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Case report

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A NOVEL APPROACH FOR ABDOMINAL SONOGRAPHIC EVALUATION OF THE PROSTATE, MEDIAN LOBE HYPERTROPHY AND HUGE PROSTATIC HYPERPLASIA

Emrah Doğan[1] A,B,D-F
• ORCID: 0000-0002-9446-2294

Uğur Taylan Bilgilisoy[2] B,E
• ORCID: 0000-0002-1515-9132

Yelda Dere[3] B
• ORCID: 0000-0003-0238-2236

Cenk Elibol[4] B
• ORCID: 0000-0001-7708-8635

[1] Department of Radiology, Muğla Sıtkı Kocman University, Mugla, Turkey

[2] Urology, Education and Research Hospital, Muğla Sıtkı Koçman University, Mugla, Turkey

[3] Department of Pathology, Muğla Sıtkı Kocman University, Mugla,Turkey

[4] Radiology, Education and Research Hospital, Muğla Sıtkı Koçman, Mugla, Turkey

A – study design, **B** – data collection, **C** – statistical analysis, **D** – interpretation of data, **E** – manuscript preparation, **F** – literature review, **G** – sourcing of funding

ABSTRACT

Background: The formula used for the calculation of prostate volume is roughly the three dimensions of prostate (L×W×H) multiplied by 0.52. Indeed, this is the formula for calculating the volume of a sphere. However, almost all of the papers on this topic describe the shape of the prostate as a pyramid. As the true prostate shape is a rhombohedral regular tetrahedron with a median lobe, a more effective calculation method is needed.

Aim of the study: This paper aims to develop a different approach for sonographic measurement of the prostate through mathematical models.

Case report: We present a 74-year-old patient with HPH and median lobe hypertrophy.

Conclusions: The classical method is insufficient for accurate measurement in patients with median lobe hypertrophy. In prostates with median lobes, the measurement should be calculated as the median lobe volume plus the spheric prostate volume.

KEYWORDS: ultrasound, prostate, benign prostate hyperplasia, median lobe

Background

Benign prostatic hyperplasia (BPH) is one of the most common urological problems in older men [1]. Enlargement of the prostate by more than 200 g is known as huge prostatic hyperplasia (HPH) [2]. Patients with this condition are evaluated before treatment and accurate measurement of the prostate is important for developing a treatment plan. The formula used to calculate prostate volume is roughly the three dimensions of the prostate (length [L] × width [W] × height [H]) multiplied by 0.52, which is the formula used to determine the volume of a sphere. However, almost all of the papers on this topic describe the shape of the prostate as a pyramid. In addition, HPH can occur with or without median lobe hypertropia. The median lobe is not a true lobe of the prostate and refers to an area of indentation towards the bladder. The prostate shape becomes a rhombohedral regular tetrahedron with the inclusion of the median lobe [3–5]. In all of these situations, prostate measurement is still made by the classic method using ultrasonography. In our opinion, the method outlined below is more accurate for HPH with median lobe

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hypertrophy, given the mathematical models. Here, we describe the sonographic evaluation of a 74-year-old patient with HPH and median lobe hypertrophy, accompanied by clinical findings.

Aim of the study

This paper aims to develop a different approach for sonographic measurement of the prostate through mathematical models.

Material and methods

The medical records of a 74-year-old male with prostate hyperplasia were used. The patient signed a consent form prior to the start of the study.

Case report

The patient was initially admitted to the hospital with acute urinary retention. There were no urinary problems described by the patient in the anamnesis. The patient had several medical comorbidities, including hypertension and depression. Physical examination of the scrotum and testicles revealed tenderness and bilateral swelling, and Prehn's sign was positive. On manual rectal examination, the anal tonus was normal and the prostate was large without palpable hard nodules. The patient's urea level was 31 mg/dL and creatinine was 1.02 mg/dL, both within the normal range. The C-reactive protein (CRP) level was 231 mg/L, the half-hour sedimentation was 22 mm, and the one hour sedimentation rate was 49 mm. These test values were elevated but the white blood cell (WBC) count (7.38 × 109 mg/L) was within the normal range. The prostate-specific antigen (PSA) level was high (18.46 ng/ml), and the results of the urinary analysis were normal.

An abdominopelvic ultrasound examination revealed that the kidneys were normal bilaterally. However, the prostate was enlarged, measuring 83 mm × × 70 mm × 114 mm with a volume of 344 ml. The parenchyma was heterogeneous, and calcifications and cystic degeneration areas were present. The median lobe was indented to the bladder from the posterior and trabeculation was increased on the bladder's wall. The wall was also thick (5 mm), likely due long-term prostate hyperplasia (Figure 1).

Disconcertingly, while the pre micturition bladder volume was 800 ml, the post micturition volume was 80 ml. The patient was able to void a large amount of urine.

With cystoscopy, the enlarged prostate with a large median lobe and a trabeculated bladder

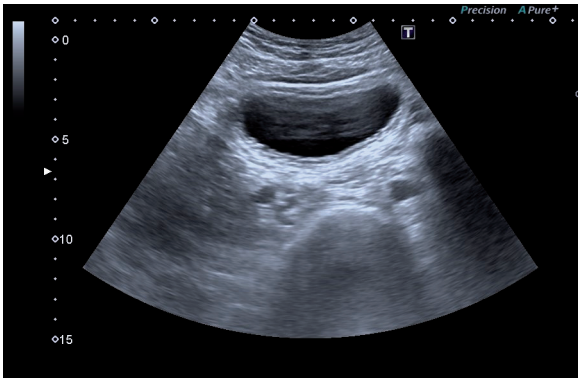

Figure 1. In the transverse sonographic plane, the bladder wall was not smooth and was trabeculated

were seen. Due to the high PSA levels, a transrectal ultrasound-guided (TRUS) prostate biopsy was performed using a 12-gauge Tru-Cut® biopsy needle prior to surgery. The histopathological findings were compatible with BPH. A transvesical open prostatectomy was performed and the gland was enucleated completely. Haematuria continued for two days and, on the second postoperative day, hemoglobin measured 7.8 g/dL. Three units of blood were transfused. The urethral catheter was removed on the seventh postoperative day and the patient was discharged from the hospital nine days after the operation. Two months later, the patient was continent and was voiding adequately.

After excision, the prostate specimen was sent for histopathological examination. The specimen measured 110 mm × 80 mm × 79 mm and weighted 360 g after peripheral tissues were removed. The histopathological findings were compatible with BPH. HE (hematoxylin-eosin) pathologic preparations showed hyperplastic benign glands in the fibromuscular prostatic stroma under the light microscope. There was also evidence supporting induration and necrosis. Prostatitis or carcinoma were not considered (Figure 2).

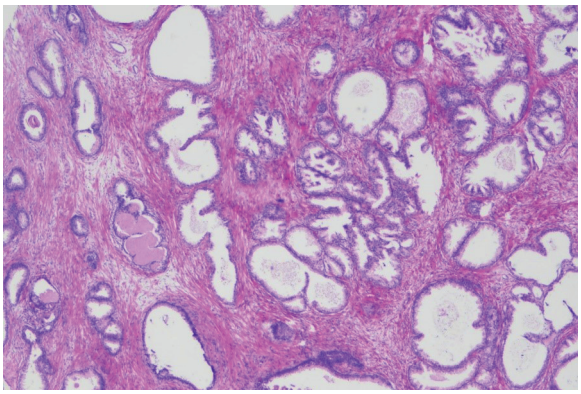

Figure 2. In the histopathological examination of the prostate, HE (hematoxylin-eosin) pathologic preparations showed hyperplastic benign glands in fibromuscular prostatic stroma under the light microscope

Discussion

The prostate gland is the largest accessory gland of the male urogenital system. Its normal weight is ~20–40 g and its mean dimensions are 30 mm × × 40 mm × 20 mm. The prostate shape resembles an upside down pyramid, with its base at the bladder neck and its top at the apex.

Transrectal ultrasound provides detailed information during prostate evaluation. It is used as a guide in interventional procedures, such as prostate biopsy, and shows the prostate anatomy in detail [6]. The prostate can also be measured using an abdominal approach. This procedure is easier and more rapid, and is therefore preferred for general evaluations of the prostate. In our country, abdominal ultrasound is a routine imaging procedure, and prostate evaluation is an important part of abdominal sonographic evaluation [7]. Prostate volume calculation is indispensable during this examination, especially for patients with BPH.

The prostate is comprised of both glandular and fibromuscular tissues. The transitional zone constitutes 5% of the normal prostate tissue, and BPH typically originates from this region. The transitional zone, which is normally located in the central area, enlarges and becomes indented at the base of the bladder. This indentation is called the median lobe; however, this is not a true anatomical structure. In fact, it is the indentation of the transitional lobe between the preprostatic sphincter and the urethra towards the bladder floor, as shown in Figure 3 [8,9].

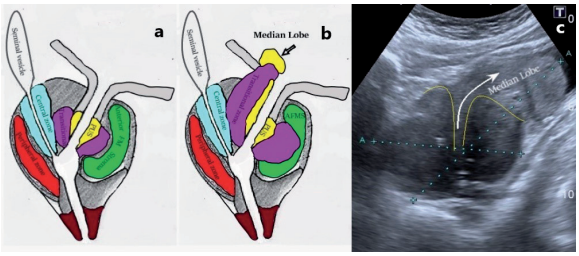

Figure 3. a – Normal anatomy of prostate; b – Median lobe hypertrophy; c – Median lobe hypertrophy in our patient

Although there are various prostate measurement methods installed on sonography devices [10], the main formula for calculating prostate size

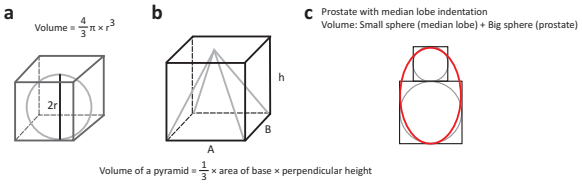

Figure 4. a – The calculation of sphere volume (The formula of prostate volume); b – The calculation of Pyramid volume; c – Red oval is the calculated prostate volume in the classic method, small sphere+ big sphere = prostate volume in our method

is volume =L×W×H×0.52 [11]. Considering that the volume of a sphere is $V=\frac{4}{3}\pi r^3$ $1\times\pi\times\frac{3}{4}=4.18$, if the volume of the sphere placed in this cube is calculated as R^3, $2^3=8$, sphere volume / cube volume =4.18/8=0.52 (Figure 4a).

In other words, the prostate is considered to be a regular sphere when the measurements are made. However, if the prostate is considered as a pyramid in the calculations, the three dimensions would have to be multiplied by 0.33, since a cube would create a pyramid equal to 1/3 of the base and height (Figure 4b).

As for the prostate, which includes the median lobe, if we consider that the upper sphere is the median lobe and the lower sphere is the prostate, the red oval is our measurement using the classical 3-dimensional measurement (Figure 4c) [12]. In other words, the volumes should be calculated separately and added.

In fact, our proposed method can be used in other complex situations encountered in daily medical practice. For example, this technique has been applied to an ultrasound from a patient with a trans ureteral resection. In this case, the central defect in the operation zone was subtracted from total volume to find the exact volume of the remaining prostate tissue [13,14].

Conclusions

Prostate volume is typically calculated as a sphere, and not a pyramid. The median lobe changes the shape of the prostate. Therefore, under these conditions, the classic formula not adequate for calculating prostate volume. In prostates with median lobes, the volume should be calculated as the median lobe volume + spheric prostate volume.

References

1. Guimaraes CTS, Sauer LJ, Romano RFT, Pacheco EO, Bittencourt LK. Prostate benign diseases. Top Magn Reson Imaging 2020Feb;29(1):1-16.doi:10.1097/RMR.0000000000000227. PMID: 32015291.
2. Tian Y, Liu HM, Yang B, Yang XS, Sun ZL, Sun F, Luo GH, Xia SJ. Prostatic anatomical parameters correlate with clinical characteristics suggestive of benign prostatic hyperplasia. Asian J Androl 2020 Sep 11. doi: 10.4103/aja.aja_47_20. Epub ahead of print. PMID: 32930102.
3. Basatac C, Cicek MC. A huge benign prostatic hyperplasia presenting with renal failure. J Surg Case Rep 2015

Jun 1;2015(6):rjv060. doi: 10.1093/jscr/rjv060. PMID: 26034239; PMCID: PMC4450250.

4. Aghamir SMK, Khatami F, Rahimi MR, Guitynavard F. Giant benign prostatic hyperplasia: a case report. Urol Case Rep 2019 Oct 19;28:101051. doi: 10.1016/j.eucr.2019.101051. PMID: 31709153; PMCID: PMC6833462.
5. Tyloch JF, Wieczorek AP. The standards of an ultrasound examination of the prostate gland. Part 2. J Ultrason 2017;17(68):43-58. doi:10.15557/JoU.2017.0007.
6. Bloch BN, Kuligowska E. Future role of ultrasound and MR imaging in prostate cancer: editorial comment on: T. Szopinski, A. Nowicki, F. Zaťura, T. Gołąbek and P. Chłosta Novel trends in transrectal ultrasound imaging of prostate gland carcinoma. J Ultrason 2015 Mar;15(60):102-104. doi: 10.15557/JoU.2015.0009. Epub 2015 Mar 30. PMID: 26672493; PMCID: PMC4579713.
7. Lieber MM, Jacobson DJ, McGree ME, St Sauver JL, Girman CJ, Jacobsen SJ. Intravesical prostatic protrusion in men in Olmsted County, Minnesota. J Urol 2009 Dec;182(6):2819-2824. doi: 10.1016/j.juro.2009.08.086. Epub 2009 Oct 17. PMID: 19837429; PMCID: PMC2864147.
8. Park HY, Lee JY, Park SY, Lee SW, Kim YT, Choi HY, Moon HS. Efficacy of alpha blocker treatment according to the degree of intravesical prostatic protrusion detected by transrectal ultrasonography in patients with benign prostatic hyperplasia. Korean J Urol 2012 Feb;53(2):92-97. doi: 10.4111/kju.2012.53.2.92. Epub 2012 Feb 20. PMID: 22379587; PMCID: PMC3285715.
9. Tyloch JF, Wieczorek AP. The standards of an ultrasound examination of the prostate gland. Part 1. J Ultrason 2016;16(67):378-390. doi:10.15557/JoU.2016.0038.
10. Lee CH, Akin-Olugbade O, Kirschenbaum A. Overview of prostate anatomy, histology, and pathology. Endocrinol Metab Clin North Am 2011 Sep;40(3):565-575, viii-ix. doi: 10.1016/j.ecl.2011.05.012. PMID: 21889721.

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Correspondence address:
Dr. Emrah Doğan
University Education and Research Hospital
Department of Radiology, Mugla/Turkey
228 sok. Obam sitesi No: 15 Kötekli /Menteşe -Muğla
E-mail: dr_e_dogan@hotmail.com

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