*VETERINARSKI ARHIV 80* (6), 771-778, 2010

# Computed tomography imaging of the prostate gland in the rabbit (*Oryctolagus cuniculus*)

**Rosen S. Dimitrov***

*Department of Veterinary Anatomy, Histology and Embryology, Faculty of Veterinary Medicine, Trakia University, Stara Zagora, Bulgaria*

**DIMITROV, R. S.: Computed tomography imaging of the prostate gland in the rabbit (*Oryctolagus cuniculus*). Vet. arhiv 80, 771-778, 2010.**

**ABSTRACT**

Six sexually mature and healthy male New Zealand White rabbits (*Oryctolagus cuniculus*), at the age of 18 months, with body mass 2.8 - 3.2 kg, were used in this imaging study. Using computed tomography, the pelvis was transversally cut from the transversal plane between the first and the second sacral vertebra, with cut thickness of 2 mm. The prostate gland is a substantial soft tissue finding, situated dorsolaterally against the prostatic urethra. The prostate is located between the vesiculous (cranially) and bulbourethral glands (caudally). A rabbit`s prostate gland is visualized as an oval, heterogeneous, relatively hyperdense structure against the surrounding soft tissues (with exception of the rectal wall). It was observed by us on the transversal scan of the pelvis through the second sacral vertebra (dorsally), coxofemoral joints (laterally) and from the ramus cranialis of the pubic bones (ventrally). Its borders are well differentiated from the adjacent soft tissue structures. The results of computed tomography imaging of the rabbit`s prostate gland could be used as a background in the diagnostics and interpretation of prostatic disorders in this species, as well as in the use of the rabbit as an animal model for investigation of human prostatic lesions.

**Key words:** prostate gland, imaging anatomy, rabbit

## Introduction

The prostate gland in the rabbit, according to BARONE (2001), VASQUEZ and DEL SOL (2002), HOLTZ and FOOTE (2005) and McCRACKEN et al. (2008) is complex, constructed in three separated parts - proprostate, prostate and paraprostate. The proprostate part is situated caudally to the vesiculous gland and cranially to the prostate. The prostate and paraprostate parts are situated cranially to the bulbourethral glands. These glandular parts are connected ventrally with the middle of the pelvic urethra, and laterally with the colliculus seminalis. Both the paraprostate parts (the left and right) are observed

*Corresponding author:

Dr. Rosen S. Dimitrov, Department of Veterinary Anatomy, Histology and Embryology, Faculty of Veterinary Medicine, Trakia University, 6000 Stara Zagora, Bulgaria, E-mail: rosiros38@abv.bg

ISSN 0372-5480
Printed in Croatia

ventrolaterally to the prostate part. The different elements of the rabbit`s prostate gland demonstrate anatomical, histological and histochemical varieties, suggesting that each glandular part has a specific role in reproduction.

The first computed tomography imaging of the prostate gland was performed in men (VAN ENGELSHOVEN and KREEL, 1979; THOENI, 1983; WEGENER, 1996). The human prostate is a homogenous oval structure with soft tissue density, located dorsally to the pelvic symphysis, immediately ventrally to the rectum. Via CT, the prostate is well visualized and its three dimensions can be precisely determined. McLAUGHLIN et al. (2005) utilized computed tomography and magnetic resonance imaging for visualization of the human prostate, defining three zones: internal, external and ventral fibromuscular.

DIMITROV and TONEVA (2007) performed a CT imaging study on the feline prostate gland and defined some traits that could be important for imaging prostate glands in this carnivore species as well as for clinical, andrological and oncological practice.

ATALAN et al. (1999) determined the length of the canine prostate gland by CT and ultrasonography, as well as its ratio to the distance between the sacral promontory to the pelvic brim. A gland with a length greater than 70% of this distance, was defined as an enlarged structure, whereas when with length is <70% it is normal.

KOZLOWSKI et al. (2001) have investigated the rabbit`s prostate gland with regard to the effect of chronic ischemia upon its structure, as well as its importance for urinary bladder obstruction. In this study, the rabbit is used as an animal model for investigation of the effect of prostate ischaemia upon the histological structure of the gland (fibrosis, atrophy and cystic degeneration) as well as for reduction of the contractile properties of prostatic stroma.

BENOIT et al. (1991) created a reconstruction image of a rabbit`s prostate gland with regard to its utilization as a model for investigating human prostatic lesions.

The aim of this study was to describe some topographic features of the rabbit`s prostate gland via computed axial tomography (CAT).

## Materials and methods

Six sexually mature and healthy male New Zealand White rabbits (*Oryctolagus cuniculus*) at the age of 18 months, weighing 2.8 - 3.2 kg, were used in this study. The animals were anaesthetized with Zoletil 50 (Virbac, France), applied at a dose of 15 mg/kg (DINEV and SIMEONOVA, 2009).

The experiments were approved by the University Animal Care Committee for compliance with the European Communities Council Directive 86/609/EEC of 24 November 1986 and the national legislation. The study 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).

As contrast agents, Optiray 350 (Healthcare Ltd., UK) was applied intravenously at 1 mL/kg in v. cephalica, and the investigation was performed immediately. The second contrast medium was Urografin 76% 20 mL (Schering Ltd., Germany), applied orally as a 1.52% aqueous solution (30 mL/kg, fractionated administration), and imaging was performed three hours later. An axial computed tomograph Siemens, Somatom, Artx with table height 125 cm, FOV = 250, filter 1, anode tension 110 kV, was used. The scanning time was 3 s. A high-resolution 512 mode, gentry (GT) - 0° was employed, with window (W) - 280 and centre - 53. Scans were done at 2 mm intervals and image reconstruction was three-dimensional.

The CT scans were done cranially between the body of the ilium, cranially to the acetabulum (laterally), cranially to the pelvic brim (ventrally) and first sacral vertebra S1 (dorsally), and caudally - by the body of the ischium, to the acetabulum (laterally), the middle of the pelvic symphysis (ventrally) and the end of the second sacral vertebra S2 (dorsally).

Two animals were positioned in ventral recumbency, and the other 4 in dorsal recumbency. The urinary bladders of two rabbits were catheterized with 5 mL physiological saline by urethral catheter without metal mandren. In two animals the CT imaging was native (without contrast amplification), in another two the contrast amplification was done with Optiray 350 and in the last two with Urografin 76%.

The transverse CT scans of the pelvis were performed in the transverse planes between the first and the second sacral vertebrae with a cut thickness of 2 mm.

**Results**

The topography of the rabbit`s prostate gland was described using the following bone markers: dorsally - the respective sacral vertebra; laterally - the body of the ilium, coxofemoral joints and the body of the ischium, and ventrally - the pelvic symphysis.

No topographic and radiologic peculiarities were found in the scanning of the animals in abdominal and spine positions.

The reconstructed image of the rabbit`s prostate gland and the peripheral structures in sagittal and dorsal views are shown on Fig. 1. and 2. The prostate gland appeared as a large heterogeneous soft tissue finding, located dorsolaterally to the contrasted prostatic urethra. The prostate gland was situated between the vesiculous (cranially) and bulbourethral glands (caudally).

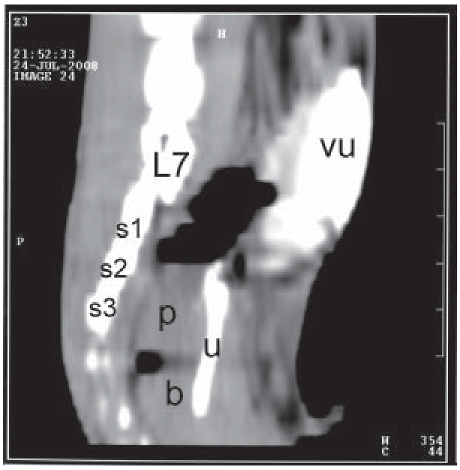


Fig. 1. Reconstructed CT image of accessory sexual glands and pelvic urethra in the rabbit - prostate gland (p), contrasted pelvic urethra (u), bulbourethral glands (b), contrasted urinary bladder (vu), seventh lumbar vertebrae (L7), first, second and third sacral vertebrae (s1, s2, and s3) (sagittal view).


Fig. 2. Reconstructed CT image of accessory sex glands and pelvic urethra in the rabbit - vesiculous glands (glv), prostatic gland (p), contrasted pelvic urethra (u), bulbourethral glands (b), body of the ilium (oi), acetabulum (ac), ischium (isch), seventh lumbar vertebrae (L7) (dorsal view).

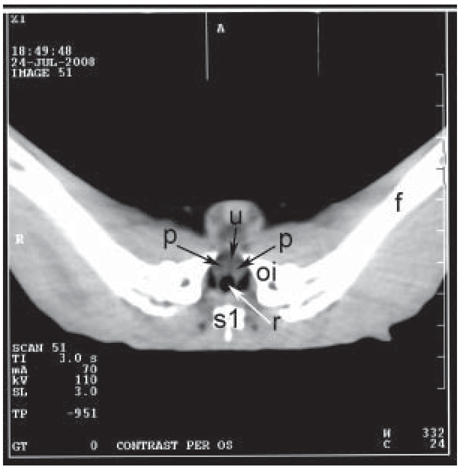


Fig. 3. Transverse CT image of rabbit pelvis (dorsal recumbency) through the caudal end of first sacral vertebrae (s1) - prostatic urethra (u), proprostate part of prostate gland (p), rectum (r), femur (f), body of the ilium (oi). Cut thickness 2 mm.


Fig. 4. Transverse CT image of rabbit pelvis (ventral recumbency) through the second sacral vertebrae (s2) - prostate and paraprostate parts of prostate gland (p), rectum (r), acetabulum (ac), pubic part of the pelvic symphysis (op). Cut thickness 2 mm.

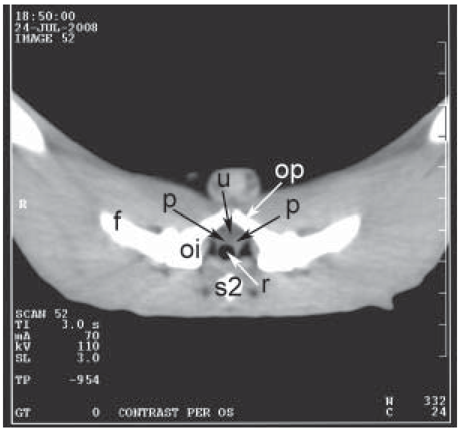


Fig. 5. Transverse CT image of rabbit pelvis (dorsal recumbency) through the second sacral vertebrae (s2) - prostatic urethra (u), prostate and paraprostate parts of prostate gland (p), rectum (r), body of the ilium (oi), pubic part of pelvic symphisis (op), femur (f). Cut thickness 2 mm.

The CT transverse imaging of the pelvis through the S1 vertebra (Fig. 3, level s1) depicted the cranial part of the prostate gland and the pelvic brim which was not visible ventromedially, but caudally the pelvis brim was completely visualized. Craniodorsally to the cranial ramus of the pubic bones, ventromedially to the coxofemoral joints and ventrally to the rectum, the non-contrasted prostatic urethra and the proprostate part, situated above the last one, were visible. The urethral lumen was hypodense, and the wall was relatively hyperdense. Glandular areas are relatively hyperdense, compared to the urethral wall but hypodense, compared to the rectal wall. The proprostate part was well differentiated from the adjacent soft tissues. The findings, demonsrated on Fig. 3, allowed us to assume, that the CT location of the proprostate part of the rabbit`s prostate gland was in the transverse plane through S1, the cranial parts of the coxofemoral joints and craniodorsally from the cranial symphysis brim.

The complete CT image of the prostate and paraprostate parts of rabbit`s prostate gland is depicted in Fig. 4 and 5 (level s2 - ventral and dorsal views). The lumen of prostatic urethra was native (hypodense) and the glandular lobes were visualized dorsolaterally to the urethra, beneath the ventral wall of the rectum, which was hyperdense, compared to the prostate gland. The prostate and paraprostate parts of the gland comprised an oval heterogeneous and relatively hyperdense structure in comparison with the adjacent soft tissues (with the exception of the rectal wall). It was observed in transverse pelvic cuts through S2 (dorsally), the coxofemoral joints (laterally) and craniodorsally to the ramus cranialis of the pubic bones. Its borders were well defined from the adjacent soft tissues.

The density of the rabbit`s prostate gland was similar to the soft tissues (from 30 HU - native to 65 HU in contrast amplification).

**Discussion**

Contrary to the findings of several authors (BARONE, 2001; VASQUEZ and DEL SOL, 2002; HOLTZ and FOOTE, 2005; McCRACKEN et al., 2008), having observed the separated anatomical parts of the rabbit`s prostate gland by native techniques, our CT imaging study demonstrates only the localization, the size and the shape of the gland. This is due to the restricted potential of the method used.

The rabbit`s prostate gland demonstrated soft tissue density, similar to that in men and cats (WEGENER, 1996; DIMITROV and TONEVA, 2007).

The positioning of the animals studied (in abdominal and spine positions) did not affect the imaging of the anatomic features of the rabbit prostate gland.

In comparison with studies on the human prostate (McLAUGHLIN et al., 2005), we did not observe the glandular tissues zones in our study of the rabbit`s prostate.

The rabbit`s prostate gland is visualized as a heterogeneous finding unlike the human prostate which is homogeneous (VAN ENGELSHOVEN and KREEL, 1979; THOENI, 1983; WEGENER, 1996).

In this study, we present the topography and the tissue radiology characteristics as quantitative evaluation traits, compared to ATALAN et al. (1999), who presented the morphometrical radiology data in the canine prostate as signs of prostatomegaly.

Compared to the feline prostate (DIMITROV and TONEVA, 2007), this gland in rabbits is relatively more cranially situated and larger in size.

The results, obtained via computed tomography imaging of the rabbit`s prostate gland, could be used as a background in the diagnostics and interpretation of prostatic disorders in this species, and in the use of the rabbit as an animal model for the investigation of human prostatic lesions.

**References**

ATALAN, G., F. BARR, P. HOLT (1999): Comparison of ultrasonographic and radiographic measurements of canine prostate dimensions. Vet. Radiol. Ultrasound. 40, 408-412.

BARONE, R. (2001): Splanchnologie II. In: Anatomie comparée des mammifères domestiques. Tome quatrième, Triosième edition, Paris, 242.

BENOIT, G., F. CAILLEAUX, J. QUILLARD, X. LEDROUX, M. MOUKARZEL, M. Y. GNAGE, A. JARDIN (1991): Computer assisted anatomical reconstruction: a prostate model. Surg. Radiol. Anatomy 13, 45-47.

DIMITROV, R., Y. TONEVA (2007): Computed tomography features of feline prostate gland. Acta Morphol. Anthropol. 12, 186-192.

DINEV, D., G. SIMEONOVA (2009): Veterinary Anaesthesiology, Kota Publishing House, Stara Zagora.

HOLTZ, W., R. FOOTE (2005): The anatomy of the reproductive system in male Dutch rabbits (*Oryctolagus cuniculus*) with special emphasis on the accessory sex glands. J. Morphol. 158, 1-20.

KOZLOWSKI, R., R. KERSHEN, M. SIROKY, R. KRANE, K. AZADZOI (2001): Chronic ischaemia alters prostate structure and reactivity in rabbits. J. Urol. 165, 1019-1026.

McCRACKEN, T. H., R. KAINER, D. CARLSON (2008): Color Atlas of Small Animal Anatomy: The Essentials. Blackwell Publishing, USA, 72.

McLAUGHLIN, P., S. TROYER, S. BERRY, V. NARAYANA, A. MEIROWITZ, P. ROBERSON, J. MONTIE (2005): Functional anatomy of the prostate: Implications for treatment planning. Int. J. Radiation Oncol. Biol. Phys. 36, 128-135.

THOENI, R. F. (1983): Computed tomography of the pelvis, In: Computed Tomography of the Body. (Moss, A., G. Gamsu, K. Genand, Eds.), San Francisco, W. B. Saunders Company, pp. 987-993.

VAN ENGELSHOVEN, J., L. KREEL (1979): Computed tomography of the prostate. J. Comp. Assist. Tomogr. 3, 45-51.

VASQUEZ, B., M. DEL SOL (2002): Complejo prostatico en el conejo (*Oryctolagus cuniculus*). Rev. Chil. Anat. 20, 175-180.

WEGENER, H. (1996): The Prostate. In: Whole Body Computed Tomography, Philadelphia, W. B. Saunders Company, 2nd ed., pp. 425-430.

Received: 21 October 2009
Accepted: 29 January 2010

**DIMITROV, R. S.: Kompjutorizirana tomografija prostate u kunića (*Oryctolagus cuniculus*). Vet. arhiv 80, 771-778, 2010.**

**SAŽETAK**

Šest novozelandskih bijelih, spolno zrelih i zdravih kunića (*Oryctolagus cuniculus*) u dobi od 18 mjeseci, tjelesne mase od 2,8 do 3,2 kg rabljeni su u ovom istraživanju. Njihova zdjelica prikazana je kompjutoriziranom tomografijom poprječnim rezom u poprječnoj ravnini između prvoga i drugoga sakralnoga kralješka s debljinom prereza od 2 mm. Prostata kunića građena je od mekog tkiva, a smještena je dorzolateralno na prostatičnom dijelu uretre, između sjemenoga mjehurića (kranijalno) i bulbouretralnih žlijezda (kaudalno). Uočava se kao jajasta heterogena tvorevina, relativno veće gustoće od okolnoga mekoga tkiva (s iznimkom stijenke izlaznoga crijeva), a na transverzalnom prikazu zdjelice nalazi se na razini drugoga sakralnoga kralješka (dorzalno), koksofemoralnih zglobova (lateralno) i kranijalne grane spolnih kostiju (ventralno). Njezini rubovi lako se razlikuju od građe priležećega mekanoga tkiva. Prikaz kunićje prostate (kestenjače) kompjutoriziranom tomografijom mogao bi se rabiti kao osnova u dijagnosticiranju i tumačenju njezinih poremećaja u kunića te pri upotrebi kunića kao životinjskog modela za istraživanje oštećenja prostate u čovjeka.

**Ključne riječi:** prostata, anatomski prikaz, kunić