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Comparative ultrasonographic study of the prostate complex and bulbourethral glands of the domestic rabbit (*Oryctolagus cuniculus*)

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Abstract: The aim of the present study was to provide a comparative description of the rabbit prostate complex and bulbourethral glands by means of ultrasonography, in order to obtain results that may be useful for the diagnosis of reproductive pathology in this species. The prostate and bulbourethral glands were studied sonographically in 12 sexually mature, clinically healthy male New Zealand rabbits that were 12 months old and weighed 2.8 to 3.2 kg. The prostate complex, composed of proprostate, prostate, and paraprostate parts, was observed using prepubic ultrasonography in sagittal and transversal planes and presented a hyperechoic stroma. The bulbourethral glands were examined by perineal ultrasonography in sagittal and transversal sections and were visualized as solid, heterogeneous structures with a relatively high echogenicity. In comparison with the prostate complex, the sonographic echogenicity of the bulbourethral glands was higher, more homogeneous, and better differentiated from the adjacent soft tissues.The information obtained by ultrasonography of these glands can be important in clinical practice for the assessment of the reproductive qualities and for the diagnosis of pathological conditions such as cystic degeneration, inflammations, and neoplastic processes in the male rabbit.

Key words: Prostate, bulbourethral glands, ultrasonography, rabbit

Introduction

The rabbit prostate complex is composed of 3 lobes: proprostate, prostate, and paraprostate parts. Previous investigations by Holtz and Foote (1) and Vasquez and Del Sol (2) have shown that the proprostate part is localized caudally to the vesicular gland and cranially to the prostate part, the latter being situated cranially to the bulbourethral glands. The proprostate and prostate parts are located dorsally to the middle region of the pelvic urethra and are connected laterally to the deferent ducts. The left and right paraprostate parts are located ventrolaterally to the proprostate.

The bulbourethral glands in rabbits were described by Barone (3) and Vasquez and Del Sol (4). The glands are well developed and relatively large. They have an elongated cuboidal shape and extend craniocaudally on the dorsal wall of the pelvic urethra. The glands are enveloped by a capsule and are largely covered by the bulbourethral muscle. They are situated retroperitoneally in the connective tissue, adjacent to the urogenital part of the perineum, and are separated from the bulbus penis by the perineal membrane. The bulbourethral glands are connected cranially with the prostate and the paraprostate parts by connective tissue.

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Ultrasonography is widely used as a noninvasive method for visualizing the animal prostate. In the domestic carnivores, ultrasonographic data about the size, shape, symmetry, echogenicity, and cystic formations of the prostate are well documented. The mature canine prostate is a symmetric, homogeneous, and echoic organ that encircles the pelvic urethra, but before reaching sexual maturity the gland is small, poorly distinguishable, and its image is homogeneous and hypoechoic, according to Selcer (5) and Basinger et al. (6). After castration the canine prostate involutes and its parts can hardly be differentiated, as defined by Barr (7).

The human prostate, the position of which depends on the filling of the urinary bladder, has been studied by Fornage (8), Chakarski et al. (9), and Grenier and Devonec (10), using suprapubic, perineal, transrectal, and transurethral sonographic methods, resulting images in 3 planes, i.e. sagittal, transversal, and dorsal. Transrectal ultrasonography permits an excellent visualization of the human prostate, but in small animals this technique is only used for experimental aims, according to Zohil and Castellano (11).

The bulbourethral glands have been studied with transrectal ultrasonography in a wide range of species, including the boar by Clark and Althouse (12), the goat by Tarigan et al. (13), the bull by Campero et al. (14), and the stallion by Little and Woods (15) and Weber and Woods (16). According to sonographic findings, they are more solid than the prostate glands and have an irregular surface. In humans, these glands have been studied transrectally for detecting hemospermia, neoplasia, inflammation, and lithiasis by Shaw et al. (17). A sonographic perineal approach was used by Dewan (18) for visualization of cystic degeneration (Cowper's syringocele) and urethral bulbar narrowing (Cobb's collar).

The aim of the present study was to provide a comparative description of the rabbit prostate complex and bulbourethral glands by means of ultrasonography, in order to obtain results that may be useful for the diagnosis of some reproductive pathological conditions such as cystic degeneration, inflammations, and neoplastic processes in the male rabbit.

Materials and methods

We studied sonographically 12 sexually mature and clinically healthy male white New Zealand rabbits (*Oryctolagus cuniculus*), aged 12 months, with weight ranging from 2.8 kg to 3.2 kg. The animals were anesthetized with 15 mg/kg Zoletil® 50 (25 mg of tiletamine hydrochloride and 25 mg of zolazepam hydrochloride per mL of solution, Virbac, France) as described by Dinev and Aminkov (19). The urinary bladder of 6 animals was catheterized and filled with 10 mL of sterile saline solution (Natrii chloridum 0.9%, Balkanpharma) to be used as an acoustic window. For transversal visualization of the prostate complex the transducer was positioned transversally to the ventral abdominal wall and parallel to the *pecten ossis pubis*. Additionally, sagittal views were imaged by transabdominal prepubic placing of the transducer.

The bulbourethral glands were visualized by perineal sonographic approach. For transversal imaging of the glands, the transducer was positioned dorsally and transversally on the perineum, parallel to the pelvic arch and oriented in the cranial direction. For sagittal visualization of the bulbourethral glands, the transducer was placed perpendicular to the pelvic arch.

The study was performed with ultrasonic CHISON 600 VET (China) equipment and a multifrequent C20605 microconvex transducer, using a frequency of 7 MHz and a radius of 20 mm. The findings were documented with a Mitsubishi P 91E thermoprinter device. Contact gel (Eko-gel® Lessa, Spain) was used for establishing better contact between the skin and the probe.

The experiment was performed in strict compliance with the ethical guidelines for humane treatment of animals as defined by the 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 the Law on Animal Protection in the Republic of Bulgaria – part IV (Animal Experimentation). The conditions in which the experimental animals were treated were respected and approved by the institutional animal care committee.

Results

Sonographically the proprostate and paraprostate parts of the rabbit prostate complex were observed as a single, ovoid, heterogeneous complex with relatively high echogenicity. The capsule and stroma of both cranial parts of this glandular complex were hyperechoic, compared to the parenchyma. The proprostate and paraprostate parts were well differentiated from the adjacent soft tissues. The caudal border of these glands was clearly visible, because of the presence of a deep transverse furrow situated between the proprostate and prostate parts. The prostate part was observed as a larger, elongated hyperechoic structure, situated caudally to the proprostate part, caudodorsally to the prostate part and parallel to the pelvic urethra. The 3 glandular parts could only be visualized by sagittal sonographic observation, whereas on the transverse views the entire prostate complex was visualized as a single, oval, heterogeneous, and hyperechoic structure (Figures 1 and 2).

The bulbourethral glands were visualized sonographically as solid heterogeneous structures with a relatively high echogenicity. The fibromuscular capsule of the glands showed a higher echogenicity than the central hypoechoic parenchyma. The glands were oval and well differentiated from the adjacent soft tissues of the perineum (Figures 3 and 4).

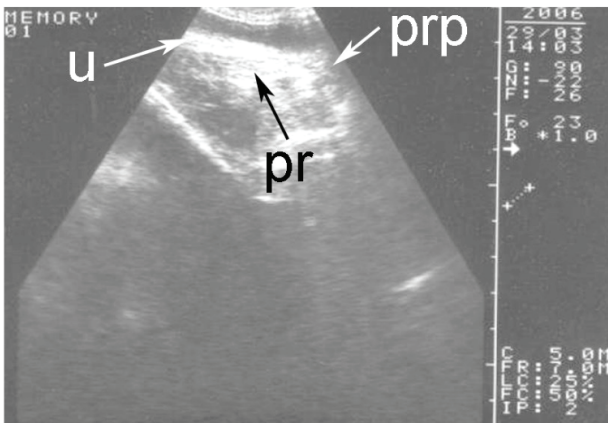

Figure 1. Sagittal sonographic section through proprostate and paraprostates (prp), prostate (pr), and prostatic urethra (u) in a rabbit.

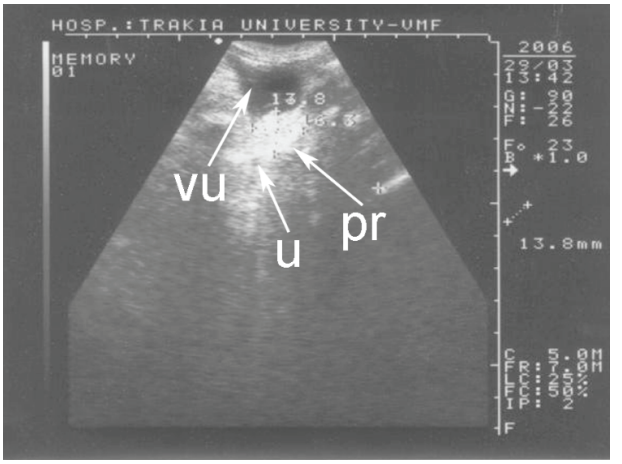

Figure 2. Transverse sonographic section through the prostate complex (pr), urinary bladder (vu), and prostatic urethra (u) in a rabbit.

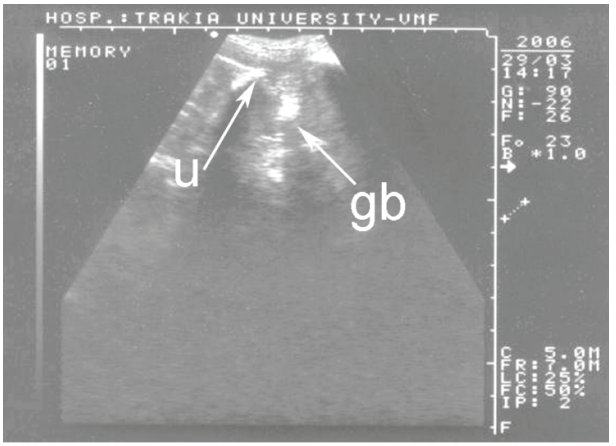

Figure 3. Sagittal sonographic section of bulbourethral glands (gb) and urethra (u) in a rabbit.

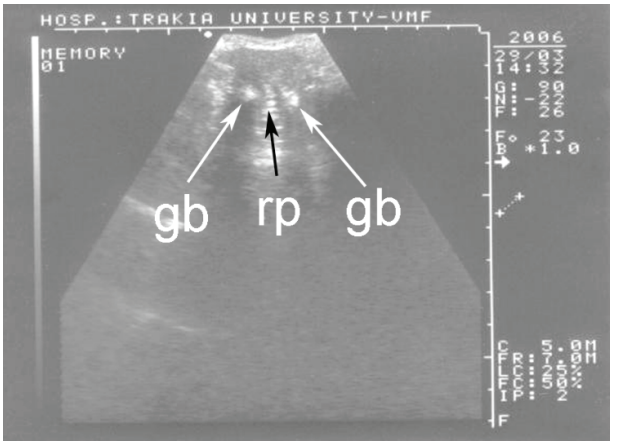

Figure 4. Transverse sonographic section of bulbourethral glands (gb) and root of penis (rp) in a rabbit.

The cranial border of the glands was visualized as a small hypoechoic zone (Figure 3).

In transversal section, the bulbourethral glands were visualized dorsolaterally to the hyperechoic root of the penis. The glandular image was completely hyperechoic and devoid of any hypoechoic central part (Figure 4).

In comparison to the prostate complex, the sonographic echogenicity of the bulbourethral glands was higher, more homogeneous, and better differentiated from the adjacent soft tissues.

Discussion

Our results, illustrating the differentiation of the rabbit prostate complex into 3 glandular parts, are in line with the investigations by Holtz and Foote (1) and Vasquez and Del Sol (2), while the sonographic characteristics of the rabbit prostate complex correlate with the findings reported by Barr (7) about dogs and by Chakarski et al. (9) about humans.

Because of the small size of the rabbit rectal lumen, the cranioventral abdominal position of the urinary bladder and the relatively highly developed prostate complex, the prepubic transabdominal sonographic approach was used in the present study for investigating the shape, size, and structure of the normal rabbit prostate complex. This technique was found to be very suitable for this purpose, which is in accordance with the findings reported by Selcer (5) and Basinger et al. (6), but contrasts with the results published by Zohil and Castellano (11), who proposed the transrectal approach for experimental aims in small animals. In line with the findings of Barr (7), our observations confirmed that the urinary bladder, when filled with liquid, is an excellent acoustic window for visualization of the prostatic gland, showing the prostatic stroma to be hyperechoic, compared to the parenchyma, both in the sagittal and transversal sonographic planes.

The results of our ultrasound study of the bulbourethral glands were in line with the descriptions given by Barone (3) and Vasquez and Del Sol (4) of the structure and topography of these organs in the rabbit. The caudal and dorsal parts of the glands could be well visualized via the perineal sonographic approach. Transrectal ultrasonography is applicable in large species and humans. It documents the dorsal and cranial aspects of the glands, as confirmed by Clark and Althose (12), Campero et al. (14), Little and Woods (15), Weber and Woods (16), and Shaw et al. (17).

The bulbourethral glands in the rabbits were ovoid in shape, like the boar's glands, studied by Clark and Althouse (12), but they were devoided of any anechoic central part, unlike the boar.

The ultrasonographic study of the bulbourethral glands in the rabbit revealed detailed information about their sonographic features, similar to the transrectal ultrasonography of these glands performed by Barr (7), Clark and Althouse (12), and Campero et al. (14).

The ultrasonographic and anatomical characteristics of the rabbit prostate complex and bulbourethral glands documented in the present study may be useful for the diagnosis of many pathological conditions in this species such as neoplastic processes, inflammations, and cystic lesions. The data obtained could be used as source of information about reproductive diseases in other species.

Conclusions

1. The use of prepubic ultrasonography can be recommended as a qualitative method for visualization the rabbit prostate complex in sagittal and transverse sections.

2. The ovoid shape and the separate parts of the prostate complex of rabbits can be well visualized by ultrasonographic imaging in the transversal and sagittal planes, respectively.

3. Ultrasonography of the accessory genital organs of male rabbits shows a higher echogenicity and better tissue differentiation of the bulbourethral glands, compared to the prostate complex.

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