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Full Length Research Paper

Sonographic Assessment of Residual Urine Volume in Benign Prostatic Hyperplasia patients in Sudan

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This was a descriptive cross sectional study which was conducted in Khartoum state, Sudan, in the ultrasound departments of different hospitals and clinics from third of January 2016 to twenty of August 2016. The problem of this study was that assessment of residual urine volume is not always considered although it helps identify patients who need further evaluation and helps via the choose treatment method. The study aimed to measure residual urine volume in benign prostatic hyperplasia patients, to measure intravesical prostatic protrusion, to correlate between prostate volume and age, pre and post void urine volume respectively, to correlate between prostate volume and pre void urinary bladder volume, to correlate between prevoid residual volume and postvoid residual urine volume and to correlate between patients age and postvoid residual urine volume, to correlate between prostate volume and intravesical prostatic protrusion and to correlate between intravesical prostatic protrusion and postvoid residual volume .The data were collected from 70 patients, classified and analyzed by SPSS (statistical package for social science). The study showed that most common affected age group of benign prostatic hyperplasia lies between 61-70 years old (38.6%), most patients, and range between (41-148) ml, the most prevoid urinary bladder volume was between 101-200ml (60%), the mean of prevoid volume was 185.26 ml lied in the ranging (28-1790) ml, most of post void residual volume was between 20-40 ml (22.9%), mean of residual urine volume was 92.29 ml and the range (8-1110) ml, most of intravesical prostatic protrusion was 0-10 mm (31.4%), the mean of intravesical prostatic protrusion was 17.49mm and the range between (0-47mm). The study showed significant correlation between prostate volume and patient age, prostate volume and prevoid bladder volume, the pre void bladder volume and post void residual volume, the age and post void residual urine volume , the prostate volume and post void residual volume, prostate volume and intravesical prostatic protrusion spearman rho correlation coefficient was 0.536, .0236, 0.571,0.388, 0.476, 0.372. The study showed that no significant correlation between intravesical prostatic protrusion and prevoid bladder, spearman's correlation coefficient was 0.04, also no significant correlation between the age and prevoid bladder volume spearman's correlation coefficient was -.031. The study concluded that Post void urinary volume is very important parameter assessed by ultrasound in patients with Benign Prostatic Hyperplasia, to determine the method of treatment either surgical or medical. The study recommended that pre and postvoid urinary bladder volume should be included in routine scan for benign prostatic hyperplasia patients.

Keywords: BPH, PVR urine volume, IPP, BOO

INTRODUCTIONS

Prostate enlargement with BPH is a common cause of **lower urinary tract symptoms** (LUTS) in older men. BPH affects about 50% of men over age 60 years and over 90% over age 70. The weight of the gland in a young man is approximately 20 g. From age 50, the doubling time of prostate weight is approximately 10

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years. Prostates weighing more than 40 g are generally considered enlarged in older men (Carol et al., 2011). Benign prostatic hyperplasia is a common disorder believed to be due to an endocrine imbalance which usually begins in the 5th decade and continues throughout life. Enlargement occurs in the periurethral transition zone and usually compresses the central zone and thins the peripheral zone so that most of the gland appears involved. The term inner gland is often used to describe the enlarged transition zone and indistinguishable central zone (Devin, 2005).

Benign prostatic hyperplasia, although contributory, is not the sole cause of lower urinary tract symptoms (LUTS) in the aging male. Not all men with BPH will have lower urinary tract symptoms or indeed benign prostatic enlargement. There is a significant overlap among many different components, including benign prostatic enlargement (BPE), bladder outlet obstruction (BOO), lower urinary tract symptoms (LUTS) (SEER Stat Fact Sheets: Prostate cancer, 1989).

The sonographic appearance of BPH varies and depends on underlying histopathologic changes. The typical sonographic feature of BPH is enlargement of the inner gland (transition zone). With BPH, the enlarged transition zone can exhibit diffuse enlargement or distinct hypoechoic, isoechoic, or hyperechoic nodules. The specific echo pattern depends on the admixture of glandular, stromal, and muscular elements and nodules, which may be fibroblastic, fibromuscular, muscular, hyperadenomatous, or fibroadenomatous and may undergo degenerative cavitation. BPH nodules tend to have distinct margins, unlike transition zone cancer, which can appear as a diffuse, poorly marginated, usually hypoechoic nodule. Hyperplasia of the periurethral glandular elements results in “median lobe” enlargement manifesting as a bulge into the urinary bladder (SEER Stat Fact Sheets: Prostate cancer, 1989; Shinoharaet al., 1989). Investigation of the patient with symptoms of BPH is best done transvesically. Transvesical ultrasound can adequately assess prostate size, identify median lobe enlargement, and evaluate bladder volume and postvoid residual, bladder wall character, trabeculation, diverticula, tumors, and calculi, as well as evaluate the kidneys and ureters for hydronephrosis and masses (Kutikov et al., 2006).

Karzar SH et al 2012 assess intravesical residual urine of patients with benign prostate hyperplasia, sonography accuracy and state that the difference between measuring through sonography and catheterization was 7.89 +/- 0.86, 14.46 +/- 1.87 and 32.73 +/- 2.99 mL in postvoid residue less than 50, 51-100 and more than 100 mL, respectively. In patients with benign prostate hyperplasia, the mean age of BPH patients was 67.1+_8.33 years transabdominal sonography is a noninvasive method to determine residue amount (Samad et al., 2012).

Adewumi et al 2014 Sonographic assessment of postvoid residual urine volumes in patients with benign prostatic hyperplasia and state that using these measurements, an equation--[PVR(CUBIC)=374.057+(-196.94+V1)+(32.5539+V1(2))+(-1.1480+V1(3), where V1=average of the length (L), width (T), and the anteroposterior distance on transverse section (Dt) of the post void urinary bladder]--more accurate than previously existing ones was obtained by cubic regression analysis. Mean ultrasound estimated volume was 220.51 ml as against 220.76 ml after catheterization. The mean difference was 0.25 ml (not significant, $p<0.01$) with 95% confidence interval of +/-10 ml. With this equation, the ultrasonographic residual urine volume showed a higher correlation coefficient with the catheterized volume at $p<0.01$ (Pearson r=0.982, r2=0.96) than previously defined formulas. The standard error of the mean was 5.11 ml (mean=220.5+/-190.4 ml). The urinary bladder ultrasound is a simple , accurate, safe, and clinically relevant method of screening for evaluated post void residual urine volume in benign prostatic hyperplasia patients (Edewumi, 2004).

MATERIALS AND METHODS

Cross sectional descriptive study done in different hospitals and clinics in Khartoum state- Sudan (Bahri hospital, Elmotawer center, Anwer clinic, Eeast Nile Model Hospital) in the period from 3rd January to 20th of August 2016. The study includes 70 patients suffering from Benign prostatic hyperplasia scan by transabdominal ultrasound ,and any patients having other causes of post void residual urine volume excluded. A designed data collection sheet was used to gather patients’ demographic data, clinical history. The study variables included age, residence, occupation, ultrasound measurements (urinary bladder volume pre and residual volume, prostate volume, protrusion), Informed consent was obtained from all participant patients. Ethical approval from the local Ethical committee of the Faculty of Radiological Sciences and Medical Imaging at Alzaiem Alazhari University was obtained also.

Ultrasound technique

A practical ultrasonography tool was used as a basic guideline for the screening of BPH. This study was carried in the Khartoum. The study was targets on Sudanese male patient who come to ultrasound department .The ages of target population above 50 years, this is common age for occurrence of Benign Prostatic Hyperplasia. The total number of patients was 70 patients. Mainly the ultrasound of bladder must be median distended. Give 4 or 5 glasses of fluid and examined after one hour. The patient should lie supine but may need to be rotated obliquely .The patient should be relaxed, lying comfortably and breathing quietly. The transducer uses a 3.5MHZ. Scanning start with transverse from the symphysis to measure prostate size and up wards to the umbilicus followed by longitudinal scan to measure the depth and to measure intravesical protrusion ,moving from one side of the lower abdomen to the other ,these scan will usually be sufficient ,but it is not always easy to see the position of lateral and anterior walls of the bladder and patients may have to be turned 30-45 degree to see an area more clearly. Any area that appears abnormal must be viewed in several projections. After scanning, the patient should be empty the bladder appears and should then be scanned; the full urinary bladder appears as a large, echo –free area arising out of the pelvis, the scan of bladder start by assessing the smoothness of the interior wall of the bladder and its symmetry section .The thickness of the bladder wall will vary with the degree of distention but should always be approximately the same all around the bladder. Any local area of thickening is abnormal. When distended, the normal bladder wall is less than 4 mm thick .After scanning, the patient should empty. Normally, there should be no residual urine: if there is, the quantity should be estimated. Measure the transverse diameter (T) of the bladder in centimeters, multiply it by the longitudinal diameter (L) in centimeters and then by the AP diameter in centimeters, multiply the total by 0.523 (Carol et al., 2011).

Statistical analysis

The data of the study was analyzed using SPSS software program version 16. Descriptive statistics Percentage were used to describe the data. T-test was used to compare between the variables and p-value ranging between 0.01- 0.05 values lesser than 0.05, 0.01 were considered significant respectively.

RESULTS

Table 1. frequency distribution of patient's age group

Age distribution	Frequency	Percent	Valid Percent	Cumulative Percent
50- 60 years	16	22.9	22.9	22.9
61- 70 years	27	38.6	38.6	61.4
71- 80 years	21	30.0	30.0	91.4
more than 80 years	6	8.6	8.6	100.0
Total	70	100.0	100.0	

Minimum = 50, maximum = 94, mean= 67.43, std= 9.972

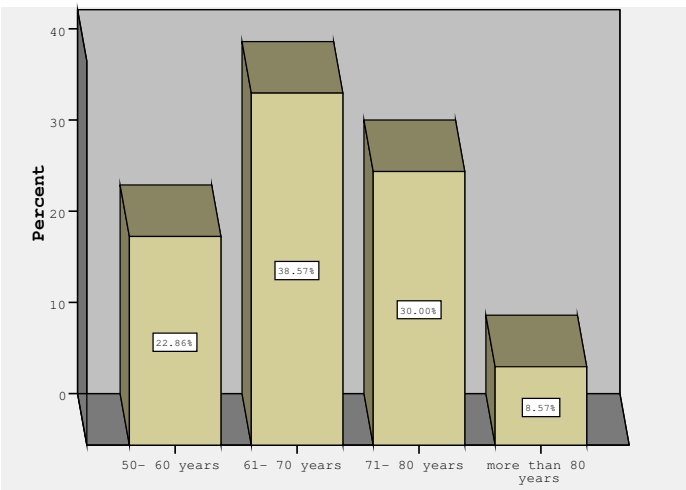

Figure 1. Frequency distribution of patients' age group

Table 2. Frequency distribution of range of prostate volume

Prostate volume	Frequency	Percent	Valid Percent	Cumulative Percent
40-50 ml	31	44.3	44.3	44.3
51-60 ml	26	37.1	37.1	81.4
61- 70 ml	1	1.4	1.4	82.9
71- 80 ml	5	7.1	7.1	90.0
81- 90 ml	4	5.7	5.7	95.7
more than 90 ml	3	4.3	4.3	100.0
Total	70	100.0	100.0	

Minimum = 41, maximum = 148, mean= 56.60, std= 17.426

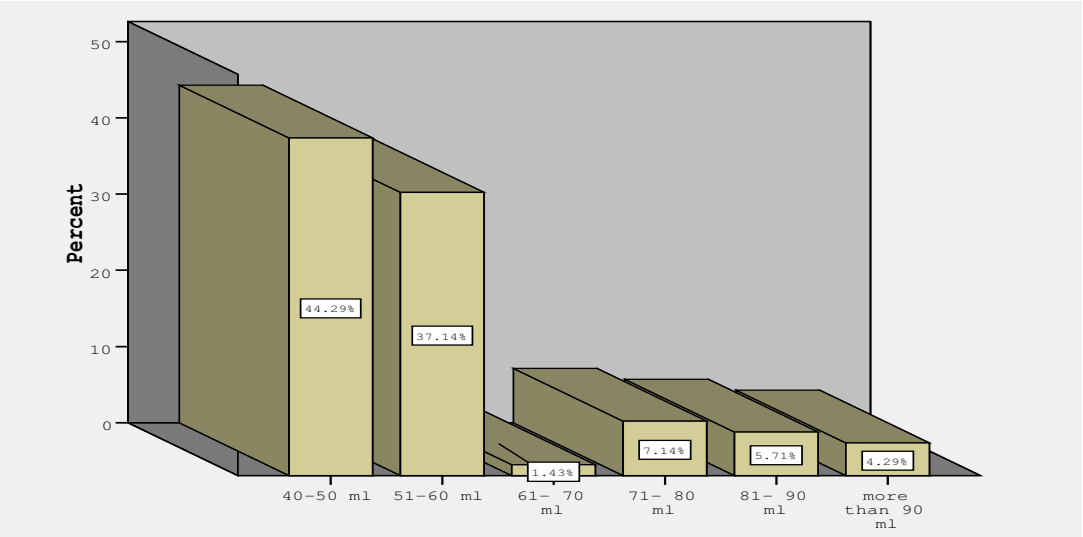

Figure 2. Frequency distribution of range of prostate volume

Table 3. Frequency distribution of range of prevoiding volume

Prevoiding volume	Frequency	Percent	Valid Percent	Cumulative Percent
less than 50	3	4.3	4.3	100.0
50- 100 ml	11	15.7	15.7	15.7
101 - 200 ml	42	60.0	60.0	75.7
201- 300 ml	8	11.4	11.4	87.1
301- 400 ml	2	2.9	2.9	90.0
more than 400 ml	4	5.7	5.7	95.7
Total	70	100.0	100.0	

Minimum = 28, maximum =1790, mean= 185.26, std= 218.532

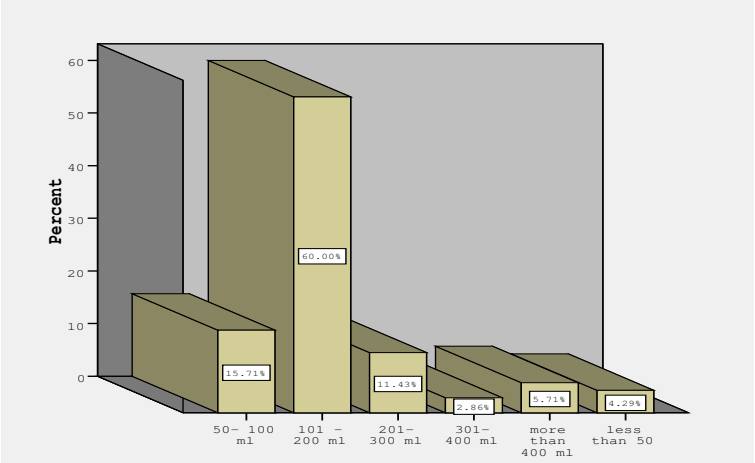

Figure 3. Frequency distribution of range of prevoiding volume

Table 4. Frequency distribution of residual urine volume

RUV	Frequency	Percent	Valid Percent	Cumulative Percent
0-20 ml	12	17.1	17.1	17.1
21- 40 ml	16	22.9	22.9	40.0
41- 60 ml	14	20.0	20.0	60.0
61-80 ml	7	10.0	10.0	70.0
81- 100 ml	6	8.6	8.6	78.6
101- 120 ml	4	5.7	5.7	84.3
120 -400 ml	8	11.4	11.4	95.7
more than 400 ml	3	4.3	4.3	100.0
Total	70	100.0	100.0	

Minimum = 8, maximum =1110, mean= 92.29 ,std= 158.342

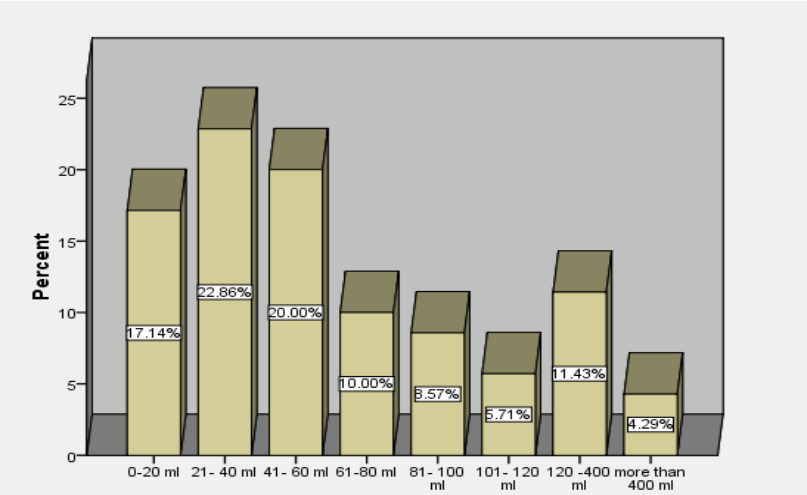

Figure 4. Frequency distribution of residual urine volume

Table 5. Frequency distribution of range of protrusion

Protrusion	Frequency	Percent	Valid Percent	Cumulative Percent
0-10 mm	22	31.4	31.4	31.4
11- 20 mm	18	25.7	25.7	57.1
21-30 mm	18	25.7	25.7	82.9
31- 40 mm	10	14.3	14.3	97.1
more than 40 mm	2	2.9	2.9	100.0
Total	70	100.0	100.0	

Minimum = 0, maximum= 47, mean = 17.49, std= 12.864

Table 6. Frequency distribution of other finding associated with BPH

Others	Frequency	Percent	Valid Percent	Cumulative Percent
calcification	1	1.4	1.4	1.4
crystal	1	1.4	1.4	2.9
cystitis	9	12.9	12.9	15.7
no	59	84.3	84.3	100.0
Total	70	100.0	100.0	

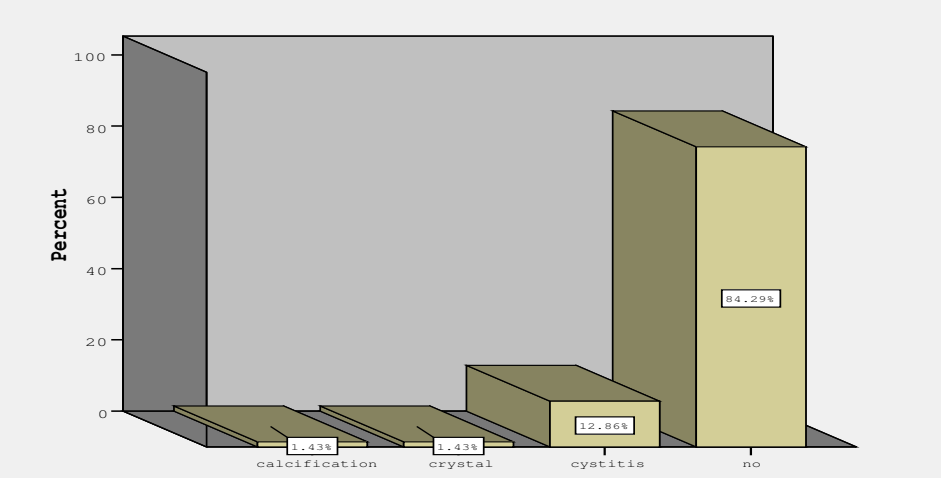

Figure 5. Frequency distribution of other finding associated with BPH

Table 7. Correlations between prostate volume and age

			age	Prostate
Spearman's rho	age	Correlation Coefficient	1.000	.536(**)
		Sig. (2-tailed)	.	.000
		N	70	70
	Prostate	Correlation Coefficient	.536(**)	1.000
		Sig. (2-tailed)	.000	.
		N	70	70

** Correlation is significant at the 0.01 level (2-tailed).

Table 8. Correlations correlation between age and prevoid urine volume

			Prevoid UV	age
Spearman's rho	Prevoid volume	Correlation Coefficient	1.000	-.031
		Sig. (2-tailed)	.	.801
		N	70	70
	age	Correlation Coefficient	-.031	1.000

Table 9. Correlations between prostate volume and prevoid volume

			prevoid	Prostate
Spearman's rho	Prevoid	Correlation Coefficient	1.000	.236(*)
		Sig. (2-tailed)	.	.050
		N	70	70
	Prostate	Correlation Coefficient	.236(*)	1.000
		Sig. (2-tailed)	.050	.
		N	70	70

*Correlation is significant at the 0.05 level (2-tailed).

Table 10. Correlations between RUV and prevoid volume

			Prevoid	RUV
Spearman's rho	prevoid	Correlation Coefficient	1.000	.571(**)
		Sig. (2-tailed)	.	.000
		N	70	70
	RUV	Correlation Coefficient	.571(**)	1.000
		Sig. (2-tailed)	.000	.
		N	70	70

**Correlation is significant at the 0.01 level (2-tailed).

Table 11. Correlations between age and RUV volume

			RUV	age
Spearman's rho	RUV	Correlation Coefficient	1.000	.388(**)
		Sig. (2-tailed)	.	.001
		N	70	70
	age	Correlation Coefficient	.388(**)	1.000
		Sig. (2-tailed)	.001	.
		N	70	70

**Correlation is significant at the 0.01 level (2-tailed).

Table 12. Correlations between prostate volume and RUV

			RUV	Prostate
Spearman's rho	RUV	Correlation Coefficient	1.000	.476(**)
		Sig. (2-tailed)	.	.000
		N	70	70
	prostate	Correlation Coefficient	.476(**)	1.000
		Sig. (2-tailed)	.000	.
		N	70	70

**Correlation is significant at the 0.01 level (2-tailed).

Table 13. Correlations between protrusion and prevoid volume

			Prevoid	Protrusion
Spearman's rho	prevoid	Correlation Coefficient	1.000	.167
		Sig. (2-tailed)	.	.167
		N	70	70
	Protrusion	Correlation Coefficient	.167	1.000
		Sig. (2-tailed)	.167	.
		N	70	70

Table 14. Correlations between prostate volume and protrusion volume

			Protrusion	Prostate volume
Spearman's rho	Protrusion	Correlation Coefficient	1.000	.372(**)
		Sig. (2-tailed)	.	.002
		N	70	70
	Prostate	Correlation Coefficient	.372(**)	1.000
		Sig. (2-tailed)	.002	.
		N	70	70

**Correlation is significant at the 0.01 level (2-tailed).

Table 15. Correlations between RUV and protrusion volume

			RUV	Protrusion
Spearman's rho	RUV	Correlation Coefficient	1.000	.054
		Sig. (2-tailed)	.	.657
		N	70	70
	Protrusion	Correlation Coefficient	.054	1.000
		Sig. (2-tailed)	.657	.
		N	70	70

DISCUSSION

This was across sectional study carried out in Khartoum state -Sudan. Several previous studies in various settings supported that ultrasound scanning as safe, cost effective, reliable, and accurate tool for the volume of residual urine in the benign prostatic hyperplasia. This study found that the most common affected age group of benign prostatic hyperplasia ranged between 61-70 years old (38.6%) and between 71-80 years old frequency (30%) respectively, as literature stated that prostate volume increases with age (Carol et al., 2011). The mean age of BPH patients in this study was 67.43+_9.972 years this results agree with Samad et al 2012 (Samad et al., 2012) Regarding the range of prostate volume for patients with benign prostatic hyperplasia the most common range is from 40-50ml (44.3%) 31 patients followed by 51-60 ml (37.1%) 26 patients. The means of prostate volume was 56.60 ml and the range of it from (41-148) ml. Concerning the prevoid urinary bladder volume most range was between 101-200ml (60%) frequency 42 patients. The mean of pre void volume was 185.26 and the range was (28-1790) ml.

According to this study, 16 patients (22.9%) were found with postvoid residual volume range between 20-40 ml, patients had residual urine volume greater than 100 was 15 patients and treated surgically. The Mean of residual urine volume was 92.29 and the range was (8-1110) ml.

Most of patients had intravesical protrusion a range from 0-10mm (31.4%) frequency 22 patients followed by two group 11-20mm and 21-30mm with equal percentage (25.7%) and equal frequency 18 patients. The means of intravesical protrusion is 17.49 mm and the range between 0-47mm. Most patients had no other ultrasound findings associated with benign prostatic hyperplasia (84.3%) and most associated finding was cystitis (12.9%).

Regarding the correlation (r) between prostate volume and patient age, the correlation is highly significant, sig (2-tail) r= 0.000, the spearman rho correlation coefficient is 0.536. This result agree S with (Shi-Jun et al., 2013) who found that prostate volume increased with age (Shi-Jun, 2013). No significant correlation between the age and prevoid bladder volume spearman correlation coefficient is -.03, r= 0.801.The correlation between the prostate volume and prevoid bladder volume is significant sig (2-tailed) r= 0.05. Spearman correlation coefficient = 0.236. There was highly significant correlation between the pre void bladder volume and post void residual volume, sig. (2-tailed) r= 0.000, spearman correlation coefficient = 0.571. Correlation between age and post void residual volume is significant sig (2-tailed) r= 0.01, spearman correlation coefficient = 0.388. This result disagree S with (Kolman et al., 1999), who found that in regression analyses post-void residual did not appear to be associated with the American Urological Association symptom index, age or peak urinary flow rate (Kolman et al., 1999). Correlation between prostate volume and post void residual volume is highly significant sig. (2-tailed) r: 0.000 , spearman rho correlation coefficient 0.476 . This result agrees with (Keqin et al., 2007) who found that Positive correlation was found between IPP and prostate volume as well as PVR (Spearman's rho = 0.401 and 0.342, respectively) (Keqin et al., 2007). No significant correlation between intravesical prostatic protrusion and pre void bladder volume. Correlation between prostate volume and intravesical prostatic protrusion is significant sig. (2-tailed) r: 0.002, spearman correlation coefficient = 0372. This result is agrees with the result (Bantis et al 2010), who found that There was a statistical correlation between the BOO and: a) PSA (P = 0.004), b) prostate volume with P of < 0.001) and c) IPP = 0.005 (Bantis, 2010) No significant correlation between intravesical prostatic protrusion and postvoid residual urine r= 0.657, spearman correlation coefficient 0.04. This result is disagrees with (Bangabandhu Sheikh Mujib Medical University BSMMU et al) and (Lim, 2006) that significantly correlates with bladder outlet obstruction in patients with benign prostatic hyperplasia and the correlation of IPP was more stronger than that of prostate volume and IPP remained the most significant independent index to determine BOO respectively (Bangabandhu et al., 2012; Lim, 2006). This result may be due to smaller sample volume in this study and the most of them protrusion lies in range (0-20mm).

Image 1 a. Volume of prostate 103.7ml in 80 years old and small amount of residual urine 40ml

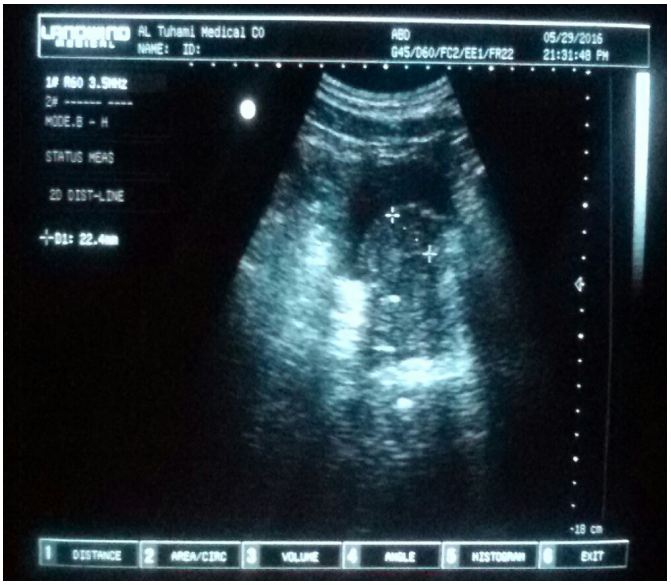

Image 1 b. Intravesical protrusion 22.4mm for the same patient

CONCLUSION

Ultrasonography is a good diagnostic method in the screening of benign prostatic hyperplasia. post voiding scan a very important to realize the efficiency of urinary bladder. There is a relation between patient age and prostate gland size, and thus the prostate size was apparently increased with increasing age. Common finding associated with enlarged prostate gland was cystitis. There was a relationship between intravesical protrusion and prostate volume and in future may become a useful factor to assess residual urine volume. There was also strong positive correlation between post void and pre void urinary volume and size of prostate gland. Post void urine volume is very important parameter assessed by ultrasound in patients with benign prostatic hyperplasia to determine the method of treatment either surgical or medical.

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