corpo dove può essere sempre individuabile negli spazi intercostali 11 e 12. La polpa della milza ha un parenchima simile a quello del fegato. Incorporati nella polpa della milza, vi sono i vasi splenici, che possono essere osservati in sezione longitudinale e trasversale. I reni possono essere più distinguibili dal fianco destro e negli ultimi due spazi intercostali sulla destra. I reni sono rappresentati differentemente a seconda della sezione. Nella sezione sagittale longitudinale attraverso l'ilo, il parenchima renale si mostra omogeneo e con regolari, echi interni finemente distribuiti. Accanto al seno si trovano le piramidi midollari con strutture da tonde a ovali, ipoecogene. Al centro del rene, si trova il seno renale è una struttura iperecogena. La vescica è più riconoscibile in via transrettale anche se in molte capre, può essere visibile anche nella regione inguinale destra o sinistra. Il suo contenuto è solitamente ipoecogeno e il suo diametro è compreso tra 1.0 e 4.8 cm. L'uretra è distinguibile per via transrettale come due linee parallele ecogene contigue senza lume evidente.

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