Correlations Between Preoperative Measurement of Prostate Volume by Transabdominal and Transrectal Ultrasound with Open Prostatectomy

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ABSTRACT:

BACKGROUND:

Despite being formally included in the assessment of patients presenting with lower urinary tract symptoms (LUTS), transrectal ultrasonography (TRUS) is not routinely offered to these patients. Data exist on the superiority of TRUS over transabdominal ultrasound in accurately predicting prostate volume.

OBJECTIVE:

To evaluate which of these methods are more accurate in calculation of prostate volume. The volume is most commonly measured using the formula, prostate volume=height×width×length × π/6, which is derived considering the gland as ellipsoid'

PATIENTS AND METHODS:

Thirty five patients aged (60-75) years; with mean age (65.1±4.016) years and mean of serum prostate specific antigen (PSA) (1.429±0.3149) complaining from LUTS due to benign prostatic hyperplasia (BPH) underwent suprapubic prostatectomy .TRUS was performed in all patients preoperatively and calculations of the prostate volume were made. These were compared with respective transabdominal calculations of the prostate volume as well as the enucleated specimen weight.

RESULTS:

TRUS slightly underestimated weight by (8.6%).while transabdominal U/S overestimated it by (94.3%). Pearson correlation analysis indicated TRUS as a better predictor of weight (0.661) at P-value of <0.001 (extremely significant) followed by transabdominal U/S (0.465) at P-Value of <0.01 (highly significant).

CONCLUSION:

TRUS is more accurate than transabdominal U/S in predicting adenoma volume in patients with BPH.

KEYWORDS: prostate volume, abdominal ultrasound, TRUS

INTRODUCTION:

Prostate size can be estimated by digital rectal examination (DRE), although the reliability across observers is in general considered poor. In addition, DRE tends to underestimate true prostate size as determined by TRUS or other imaging modalities [(1)].The magnitude of the underestimation increases with increasing prostate size from 25% up to 50% or more. For the purpose of epidemiologic studies, TRUS and MRI measurements are preferred, although MRI measurements are somewhat expensive when attempting cross-sectional examinations of populations [(2)]. TRUS volume measurements using the prolate ellipsoid volume formula are the most widely accepted measure of prostate volume with reasonable statistical performance characteristics, particularly when performed by a single or several well-trained examiners [(3)]. TRUS of the prostate, first described by Wantanabe and colleagues (1968) [(4)], expanded to routine clinical use with improvements in ultrasound technology [(5).] Prostate volume can be calculated through a variety of formulas. Volume calculation requires measurement of up to three prostate dimensions [(6)]. In the axial plane, the transverse and anteroposterior (AP) dimensions are measured at the point of widest transverse diameter The longitudinal dimension is measured in the sagittal plane just off the midline because the bladder neck may obscure the cephalad extent of the gland. Most formulas assume that the gland conforms to an ideal geometric shape: either an ellipse (π/6 × transverse diameter × AP diameter × longitudinal diameter), sphere (π/6 × transverse diameter[(3)]), or a prolate (egg shaped) spheroid (π/6

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× transverse diameter^2 × AP diameter). Despite the inherent inaccuracies that arise from these geometric assumptions, all formulas reliably estimate gland volume and weight, with correlation coefficients greater than 0.90 with radical prostatectomy specimen weights, since 1 cm^3 equals approximately 1 g of prostate tissue. The mature average prostate is between 20 and 25 g and remains relatively constant until about age 50, when the gland enlarges in many men [(7)].

Once gland volume has been obtained, one can calculate derivatives such as the PSA density (PSAD = serum PSA/gland volume). An elevated PSAD of the entire gland has been shown to have a sensitivity and specificity of 75% and 44%, respectively, for predicting a positive cancer diagnosis on repeat biopsy. Unfortunately, there is high inter-operator and intra-operator variability in PSAD determinations and similar predictive information can now be obtained using serum free: total PSA [(4).]

AIM OF THE STUDY:

The aim of study is to compare the efficacy of transrectal versus transabdominal ultrasound in assessment of the prostate size guided by postoperative weight measurement.

PATIENTS AND METHODS:

This prospective study was conducted from June 2009 to October 2010; thirty five patients were selected for this study in Al-Kadhymia teaching hospital. Their ages ranged (60-75 years) with mean (65.1±4.016).Their Complaint varied from acute refractory urinary retention, significant symptoms from bladder outlet obstruction (BOO) not responsive to medical therapy, urinary bladder calculi in some patients, and LUTS due to benign BPH.

All patients were submitted for thorough history and physical examination including DRE, investigated for PSA, urinalysis, full blood count, clotting factors assay, renal function test, random blood sugar, chest x-ray, electrocardiogram (ECG) and echocardiography in some patients according to request of physician. TRUS and abdominal ultrasound examination were performed in all patients preoperatively and calculation of prostate size was made.

All patients underwent suprapubic prostatectomy either under general or spinal anesthesia, complete enculeation of adenoma. Each adenoma was weighed by fine electronic scale then put in a cylinder to measure the column of water displaced by adenoma according to Archimedes's law [(8)], fig 1 the results were compared with respective transabdominal ultrasonic calculation of prostate size. All specimens were sent for histopathological examination.

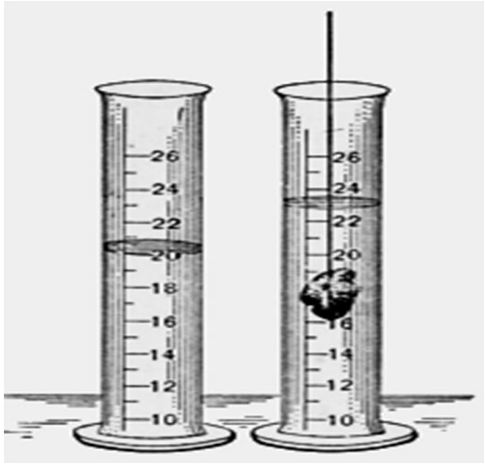

Figure 1: The Law of Buoyancy: The buoyant force is equal to the weight of the displaced fluid [(8)].

Statistical analysis: Data were arranged and tabulated in mean±SD, number and percentage by using SPSS 17.Association between different variables was measured by using paired T-test and Pearson correlation.

P- Value < 0.05 was considered as statistically significant.

P-Value < 0.01 was considered as statistically highly significant.

P-Value < 0.001 was considered as statistically extremely significant.

RESULTS:

The results are shown in the following tables:

Table 1: The paired T-test between the weight (gm) and the cylinder (ml) parameters.

Parameters	Sample size	Mean	Standard deviation	Standard error mean	P-Value*
Weight (gm)	35	81.926	24.2447	4.0981	-
Cylinder (ml)	35	81.694	24.2592	4.1005	-
Paired-test	-	0.231	0.0718	0.0121	> 0.05

*P-Value > 0.05 not significant.

Out of results of paired T-test of 35 patients presented with (BPH) shows that the paired T-test between means is (0.231), between standard deviations is (0.0718) and between standard error of means is (0.0121) which is at P-Value (> 0.05) which is not significant which indicate that there is no difference between the weight and cylinder parameters.

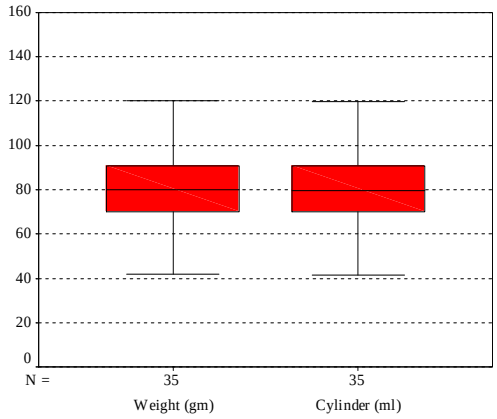

Figure 2: The box-plot chart shows there is no difference between weight (gm) and cylinder (ml) parameters.

Table 2: Shows Pearson correlation between the weight (gm) and trans-rectal ultrasound parameters.

Parameters	Sample size	Mean	Standard deviation	Pearson Correlation	P.value
weight (gm)	35	81.926	24.2447	0.661	< 0.001*
Trans-rectal ultrasound (cm^3)	35	90.74	15.504	0.661	< 0.001*

*P-Value < 0.001 is extremely significant.

Out the results of Pearson correlation of 35 patients presented with (BPH) which shows the mean of weight (81.926) with standard deviation (24.2447) and mean of trans-rectal ultrasound (90.74) with standard deviation (15.504) with Pearson correlation (0.661) which is at P-Value of (< 0.001) which is extremely significant which indicates extremely significant correlation between actual weight and TRUS estimation.

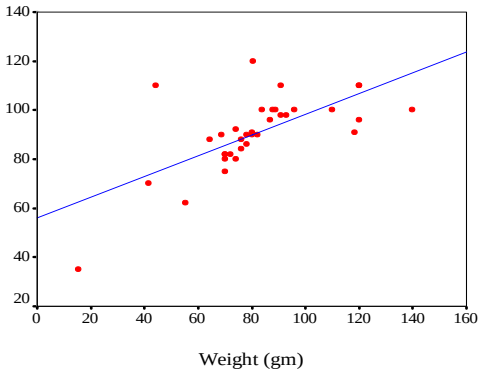

Figure 3: The scatter plot chart shows highly significant correlation between trans-rectal ultrasound (cm^3) and cylinder (ml) parameters.

Table 3: Shows Pearson correlation between the weight (gm) and abdominal ultrasound (cm^3) parameters.

Parameters	Sample size	Mean	Standard deviation	Pearson Correlation	P-Value
Weight(gm)	35	81.926	24.2447	0.465	< 0.01*
Abdominal ultrasound (cm^3)	35	145.34	186.276	0.465	< 0.01*

*P-Value < 0.01 is highly significant.

Out the results of Pearson correlation of 35 patients presented with (BPH) which shows the mean of weight (81.926) with standard deviation (24.2447) and mean of abdominal ultrasound (145.34) with standard deviation (186.276) with Pearson correlation (0.465) which is at P-Value of (< 0.01) which is highly significant which indicates highly significant correlation between weight and abdominal ultrasound estimation.

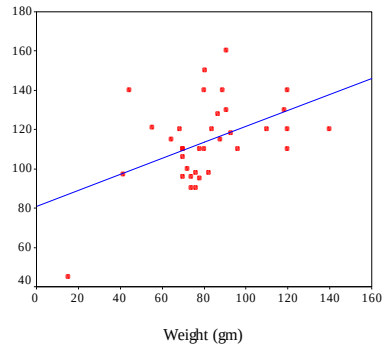

Figure 4: The scatter plot chart shows significant correlation between abdominal ultrasound (cm^3) and cylinder (ml).

DISCUSSION:

Symptomatic BPH is considered an endemic disease and treatment of this problem of elderly men constitute a substantial drain on health care resources [9].Treatment evaluation is necessary to make choices between the different treatment strategies available for clinical BPH. The number and variety of treatment options for patients presenting with LUTS due to BPH symptoms is large and steadily increasing. It seems at least one or two new technologies approaches and / or drugs are being introduced each year [10]. The advantages of TRUS over transabdominal U/S are [11].

1) Anatomically better since the prostate is intrapelvic organ and just anterior to the rectum make it more approachable by TRUS.

2) Concomitant assessment of lesions in the prostate like carcinoma of the prostate.

3) Concomitant prostatic biopsy.

In the current study the sample size was (35) with age (65.1±4.016) and PSA (1.429±0.3149), it proved that the mean weight in (gm) of adenoma (81.926±24.2447) was equal to the mean volume of adenoma in (cc) (81.694±24.2592) measured by cylinder according to Archimedes's law by using paired T-test which revealed that the difference between 2 measurements was (0.231±0.0718) at P-Value of > 0.05 (not significant) which means that there is no difference between 2 measurements as shown in table (1) and figure (2).

It also proved that the TRUS was more accurate than transabdominal U/S in predicting adenoma volume, this was done by using Pearson correlation, which showed that the weight in (gm) (81.926±24.2447) and transabdominal U/S (cm^3) (145.34±186.276) with Pearson correlation (0.465) gave a P-value of < 0.01 (highly significant) as shown in table (2) and figure (3) while the TRUS (90.74±15.504) with Pearson correlation (0.661) gave a P-Value of < 0.001 (extremely significant) as shown in table(2) and figure (3).

The TRUS had accurately estimated the size of prostate in (32) patients (91.4%) and underestimated it in (3) patients (8.6%).The transabdominal U/S had overestimated the size of the prostate in (33) patients (94.3%) while underestimated it in (2) patients (5.7%).

In a study done in at The Urology Department, University of Athens medical school, (TRUS versus transabdominal ultrasound as a predictor of enucleated adenoma weight in patients with BPH: a tool for standard preoperative work-up?)[12]. in which (71) patients presenting with LUTS due to BPH and eventually managed with open surgery were involved, TRUS was performed in all patients preoperatively. These were compared with respective transabdominal U/S calculations of the prostate volume as well the enucleated specimen. This study showed that the TRUS is better predictor of weight with (0.817) at a P-Value of < 0.0005. In the current study the predictor (**Pearson correlation** between the **weight-** in gm- and **trans-rectal ultrasound** parameters) was (0.661) at a P-Value of <0.001.

While the transabdominal U/S the predictor of weight with (0.669) at a PValue of < 0.0005. In the current study, the predictor, **Pearson correlation** between the **weight** (gm) and **abdominal ultrasound** (cm^3), was (0.465) at a P-Value of <0.01.

TRUS, in that study, slightly underestimated weight by (4.4%), and in current study (8.6%).Transabdominal U/S overestimated it by (55.7%) and in the current study by (94.3%).

The slight difference in P-Value might related to

1. Sample size of patients in these two studies
2. Radiologist experience in calculation of prostate volume by TRUS.

U/S, in general, has been associated with concern of operator dependant variability [13].

A study that was done in the department of Urology, University of California at San Francisco, USA, (Comparison of TRUS prostatic volume estimation with MRI volume estimation and surgical specimen in patients with BPH), compared volumes determined by TRUS with MRI and TRUS-estimated weights with surgical specimen weights. The main findings of this study were (a) TRUS and MRI measurement of prostate volumes are quite similar; and (b) TRUS underestimates by (10%) the prostatic weight as determined from the surgical specimen [14]. In the current study TRUS underestimated the prostate weight in (8.6%) when compared with the prostatic weight of the surgical specimen.

CONCLUSION:

TRUS is more accurate than transabdominal U/S in predicting adenoma (prostate) volume in patients with BPH, and its standard use might lead to fewer open approaches, with consequent less morbidity and hospitalization.

Recommendation:

According to this study it is better to do TRUS than transabdominal U/S in the assessment of patients with BPH to choose the best option of surgical interventions either open simple prostatectomy or other techniques like endoscopic technique.

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