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Computed tomography of the abdomen of calves during the first 105 days of life: III. Urinary tract and adrenal glands

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Summary

Computed tomographic (CT) findings of the urinary tract and adrenal glands of five healthy male calves in the first 105 days of life were compared with corresponding cadaver slices. The structures seen on CT images were identified using the corresponding cadaver slices. CT produced exact images of the kidneys, urinary bladder, urethra and adrenal glands, but reliable images of the ureters were only obtained near the renal hilus. There was excellent agreement between the structures on the CT images and the tissue slices. The structure and vessels of the kidneys, the origin of the ureters, the location, size and content of the urinary bladder and the course of the urethra in the pelvis and penis were evident on images. The size and volume of the kidneys and the length and width of the adrenal glands increased significantly during the study, but the ureteral and urethral diameters changed little.

Keywords: computed tomography, cattle, calf, urinary tract, kidney, urinary bladder, ureter, urethra, adrenal glands

Computertomographie des Abdomens von Kälbern vom ersten bis zum 105. Lebenstag: III. Harnapparat und Nebennieren

In der vorliegenden Arbeit werden die computertomographischen (CT) Befunde an Harnapparat und Nebennieren von 5 gesunden männlichen Kälbern von der Geburt bis zum Alter von 105 Tagen beschrieben und mit denjenigen der postmortalen Untersuchung verglichen. Nieren, Harnblase, Urethra und Nebennieren konnten computertomographisch exakt dargestellt werden, während die Ureteren nur im Bereich des Hilus renalis zuverlässig identifiziert werden konnten. Die Topographie der Organe bzw. der Strukturen und der anatomischen Schnittpräparate stimmten sehr gut überein. An den Nieren waren die Struktur und die Blutgefässe, an den Ureteren deren Anfangsteil, an der Harnblase Lage, Grösse und Inhalt und an der Urethra der Verlauf im Becken und Penis zu sehen. Die Ausdehnung und das Volumen der Nieren nahmen von der ersten bis zur sechsten Untersuchung signifikant zu. Das Gleiche gilt für die Länge und Breite der Nebennieren, während sich die Durchmesser von Ureteren und Urethra kaum veränderten.

Schlüsselwörter: Computertomographie, Rind, Kalb, Harnapparat, Niere, Harnblase, Ureter, Urethra, Nebennieren

Introduction

Computed tomography (CT) is an established imaging modality for the examination of the urinary tract in cats and dogs. It has also been used to study the urinary tract in adult goats by comparing transverse, dorsal and sagittal CT images with corresponding anatomical cadaver slices (Irmer, 2010; Braun et al., 2011c). Diagnostic procedures in calves with suspected urinary tract disorders include clinical examination, urinalysis, haematological analyses, radiography, cystoscopy (in nanny goats) and ultrasonography (Weisser, 2000). Computed tomography is indispensable for the diagnosis of urinary tract disorders in humans (Dobry and Danuser, 2009) and small animals. Because there have been no CT studies of the urinary tract in calves, the goal of this investigation was to document CT findings of the urinary tract in five healthy male calves in the first 105 days of life and to compare the findings with corresponding anatomical cadaver slices.

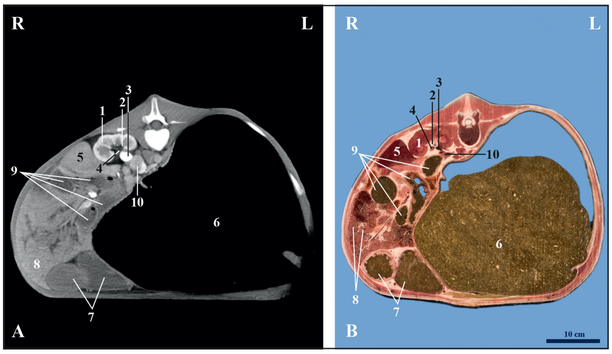

Figure 1: Comparison of a transverse CT image in a soft-tissue window setting (A) and the corresponding anatomical slice (B) at the level of the 3rd lumbar vertebra in a 104-day-old Holstein-Friesian bull calf. 1 Right kidney, 2 Renal sinus, 3 Renal vein, 4 Right ureter, 5 Liver, 6 Rumen, 7 Abomasum, 8 Small intestine, 9 Large intestine, 10 Caudal vena cava, L Left, R Right.

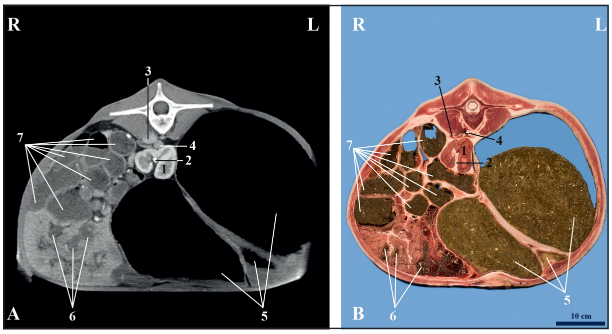

Figure 2: Comparison of a transverse CT image in a soft-window setting (A) and the corresponding anatomical slice (B) at the level of the 6th lumbar vertebra in a 104-day-old Holstein-Friesian bull calf. 1 Left kidney, 2 Left ureter, 3 Caudal vena cava, 4 Aorta, 5 Rumen, 6 Small intestine, 7 Large intestine, L Left, R Right.

Animals, Material and Methods

See communication I.

Kidneys

Depending on which plane provided the best images, the maximum length of the kidneys was determined in the sagittal or dorsal plane by measuring the distance between the cranial and caudal poles. The same plane was used to measure the maximum width of the kidneys, defined as the distance between the hilus and the lateral border. Multiple transverse sections were used to calculate the kidney volume (in cm^3) and to determine the parenchymal density in a 4-cm^2 area between the hilus and the lateral border (in HU) as described in detail (Schnetzler, 2012).

Ureters

The diameter of both ureters was measured near the kidney in the plane that provided the best images of the structures.

Urinary bladder

The distance between the apex of the bladder and the pelvic brim was measured in the sagittal plane. The density of the urine was determined in a 5-cm^2 area 5 mm from the bladder wall.

Urethra

The urethral diameter was measured in the transverse plane.

Adrenal glands

The maximum length and width of the adrenal glands were measured in the plane that provided the best images of these organs.

Results

All structures in the CT images could be accurately identified based on transverse, sagittal and horizontal anatomical cadaver sections (Fig. 1, 2). Visual comparison of the CT images with the corresponding cadaver slices was made in the transverse plane at each vertebra from the 6th thoracic vertebra to the middle part of the sacrum (Schnetzler, 2012).

Kidneys

Both kidneys were easily identified in all calves based on the unique pattern afforded by the reniculi. Contrast enhancement rendered the kidneys hyperdense relative to the surrounding tissue. The density of the renal cortex was greater than that of the medulla, and the renal pelvis was hypodense.

Left kidney

The left kidney extended from the 3rd lumbar vertebra to the sacrum but could only be identified consistently at the level of the 5th lumbar vertebra (Fig. 3). In all calves, it was seen from the 4th to the 6th lumbar vertebra at the first examination and from the 5th and 6th lumbar vertebra in the last examination. During the study period, it became displaced by the expanding dorsal sac of the rumen from the left side toward the median or sometimes into the right hemiabdomen (Fig. 4). In the dorsal and sagittal planes, the left renal artery was seen running from the aorta to the kidney and in the right paramedian re-

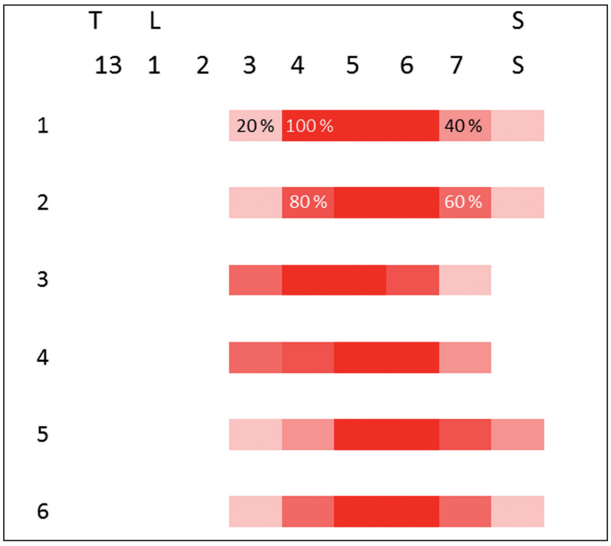

Figure 3: Visibility of the left kidney on transverse CT images in five Holstein-Friesian bull calves. The images were taken at different lumbar vertebrae and the sacrum during six CT scans in the first 104 days of life. The different shades of red indicate the number of calves in which the kidney was visible at the respective levels. 20 %, 40 %, 60 %, 80 % and 100 %, visible in 1, 2, 3, 4 and in all calves, respectively.

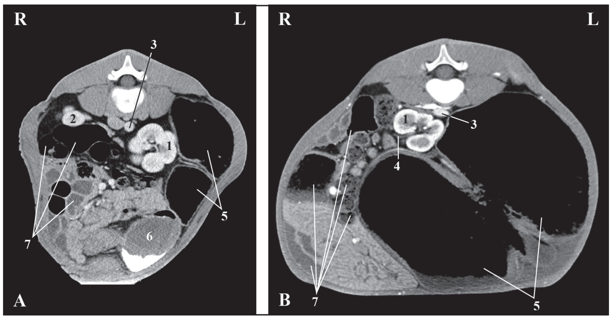

Figure 4: Transverse CT images of the abdomen at the level of the 1st lumbar vertebra in a one-day-old (A) and at the level of the 6th lumbar vertebra in a 104-day-old Holstein-Friesian bull calf (B). 1 Left kidney, 2 Right kidney, 3 Aorta, 4 Left ureter, 5 Rumen, 6 Abomasum, 7 Intestines, L Left, R Right.

gion, the left renal vein was observed running from the kidney to the caudal vena cava (Fig. 5, 6). Both blood vessels appeared as straight structures and were only a few centimetres in length. They had a cranioventral course to the renal hilus until the age of three weeks, when it changed to a craniodorsal course relative to the left kidney. The latter change was the result of displacement of the kidney to the right paramedian region by the rumen accompanied by a rotation of the renal hilus. The ureter was seen exiting from the hilar region. The left kidney

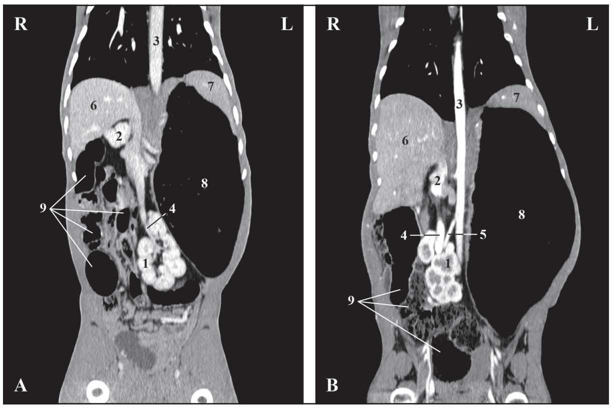

Figure 5: Dorsal CT images of the abdomen at the level of the aorta in a 21-day-old (A) and 103-day-old Holstein-Friesian bull calf (B). 1 Left kidney, 2 Right kidney, 3 Aorta, 4 Left renal vein, 5 Left renal artery, 6 Liver, 7 Spleen, 8 Rumen, 9 Intestines, L Left, R Right.

Table 1: CT measurements of the left kidney and left ureter in five Holstein-Friesian bull calves during the first 105 days of life (mean ± sd, range).

Variable	Examination 1	2	3	4	5	6
Length (cm)	10.8 ± 1.05 (9.2–11.8)	11.0 ± 1.72^{a} (9.0–12.6)	12.2 ± 1.57^{a} (10.4–13.5)	13.2 ± 1.11^{b,§} (11.6–14.0)	14.0 ± 1.13^{b} (12.7–15.5)	14.6 ± 1.09 (12.8–15.7)
Width (cm)	6.0 ± 0.65 (5.0–6.7)	5.9 ± 1.19^{a} (4.8–7.8)	7.6 ± 0.33^{a,§} (7.1–8.0)	7.6 ± 0.57 (7.0–8.5)	7.0 ± 0.93 (6.0–8.3)	7.1 ± 0.91 (6.3–8.4)
Volume (cm^3)	149.4 ± 23.64^{a} (116.5–177.2)	185.4 ± 29.51^{a,b,§} (142.0–224.4)	248.3 ± 26.63^{b,c} (217.4–283.7)	310.3 ± 28.5^{c} (278.4–348.9)	287.9 ± 31.97^{d} (248.7–332.9)	307.5 ± 32.67^{d} (272.8–358.0)
Parenchymal density (HU)	42.8 ± 3.15 (39.1–46.6)	44.6 ± 5.94 (34.9–49.2)	38.2 ± 4.77 (33.7–44.4)	38.8 ± 7.80 (29.7–50.3)	30.9 ± 11.7§ (14.0–46.4)	27.2 ± 11.81 (16.6–42.9)
Ureteral diameter (cm)	0.3 ± 0.08 (0.2–0.4)	0.3 ± 0.07 (0.2–0.4)	0.3 ± 0.07$^{\circ,a}$ (0.3–0.4)	0.3 ± 0.13^{a} (0.2–0.6)	0.5 ± 0.34° (0.3–1.0)	0.5 ± 0.12$^{\circ,\S}$ (0.4–0.7)

° Measured in 4 of 5 calves
^{a,b,c,d} Within rows measurements with identical indices are different ($P < 0.05$)
§ First significant difference compared with examination 1 ($P < 0.05$)

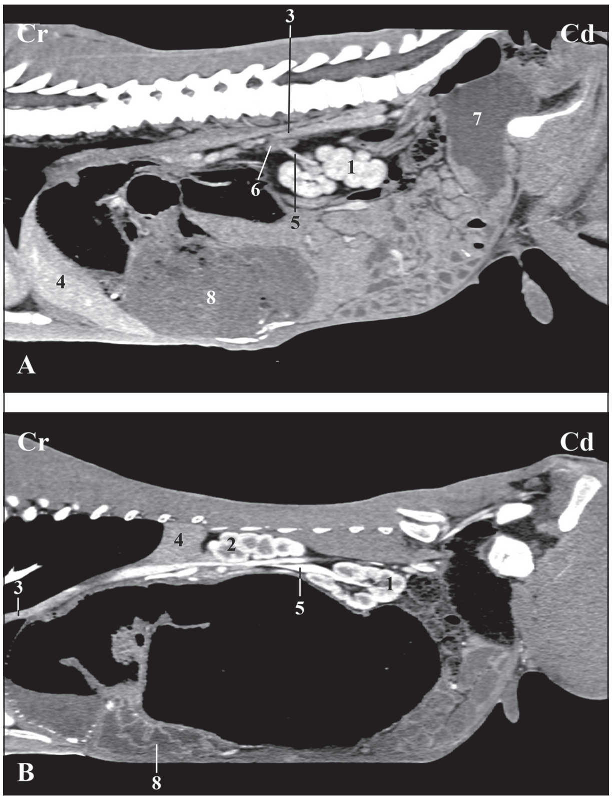

Figure 6: Sagittal CT images of the abdomen at the level of the left adrenal gland in a two-day-old (A) and at the level of the caudal vena cava in a 103-day-old Holstein-Friesian bull calf (B). 1 Left kidney, 2 Right kidney, 3 Caudal vena cava, 4 Liver, 5 Left renal vein, 6 Left adrenal gland, 7 Urinary bladder, 8 Abomasum, Cr Cranial, Cd Caudal.

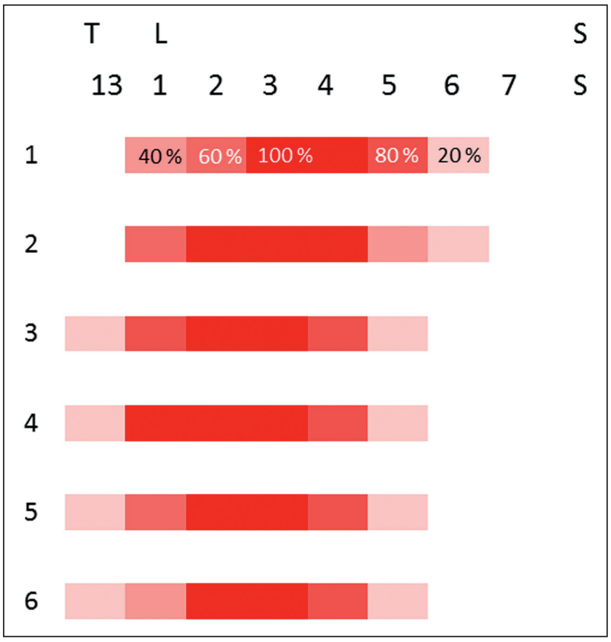

Figure 7: Visibility of the right kidney on transverse CT images in five Holstein-Friesian bull calves. The images were taken at different thoracic and lumbar vertebrae during six CT scans in the first 105 days of life. The different shades of red indicate the number of calves in which the right kidney was visible at the respective levels. 20 %, 40 %, 60 %, 80 % and 100 %, visible in 1, 2, 3, 4 and in all calves, respectively.

underwent significant growth during the study period; it was 10.8 cm long and 6.0 cm wide at the first examination and 14.6 cm long and 7.1 cm wide at the last examination ($P < 0.05$) (Tab. 1). During the same time period, the mean volume increased from 149.4 to 307.5 cm^3 ($P < 0.05$). The mean parenchymal density decreased significantly from 42.8 to 27.2 HU during the same period.

Right kidney

The right kidney was imaged from the 13th thoracic to the 6th lumbar vertebra (Fig. 7) but could only be seen consistently at the level of the 3rd lumbar vertebra. It was seen in all calves at the level of the 3rd and 4th lum-

Table 2: CT measurements of the right kidney and left ureter in five Holstein-Friesian bull calves during the first 105 days of life (mean ± sd, range).

Variable	Examination 1	2	3	4	5	6
Length (cm)	11.8 ± 1.03 (10.2–12.7)	11.9 ± 1.51[a] (9.5–13.3)	12.9 ± 1.52[a,b,§] (10.4–14.2)	14.3 ± 1.17[b,c] (12.5–15.7)	15.0 ± 1.32[c] (13.0–16.7)	15.7 ± 1.30 (13.7–17.0)
Width (cm)	6.4 ± 0.82 (5.4–7.2)	6.5 ± 0.77[a] (5.5–7.5)	7.1 ± 1.10[a] (5.3–8.3)	8.0 ± 0.74[§] (7.3–8.8)	7.7 ± 0.52 (7.2–8.6)	8.0 ± 0.77 (7.2–9.2)
Volume (cm^3)	147.5 ± 20.82[a] (125.6–182.0)	179.1 ± 26.55[a,b,§] (143.0–202.4)	238.0 ± 19.08[b,c] (213.3–262.1)	292.4 ± 17.00[c] (272.7–317.7)	270.9 ± 41.77[d] (225.0–339.2)	288.7 ± 43.22[d] (260.1–365.3)
Parenchymal density (HU)	45.2 ± 1.05 (44.6–47.1)	44.4 ± 5.53 (36.4–51.2)	35.9 ± 6.73[§] (29.7–44.0)	34.6 ± 8.6 (23.6–46.2)	30.5 ± 3.50 (26.8–34.5)	30.1 ± 11.64 (21.5–48.6)
Ureteral diameter (cm)	0.3 ± 0.07 (0.2–0.4)	0.3 ± 0.05 (0.3–0.4)	0.4 ± 0.20 (0.3–0.7)	0.4 ± 0.24 (0.3–0.9)	0.6 ± 0.20[§] (0.4–0.8)	0.7 ± 0.06 (0.6–0.8)

[a, b, c, d] Within rows measurements with idential indices are different ($P < 0.05$)
[§] First significant difference compared with examination 1 ($P < 0.05$)

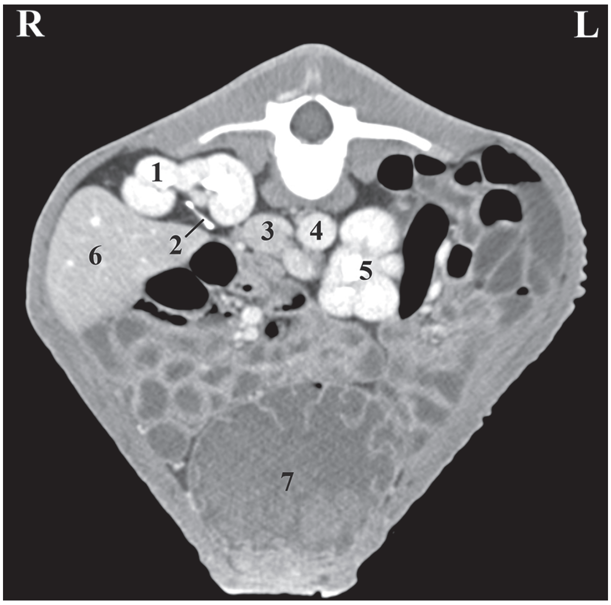

Figure 8: Transverse CT image of the abdomen at the level of the 4th lumbar vertebra in a one-day-old Holstein-Friesian bull calf. 1 Right kidney, 2 Right ureter, 3 Caudal vena cava, 4 Aorta, 5 Left kidney, 6 Liver, 7 Abomasum, L Left, R Right.

Figure 9: Dorsal CT image at the level of the aorta in a 104-day-old calf. 1 Right kidney, 2 Aorta, 3 Right renal vein, 4 Left kidney, 5 Urinary bladder, 6 Liver, L Left, R Right.

bar vertebrae at the first examination and from the 2nd thoracic to 3rd lumbar vertebra at the last examination. It was located retroperitoneally, embedded in perirenal fat, always in the right hemiabdomen cranial to the left kidney and in contact with the liver in the renal depression (Fig. 8–10). It appeared oval in all planes. As for the left kidney, the right renal artery and vein were seen medially. The hilus and ureter exiting from the left kidney were directed ventromedially. The length, width, volume and density of the right and left kidneys were similar (Tab. 2).

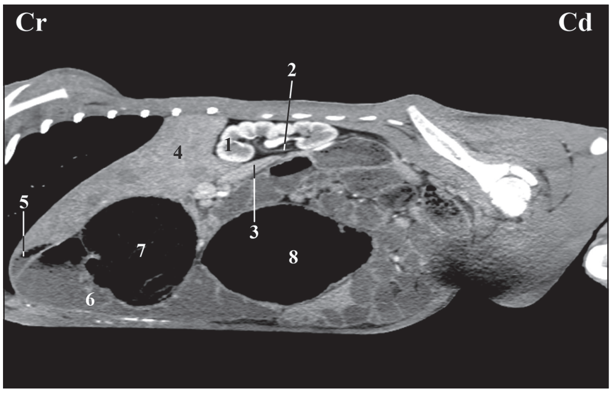

Figure 10: Sagittal CT image at the level of the right hip joint in a 104-day-old Holstein-Friesian bull calf. 1 Right kidney, 2 Right ureter, 3 Caudal vena cava, 4 Liver, 5 Reticulum, 6 Abomasum, 7 Omasum, 8 Rumen, Cr Cranial, Cd Caudal.

Ureters

The renal attachment of the ureter at the hilus was always seen in the right kidney (Fig. 8, 9) and in over 80 % of examinations of the left kidney. Both ureters ran caudally in a dorsomedial direction but were only occasionally identified; their site of entry into the urinary bladder was also not usually seen. The left and right ureters had similar diameters, which measured 0.3 cm on average at the first examination and 0.5 and 0.7 cm, respectively, at the last examination (Tab. 1, 2).

Urinary bladder

The urinary bladder was identified as an oval to circular structure at the level of the sacrum on the pelvic floor beneath the uterus at all examinations (Fig. 11). Depending on the degree of fill it reached beyond the pelvic brim into the abdomen.

Urethra

The urethra was seen exiting from the neck of the urinary bladder in all three planes. It ran caudally below the rectum to the ischiadic arc, where it turned back cranioventrally and continued along the penis to the tip of the penis in the prepuce (Fig. 12, 13). The mean urethral diameter was 1.5 cm at the first examination and 1.7 cm at the last examination (Tab. 3).

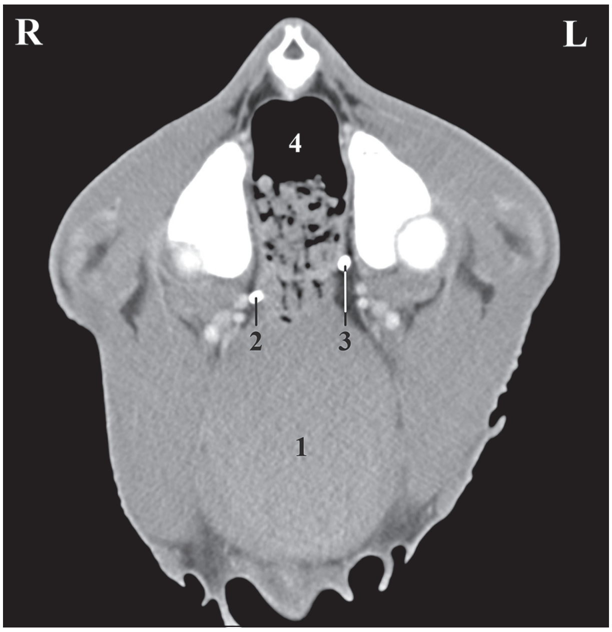

Figure 11: Transverse CT image at the level of the sacrum in a one-day-old Holstein-Friesian bull calf. 1 Urinary bladder, 2 Right ureter, 3 Left ureter, 4 Rectum, L Left, R Right.

Figure 12: Transverse CT image at the level of the pelvis in a two-day-old Holstein-Friesian bull calf. 1 Penis with urethra, 2 Testes, 3 Rectum, L Left, R Right.

Adrenal glands

The adrenal glands were best seen in the transverse plane and appeared as oval to bean-shaped structures. The left adrenal gland was located at the level of the cranial pole of the left kidney in the immediate vicinity of the renal vessels (Fig. 6 A). It was exactly in the median and ventral to the aorta and the caudal vena cava. The right adrenal gland was located medial to the hilus of the right kidney and immediately cranial to or between the renal vein and artery (Fig. 14, 15). From the first to the last examination, the mean length of the left adrenal gland increased from 1.01 to 1.53 cm and the width from 0.66 to 0.91 cm (Tab. 4); similar increases were recorded for the right adrenal gland.

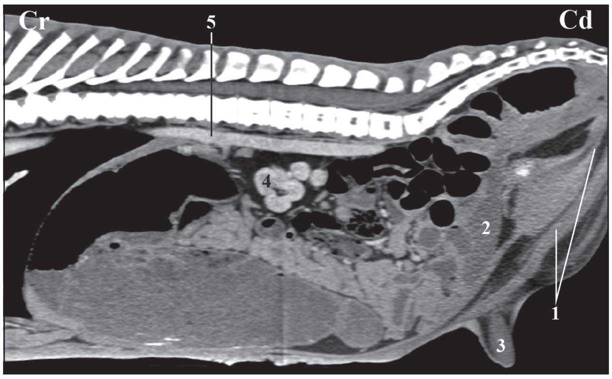

Figure 13: Sagittal CT image at the level of the aorta in a 40-day-old Holstein-Friesian bull calf. 1 Urethra, 2 Urinary bladder, 3 Testis, 4 Left kidney, 5 Aorta, Cr Cranial, Cd Caudal.

Table 3: CT measurements of the urinary bladder and urethra in five Holstein-Friesian bull calves during the first 105 days of life (mean ± sd, median, range).

Variable	Examination					
	1	2	3	4	5	6
Distance between apex of bladder and pelvic brim	6.5 ± 3.52 (4.0–12.6)	6.1 ± 1.97 (2.9–7.8)	7.3 ± 2.33 (5.0–10.5)	7.9 ± 4.0 (2.9–12.8)	6.4 ± 1.97* (4.3–8.2)	4.4 ± 0.35#,$ (4.2–4.7)
Urinary density (HU)	10.6 (7.4–39.2)	9.5 (5.6–15.6)	10.8 (-2.7–18.8)	7.5 (1.2–37.7)	20.0 (-3.0–30.2)	27.5# (21.4–33.5)
Urethral diameter (cm)	1.5 ± 0.33 (1.1–1.9)	1.5 ± 0.27 (1.2–1.9)	1.4 ± 0.27 (1.1–1.8)	1.6 ± 0.16 (1.4–1.8)	1.5 ± 0.24 (1.1–1.7)	1.7 ± 0.24° (1.5–2.0)

° Measured in 4 of 5 calves
* Measured in 3 of 5 calves
# Measured in 2 of 5 calves

Table 4: CT measurements of the adrenal glands in five Holstein-Friesian bull calves during the first 105 days of life (mean ± sd, range, all measurements in cm).

Variable	Untersuchung					
	1	2	3	4	5	6
Length of right gland	1.27 ± 0.23 (0.89–1.45)	1.46 ± 0.46 (0.96–2.06)	1.47 ± 0.32 (1.18–1.95)	1.65 ± 0.26[$] (1.30–1.96)	1.69 ± 0.38° (1.26–2.04)	1.78 ± 0.31 (1.38–2.13)
Widht of right gland	0.77 ± 0.17 0.53–0.98	0.87 ± 0.34 0.58–1.44	0.85 ± 0.22 (0.49–1.10)	0.85 ± 0.22 (0.51–1.06)	0.89 ± 0.17[$] (0.71–1.10)	0.92 ± 0.21 (0.68–1.18)
Length of left gland	1.01 ± 0.14 (0.88–1.23)	0.99 ± 0.28 (0.68–1.32)	1.33 ± 0.23[$] (0.96–1.58)	1.42 ± 0.64 (0.90–2.46)	1.28 ± 0.22°,* (0.98–1.53)	1.53 ± 0.21 (1.39–1.90)
Widht of left gland	0.66 ± 0.06 (0.59–0.75)	0.55 ± 0.13[a] (0.36–0.69)	0.76 ± 0.17[a] (0.55–1.02)	0.94 ± 0.33 (0.52–1.28)	0.74 ± 0.22 (0.51–0.98)	0.91 ± 0.15[$] (0.77–1.13)

° Measured in 4 of 5 calves
[a] Measurements are different ($P < 0.05$)
[$] First significant difference compared with examination 1 ($P < 0.05$)
* Significant difference compared with right adrenal gland ($P < 0.05$)

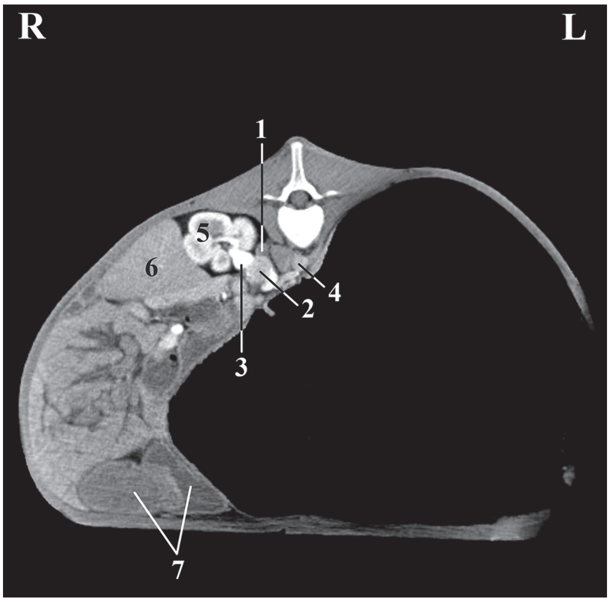

Figure 14: Transverse CT image at the level of the 2nd lumbar vertebra in a 104-day-old Holstein-Friesian bull calf. 1 Right adrenal gland, 2 Caudal vena cava, 3 Right renal vein, 4 Aorta, 5 Right kidney, 6 Liver, 7 Abomasum, L Left, R Right.

Figure 15: Dorsal CT image at the level of the aorta in a one-day-old Holstein-Friesian bull calf. 1 Right adrenal gland, 2 Caudal vena cava, 3 Right renal vein, 4 Aorta, 5 Right kidney, 6 Liver, 7 Left kidney, 8 Spleen, 9 Rumen, L Left, R Right.

Discussion

The kidneys were readily identified in calves at all ages because of their unmistakable shape, the unique structure of the reniculi and the strong contrast enhancement. Differentiation of neighbouring organs was also aided by the surrounding hypodense perirenal fat. The size and volume of the kidneys of newborn calves were the same as those of adult goats (Braun et al., 2011c), but increased considerably by the age of 105 days. The length, width and volume of the left kidney of goats were on average 9.3 cm, 5.0 cm and 154.9 cm^3, respectively (Braun et al., 2011c), compared with 14.6 cm, 7.1 cm and 307.5 cm^3 in 105-day-old calves. There was considerable individual variation in the density of the renal parenchyma, but there were no differences between the kidneys of individual calves. This is in agreement with the results of CT of human kidneys, in which the parenchyma appeared relatively homogeneous and had a density of 30 to 50 HU (Sagel et al., 2002). The renal density of the calves at the last examination (27.2 HU left, 30.1 HU right) was simi-

lar to that of adult goats (18.5 to 39.5 HU). A difference in density between paired kidneys of more than 5 HU indicates urolithiasis in human medicine (Goldman et al., 2004). Computed tomography is the diagnostic technique of choice in people with suspected pyelonephritis (Craig et al., 2008), kidney tumours (Dobry and Danuser, 2009; Griffin et al., 2009) and kidney trauma (Lee et al., 2007), and is indispensible for the examination of patients with renal colic attributable to urolithiasis (Jindal and Ramchandani, 2007). It is likely that CT will improve the diagnosis of urinary tract diseases in calves.
The ureters were seen at the hilus of the right kidney in all scans and at the hilus of the left kidney in 80 % of scans, but their course to and junction with the urinary bladder were only occasionally seen, in contrast to CT scans in goats (Braun et al., 2011c). We assume that dilated or otherwise diseased ureters would also be visible on CT scans in calves. In contrast to the ureters, the urinary bladder and urethra were always seen at the level of the sacrum. Omphaloarteritis, omphalourachitis and various other urachal abnormalities are common problems in calves and can be diagnosed quite reliably using ultrasonography (Lischer and Steiner, 1993, 1994; Lischer et al., 1994). Computed tomography should further improve images of umbilical and urachal disease processes and facilitate the planning of the surgical treatment. While ultrasonographic imaging of the urinary bladder is straightforward, imaging of the urethra of bull calves is much more difficult and reports are scant (Weisser, 2000); the penile urethra was only vaguely seen during urination. Concrement in the urethra is readily seen on radiographs and should also be visible on CT images.
Unlike the umbilical vein, which could be seen on CT scans until the age of three weeks (communication I), the umbilical artery was never identified caudal to the umbilicus, which was in agreement with ultrasonographic findings (Lischer, 1991; Watson et al., 1994).
The adrenal glands were reliably seen on CT scans, although their measurements varied greatly. Measurements of smaller structures are less precise than those of larger ones (Voorhout, 1990), but also depend on the position of the organ relative to the tomographic plane (Voorhout, 1990). The adrenal glands did not grow significantly during the study period and their size at the age of 105 days corresponded to measurements obtained in adult goats and dogs (Assheuer and Sager, 1997; Braun et al., 2011c). In the calf, adrenal disease is rare and CT examination of the adrenal glands is of little clinical importance. This is in contrast to the goat, in which adrenal cortical adenoma (Smith and Sherman, 2009), medullary phaeochromocytoma (De Gritz, 1997) and adrenal hypocortisolism (Swart et al., 1996; Engelbrecht et al., 2000) have been reported, although adrenal disease is generally considered to be rare.

Conclusion

This study has shown that CT is very useful for the examination of the urogenital tract of calves. The transverse, horizontal and sagittal cadaver sections were essential for identification of the structures on CT images. This study provides reference values for CT examination of calves with suspected diseases of the urinary tract and adrenal glands.

Tomodensitométrie de l'abdomen de veaux dans les 105 premiers jours de vie: III. Appareil urinaire et surrénales

Dans le présent travail, on décrit les constatations tomodensitométriques sur l'appareil urinaire et les surrénales de 5 veaux mâles en bonne santé dans les 105 premiers jours de vie et on les compare avec les résultats des examens post-mortem. Il est possible de visualiser exactement les reins, la vessie, l'urètre et les surrénales par tomodensitométrie alors que les uretères ne peuvent être identifiés de façon sûre que dans la zone du hile rénal. La topographie des organes et leur structure correspondent très bien aux coupes anatomiques. Il est possible de visualiser la structure et les vaisseaux des reins, le début des uretères, la position, la taille et le contenu de la vessie et le parcours de l'urètre dans le bassin et le pénis. L'extension et le volume des reins augmentent de façon significative entre le premier et le sixième examen. Il en est de même pour la longueur et la largeur des surrénales, alors que les diamètres des uretères et de l'urètre ne changent presque pas.

Tomografia computerizzata dell'addome dei vitelli dal primo al 105esimo giorno di vita Giorni di vita: III. Apparato urinario e ghiandole surrenali

In questo studio sono stati descritti i risultati della tomografia computerizzata (CT) dell'apparato urinario e delle ghiandole surrenali di 5 vitelli sani dalla nascita fino al 105esimo giorno di vita e confrontati con le analisi post mortem. Reni, vescica, ureteri e ghiandole surrenali possono essere visualizzati precisamente tramite la tomografia computerizzata, mentre gli ureteri possono essere localizzati solo in modo affidabile nella zona dell'ilo renale. La topografia risp. le strutture degli organi e i preparati anatomici coincidevano molto bene. Ben visibili nei reni vi erano la struttura e i vasi sanguigni, negli ureteri la loro parte iniziale, nella vescica la posizione, le dimensioni e il contenuto e nell'uretra il corso nelle pelvi e nel pene. La dilatazione e i volumi dei reni aumentavano significativamente dalla prima alla sesta analisi. Lo stesso vale per le lunghezze e le larghezze delle ghiandole surrenali, mentre il diametro degli ureteri e dell'uretra rimaneva quasi immutato.

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