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ULTRASONOGRAPHY-AIDED ANATOMICAL INVESTIGATION OF THE HEART AND SOME PELVIC ORGANS

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Abstract

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Echography or ultrasonography is commonly utilized in imaging anatomy and diagnostics of internal diseases; Echography has enhanced the process of diagnostics, increased the options for morphological and functional evaluation of organs, has replaced other techniques of examination and allowed the performance of diagnostic and therapeutic manipulations under real-time ultrasound-guided control. The ultrasonographic images depict the cross sectional anatomy of a given anatomical area or organ. Echocardiography is a technique using ultrasound for examination of the heart and the large blood vessels. The identification of cardiac structures and other organs is important for achieving a general picture, localization of a specific process and deviations from the normal image of the organ. Ultrasonography is a non-invasive technique for visualization of benign and malignant lesions of accessory sex glands in both animals and men. The early detection of abnormalities of prostate and bulbourethral glands in cats is essential for the normal reproduction in this carnivore species.

Key words: ultrasonography, imaging anatomy, thorax, pelvis, cat

Introduction

During the recent years, ultrasonography is more and more widely used in diagnostics of internal diseases. It has speeded up the process of diagnostics, has provided more opportunities for morphological and functional evaluation of the status of organs and allowed the performance of ultrasound-guided diagnostic and therapeutic procedures.

Ultrasonography of the heart

Ultrasonography provides morphological and functional information about cardiac structures (Lee, 1995). The adequate knowledge of topographic anatomy is essential for the proper orientation during the examination. The echographic image presents the cross-sectional anatomy of a given organ or body area. The identification of cardiac structures and other organs is important for achieving general information, for the topography of a given process and for detection of deviations from the normal image of a given organ (Tomov and Naumov, 1992).

The contemporary imaging methods, ultrasonography in particular, have the advantage of offering non-invasive means for examination of structures, organs and body cavities. The increased interest towards

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imaging techniques in medicine is reflected in numerous publications about ultrasonography and computed tomography (CT visualization of cardiovascular structures, especially in men (Shin et al., 1981; Churchill, 1983; Wooding and West, 1989; Kurihara, 2001; Knollmann et al., 2003; Anderson et al., 2004).

After birth, the cardiovascular system is continuously developing and is characterized with age-related features. Frantsov (1990) affirms that in humans, the heart of the child is not a smaller image of adult heart, but has its own traits. With age, some of cardiovascular structures become better visualized with diagnostic imaging techniques due to their higher density. These are the ascending aorta, the aortic arch and the position of the azygos vein. Galabov and Vankov (1986) also point out age-related peculiarities as well as individual variations in adult individuals. The authors showed some features related to the position of the body, the respiratory and cardiac activity and describe from anatomical imaging point of view the topography of human heart, the projections of atrioventricular orifices upon the thoracic wall, the aortic opening and the pulmonary trunk. The correct interpretation of echographic images is not possible without knowing the regional transverse anatomy (Samii, 1998; Shojaei et al, 2002; Henninger et al., 2003; Shojaei et al, 2003).

The results of Vladova et al. (2005) showed that in corresponding topographic, CT and echographic cross sections at the level of the sixth thoracic vertebra in cats, the left atrium, the right atrium, the left ventricle and the right ventricle could be observed. Among these cardiac structures is situated the ascendant aorta. The findings of parasternal ultrasonography along the short cardiac axis confirmed the structures observed via CT. The three imaging anatomy variants, viz. transverse cardiac anatomy, CT and echocardiography, are a good example for methodical correlation. Echocardiography presents the heart as a separate part of the overall thoracic anatomy and adds to computed tomography anatomical findings, thus allowing the visualization of cardiac valves with a suitable position of the transducer (Vladova et al., 2005). The imaging anatomy techniques and their diagnostic importance emphasize the role of morphology for the interpretation of obtained images (Barr, 1997).

Ultrasonography of some pelvic organs

In male cats, the neck of the urinary bladder passes caudally into a relatively long preprostatic urethra situated ventrally to the rectum and craniodorsally to the pelvic brim. The prostate is a bilobular symmetric organ located dorsolaterally to the prostatic urethra behind the cranial border of pelvic symphysis. Caudally, the pelvic (membranous) urethra extends to bulbourethral glands (McClure at al., 1973).

According to Barsanti (1995), feline prostate gland is less developed as compared to the same organ in the dog, and prostate urethra is respectively shorter. The gland does not enclose the urethra ventrally unlike its position in dogs.

By means of echography, feline prostate is visualized as a solid homogenous structure with a relatively high echogenicity. The capsule and the stroma are more hyperechoic than the parenchyma. In the middle of the gland, linear hyperechoic findings are observed. The caudal of the gland is not observed because of the vicinity of pelvic bones and its caudal location vs the pelvic brim. The normal prostate surrounds the urethra dorsoventrally whereas ventrally, the hypo- or anechoic urethra is seen. By ultrasonography, the lumen of prostatic urethra is observed as a hypoechoic ventromedial finding on transverse sections whereas the hyperechoic urethral wall is better visualized on longitudinal sections against the previously catheterized urinary bladder. Also, it is shown that the wall of feline urethra is also with higher echogenicity than its lumen, i.e. the periurethral area is hyperechoic and homogenous. On transverse section, a hyperechoic gland, located dorsolaterally to a hypoechoic ventromedial centre (the prostatic urethra), as well as the transversely ovoid gland shape are visualized. The authors recommend the application of the prepubic ultrasonography against a distended urinary bladder as a good means for visualization of feline prostate in both transverse and longitudinal sections up to the level of the transition between gland and membranous urethra. Because of the small rectal lumen in male cats, the cranioventral and abdominal position of the distended urinary bladder and the well developed pars externa prostate, the authors assume that the prepubic transabdominal ultrasonography is fairly sufficient for evaluation of the shape, size and structure of the normal feline prostate. They have also shown that the filled urinary bladder is the only acoustic window for observation of the gland. Post mortem investigations performed in isotonic fluid medium also exhibit hyperechoic glandular finding with ventrally located hypoechoic prostatic urethra (Dimitrov et al., 2005).

By means of rectal ultrasonography of prostate gland in 32 clinically healthy dogs, Souza at al. (2002) established that there was not a significant correlation between age, body weight, localization, shape and dimensions of prostate.

In dogs, Atalan at al. (1999) investigated the relationship between gland weight, its volume, body weight and age.

In animals, prostate gland is examined to obtain information about its size, shape, symmetry, echogenicity and cavity formations. Its caudal border could be hidden by ossa pubis. The adult prostate gland is symmetrically homogenous, echoic. After castration, an involution of the gland occurs and its lobes could be hardly differentiated (Barr, 1997). As shown by the author, ultrasonography is a popular, safe and non-invasive method for visualization of prostate gland.

In adolescent dogs, prior to sexual maturity, prostate gland embraces the urethra, its size is small, its lobes are vaguely distinguished and its echographic image is homogenous and hypoechoic (Selcer, 1995; Basinger, 1997).

In men, transrectal ultrasonography allows a perfect visualization of the gland, whereas in small animals, this is done only for experimental purposes (Zohil and Castellano, 1995).

It is recommended to perform the echography of human prostate gland in three views: sagittal, transversal and dorsal, depending on the extent of urinary bladder filling (Chakarski et al., 1996).

According to reported data, its could be concluded that the ultrasonography of feline prostate gland could provide relatively detailed anatomical information about the structure of the gland, that could be used in both diagnostics and clinical practice.

Bulb urethral glands are examined for their shape, symmetry, dimensions, echogenicity and cavity formations (Campero et al., 1988; Weber and Weber, 1992; Barr, 1997; Hildebrandt et al., 1998; Clark and Althouse, 2002; Yagci et al., 2004).

In the cat, the glands are located behind the prostate gland, over the pelvic arc, at the caudal part of pelvic urethra between m. urethralis and m. bulbospongiosus, , in front of penile root. They are a paired organ and are located dorsolaterally to the caudal part of the membranous urethra that continues dorsally with penile urethra (Crouch et al., 1969; McClure et al., 1973).

By echography, feline bulbourethral glands appear as a solid heterogenous finding with a relatively high echogenicity. The peripheral glandular zone, that includes parts of *m. urethralis* and m. bulbospongiosus, is more echoic than the central hypoechoic parenchymal zone. The glands are with an ovoid shape, well are differentiated from the adjacent perineal soft tissues. They are observed dorsally to the pelvic arc and the penile root. The cranial border of glands is not visible depicted because of the vicinity of hip bones and the limitations of the perineal approach. Normal feline bulbourethral glands are visualized dorsolaterally to bulbar urethra and ventrally, the hyperechoic catheterised urethral lumen is seen. On transversr cross-sectiond, the finding is hyperechoic, but without a visible hypoechoic central part. On sagittal cross-sections, an echoic gland with hyperechoic periphery and hypoechoic centre is visualized. It is observed dorsolaterally to a hyperechoic ventromedial centre, that depicts the catheter-marked urethral lumen. By perineal ultrasonography, the caudal, dorsocaudal and vendrocaudal parts of the glands could be observed (Dimitrov and Russenov, 2006).

The glands removed post mortem and investigated in an isotonic liquid medium, are observed from a dorsal aspect. That way, the findings are also with a hyperechoic peripheral glandular zone formed by skeletomuscular coating and a hypoechoic centre, situated parallel to the hyperechoic bulbar urethra. The identical results obtained via both methods allowed the authors to propose perineal ultrasonography as an excellent non- invasive method for visualization of feline bulbourethral glands in transverse and sagittal cross-sections as compared to transrectal ultrasonography in large mammals and men (Dimitrov and Russenov, 2006).

Via transrectal ultrasonography, the bulbourethral glands in boar have been studied in boars and are described as elongated oval echoic findings with large anechoic central zones (Clark and Althouse, 2002).

In bulls, stallions and elephants, these glands have been examined by transrectal ultrasonography and in stallions, they were studied by echography prior and after ejaculation and post mortem in a liquid medium (Little and Woods, 1987; Campero et al., 1988; Weber and Woods, 1993; Hildebrandt et al., 1998).

In men, the bulbourethral glands are two small oval yellowish pea-sized structures situated dorsolaterally at the end of membranous urethra between both fasciae of pelvic diaphragm. From a topographical point of view, the glands are classified as diaphragmal, diaphragm-bulbar and bulbar. They release a mucinous secretion that drains in the beginning of spongious urethra prior to ejaculation (Sikorski, 1977; Chughtai et al., 2005).

By means of perineal echography, bulbourethral glands have been investigated in men on the occasion of their cystic degeneration (syringocele) and urethral bulbar narrowing – Cobb's collar (Dewan, 1996).

The glands in men are visualized as small tubular findings parallel to the urethra (Palvica et al., 1989).

Using the transrectal approach, these glands were studied in men in cases of haemospermia, neoplasms, inflammation or lytiasis (Yagci et al., 2004, Shaw et al., 2004). Bulbourethral cysts (syringocele) are also reported in goats and mice (Tarigan et al., 1990; Wardrip et al., 1998).

The data of all reviewed studies allowed us to recommend the percutaneous ultrasonography of bulbourethral glands in cats as a sufficiently definitive imaging technique for obtaining information about important anatomical traits of these glands' structures. It could be utilized not only for the image anatomy of the glands but also for their diagnostic imaging.

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