

# Analysis of Suprapubic and Transrectal Measurements in Assessment of Prostate Dimensions and Volume

## Is Transrectal Ultrasonography Really Necessary for Prostate Measurements?

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**Introduction:** The objective of this study was to evaluate the correlation of suprapubic ultrasonography and transrectal ultrasonography in measurements of prostate dimension and volume.

**Materials and Methods:** One hundred consecutive patients with lower urinary tract symptoms were examined by suprapubic and transrectal ultrasonography modalities in a same session. Measurements of the 3 dimensions of the prostate (anteroposterior, transverse, and craniocaudal) and its volume performed by suprapubic ultrasonography were compared with the corresponding measurements by transrectal ultrasonography in order to determine the correlation of the measurements. Prostate volumes were calculated using the ellipsoid formula. Data were further analyzed in subgroups according to prostate volumes smaller or larger than 50 mL, measured by suprapubic ultrasonography.

**Results:** The mean prostate volume of the 100 patients, measured by suprapubic and transrectal ultrasonography were  $65.9 \pm 35.8$  mL and  $62.5 \pm 32.0$  mL, respectively ( $r = 0.94$ ;  $P < .001$ ). The craniocaudal diameters had the strongest correlation among dimension measurements ( $r = 0.89$ ;  $P < .001$ ). Suprapubic and transrectal ultrasonography measurements also showed significant correlations for both prostates smaller or larger than 50 mL. Eighty-five percent of the patients had both volume measurements under or above this limit.

**Conclusion:** There was strong correlation between suprapubic and transrectal ultrasonography measurements of the prostate sizes, including both for volume or specific dimension measurements.

Keywords: ultrasonography, organ size, prostatic, prostatic hyperplasia

Urol J. 2009;6:208-13.  
www.uj.unrc.ir

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Received September 2008

Accepted April 2009

## INTRODUCTION

Dimensions of the prostate are used as a preoperative criterion for deciding on the operation method like transabdominal open prostatectomy, transurethral resection (TUR), and laser ablation. Therefore, it is quite important to accurately assess the dimensions

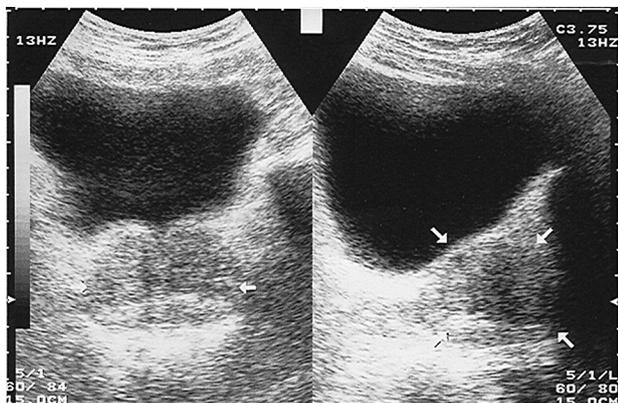
of the prostate in patients with benign prostate hyperplasia.<sup>(1)</sup> Digital rectal examination and intravenous pyelography are inadequate for determining the prostate dimensions.<sup>(2)</sup> Transrectal ultrasonography (TRUS) is considered superior to digital rectal examination, cystourethrography,

and urethroscopy in the evaluation of prostate volume.<sup>(1,3)</sup> According to the literature, there is a strong correlation between prostate weights measured by TRUS and the real prostate weight in specimens excised operatively or in cadavers.<sup>(1,4,5)</sup> Although it is accepted that TRUS is superior to suprapubic ultrasonography (SPUS) in the evaluation of the prostate, SPUS is used more commonly in the measurement of prostate dimensions.<sup>(6)</sup> The aim of our study was to determine the correlation of SPUS and TRUS measurements of prostate dimensions and volume in patients with lower urinary tract symptoms.

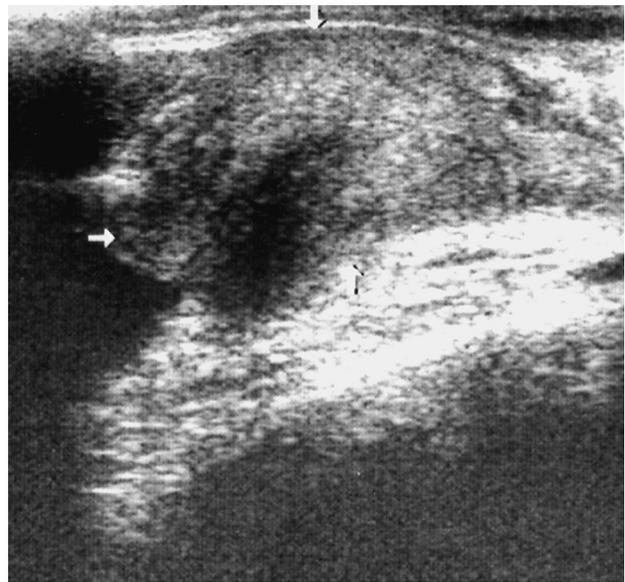
## MATERIALS AND METHODS

In this study, 100 consecutive patients presented to our clinic with lower urinary tract symptoms were evaluated. They all had serum prostatic antigen (PSA) levels equal or less than 4 ng/dL and their digital rectal examination showed no abnormal sign. Informed consent was obtained from all patients, and they underwent both TRUS and SPUS at a same session. The study was planned and conducted in compliance with the Helsinki declaration and good clinical practice rules.

Ultrasonographic examinations were performed using a Toshiba SSA-250 ultrasonography system (Tokyo, Japan). A 3.5-MHz convex probe was used for SPUS and a biplane transrectal probe (6-MHz end fire sector, 7-MHz linear) for TRUS (Figures 1 to 3). Measurements were performed with a full bladder, which was determined as the patient having a desire to micturate, but not



**Figure 1.** Suprapubic ultrasonographic measurement of prostate dimensions at the transverse and sagittal planes.



**Figure 2.** Transrectal ultrasonographic measurement of prostate dimensions by biplane linear probe at the sagittal plane.



**Figure 3.** Transrectal ultrasonographic measurement of prostate dimensions by biplane convex probe at the transverse plane.

with a severe discomfort. Measurements were performed in the supine position during SPUS and in left lateral decubitus position during TRUS examinations. The transverse (width), craniocaudal (length) and anteroposterior (height) dimensions of the prostates were measured using both methods. The craniocaudal and anteroposterior dimensions were measured in the sagittal plane, and the transverse dimensions were measured in the transverse plane. The longest dimension from the base of the prostate to the apex was measured for the craniocaudal dimension. The longest distance between the

anterior-posterior prostate margins that crosses the trace of craniocaudal measurement at an acute angle was measured for anteroposterior dimension. The longest dimension between the right and the left lateral margins where the prostate is observed widest was measured for transverse dimension. All measurements were performed at the same session. Volume of the prostate was calculated by using the ellipsoid formula (multiplication of the three measured dimensions  $\times 0.52$ ).<sup>(7)</sup>

The three dimension and volume measurements performed by SPUS were compared with corresponding measurements performed by TRUS in order to determine the correlation of the measurements. The patients' data were further analyzed in subgroups according to prostate volumes measured by SPUS as smaller and larger than 50 mL. The paired-samples *t* test was used to compare differences of prostate volumes in groups, and correlations were assessed using the Pearson correlation coefficient.

## RESULTS

The mean age of the patients was 66.5 years (range, 45 to 77 years) and the mean level of serum PSA was 2.8 ng/mL (range, 0.6 ng/mL to 4 ng/mL). The results of measurements performed by SPUS and TRUS and correlation coefficients are summarized in Table 1. The Pearson correlation coefficient test showed significant correlations between SPUS and TRUS in their measurements of the three dimensions and the

volume of the prostate. The strongest correlation for dimension measurements was found in the craniocaudal dimension ( $r = 0.89$ ;  $P < .001$ ).

According to the results, volume measurements performed by SPUS were  $5.47 \pm 1.53\%$  greater than those measured by TRUS (range, 1.1% to 8.3%;  $P = .12$ ).

Table 2 outlines the mean prostate volumes in groups of patients with a prostate volume of 50 mL or less and larger than 50 mL, based on the SPUS results. Eighty-five percent of the patients had both TRUS and SPUS volume measurements under or above this limit, while 15% had one of the SPUS or TRUS measurements under this limit while the other was above.

## DISCUSSION

Ultrasonography has become an important part of urology in prostate examination as it is noninvasive and safe. Developments in the technology in the recent 20 years enabled this imaging method to be used in the diagnosis, management, and follow-up of prostatic diseases, especially benign prostate hyperplasia.<sup>(8)</sup>

Determination of focal lesions in the prostate and imaging of paranchymal structure can be performed by TRUS.<sup>(1,4,9)</sup> This modality is also considered as the best in vivo method to calculate the volume of the prostate.<sup>(7)</sup>

Preoperative prostate volumes are used as a criterion for choosing the operation method like transabdominal open prostatectomy or TUR.<sup>(1)</sup> Reliable information about prostate volume

**Table 1.** Measurements of Prostate Size by Suprapubic Ultrasonography (SPUS) and Transrectal Ultrasonography (TRUS) and Their Correlation Coefficients\*

Prostate Parameters	SPUS	TRUS	r	P
Volume, mL	65.9 $\pm$ 35.9	62.5 $\pm$ 32.1	0.94	< .001
Craniocaudal dimension, mm	50.1 $\pm$ 11.0	51.9 $\pm$ 9.2	0.89	< .001
Anteroposterior dimension, mm	43.9 $\pm$ 8.4	40.5 $\pm$ 8.9	0.86	< .001
Transverse dimension, mm	50.5 $\pm$ 8.0	50.4 $\pm$ 6.2	0.79	< .001

\*Values are demonstrated as mean standard  $\pm$  deviation.

**Table 2.** Measurements of Prostate Volume by Suprapubic Ultrasonography (SPUS) and Transrectal Ultrasonography (TRUS) in Small and Large Prostates\*

Prostate Volume	Number of Patients	SPUS	TRUS	r	P
$\leq 50$ mL	41	36.9 $\pm$ 9.9	38.1 $\pm$ 10.8	0.77	< .001
>50 mL	59	85.3 $\pm$ 32.8	78.9 $\pm$ 31.3	0.90	< .001

\*Dividing the patients according to their prostate volumes is based on the SPUS results. Values are demonstrated as mean standard  $\pm$  deviation.

is also important, as when the time required to resect the adenoma increases, the risk of hemorrhage and TUR of the prostate syndrome increases with larger gland volumes and operative morbidity increases in proportion to gland size during open prostatectomy.<sup>(10-12)</sup>

A strong correlation has been reported between prostate weights measured by TRUS and the real prostate weight in specimens excised operatively or in cadavers.<sup>(5)</sup> However, TRUS is discomforting, especially in patients with anal diseases such as hemorrhoid, anal fissure, and anal fistula, as well as patients with a low pain threshold. Moreover, it cannot be performed in patients with abdominoperineal resection.<sup>(7)</sup> On the other hand, although SPUS may have pitfalls in obese patients, in patients with very full bladders or in those, who cannot fill the bladder adequately, it is a nontraumatic method, and can be easily tolerated by the patients. It has been reported that in patients with benign prostate hyperplasia, there is a strong correlation between the measurements of prostate dimension and volume measured by SPUS and the real prostate weight in excised specimens.<sup>(13,14)</sup> In agreement with our findings, Prassopoulos and colleagues reported a strong correlation between TRUS and SPUS in the measurement of prostate volume.<sup>(7)</sup> Yuen and coworkers found that transabdominal measurement of prostate volume had a good correlation with the measurements performed by TRUS, and thus, there was no need for the discomforting TRUS.<sup>(8)</sup> We showed a very strong correlation between volume measurements performed by SPUS and TRUS. The correlation coefficient of the two methods was 0.94 for volume measurement ( $P < .001$ ). However, SPUS may slightly overestimate the prostate volume. Doebler found that prostate volumes were measured higher by SPUS with a mean value of 12.4% than TRUS.<sup>(15)</sup> Prassopoulos and colleagues also reported that measurements with SPUS were higher with a rate of 5% than TRUS.<sup>(7)</sup> We reached the same results with a mean of 5.47% higher values by SPUS in comparison with TRUS.

Prostate volume is one of the helpful factors for deciding open prostatectomy or TUR of the

prostate. It has been reported that the volume limit for decision of open surgery differs between 50 mL and 100 mL for the prostate according to the experience of the surgeon.<sup>(11)</sup> Gurdal and associates suggested that although open prostatectomy was suitable for large prostates, its operative morbidity also increased in direct proportion to the gland size.<sup>(12)</sup> In our study, the correlation of prostate measurements performed by each method was also evaluated by accepting 50 mL as cutoff value. According to our results, measurements performed by SPUS and TRUS shows a strong correlation both for prostates smaller than 50 mL, with a correlation coefficient of 0.77 ( $P < .001$ ), and for prostates larger than 50 mL, with a correlation coefficient of 0.90 ( $P < .001$ ). This shows that, correlation between TRUS and SPUS becomes stronger in higher prostate volumes. Taking 50 mL as a threshold, 85% of patients had both TRUS- and SPUS-based volumes under this limit or both above this limit. Although previous studies reported that volume estimation by ultrasonography are volume dependent, our results showed that prostate volume did not affect the correlation significantly.<sup>(16,17)</sup> Kim and Kim reported that larger prostates might make the dimension measurements difficult, especially because of the difficulty in determination of the caudal end of the prostate. They concluded that experienced examiners can determine the caudal end more accurately.<sup>(16)</sup> We think that the high correlation of measurements for both small and large prostates in our study were due to the highly experienced radiologist who performed all the examinations. Kim and Kim also mentioned that an overdistended bladder may distort and displace the prostate, and as far as the prostate is within the field of view on TAUS, additional bladder filling is not helpful.<sup>(16)</sup> In our study group, there was a standardized moderate bladder fullness which enabled us to measure dimensions without distorting or displacing the prostate.

Another result of this study was the strong correlation found between dimension measurements. In addition to the importance of volume measurements, specific dimension measurements also have clinical importance. Doebler stated that measurement of the transverse dimension of the prostate was

important before transurethral needle ablation, and added that this measurement could be performed by SPUS, because there was a strong correlation between SPUS and TRUS measurements.<sup>(15)</sup> Chia and coworkers used craniocaudal measurements for determining the correlation of intravesical prostatic protrusion with bladder outlet obstruction.<sup>(18)</sup> Watanabe and Miyagawa used height and width of the prostate in calculating a parameter as the horizontal shape of the prostate and concluded that this parameter made a reliable assessment of the degree of prostatic obstruction.<sup>(6)</sup> These articles imply that, not only prostatic volume measurements, but also specific prostate dimension measurements are helpful parameters. According to our results, there is a strong correlation between dimension measurements performed by SPUS or TRUS. Although strong correlations exist between transverse dimensions ( $r = 0.79$ ;  $P < .001$ ) and anteroposterior dimensions ( $r = 0.86$ ;  $P < .001$ ) measured by TRUS and SPUS, the strongest correlation of dimension measurements was determined for craniocaudal dimension in our study ( $r = 0.89$ ;  $P < .001$ ). Some previous studies reported lowest correlations in the craniocaudal dimensions.<sup>(19)</sup> Kim and Kim has described that the problem in measuring craniocaudal dimensions were based on imaging the distal tip of the prostate, and this was because of very full or inadequate bladder distension and the inexperienced examiner, as the experienced examiner could determine the caudal part of the prostate more accurately in their study.<sup>(16)</sup> In our study, the correlation for craniocaudal dimension measurements were high, because all the examinations were performed by the same experienced radiologist and all the patients had full bladders up to a degree of having a desire to micturate, but not with a severe distension. Therefore, we could image the distal tip of the prostate easily both with TRUS and SPUS. Our results imply that in addition to the volume measurements, specific dimension measurements can also be performed by SPUS instead of TRUS. It should also be noted that a pitfall of this study was that all measurements were made by the same radiologist, and therefore, interexaminer variability could not be studied.

## CONCLUSION

We observed a strong correlation between the measurements of prostate volume or dimensions performed by SPUS and TRUS for both small and large glands. Thus, we believe that SPUS can be a reliable alternative for TRUS, where it is discomfiting, especially in patients with anal diseases and patients with a low pain threshold or a history of abdominoperineal resection.

## CONFLICT OF INTEREST

None declared.

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