Accuracy of ultrasound in estimation of prostate weight: comparison of urologists and radiologists

Rafael Nunez-Nateras, MD,[1] Jack R. Andrews,[1] George L. Martin, MD,[1] Paul E. Andrews, MD,[1] Mitchell R. Humphreys, MD,[1] Robert G. Ferrigni, MD,[1] William G. Eversman, MD,[2] Erik P. Castle, MD[1]

[1]Department of Urology, Mayo Clinic, Phoenix, Arizona, USA
[2]Department of Radiology, Mayo Clinic, Phoenix, Arizona, USA

NUNEZ-NATERAS R, ANDREWS JR, MARTIN GL, ANDREWS PE, HUMPHREYS MR, FERRIGNI RG, EVERSMAN WG, CASTLE EP. Accuracy of ultrasound in estimation of prostate weight: comparison of urologists and radiologists. The Canadian Journal of Urology. 2010;17(1):4985-4988..

Introduction: *Measurements of prostate size are obtained to contribute in the diagnosis and follow up of patients with a variety of diseases. Since its introduction, transrectal ultrasonography (TRUS) of the prostate has become the most common method for assessment of prostate volumes. Ultrasonography, in general, has been associated with concerns of operator dependent variability. Herein, we analyze the accuracy of urologists and radiologists performing TRUS.*

Material and methods: *The accuracy of preoperative TRUS prostate volume estimation was evaluated by comparing it to gross specimen prostate weight following robot-assisted radical prostatectomy (RARP) performed from August 2004 to March 2008 in Mayo Clinic Arizona. A total of 800 RARPs were evaluated retrospectively with 302 patients having a prostate volume measurement with TRUS at our institution followed by RARP being performed within 30 days. The TRUS measurements were divided into two groups: those TRUS measurements performed by urologists (group 1), and those performed by radiologists (group 2). The accuracy of the two groups were compared using a Pearson correlation analysis.*

Results: *The estimated weight by TRUS in the total cohort of patients correlated with the pathological specimen weight at 0.802 with a standard error of 0.90. Group 1 performed a total of 114 ultrasounds with a correlation of 0.835 and a standard error of 1.27. Group 2 performed a total of 188 with a correlation of 0.786 and a standard error of 0.88.*

Conclusions: *Urologists and radiologists are both consistently within 17%-22% of the estimated prostate specimen weight. Urologists appeared to have a slightly higher accuracy in estimation but a higher range of error for the whole group when compared to radiologists. Transrectal ultrasonography is a reliable technique to estimate prostate weight and accuracy to within 20% of the pathological weight. Urologists and radiologists are essentially equally proficient in estimating prostate weight with TRUS. These findings are particularly important with respect to specialty certification and competency/proficiency evaluation, as health care increasingly moves towards outcomes based reimbursement.*

Key Words: transrectal ultrasound, prostate cancer, prostate size estimation

Accepted for publication August 2009

Acknowledgement
The authors especially thank the Desert Mountain CARE, MCA Prostate Cancer Research Fund for their support on prostate cancer research.

Address correspondence to Dr. Rafael Nunez-Nateras, 5777 E. Mayo Boulevard, Phoenix, Arizona 85054 USA

Introduction

Since its introduction by Watanabe and colleagues in 1967[1] transrectal ultrasonography (TRUS) of the prostate has become the most common office based prostate procedure performed by the urologists.[2] The low cost, lack of ionized radiation for patient and examiner, noninvasive characteristics and relative ease

TABLE 1. **BMI, age prostate size and TRUS estimated volume among urologists and radiologists**

	Group 1 Urologists n= 114			Group 2 Radiologists n= 188			p value
	Range	**Mean**	**SD**	**Range**	**Mean**	**SD**	
BMI	20-43	27.7	± 3.7	21-40	27.6	± 3.7	0.37
Age (years)	47-81	66	± 8.1	46-82	66	± 6.7	0.82
Prostate size (gm)	21-125	55	± 18.4	20-136	54	± 19	0.24
TRUS estimated volume (cc)	16-143	41.5	± 19	14-99	42	± 17.1	0.42

of acquiring the basic skills of TRUS, has made it the most practical and common method for estimating prostate weight.[3-5] The assessment of prostate volume aids in diagnosis, treatment planning, and evaluation of a patient's response to treatment of both benign and malignant prostatic disease.[6] Therefore, accurate volume measurement is imperative in evaluation of the prostate. Several studies have addressed the accuracy of TRUS for determining prostate specimen weight. Loeb et al explored the correlation between TRUS and prostate specimen weight,[7] while others have evaluated the effect of body mass index (BMI), and the use of various devices.[8-10] To our knowledge, the impact of the performer on the accuracy of TRUS has not been studied before. In this study we compare the accuracy of urologists and radiologists in estimating prostate weight using TRUS.

Material and methods

A retrospective review was performed of 800 patients diagnosed with localized prostate adenocarcinoma who subsequently underwent robot-assisted radical prostatectomy (RARP) (August 2004 to March 2008). At our institution, transrectal ultrasonography for prostate volume and biopsy have been performed by both radiologists and urologists. Three hundred and two (37.8%) patients who had documented prostate volume estimation with a TRUS at our institution 1 month before surgery were included in this study. Prostate volume estimation through TRUS was performed using the prolate ellipsoid formula: width x length x height x 0.52.[11]

The correlation between preoperative TRUS prostate volume estimation and prostate specimen weight obtained after RARP were compared, analyzed, and assessed for accuracy. The TRUS measurements were divided into two groups: those TRUS measurements performed by urologists (group 1), and those performed by radiologists (group 2). There were seven urologists in group 1 and seven radiologists in group 2. A single ultrasound device was used by both groups (B-K Medical systems, Model 3535 with a 7 MHz transductor, type 8551). All prostate specimens were weighed before fixation using the same scale. Correlation was assessed using Pearson product-moment correlation with the software package SPSS.

Results

Among our total population, the mean age was 65 ± 7.1 years (range: 46-82), with a mean BMI 27.6 ± 3.7 (20.2-42.6). The mean TRUS prostate volume estimation range was 42.5 ± 17.7 cc^3 (14-143), with an actual mean prostate specimen weight of 54.4 ± 19g (20-136). The breakdown of BMI, age, TRUS prostate volume estimation and prostate weight of the RARP specimen among groups 1 and 2 are displayed in Table 1. There were no significant differences in these variables between the two groups. The entire sample studied presented a correlation with actual prostate weight of 0.806 (p = 0.001) with a standard error of 1.83, Figure 1. Group 1 (urologists) performed a total of 114 TRUS prostate volume estimations with a

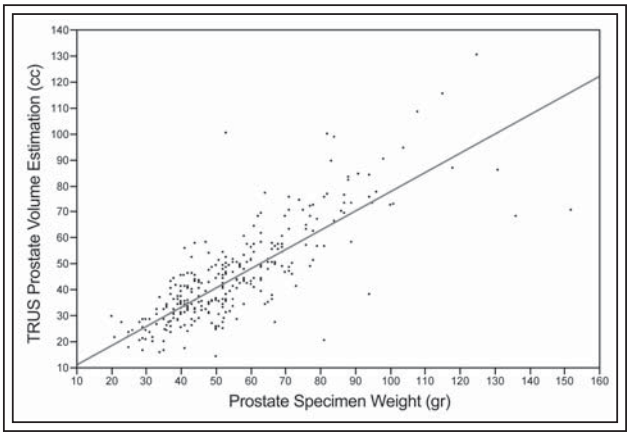

Figure 1. Scatterplot of TRUS and pathological prostate specimen weight (total sample n = 302 cases).

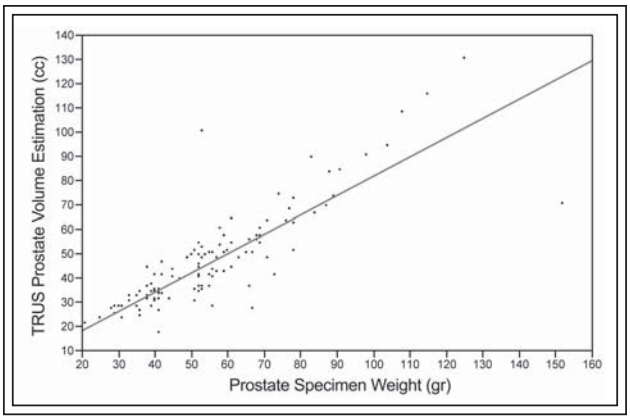

Figure 2. Scatterplot and line of best fit for TRUS and pathological prostate specimen weight. Group 1 (urologists), (n = 114).

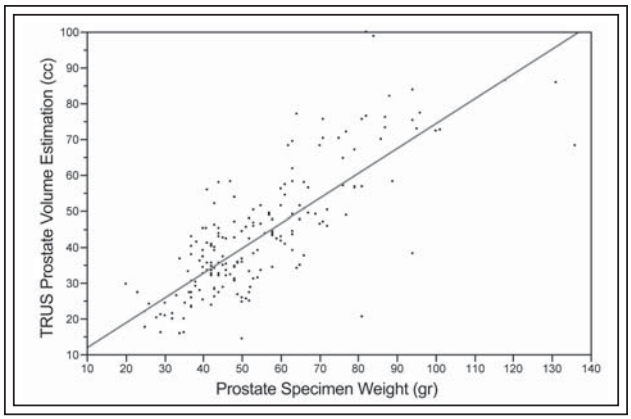

Figure 3. Scatterplot and line of best Fit for TRUS and prostate specimen weight. Group 2 (radiologists), (n = 188).

correlation of 0.837 (p = 0.001) and a standard error of 2.94, Figure 2. Group 2 (radiologists) performed a total of 188 TRUS with a correlation of 0.786 (p = 0.001) and a standard error of 2.31, Figure 3. When analyzed based on physician performing the procedure, there were none with a significantly worse ability to estimate prostate size compared to the mean.

Discussion

Accurate estimation of prostate volume is important for the diagnosis, treatment and follow up of benign and malignant prostate disease.[12-14] In work up of benign prostatic hypertrophy, recent data suggest that prostate gland size may predict which patients with LUTS will develop progressive symptoms and complications. Moreover, prostate size BPH may help select patients for specific treatment options and is useful in follow up of these patients.[14,18]

Ultrasound imaging estimation of prostate size is also a useful adjunct in malignant disease. When treating prostate cancer with any modality of radiotherapy, accurate prostate size estimation is crucial to deliver a homogeneous dose to the entire prostate.[15] In addition, size estimation correlates with outcomes of laparoscopic or robot-assisted prostatectomy[16] and has been shown to be an independent predictor of both extracapsular extension and positive surgical margins.[17] It is generally assumed that estimated TRUS volumes are reasonably accurate estimations of actual prostate size. This in combination with the low cost, lack or radiation, and ease of performing the procedure have made ultrasound the most common modality for prostate measurement.[2,19,20]

The results show that TRUS preformed by group 1 and group 2 are comparable. While group 1 presented a higher correlation, they also were found to have a higher standard error, compared to the group 2. In other words, group 1 was slightly more accurate, however group 2 was more uniform in their measurements. With this in mind, measurements with TRUS were comparatively similar between group 1 and group 2; suggesting that the performer, whether urologist or radiologist, was not a significant determinant of accuracy in our study.

Throughout the practice of medicine, there have been growing concerns over the needs for certification for a variety of therapeutic and diagnostic procedures. Transrectal ultrasonography has been a standard diagnostic modality within the armamentarium of both the urologist and radiologist alike. Based on our results, both specialists have demonstrated equivalent accuracy in prostate weight estimation. One of the strengths of this retrospective study is the unique aspect of our practice which allowed for a direct comparison of two groups using the same technology and validating it with gross specimens. As far as we know, this is the first statistical evaluation and comparison of radiologists' and urologists' competency in predicting prostate volume.

Conclusion

Urologists and radiologists are both consistently within 17%-22% of the estimated prostate specimen weight. Urologists appeared to have a slightly higher accuracy in estimation but a higher range of error for the whole group when compared to radiologists. Transrectal ultrasonography is a reliable technique

to estimate prostate weight and is accurate to within 20% of the pathological weight. Urologists and radiologists are essentially equally proficient in estimating prostate weight with TRUS. These findings are particularly important with respect to specialty certification and competency/proficiency evaluation, as healthcare increasingly moves towards outcomes based reimbursement. □

References

1. Watanabe H. History of ultrasound in nephrourology. *Ultrasound Med Biol* 2001;27(4):447-453.
2. Atug F, Castle EP, Thomas R. Office-based prostate procedures. *Urol Clin North Am* 2005;32(3):327-335.
3. Boczko J, Messing E, Dogra V. Transrectal sonography in prostate evaluation. *Radiol Clin North Am* 2006;44(5):679-687.
4. Lee G, Attar K, Laniado M, Karim O. Safety and detailed patterns of morbidity of transrectal ultrasound guided needle biopsy of prostate in a urologist-led unit. *Int Urol Nephrol* 2006;38(2):281-285.
5. Lee G, Attar K, Laniado M, Karim O. Trans-rectal ultrasound guided biopsy of the prostate: nationwide diversity in practice and training in the United Kingdom. *Int Urol Nephrol* 2007;39(1):185-188.
6. Rodriguez E Jr, Skarecky D, Narula N, Ahlering TE. Prostate volume estimation using the ellipsoid formula consistently underestimates actual gland size. *J Urol* 2008;179(2):501-503.
7. Loeb S, Han M, Roehl KA, Antenor JA, Catalona WJ. Accuracy of prostate weight estimation by digital rectal examination versus transrectal ultrasonography. *J Urol* 2005;173(1):63-65.
8. Sajadi KP, Terris MK, Hamilton RJ, Cullen J, Amling CL, Kane CJ, Presti JC Jr, Aronson WJ, Freedland SJ. Body mass index, prostate weight and transrectal ultrasound prostate volume accuracy. *J Urol* 2007;178:990-995.
9. Lee JS, Chung BH. Transrectal ultrasound versus magnetic resonance imaging in the estimation of prostate volume as compared with radical prostatectomy specimens. *Urol Int* 2007;78(4):323-327.
10. Matthews GJ, Motta J, Fracehia JA. The accuracy of transrectal ultrasound prostate volume estimation: clinical correlations. *J Clin Ultrasound* 1996;24(9):501-505.
11. Aarnink RG, de la Rosette JJ, Debruyne FM, Wijkstra H. Formula-derived prostate volume determination. *Eur Urol* 1996;29(4):399-402.
12. Pucar D, Sella T, Schöder H. The role of imaging in the detection of prostate cancer local recurrence after radiation therapy and surgery. *Curr Opin Urol* 2008;18(1):87-97.
13. Sladden M, Dickinson J. Effectiveness of screening for prostate cancer. *Aust Fam Physician* 1993;22(8):1385-1386.
14. Grossfeld GD, Coakley FV. Benign prostatic hyperplasia: clinical overview and value of diagnostic imaging. *Radiol Clin North Am* 2000;38(1):31-47
15. Hoffelt SC, Marshall LM, Garzotto M, Hung A, Holland J, Beer TM. A comparison of CT scan to transrectal ultrasound-measured prostate volume in untreated prostate cancer. *Int J Radiat Oncol Biol Phys* 2003;57(1):29-32.
16. Konety BR, Sadetsky N, Carroll PR; CaPSURE Investigators. Recovery of urinary continence following radical prostatectomy: the impact of prostate volume--analysis of data from the CaPSURE Database. *J Urol* 2007;177(4):1423-1425
17. Msezane LP, Gofrit ON, Lin S, Shalhav AL, Zagaja GP, Zorn KC. Prostate weight: an independent predictor for positive surgical margins during robotic-assisted laparoscopic radical prostatectomy. *Can J Urol* 2007;14(5):3697-3701.
18. Rosario DJ, Phillips JT, Chapple CR. Durability and cost-effectiveness of transurethral needle ablation of the prostate as an alternative to transurethral resection of the prostate when alpha-adrenergic antagonist therapy fails. *J Urol* 2007;177(3):1047-1051
19. Terris MK, Stamey TA. Determination of prostate volume by transrectal ultrasound. *J Urol* 1991;145(5):984-987.
20. Wolff JM, Boeckmann W, Mattelaer P, Handt S, Adam G, Jakse G. Determination of prostate gland volume by transrectal ultrasound: correlation with radical prostatectomy specimens. *Eur Urol* 1995;28(1):10-12.15. Ficarra V, Zattoni F, Artibani W, Fandella A, Martignoni G, Novara G, Galetti TP, Zambolin T, Kattan MW, GUONE Penile Cancer Project Members. Nomogam predictive of pathological inguinal lymph node involvement in patients with squamous cell carcinoma of the penis. *J Urol* 2006;175(5):1700-1704.