

POST MICTIONAL URINARY RESIDUE IN MEN: AN ULTRASOUND ANALYSIS

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ABSTRACT

INTRODUCTION: Prostate ultrasound is commonly requested by doctors for male patients over 40 years old, both for diagnostic and screening purposes. An enlarged prostate can result in voiding dysfunction due to static (mechanical) or dynamic (smooth muscles of the bladder neck and prostatic urethra) obstruction.

OBJECTIVE: Evaluate if there is a correlation between prostate volume and post-void residual (PVR) urine.

METHODS: This is a retrospective cross-sectional observational study. The study was conducted with male patients using data from January to July 2023.

RESULTS: A total of 500 male patients with an average age of 62 years, ranging from 40 to 83 years, were analyzed. Measuring post-void residual (PVR) urine is crucial for assessing potential prostate-related issues. In this study, a PVR of 0 to 40 ml was considered normal, and anything above 40 ml was considered abnormal. The highest PVR recorded was 287 ml, and the heaviest prostate weighed 79.64 g, while the normal weight of a healthy adult prostate ranges between 20-30 grams, or 20-25 cm³. Out of the 500 patients, 216 were found to have abnormalities: 145 had an increased prostate weight but normal PVR, 71 had both increased prostate weight and PVR, 50 had increased PVR but normal prostate weight, and 234 were normal. According to the Pearson index, the correlation was considered weak. The data distribution was tested using the Kolmogorov-Smirnov test, which showed that these variables did not follow a parametric distribution. Therefore, the Spearman correlation technique was adopted.

CONCLUSION: The retrospective cross-sectional observational study showed that abdominal ultrasound was able to identify changes in prostate size and post-void residual (PVR) urine, providing information for the evaluation and monitoring of these patients. However, there are weak correlations between prostate ultrasound (volume) and post-void residual urine.

KEYWORDS: CHANGES, PROSTATE, ULTRASOUND.

INTRODUCTION

Prostate ultrasound is commonly requested by doctors for male patients over 40 years old, both for diagnostic and screening purposes. The accurate determination of prostate volume is important for determining the degree of hyperplastic enlargement, the resulting tendency for urinary tract obstruction, and the preferred option for surgical treatment. The literature available for transabdominal prostate ultrasound instructs that the scan should be performed with a full bladder and the transducer tilted 15° towards the feet¹.

An enlarged prostate can result in voiding dysfunction due to static (mechanical) or dynamic (smooth muscles of the bladder neck and prostatic urethra) obstruction. Although classical literature is controversial regarding the direct relationship between prostate size and voiding dysfunction in patients with benign prostatic hyperplasia (BPH) and its implications for management and outcomes, some recent studies have highlighted the role of predominant secondary changes in the bladder in small-sized prostates, including a high bladder neck, increased smooth muscle tone in the bladder neck/prostate, and increased prostatic urethral angle, in contrast to the pri-

mary obstructive component in large glands².

Therefore, the cause of voiding dysfunction in patients with BPH should be established before undergoing surgery to improve the patient's condition, as management strategies differ in bladder outlet obstruction due to small and large prostates. The assessment of post-void residual urine is considered by many urologists to be an important test in patients with benign prostatic hyperplasia. Residual urine is found more frequently in these patients than in the healthy population. However, it does not always correlate with uroflowmetric findings.

Therefore, the objective of this study is to evaluate if there is a correlation between prostate volume and post-void residual urine volume.

METHODS

This is a retrospective cross-sectional observational study conducted with male patients using data from January to July 2023. The sample size was determined by temporal convenience, and the data were analyzed using Excel. The research was submitted to the Ethics Committee through the Brazil platform, respecting the ethical principles regulat-

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ing research in human subjects (resolution 466/12).

The variables related to ultrasound findings were: patient age, prostate weight, and post-void residual urine volume.

For the statistical analysis, the Pearson correlation test was applied, where 1 = perfect correlation; 0.75 = strong correlation; 0.5 = moderate correlation; -0.5 = no correlation. Additionally, the Kolmogorov-Smirnov test and Spearman correlation were used.

For the abdominal prostate ultrasound examination, it is essential to have a full bladder. Patients should drink a large volume of water (5 cups) one hour before the procedure. Once ready, the patient lies down in a supine position, and the transducer is used with gel for visualizing the prostate in the pelvic region. Two measurements are taken with the transducer in the longitudinal plane and one in the transverse plane to calculate the volume (transverse x anteroposterior x longitudinal x 0.52), as shown in figure 1. The initial bladder volume is also calculated in the same way at this time. Afterward, the patient empties their bladder to calculate the post-void residual volume.

The reference values for post-void residual urine (PVR) in the study are: absent (no residue), negligible (0 to 40 ml), moderate (40 to 100 ml), and significant (> 100 ml), as shown in figure 2.

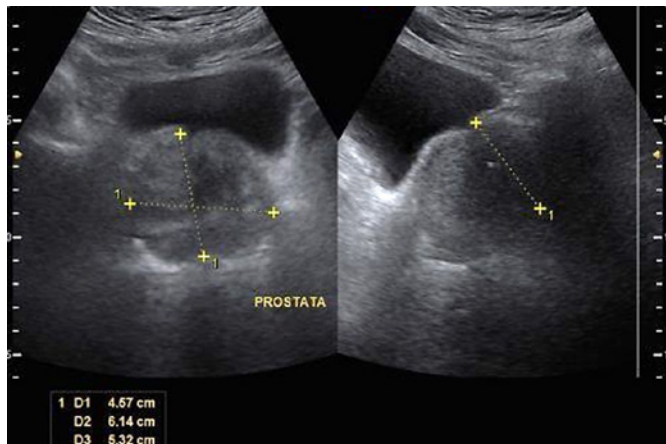


Figure 1. Illustrates an ultrasound image for calculating prostate volume.

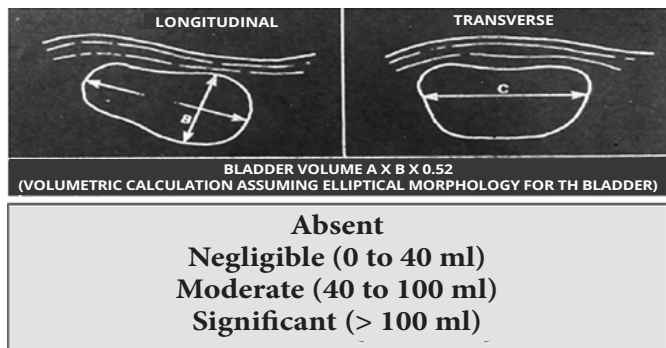


Figure 2. Methodology for calculating post-void residual bladder volume.

RESULTS

A total of 500 male patients were analyzed, with an average age of 62 years, ranging from 40 to 83 years old.

The measurement of post-void residual urine (PVR) is fundamental for evaluating possible prostate-related problems. For this study, a PVR of 0 to 40 ml was considered normal, and above 40 ml was considered abnormal. The highest recorded PVR was 287 ml, and the heaviest prostate weighed 79.64 g. The normal weight of a healthy adult prostate is between 20-30 grams, which is equivalent to 20-25 cm³ (cubic centimeters) - see table 1.

DADOS	RPM (N = 500)	PESO (N = 500)
Média	54,99	29,74
Mediana	28,00	24,45
Erro Desvio	66,13	18,23
Intervalo	287,00	92,53
Mínimo	0,00	2,950
Máximo	287,00	95,48

Table 1 - Illustrates the data regarding post-void residual urine (PVR) and prostate weight.

Out of the 500 patients, 216 were found to have abnormalities: 145 had an increased prostate weight but normal PVR (as exemplified in figure 3A); 71 had both increased prostate weight and PVR; 50 had increased PVR but normal prostate weight (exemplified in figure 3B), and 234 patients were normal.

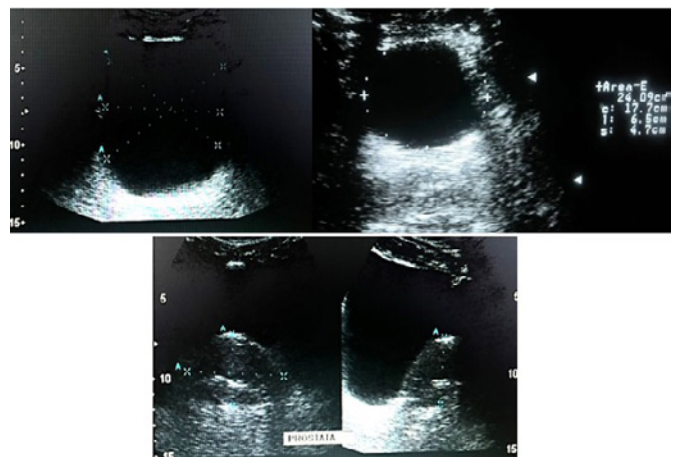


Figure 3A: Illustrates a patient with enlarged prostate and normal PVR.

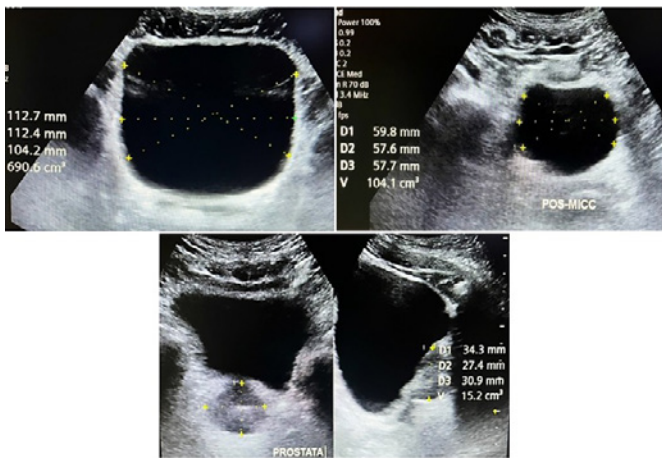


Figure 3B: Illustrates a patient with normal prostate volume and increased PVR.

The Pearson correlation index was considered weak (<0.5). The data distribution was tested using the Kolmogorov-Smirnov test, which determines if the correlation is parametric. It was found that the distribution of these variables does not correspond to a parametric distribution (they are not correlated), as shown in graph 1. Therefore, the correction technique adopted was the Spearman correlation - see table 2.

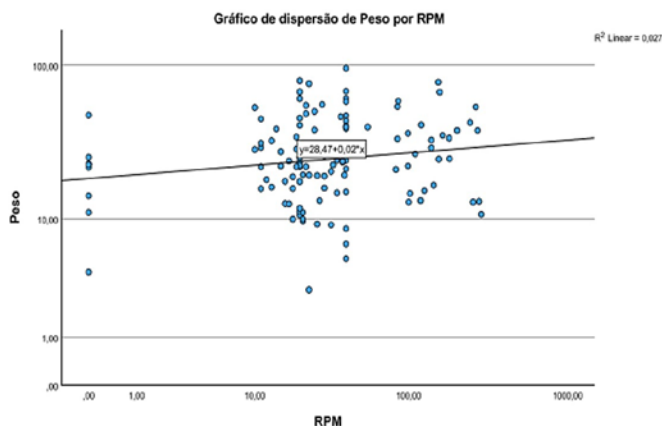


Gráfico 1 - Dispersão de peso por RPM

		RPM	Peso
rô de Spearman	RPM	1,000	,158
	Coeficiente de Correlação		,158
	Sig. (2 extremidades)		,085
	N	500	500
Peso	Peso	,158	1,000
	Coeficiente de Correlação	,158	
	Sig. (2 extremidades)	,085	
	N	500	500

Table 2 - Data related to non-parametric correlations.

DISCUSSION

Prostate volume plays a vital role in all types of prostate diseases. The American Urological Association guidelines

(2018) for the surgical management of benign prostatic hyperplasia now include the consideration of measuring prostate volume before surgical intervention. Ultrasound is a fast and radiation-free imaging modality.

Transabdominal ultrasound should be performed in patients complaining of dysuria symptoms. A complement to the exam, especially when the prostate is enlarged, should be the measurement of bladder capacity and evaluation of the amount of residual urine after micturition³⁻⁵.

The importance of prostate ultrasound in the evaluation of urinary problems in men plays a crucial role for several reasons:

- Prostate volume determination: precise measurement of volume;
- Monitoring of urinary function: initial volume and post-micturition residual;
- Diagnosis of prostate diseases: BPH, tumors, and infections;
- Safety and accessibility: safe, non-invasive, and relatively accessible technique.

In addition, post-void residual urine can help indicate dysfunctions in the prostate such as: urinary tract obstruction; voiding dysfunction; and monitoring the effectiveness of BPH treatment. This study revealed significant results regarding the correlation between post-void residual urine and prostate size, as there is not always a strong correlation between the variables. Therefore, not all patients with a history of BPH have increased post-void residual urine or other types of voiding alterations.

A retrospective study with 85 patients undergoing multiparametric magnetic resonance imaging compared to ultrasound concluded that prostate volume measured by multiparametric magnetic resonance imaging and ultrasound showed similar values, and excellent agreement with the actual weight of the prostate from surgical specimens. This demonstrates the importance of ultrasound in these cases. Estimating prostate volume with ultrasound offers many advantages, such as portability, low cost, harmlessness, and suitability for real-time operation⁵⁻⁹.

There is limited literature analyzing the correlation between prostate volume and post-void residual urine. An analysis that included 452 patients with lower urinary tract symptoms (LUTS) from the Urology Outpatient Clinic of UNICAMP corroborates with our findings and suggests weak correlations between prostate ultrasound and post-void residual urine (p <0.001; c = 0.31)¹⁰.

At the end of the analysis, it was observed that there are patients with alterations in post-void residual urine, even without prostatic alterations, due to bladder repletion. The studies analyzed demonstrate that ultrasound is an important tool in the evaluation of the prostate and urinary function, offering advantages such as accessibility, low cost, and safety. These findings reinforce ultrasound as an integral part of clinical practice in urology, contributing to a more precise and effective diagnostic approach in patients with conditions such as benign prostatic hyperplasia and other urinary tract disorders.

CONCLUSION

The retrospective observational cross-sectional study showed that abdominal ultrasound was able to identify changes in prostate size and post-void residual urine, providing information for the evaluation and monitoring of these patients. However, there are weak correlations between prostate ultrasound (volume) and post-void residual urine.

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