IJVS 2013; 8(2); Serial No:19

IRANIAN JOURNAL OF VETERINARY SURGERY (IJVS)
WWW.IVSA.IR

Comparison of Transabdominal and Transrectal Ultrasonography of the Prostate Gland in Dogs

Alireza Ghadiri[1], Reza Avizeh[1], Ali Baniadam[1], Amin Ranjbar[2]

Abstract

Objective- To compare transabdominal (TA) and transrectal (TR) ultrasonography of the prostate gland.
Design- Experimental study.
Animals- 10 intact male dogs that required euthanasia for reasons other than prostatic disease.
Procedures- Prostatic length (L), width (W) and height (H) were measured in T A (L_1, W_1 and H_1) and TR (L_2 and H_2) ultrasonography. Prostatic volume was calculated using the formula for the volume of an ellipsoid (V_{E1} and V_{E2}) or for a box (V_{B1} and V_{B2}) in TA and TR procedures, respectively. The dogs were euthanized, the prostate gland removed, and actual prostate dimensions and volume were measured. Linear regression was used to compare prostatic dimensions and volume measured by ultrasonography to actual ones.
Results- In TR ultrasonography there was no damage to rectum, the time for evaluation of the prostate gland was faster and the resolution of prostatic images was better than other procedure. There was highly significant correlation between prostatic parameters and their actual dimension. V_{B1}, V_{E1} and V_{B2} were greater and V_{E2} were lesser than actual prostatic volume. In TR and TA methods the dimensions had significant correlation with real prostatic sizes, while had not significant statistical differences with real prostatic sizes.
Conclusions and Clinical Relevance - TR ultrasonography found to be a simple, quick and noninvasive method and TA ultrasonography also yields useful information about the prostate. Calculated prostatic volume doesn't estimated prostatic volume correctly and need to use equations produced by linear regression:

$V = 0.427\ V_{B1} - 0.88$. $V = 0.796\ V_{E1} - 0.40$.
$V = 0.680\ V_{B2} - 1.95$. $V = 0.980\ V_{E2} + 1.94$.

Key Words- Transrectal ultrasonography, Prostate gland, Dog.

Introduction

The prostate gland is the major accessory gland in male dogs. A fluid which will transport and support the survival of sperm and which is delivered to the urethra during the terminal phase of ejaculation is produced by prostate gland.[1,2,3] Prostate disease is common problem in older sexually intact male dogs. The most common prostatic diseases are bacterial prostatitis, prostatic cyst, benign prostatic hyperplasia, prostatic adenocarcinoma and prostatic abscesses.[1,3] The main diagnostic techniques for prostatic diseases are history, physical and laboratory examinations, radiography, ultrasonography, computed tomography and magnetic resonance imaging.[4,5,6,7] The canine prostate remains the best model for assessing the effectiveness and complications of human studies.[8,9] The canine prostate gland can be affected by several disease processes, which often have overlapping clinical signs, making it difficult to reach the correct diagnosis.[1,3] Accurate diagnosis of prostatic disease requires a thorough understanding of prostatic anatomy, as well as clinical signs associated with canine prostatic disease. Furthermore, knowing which diagnostic tests are indicated, and how to properly them, facilitates an efficient and accurate diagnostic process.[1,10,11]
Ultrasonography is a useful, safe and noninvasive technique to assess the canine prostate gland. It allows better identification of the prostatic parenchyma compared to radiographic or urethrocystographic procedures. It is an excellent means for guiding

[1]Department of Clinical Sciences, School of Veterinary Medicine, Shahid Chamran University of Ahvaz, Ahvaz, Iran.
[2]Graudated from School of Veterinary Medicine, Shahid Chamran University of Ahvaz, Ahvaz, Iran.
Address all correspondence to Dr. Alireza Ghadiri (DVM, DVSc), E-mail: alighadiri@scu.ac.ir

prostatic biopsies.[4,6,7,12,13,14] Ultrasonography was used in the evaluation of prostate gland in dogs, via transabdominal and transrectal route'.[15-23, 25] Dimensions of the prostate gland are used as a preoperative criterion for deciding on the best way for treatment. Therefore, it is quite important to accurately assess the dimensions.[13, 15, 24] Prostate volume is used in man to decide between possible treatment modalities and prostatic volume estimation by transrectal ultrasound is a common clinical procedure. Step section planimetry is assumed to be the most accurate method of prostate volume determination, but it is time consuming and requires cumbersome special equipment.[8, 9]

Although Zoheil and Castellano (1995) compared prostatic ultrasonography by prepubic and transrectal technique in dogs, but in healthy young adult dogs,[24] it seems there is no document about comparison of transabdominal and transrectal ultrasonography for prostatic dimensions with actual size. The aims of this study were: to compare the transabdominal and transrectal ultrasonography of the prostate gland in dogs, to estimate the dimension, volume and weight of the prostate gland by transabdominal and transrectal ultrasonography and to derive a simple formula from actual and ultrasonographic prostate measurements for estimating prostate volume and weight.

Materials and Methods

The study was performed on 10 intact male dogs referred to our veterinary teaching hospital that required euthanasia for reasons other than prostatic disease. Their body weights ranged 16-23 kg and their ages between 2 to 4 years old.

Transabdominal and transrectal ultrasonography were performed using a 5 MHz linear array transducer (Veterinary Rectal probe, Piemedical 450 VET, Netherland). After complete preparations, each dog was placed in dorsal recumbency for transabdominal and in lateral and sternal recumbency for transrectal methods. Standard longitudinal and transverse sections (based on Atalan study[17], 1999) were obtained and prostatic length (L_1), width (W_1) and height (H_1) were measured in cm in transabdominal technique. Length was defined as the maximum diameter of the gland along the urethral axis. Height was defined as the maximum dorsoventrally diameter of the prostate. Width Width was defined in transverse section in maximum diameter perpendicular to the axis of the H_1. But in transrectal procedure only prostatic length (L_2) and height (H_2) were obtained for right and left prostatic lobs. Because of the equal measurements in both lobes only right lobe were documented. After measurement L_1, W_1 and H_1 by transabdominal ultrasonography, prostatic volume was calculated using the formula for the volume of an ellipsoid (V_{E1}): $V_{E1} = 0.524 \times L_1 \times W_1 \times H_1$ or for the volume of a box (V_{B1}): $V_{B1} = L_1 \times W_1 \times H_1$. In transrectal procedure prostatic volume was also calculated by $V_{E2} = 0.524 \times L_2 \times L_2 \times H_2$ and $V_{B2} = L_2 \times L_2 \times H_2$.

After the ultrasonographic evaluations the dogs were euthanized and the prostate gland was removed from cadaver, immediately. Connective tissues around the prostate gland were removed and weighed with a digital scale in grams. The actual prostate length (L), width (W) and height (H) were measured using a mechanical caliper graduated in mm. The actual prostate volume (V_A) was determined through water displacement in a graduated cylindrical containing in cm^3. Prostatic volume was also calculated using the formula for the volume of an ellipsoid $V_E = 0.524 \times L \times W \times H$ and for the volume of a box $V_B = L \times W \times H$. Specific gravity of the prostate glands was determined by dividing prostatic weight in grams by prostatic volume in cm^3. In necropsy rectum, colon, prostate gland and urinary bladder were controlled for any gross pathologic changes.

All statistical analyses were performed using SPSS 16 software. Linear regression was used to compare prostatic dimension and volume measured by ultrasonography to actual prostate L, W, H and V_A. Correlation coefficient method was used to compare prostatic dimension measured by ultrasonography to actual sizes. The relationships between age or bodyweight and prostatic dimensions, volume and weight were tested by means of correlation analyses, in all entire dogs. Results were considered significant when $P > 0.05$.

Results

In physical and ultrasonographic examinations and after necropsy there were no signs of prostatic diseases. In transrectal ultrasonography there was no damage to rectum and the time for evaluation of the prostate gland was faster than transabdominal ones. Also the resolution of prostatic images in transrectal method was better than other procedure. Lateral recumbency was better than sternal recumbency for transrectal examination. After transrectal ultrasonography there were not any signs of mucosal damages and hemorrhage. Rectal perforation had not observed in necropsy.

Mean±SD of the dimensions of the prostate gland measured by transabdominal and transrectal ultrasonography and prostatic actual measurements are summarized in table 1. Measurements obtained from transabdominal and transrectal ultrasonography were greater than actual prostatic dimensions. But measurements obtained from transrectal method were closer to actual prostatic dimensions than transabdominal ultrasonography. In transrectal ultrasonography only length and height could be measured due to type of transducer that was used. There was highly significant correlation between prostatic parameters calculated from transabdominal (L_1, W_1 and H_1) and transrectal (L_2 and H_2) ultrasonography and their actual dimension ($P < 0.001$). The measurements

were highly accurate in both methods and had not significant statistical differences with real prostatic sizes ($p<0.001$).

The mean ± SD of V_{E1} and V_{B1} measured by transabdominal ultrasonography were 16.68±8.7 and 31.85±9.3 cm^3, respectively. Based on table 1, V_B, V_{B1}, V_{E1} and V_{B2} were greater than actual prostatic volume while, V_E and V_{E2} were lesser than actual prostatic volume.

All of the prostate weights were greater than their volume. Actual prostatic volume and weight were 12.5±6.72 cm^3 and 12.82±6.8 grams, respectively. The mean±SD of specific gravity of prostate gland was 1.026±0.016 and there was highly significant correlation between actual weight and volume ($P \leq 0.001$). Also there were significant correlation between body weight ($P \leq 0.05$) and age ($P \leq 0.001$) of dogs to their actual prostatic volume.

Based on linear regression the equations comparing actual prostatic dimensions (L, W and H) to transabdominal ultrasonographic ones (L_1, W_1 and H_1) are:

$L = 1.06L_1 – 0.99$; ($R^2 = 0.93$).
$W = 0.99W_1 – 0.4$; ($R^2 = 0.87$).
$H = 1.06\ H_1 – 0.62$;($R^2 = 0.82$).

Based on linear regression the equations comparing actual prostatic dimensions (L and D) to transrectal ultrasonographic ones (L_2 and D_2) are:
$L = 1.32\ L_2 – 1.49$; ($R^2 = 0.88$).
$H = 1.1\ H_2 – 0.26$; ($R^2 = 0.92$).

Based on linear regression the equations comparing actual prostatic volume to calculated volume (V_{B1} and V_{E1}) by transabdominal ultrasonography are:
$V = 0.427\ V_{B1} – 0.88$; ($R^2 = 0.95$).
$V = 0.796\ V_{E1} – 0.40$; ($R^2 = 0.94$).

Based on linear regression the equations comparing actual prostatic volume to calculated volume by transrectal ultrasonography are:
$V = 0.680\ V_{B2} – 1.95$; ($R^2 = 0.89$).
$V = 0.980\ V_{E2} + 1.94$; ($R^2 = 0.91$).

Also the equations comparing actual prostatic weight (W) to calculated weight are:
$W = 0.434\ V_{B1} – 0.747$ ($R^2 = 0.96$).
$W = 0.81\ V_{E1} – 0.265$ ($R^2 = 0.95$).

Table 1. Comparisons between prostatic dimensions (mean ± SD) in present study and others [15, 21, 25].

	Length (cm)	Width (cm)	Height (cm)	Volume, Box(cm^3)	Volume, Ellipsoid (cm^3)
Present study transabdominal method	3.35± 0.4	3.42± 0.53	2.78±0.5	31.85±9.3	16.68±8.7
Present study transrectal method	3.01±0.32	undetermined	2.30±0.32	*20.83±7.1	*10.92±6.5
Present study actual size	2.5±0.45	2.92±0.52	2.27±0.36	16.75±6.23	8.68±5.72
Ruel et al. (1998)[25]	3. 4±1.1	3.3±0.9	2.8±0.8	-	18.9±15.5
Atalan et al. (1999)[16] Ω	2.9	2.5	2.3	12.3	-
Kamolpatana et al. (2000)[22]	3.15±0.83	3.15±0.9	2.83±0.6	32.0±22.6	16.7±11.77

*Volume was calculated with length instead of width, which could not measured by linear transducer in transrectal ultrasonography. Ω SD was not published in Atalan et al. (1999) study[16].

Discussion

This study was successfully performed on 10 intact male young adult dogs by transabdominal and transrectal ultrasonography. Ultrasound has become increasingly popular in the measurement of prostate size in men, via transabdominal, transrectal, perineal or transurethral routes.[8, 9] In dogs, transabdominal and transrectal ultrasound have been used for the assessment of prostate size. To the best of our knowledge there is no study to compare prostatic dimensions and volume measured by transabdominal and transrectal ultrasonography and to compare each one to actual prostatic size. Based on our findings transabdominal method took more time than other procedure. It could be due to clipping hair from caudoventral abdomen and require of a full bladder. The higher resolution of images of the prostate gland obtained with transrectal ultrasonography. In this method there was not any adverse reaction like bleeding, tenesmus or mucosal damages. A comparative study was done by Zoheil and Castellano (1995) in ten dogs with signs of prostatic disease in order to evaluate the usefulness of the prepubic and transrectal ultrasonography. They found both techniques were adequate to identify the prostate gland and prostatic urethra but transrectal ultrasound found 5 occurrences of parenchymal echogenicity changes whereas the prepubic technique found only 2.[24] The normal (actual) size of the canine prostate is said to be 2.5 to 3·0 cm in diameter (Allen and others 1991).[26]

Christensen (1979) found that the size in two- to five-year-old 25-lb dogs varied from ovoid, 1.7 cm in length by 2.6 cm in width by 0.8 cm in height, to spheroid, 2 cm in diameter.[2] These measurements are comparable with the results in the present study.

The mean ±SD of prostatic measurements using ultrasonography in present study and others in centimeters were summarized in table 1. There are differences between prostatic dimensions in our study and others. The differences between this study and previous studies can be explained by variations due to breed differences, animal size, age, body weight, inter observer's variability and numbers of dogs were used in the study. Cartee and Rowles (1983), in eight normal dogs weighing 7 to 30 Kg, measured the prostate dimensions using ultrasonography.[18] Atalan et al used 154 healthy adult (1-14 years) dogs with body weight 4.5 to 65 Kg,[15] Ruel et al used 100 healthy adult (0.75 to 14 years) dogs with 2 to 50 Kg weight that 14% of them had prostatic cysts[25] and Kamolpatana used 12 intact adult (less than 5 years old) male dogs with 11 to 30.8 Kg.[22] Despite of similarity of the age and weight of the dogs in Kamolpatana's report[3] to ours but they measured prostatic dimension on cadavers.

Based on the table 1 prostatic dimensions in transabdominal method in this study was slightly greater and in transrectal method was smaller than other studies. In transrectal method transducer could be positioned in close proximity to the prostate gland so that prostatic dimensions were closer to actual dimension than the other one method.

The mean ±SD prostatic volume determined by transabdominal ultrasonography and calculated using formulas of V_E and V_B were 16.68±8.7 and 31.85±9.29 cm3 respectively. While in Kamolpatana et al (2000) study, V_E and V_B of prostate gland were 16.77 ± 11.77 and 32 ± 22.6 cm^3 respectively.[22] Prostatic volume using formula of V_E in Ruel et al (1998) research was 18.9 ± 15.1 cm^3.[25] The normal size, volume and weight of the canine prostate gland are said to vary depending on age, breed and bodyweight (Barsanti and Finco 1979).[1] It varies in shape from almost spherical to bilobed or pear-shaped,[14, 19] so that it seems it would be difficult to use formula of a box or an ellipsoid to calculate prostatic volume.

It must be mentioned that there was highly significant correlation between prostatic volume calculated by ultrasonography and water displacement in present study like Kamolpatana's study. The formula for measurement of prostatic volume by ultrasonography determined in this study is different from later study. Furthermore Kamolpatana's study was performed on dead dogs, before necropsy.[22]

Based on our findings calculated prostatic volume, (V_B, V_{B1}, V_{B2} and V_{E1}) overestimate prostatic volume. Otherwise V_E and V_{E2} underestimate prostatic volume. So, due to these facts calculated prostatic volume must be corrected with equations produced by linear regression.

L_1 and W_1 in transabdominal ultrasonography and L and W in actual prostatic measurement were very close to each other in our study. So that we used L_2 instead of W_2 to calculate V_{E2} and V_{B2} which could not measured in transrectal ultrasonography.

Numeric prostatic weight in grams is similar to volume in cubic centimeters so that specific gravity is near to one. The prostate specific gravity in this study was comparable to Kamolpatana et al in the dog (1 ± 0.05) and Vilman et al study (1.05 to 1.06) in human. [8, 22]

In conclusion, transrectal ultrasonography found to be a simple, quick and noninvasive method for evaluating the prostate in the dog and transabdominal ultrasonography also yields useful information about the prostate and is the modality commonly used in veterinary practice. Calculated prostatic volume by formula of a box or an ellipsoid do not estimated prostatic volume correctly and need to correct with equations produced by linear regression.

Acknowledgments

This study was financially supported by Research Council of Shahid Chamran University of Ahvaz, Iran.

References

1. Barasanti JA. Disease of the Prostatic Gland. In: Osborn CA, Finco, DR, eds. Canine and Feline Nephrology and Urology. 1st ed. Philadelphia: Williams and Wilkins Co, 1995;726-755.
2. Christensen GS. The urogenital system and mammary glands. In: Miller E, Christensen GC, Evans HE. eds. Anatomy of the Dog. Philadelphia: WB Saunders, 1979;579.
3. Kutzler M, Yeager A, Prostatic diseases. in Ettinger SJ, Feldman EC, eds; Textbook of Veterinary Internal Medicine, 6th ed. St. Louis, Elsevier Saunders, 2005;1809–1819.
4. Burk RL, Feeney DA. Small Animal Radiology and Ultrasonography A Diagnostic Atlas and Texts. 3rd ed. Philadelphia: Saunders Co, 2003;437-445.
5. Johnston SD, Kamolpatana K, Root MV, Johnston GR. Prostatic Disorders in the Dog, Anim Reprod Sci 2000;60:405-415.
6. Kealy KJ, McAllister H, Graham JG. Diagnostic Radiology and Ultrasonography of the Dog and Cat, 5th Ed Saunders, an imprint of Elsevier Inc. 2011;175-181.

7. Lattimer JC, Essman CS. The Prostate Gland. In: Thrall DE, ed. Textbook of Veterinary Diagnostic Radiology. 5th ed. Philadelphia: W.B. Saunders Co, 2007;592- 602.
8. Vilman P, Hancke S, Strange-Vogrisen HH, Nielsen K, Sorensen SM. The reliability of transabdominal ultrasound scanning in the determination of prostatic volume. Scand J Urol Nephrol 1987;21:5-7.
9. Wasserman NF. Benign prostatic hyperplasia: a review and ultrasound classification. Radiol Clin North Am 2006;44:689-710.
10. Feeney DA, Johnston GR, Klausner JS. Tow-dimensional gray-scale ultrasonography. Application canine prostatic disease. Vet Clinics North Am Sm Anim Prac 1985;15:1159-1176.
11. Krawiec DR, Helfin D. Study of prostatic disease in dogs: 177 cases (1981-1986). JAVMA 1992;200:1119-1125.
12. Blum MD, Bahnson RR, Lee C, Deschler TW, Grayhack JT. Estimation of canine prostatic size by in vivo ultrasound and volumetric measurement. J Urology 1985;133:1082-1086.
13. Hecht S. Male reproductive tract, In atlas of small animal ultrasonography. Eds Pennincck DP, d' Anjou MA, 1st ed. Iowa: Blackwell Science, 2007;417-421.
14. Nyland TG, Matton JS, Prostate and Testis. In: Nyland TG, Matton JS eds. Small Animal Diagnostic Ultrasound. 2nd ed. Philadelphia: W.B.Saunders Co, 2002:250-266.
15. Atalan G, Barr FJ, Holt PE. Comparison of ultrasonography and radiographic measurement of canine prostate dimensions. Vet Radiol Ultras, 1999;40:408-412.
16. Atalan G, Holt PE, Barr FJ, Brown PJ. Ultrasonographic estimation of prostatic size in canine cadavers. Res Vet Sci 1999;67:7-15.
17. Atalan G, Holt, PE, Barr FJ. Ultrasonographic estimation of prostate size in normal dogs and relationship to bodyweight and age. J Sm Anim Pract 1999;40:119-122.
18. Cartee RE, Rowles T. Transabdominal sonographic evaluation of the canine prostate. Vet Radiol 1983;24:156-164.
19. Chang SC, Anthony S, Koder PC, Brown SG. Transrectal ultrasound guided manipulation of the canine prostate with minimum intervention. Lab Animal 1997;31:219-224.
20. Juniewicz PE, Ewing LL. Determination of canine prostatic size in situ: comparison of direct caliper measurement with radiologic and transrectal ultrasonographic measurement. Prostate 1989;14:55-64.
21. Juniewicz PE, Lemp BM, Batzold FH, Reel JR. Transrectal ultrasonography as a method to monitor canine prostatic size in situ: measurements following endocrine manipulation and ejaculation. Prostate 1989;14:265-277.
22. Kamolpatana K, Johnston GR, Johnston SD. Determination of canine prostate volume using transabdominal ultrasonography. Vet Radiol Ultras 2000;41:73-77.
23. Miyashita H, Watanabe H, Ohe H, Saitoh M, Oogama Y, Iijima S. Transrectal ultrasonotomography of the canine prostate. Prostate 1984;5:453-457.
24. Zohil AM, Castellano MC, Prepubic and transrectal ultrasonography of the canine prostate: A comprative study. Vet Radiol Ultras 1995;36:393-396.
25. Ruel Y, Barthez PY, Mailles A, Begon D. Ultrasonographic evaluation of the prostate in the healthy intact dogs Vet Radiol Ultras 1998;39:212-216.
26. Allen W.E, Noakes DE, Renton JP. The genital system. In: Chandler, EA, Thompson DJ, Sutton JB, Price CJ. Eds. Canine Medicine and Therapeutics, 3rd ed. London: Blackwell Scientific Publications, 1991;659-666.

نشریه جراحی دامپزشکی ایران
سال ۲۰۱۳، جلد ۸ (شماره ۲)، شماره پیاپی ۱۹

چکیده

مقایسه اولتراسونوگرافی سطح شکمی و داخل رکتومی غده‌ی پروستات سگ‌ها

علیرضا غدیری*[۱]، رضا آویزه [۱]، علی بنی‌آدم[۱]، امین رنجبر[۲]

[۱] گروه علوم درمانگاهی، دانشکده دامپزشکی دانشگاه شهید چمران اهواز، اهواز، ایران.
[۲] دانش آموخته دامپزشکی، دانشکده دامپزشکی دانشگاه شهید چمران اهواز، اهواز، ایران.

هدف- مقایسه اولتراسونوگرافی سطح شکمی و داخل رکتومی غده‌ی پروستات سگ

طرح- مطالعه‌ی تجربی

حیوانات- ده قلاده سگ که به دلایلی غیر از بیماریهای پروستات مرگ با ترحم روی آنها انجام گرفت.

روش کار- طول (L)، عرض (W) و ارتفاع (H) غده پروستات در اولتراسونوگرافی سطح شکمی (L_1، W_1 و H_1) و داخل رکتومی (L_2 و H_2) اندازه‌گیری شدند. حجم غده‌ی پروستات با استفاده از فرمول حجم بیضوی (V_{E1} و V_{E2}) یا حجم مکعب (V_{B1} و V_{B2}) به ترتیب، در روش‌های سطح شکمی و داخل رکتومی محاسبه گردید. بعد از آسان‌کشی سگ‌ها، غده پروستات خارج و ابعاد و حجم واقعی آن اندازه-گیری شد. برای مقایسه ابعاد و حجم غده پروستات در روش اندازه‌گیری اولتراسونوگرافی با ابعاد و حجم واقعی از روش رگرسیون خطی استفاده گردید.

نتایج- در روش اولتراسونوگرافی داخل رکتومی آسیبی به مخاط راست روده وارد نشده بود، زمان ارزیابی غده‌ی پروستات سریع‌تر و تصاویر به دست آمده از پروستات از وضوع بهتری برخوردار بود. همبستگی قوی و معنی‌داری بین ابعاد پروستات و اندازه‌های واقعی آنها وجود داشت. V_{B1}، V_{E1} و V_{B2} نسبت به حجم واقعی پروستات بزرگتر بوده ولی V_{E2} کوچکتر بود. در هر دو روش اولتراسونوگرافی ابعاد اندازه‌گیری شده همبستگی معنی‌داری با ابعاد واقعی داشته و همچنین اختلاف معنی‌داری نیز بین آنها وجود نداشت.

نتیجه‌گیری و کاربرد بالینی- اولتراسونوگرافی داخل رکتومی روشی آسان، سریع و بی‌خطر می‌باشد و روش سطح شکمی نیز اطلاعات مفیدی از غده پروستات ارائه می‌کند. حجم محاسبه شده، به درستی حجم واقعی پروستات را ارایه نمی‌کند و برای این منظور لازم است که از معادلات به دست آمده از رگرسیون خطی استفاده شود:

$V = 0.796\ V_{E1} - 0.40.$
$V = 0.980\ V_{E2} + 1.94.$
$V = 0.427\ V_{B1} - 0.88.$
$V = 0.680\ V_{B2} - 1.95.$

کلید واژه‌ها: اولتراسونوگرافی داخل رکتومی، غده‌ی پروستات، سگ.