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AGREEMENT BETWEEN SAGITTAL PLANE CROSS SECTIONAL ANATOMY, SONOANATOMY AND COMPUTED TOMOGRAPHY OF RABBIT PROSTATE AND BULBOURETHRAL GLANDS

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Summary

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The purpose of the study was to present some anatomy imaging characteristics of prostate gland and bulbourethral glands of domestic rabbits and to evaluate the consistency of information for depicting the normal morphological topography of studied organs. Ten clinically healthy, sexually mature male New Zealand White rabbits at the age of 8 months, weighing 2.8–3.2 kg were examined by ultrasonography. The prostatic complex was investigated by transabdominal prepubic approach and bulbourethral glands – by perineal approach. Six rabbits were submitted to computed tomography (CT) study in dorsal recumbency. The CT images of prostate and bulbourethral glands were obtained by sagittal scans of the pelvis from the promontory to the caudal rim of pubic symphysis. In five animals, frozen sagittal cross sections through the pelvis were obtained after euthanasia and were compared to sagittal diagnostic anatomy images. The sagittal ultrasonographic image of rabbit prostatic complex was observed as homogeneous, massive, oval finding with a relatively high echogenicity whereas bulbourethral glands were visualized as a relatively hyperechoic solid homogeneous oval finding. The CT image of rabbit prostate was visualized at the level of the second sacral vertebra and dorsally to the anterior symphyseal rim whereas the bulbourethral glands were observed at the level of the second coccygeal vertebra dorsally to the posterior symphyseal rim.

Key words: bulbourethral glands, imaging anatomy, prostate, rabbit

INTRODUCTION

The rabbit prostate gland is composed of proprostate (*Proprostata*), prostate (*Prostata*) and paraprostate (*Paraprostata*) (Vasquez & Del Sol, 2002; McCracken *et al.*, 2008).

Ultrasonography is a safe non-invasive method for visualization of prostate. In animals, the gland is examined to determine its shape, dimensions, solid and cavity-like formations (Barr, 1997; Basinger, 1997). Kozlowski *et al.* (2001) have created a reconstituted image of rabbit prostate in order to use it as a model for investigation of prostate lesions in men. The sagittal ultrasonography has been used for imaging of rat prostate by Suzuki *et al.* (2005) for determination of the localization of the gland in the pelvic cavity and in relation to the urinary bladder. Transrectal ultrasonography permits a good visualization of the gland in men, whereas in small animals it was used only for experimental purposes (Zohil & Castellano, 1995). Human prostate is visualized as a homogenous, limited oval soft tissue finding behind the pubic symphysis, with dimensions increasing with age (Wegener, 1996; McLaughlin *et al.,* 2005).

Dimitrov & Toneva (2007) have performed a computed tomography study of feline prostate gland and have observed it during the transverse scans of the pelvic inlet between the first and second coccygeal vertebrae. Atalan *et al.* (1999) used CT to determine the dimensions of canine prostate.

The bulbourethral glands of rabbits are situated in the connective tissue of the perineum's urogenital part, have a cubic shape and are surrounded by the bulboglandularis muscle. Caudally, the gland is separated from the penile bulb by the external fascia of the urogenital diaphragm (Barone, 2001; Vasquez & Del Sol, 2001; McCracken *et al.*, 2008).

Depending on their localization, human bulbourethral glands are classified as diaphragmatic, diaphragm–bulbar and bulbar (Chughtai *et al.*, 2005; Nakajiama *et al.*, 2007). Dewan (1996) has employed perineal ultrasonography for investigation of human bulbourethral glands for visualization of their cystic degeneration (syringocele), whereas Yagci *et al.* (2004) have examined those glands by transrectal ultrasonography. The bulbourethral glands of animals are examined for shape, symmetry, echogenicity and cavity-like formations (Barr, 1997). Clark & Althouse (2002) have performed a transrectal ultrasonography of the bulbourethral glands in boars and described them as oval echoic findings with large anechoic central areas.

The cystic degeneration of human bulbourethral glands has been studied by computed tomography by Cerqueira *et al.* (2004). Cysts of bulbourethral glands have been reported in male goats (Tarigan *et al.*, 1990) and mice (Wardrip *et al.*, 1998). In a CT imaging study of feline bulbourethral glands, Dimitrov & Toneva (2005) observed them throughout the transverse scan of the pelvic outlet between the 3rd and 4th coccygeal vertebrae.

The lack of detailed data about the anatomy imaging and native characteristics of prostatic complex and bulbourethral glands of domestic rabbits motivated the present investigation aiming at evaluation of the reliability of results obtained in presenting the normal morphology and topography of studied organs.

MATERIALS AND METHODS

Ten sexually mature, clinically healthy male New Zealand White rabbits, at the age of 8 months and body weight 2.8–3.2 kg were examined by ultrasonography. The animals were anaesthetized with 15 mg/kg Zoletil 50 (tiletamine hydrochloride 125 mg and zolazepam hydrochloride 125 mg in 5 mL of the solution) (Virbac, France).

The study was performed with CHISON 600 VET (China) Micrus ultrasound equipment, a 7 MHz multi-frequency micro-convex transducer C20605 with front length 20 mm. The findings were documented on Mitsubishi P91E printing device. Contact transmission gel (Eko-gel® Lessa, Spain) was used. The approach for sagittal examination was transabdominal prepubic (for prostate complex) and perineal (for bulbourethral glands).

Six rabbits were submitted to computed tomography study. An axial computed tomograph SIEMENS, SOMATOM, ARTX with table height 125 cm, FOV = 250, filter 1, anode current 70 mA, anode tension 110 kV, was used. The scanning time was 3 s. As contrast agent, 741 mg/mL ioversol (Optiray® 350, Healthcare Ltd., UK) was applied intravenously at 1 mL/kg in *v. cephalica.* A high-resolution 512 mode, gantry (GT) – 0° was employed, with window (W) – 280 and centre – 53. Scans were done at 2 mm intervals.

The animals were positioned in ventrodorsal recumbency. The sagittal CT scans of the pelvis were performed from the promontory to the caudal rim of the pubic symphysis.

Five of examined rabbits were euthanized with intravenous administration of 150 mg Thiopental® (thiopental sodium 1000 mg, Biochemie, Austria). Sagittal cross sections of bodies frozen at –18°C (Zotti *et al.*, 2009) were obtained in order to compare the anatomy imaging traits of studied glands with normal topography.

The experiment was performed in strict compliance with the ethical guidelines for humane treatment of animals as per European convention for the Protection of Vertebrate Animals used for Experimental and Other Scientific Purposes, the European Convention for the Protection of Pet Animals, and Law on Animal Protection in the Republic of Bulgaria – part IV (Experiments with animals, art. 26, 27, 28, State Gazette No.13/2008).

RESULTS

The ultrasonographic sagittal image of rabbit prostatic complex was an uniform, massive oval homogeneous hyperechoic finding as compared to peripheral soft tissues. The cranial and caudal borders of the glandular complex were distinguishable, and it was observed as a hyperechoic structure parallel to the urethra (Fig. 1).

Ultrasonographically, rabbit bulbourethral glands were visualized as solid homogeneous hyperechoic finding, well differentiated from adjacent soft tissues, The cranial and caudal glandular borders were visualized, with one hyperechoic gland without hypoechoic centre being observed (Fig. 2).

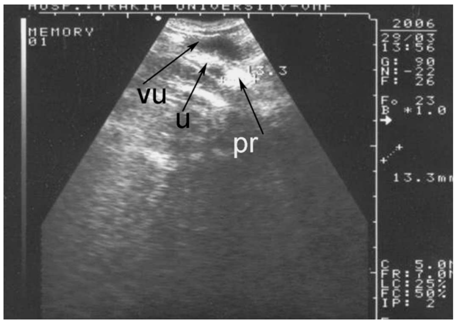

Fig. 1. Sagittal ultrasonographic image of pelvic organs in the rabbit: pr – prostate; u –urethra; vu – urinary bladder.

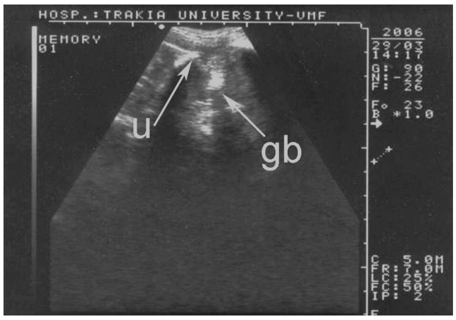

Fig. 2. Sagittal ultrasonographic image of pelvic organs in the rabbit: gb – bulbourethral glands; u – urethra.

The computed tomography sagittal image of rabbit prostatic complex was visualized at the level of the second sacral vertebra dorsally to the anterior symphyseal rim. The glandular complex was a massive heterogeneous soft-tissue hyperdense structure located dorsolaterally against the contrasted pelvic urethra and ventrally to the rectum. The prostate was situated between the vesiculous glands (from the cranial side) and bulbourethral

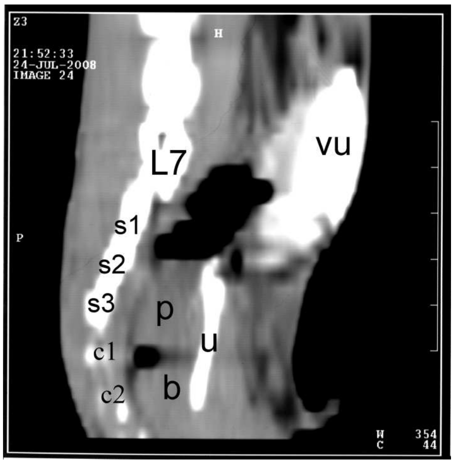

Fig. 3. Sagittal CT image of accessory sex glands and pelvic urethra in the rabbit: p – prostate; u – pelvic urethra; b – bulbourethral glands; vu – urinary bladder, L7 – 7th lumbar vertebra; s1, s2, s3 – sacral vertebrae; c1, c2 – coccygeal vertebrae.

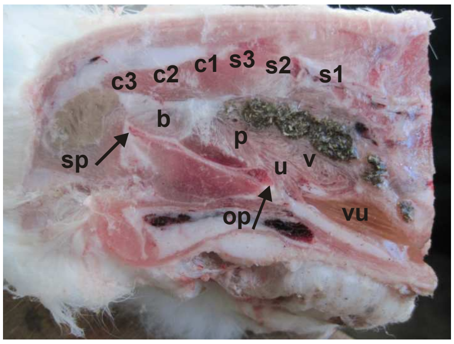

Fig. 4. Sagittal native cross section of rabbit pelvis: s1, s2, s3 – sacral vertebrae; c1, c2, c3 – coccygeal vertebrae; u – urethra; p – prostate; b – bulbourethral glands, v – vesicular glands, r – rectum, op – cranial part of the pubic symphysis; sp – caudal part of the pubic symphysis; vu – urinary bladder.

glands (from the caudal side). The entire prostatic complex is well-differentiated from adjacent soft tissues (Fig. 3). The CT image of bulbourethral glands could be observed at the level of the second coccygeal vertebra and dorsally to the posterior symphyseal rim. Bulbourethral glands are oval, homogeneous hyperdense findings located dorsolaterally to contrasted bulbar urethra and ventrally to the rectum. The glands are located behind the cranially situated prostatic complex at the pelvic outlet (Fig. 3).

The examination of postmortally frozen rabbit pelvis sagittal cross sections, prostatic complex and bulbourethral glands exhibited similar morphological and anatomotopographic traits to those obtained from ultrasonography and computed tomography imaging (Fig. 4).

DISCUSSION

From our data, similarly to Basinger (1997) it could be affirmed that the prepubic transabdominal ultrasonography was suitable for examination of the shape, dimensions and structure of normal rabbit prostate gland.

During the ultrasonography, we confirmed the opinion of Barr (1997) that the fluid-filled urinary bladder was the only acoustic window for observation of the gland.

Unlike some authors (Barone, 2001; Vasquez & Del Sol, 2002; McCracken *et al.*, 2008) who demonstrated the different anatomical parts of the prostate in rabbits, the present computed tomography study showed only the localization and the shape of the gland. Rabbit prostate had a soft tissue density, similar to that of human (Wegener, 1996) and feline prostate (Dimitrov & Toneva, 2007). It appears as a heterogeneous glandular finding contrary to human prostate that is homogeneous (Wegener, 1996). Compared to feline prostate (Dimitrov & Toneva, 2007), that of the rabbit was located relatively cranially.

The results of our studies allowed us to recommend the prepubic ultrasonography for investigation of the rabbit prostatic complex and its borders in a sagittal view, unlike Zohil & Castellano (1995), who determined the borders of human and canine prostate glands by transrectal ultrasonography.

Our results from the ultrasonographic examination of bulbourethral glands added some information to that reported by Barone (2001) and Vasquez & Del Sol (2001) about the localization, structure and topography of these glands in rabbits.

Perineal ultrasonography made possible the investigation of these glands contrary to the transrectal approach used in boars and men (Clark & Althouse, 2002; Yagci *et al.*, 2004). Rabbit bulbourethral glands were ovoid and similar to those of boars, but they lacked large anechoic central areas (Clark & Althouse, 2002). The present ultrasonography of rabbit bulbourethral glands was similar to that of Barr (1997) performed in dogs. In our view, rabbit bulbourethral glands were diaphragm-bulbar, as in men (Chughtai *et al.*, 2005).

Ultrasonography of bulbourethral glands could provide information for the anatomy of the glandular structure as well as about the presence of pathological lesions. Similar data are reported by Dewan (1996) and Yagci *et al.* (2004) in men and by Wardrip *et al.* (1998) and Tarigan *et al.* (1990) in mice and male goats.

The native anatomy data for rabbit bulbourethral glands reported by Barone (2001), Vasquez & Del Sol (2002), McCracken *et al.* (2008) were confirmed in our computed tomography imaging study too. Rabbit bulbourethral glands were with a soft tissue density and structural traits similar to those in cats (Dimitrov & Toneva, 2005), but the glands in the rabbit were relatively cranially situated. Bulbourethral glands in the rabbit appeared as homogeneous, hyperdense findings with soft tissue glandular traits similar to those of human gland (Dewan, 1996; Cerqueira *et al.*, 2004).

Comparing the results from the three methods of investigation, it could be affirmed that ultrasonography, computed tomography and native anatomical sagittal cross sections provided a complete morphological and topographic picture of prostatic complex and bulbourethral glands in the rabbit.

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