Original Article

Comparision of reliability and accuracy of ultrasonography with conventional catheterisation method for quantification of postvoid residual urine (PVRU) in men with lower urinary tract symptoms

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Abstract

Introduction : Ultrasonography (USG) of abdomen is widely available, safe, noninvasive, cost-effective, painless, repeatable, less time-consuming and demands little co-operation from the patient. It is used for measuring the postvoid residual urine volume (PVRU) in men with lower urinary tract symptoms (LUTS). However conventional catheterisation method is the most accurate method for measuring PVRU though the procedure is cumbersome and uncomfortable for patients. Significant PVRU is common in patients withLUTS such as incomplete emptying, frequency, urgency, weak stream, nocturia, straining and intermittency. **Aims and Objectives:** 1.To assess the reliability of abdominal USG formeasuring PVRU in men with LUTS. 2. To compare estimates of PVRU as measured by USG and Urethral Catheterisation for assessing the accuracy of USG. **Materials and Methods :** This was a prospective comparative study conducted between March 2015 and March 2016 among men attending urology OPD of MIMS Medical college, Vizianagaramwith complaints of persistent LUTS who underwent both abdominal USG and Urethral catheterization. The study included 90 cases who gave written consent after being fully informed about the procedures of the study. **RESULTS:** 1. Mean age of the study population is56.18 years. 2. The difference of PVRU values between two successive USG scans was less than 5cc in 84 cases out of 90 cases, suggesting that the measurements were reproducible in 93 % cases. 3. The difference of PVRU values obtained from USG and Catheterisation was less than 10cc in 85 cases out of 90 cases.So the percentage of cases in whom the USG measurement was accurate was 94%. **Conclusion :** The measurement of PVRU by USG is reliable, reproducible with a Positive correlation between the two methods (USG& urethral catheterization) of measuring PVRU.

Key words: lower urinary tract symptoms (LUTS), postvoid residual urine volume (PVRU), ultrasonography (USG), catheter.

Introduction

The postvoid residual volume of urine (PVRU) is definedas the volume of urine remaining in the bladder immediatelyafter complete voiding[1]. PVRU is significant if it is more than 50cc. In patients with LUTS significant PVRU iscommonly seen whichresults from inadequate evacuation of the bladder, eitherdue to obstruction below the level of bladder or a weak urinary bladder muscle (detrusor), or a combination of both. Thus measuring the PVRU isimportant in making the diagnosis, follow-up and assessing clinical progression of lower urinary tract diseases[2].Urethral catheterisation is reportedto have 100% sensitivity and specificity for estimatingthe PVRU. However, a urethral catheterisation can cause discomfort, trauma to the urethraand carries the risk of a UTI. The PVRUmeasurement by ultrasonography (USG) could protect patients from the discomfort and risk ofurethral injury caused by catheters.

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AIMS AND OBJECTIVES:

1. To assess the reliability of abdominal USG fo rmeasuring PVRU in men with LUTS.
2. To compare estimates of PVRU as measured by USG and Urethral Catheterisation for assessing the accuracy of USG.

MATERIALS AND METHODS:

This was a prospective comparative study conducted between March 2015 and March 2016 among men attending urology OPD of MIMS Medical college, Vizianagaramwith complaints of persistent LUTS who underwent both abdominal USG and Urethral catheterization. The study included 90 cases who gave written consent after being fully informed about the procedures of the study.

Inclusion critera:

a) Age >45 years
b) History of persistent LUTS.

Exclusion criteria :

a) History of urinary bladder surgery.
b) Difficulty in catheterisation (e.g., due to urethral strictures).
c) With an indwelling bladder catheter due to acute urinary retention or neurological disorders.
d) Refusal to participate in the study.
e) US evidence of dilatation of the upper renal tract and bladder diverticula.

Equipments:

a) Ultrasound machine- Phillips affinity 70
b) Urethral catheter- 12F

Methodology:

The patient was instructed to present with a full bladderand Ultrasound examination of abdomen was performed using curvilinear probe of 5 MHz in supine position and with sufficient acoustic coupling gel between probe and skin. Then the patient was asked for complete voiding of urine in privacy with no abdominal straining or coughing and was examined immediately after voiding. Using volume measurement option of the ultrasound machine the sagittal height, depth andtransverse width were measured and the volume of PVRU was automatically generated. Repeatedmeasurements were taken and PVRU volume was calculated to assess the reliability of Ultrasound.After the US measurement of PVRU a 12-Furethral catheter (without balloon) was inserted into urethra via a sterile technique under local anaesthesia.The urinary bladderwas drained into a urine collecting bag, with the endpointof collection of residual urine defined as the cessationof flow. Then the catheter was slowly withdrawn. The volume of urine in the collecting bag was recorded. Theinterval betweenthe end of the USG measurement and collection of residual urine is1.5–2.5 min.

Analysis-Statistical analysis weredone to find out reliability, reproducibility and accuracy of Ultrasonography in measuring PVRU.

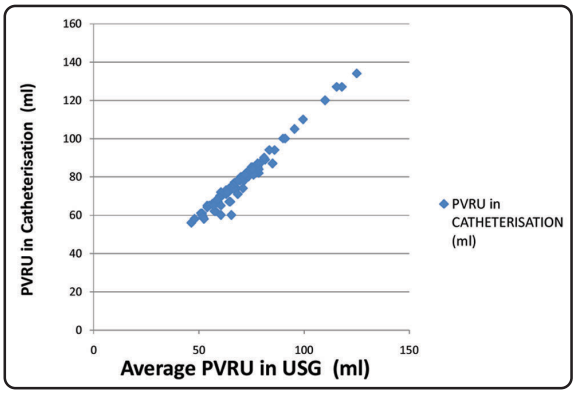
- Reliability of USG was calculated using Cronbach's alpha.
- The measurements were said to be :-
- Reproducible if the difference between the PVRU volumes measured in two successive USG scans was less than 5cc.
- Accurate if the difference between the PVRU volumes measured by USG and urethral catheterisation was less than 10cc.

RESULTS:

1. Mean age of the study population is56.18 years.
2. Age distribution of study population

Age group (Years)	No. of patients
45-54	45
55-64	35
> 65	10

3. The Mean PVRU in USG and Catheterisation was 70.12 ccand 78.13cc respectively.
4. The reliability of USG for measuring PVRU was assessed using Cronbach's alpha (99.2%). As Cronbach's alpha is more than 70%,so USG can be considered reliable for measuring PVRU.
5. The difference of PVRU values between two successive USG scans was less than 5cc in 84 cases out of 90 cases, suggesting that the measurements were reproducible in 93 % cases.
6. The difference of PVRU values obtained from USG and Catheterisation was less than 10cc in 85 cases out of 90 cases.So the percentage of cases in whom the USG measurement was accurate was 94%.
7. Scatter Plot of PVRU values obtained from USG and Catheterisation The plot shows linear relationship between the two methods of PVRU measurement.
8. The Pearson's correlation coefficient is 0.984. The correlation is significant at the 0.01 level.



DISCUSSION:

In Patients with LUTS such as urinary frequency, nocturia, overflow incontinence and recurrent UTI, significant

PVRU is quite common which is important to exclude both neurological abnormalities and/or obstructive voiding disorders[2,3]. Although bladder catheterisation is regardedas the standard for measuring PVRU, it can cause discomfortand carries the risk of infection andtrauma to the urethra. USG, is a noninvasive method and rapidly assessing tool, which is recommendedas an alternative to catheter estimation. However, some advocate caution wheninterpreting PVRU measurements made by abdominalUSG, others consider it to be too inaccurate[2,4]. Keeping the given background in mind the present study was conductedto investigate the reliability and reproducibilityof USGvs catheterisation for measuring PVRU in menwith LUTS.

The mean age of the presentstudy was 56.18 (range 45-80) years, and was comparableto that of the patients included in the study ofAmole et al.[2], who assessed 52 consecutive patientswith BPH, with a mean age of 64.98 (9.57) years.Simforoosh et al[1]. studied 324 men with persistent LUTS (mean age 61.5, range 48–75 years), to assessthe value of USG for measuring the PVRU.

According to the reliability testing (Cronbach's alpha) between USG andurethral catheterisation for measuring PVRUthe reliability of USG for measuring the PVR was 99.2%. As Cronbach's alpha was more than 70%; this indicated that USG was reliable. Kiely et al.[5] found that USG could provide an approximatemeasurement of bladder urine volume, but it was notsufficiently reliable and accurate in situations wheremore precise measurements of changes in PVR wererequired. Roehrborn and Peters[6] found that catheterisation was moreaccurate and reliable than US for predicting the actualbladder urine volume. However, abdominal US is lessinvasive than catheterisation, and can also be used toassess bladder wall thickness and vesical calculus. Estimating PVRU by abdominal USG is an imperfect measure of theactual volume, and can be subject to considerable variability [1, 5, 7–9]. A systematic overview by Nwosu et al[10]. and thereports of others[2, 11, 12] show that USG is useful and accurate for measuring PVRU, and has a good correlation with the catheterisation volume. Some suggest that some USG systems can provide more accurate information than others[13].

These differences might be due to the design andanalysis of these studies, which were often inadequate. Also, previous studies used different methods, techniques and equipment, and the inclusion and exclusion criteria of the recruited patients also differed. There was no significant variability in the mean readings obtained by the urologist or the radiologistusing USG in the two reading sessions, indicating that the US estimate is reproducible with one examiner and several examiners using a single tool. Elsamra et al.[14] reported that a USG estimate of PVRU was accurate and reproducible. In the present study we confirmed that the reproducibility of the USG estimate of PVRU was good when made by a radiologist. Several studies agreed with these findings [15–17], noting that recent developments and modifications in ultrasound technology have led to improved reliability andportability of ultrasound instruments that can be used to measure bladder volume. By contrast with our results, it was suggested that a single measurement of PVR by USG might not be useful because it might not be reproducible [9,18,19]. Also, Elsamra et al[14] stated that although the USGestimateis reproducible, it cannot differentiate between a distended-bladder and other cystic pelvic structures. They presented several case reports showing falsely high PVR values by bladder USG in adults with cystic pelvic structures.

In the present study, the Mean PVRU in USG and Catheterisation was 70.12 (14.80) and 78.13 (15.27) respectively. The difference of PVRU values between two successive USG scans was less than 5cc in 84 cases out of 90 cases, suggesting that the measurements were reproducible in 93 % cases.The difference of PVRU values obtained from USG and Catheterisation was less than 10cc in 85 cases out of 90 cases. Positive correlation was found between the two methods of measuring PVRU. The Pearson's correlation coefficient was 0.984 with the correlation being significant at the 0.01 level. Lertbunnaphong et al.[20] evaluatedthe correlation between an assessment of PVRU by abdominal USG and catheterisation. The calculated PVRU by US correlated significantly with the catheterised urine volume. From a review of the Cochrane Database System, Zeif and Subramonian[4] reported that in adults aged > 60 years, because of the decreased contractility of the detrusor muscle, the PVR can be>100 mL and US of the bladder might show a massive increase in bladder capacity.

CONCLUSION:

The measurement of PVRU by USG is reliable, reproducible with a positive correlation between the two methods (USG & urethral catheterization) of measuring PVRU.

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