

Original Article

Advantages of Using a Portable Bladder Scanner to Measure the Postvoid Residual Urine Volume in Spinal Cord Injury Patients

Suad Fakhri, Mohieldin MH Ahmed, Safa H Allam, Mohammed Akbar, Abdulla A Eyadeh
Physical Medicine and Rehabilitation Hospital, Kuwait

Kuwait Medical Journal 2002, 34 (4): 286-288

ABSTRACT

Introduction: Estimation of post-void residual urine volume (PRV) is a useful tool in the diagnosis and management of lower urinary tract dysfunction. It indicates the rehabilitation outcome of urinary bladder retraining measures.

Objective: To assess the accuracy and the advantages of using the portable bladder scanner (BVI 3000) to measure the PRV in spinal cord injury patients with neurogenic bladder disorders and to determine whether ultrasound scanning can be considered accurate for determining the PRV.

Setting: Physical Medicine and Rehabilitation Hospital, Kuwait .

Methods: The bladder scanner (BVI 3000) was used to display bladder shape and residual urine volume. A total of 39 patients with spinal cord injury (SCI) were included in this study. They were divided into two groups. Group I included 21 SCI patients with hyperreflexic bladder and

group II included 18 SCI patients with hyporeflexic bladder. Ultrasound PVR measurements were done immediately before urethral catheterization to measure the residual urine volume. The residual urine volume by ultrasound and urethral catheter was recorded in millilitres. The mean differences between the residual volume by ultrasound and urethral catheter were determined.

Results: There was no significant difference of residual urine volume measured by ultrasound and catheterisation in both groups of SCI patients. The mean \pm SD difference of residual urine volume measured by ultrasound and catheterisation in the first group of SCI patients was 29 ± 7 ml, while it was 47 ± 11 ml in the second group.

Conclusion: The bladder scan is a non-invasive as well as a non-infective technique to measure residual volume. The bladder scan results are reliable and have a good correlation with the results of urethral catheterisation.

KEYWORDS: bladder scanner, post-void residual urine volume, spinal cord injury

INTRODUCTION

Estimation of post-void residual urine volume (PPV) is a useful tool in the diagnosis and management of lower urinary tract dysfunction^[1]. It indicates the rehabilitation outcome of urinary bladder retraining measures. The routine procedure is to measure the PRV using a urethral catheter. However, urethral catheterisation has the drawbacks of discomfort to the patient along with the risks of urethral trauma and infection. Further, it has been shown that it is unreliable in determining the bladder volume of up to 5 ml^[2].

Ultrasound imaging of bladder volume has been reported for many years with large machines^[3]. The objectives of this study were: to assess the accuracy and the advantages of using the portable bladder scanner (BVI 3000, Diagnostic Ultrasound, Redmand Virginia, VA 98052, USA), to measure the PRV in spinal cord injury patients with neurogenic bladder and to determine whether ultrasound scanning can be considered accurate for determining the PRV.

MATERIALS AND METHODS

The bladder scanner (BVI 3000) was used for this study. It is a portable (2.5 kg) and compact battery powered ultrasound unit consisting of a hand-activated B mode, 2 MHz scan head and a portable liquid crystal display to show the bladder shape and residual urine volume (Fig. 1).

A total of 39 male patients with spinal cord injury (SCI) were included in this study. Of these, 21 patients had hyperreflexic bladder and 18 patients had hyporeflexic bladder. Ultrasound PVR measurement was done while the patient was in supine position, immediately before urethral catheterization, to measure the residual urine volume. The patient was then catheterized and the residual volume of urine was recorded. The residual urine volume by ultrasound and after catheterization were recorded in millilitres. The mean difference between the residual volume by ultrasound and catheter were determined.

Address correspondence to:

Dr. Suad Fakhri, Physical Medicine and Rehabilitation Hospital, Kuwait. Tel: Mobile +965 9406893, Work: +965 4874240



Fig. 1: The bladder scanner (BVI 3000). It is a portable equipment (2.5 kg.) of a compact battery powered ultrasound unit consisting of a hand-activated B mode, 2 MHz scan head and a portable liquid crystal.

SCI patients with any intravesicular pelvic mass or foreign body and those with an indwelling urethral or a suprapubic catheter were excluded from this study.

RESULTS

Table 1 shows the age, mean \pm SD of PRV (ml) and mean difference of ultrasound and catheterisation PRV in 39 SCI patients with a neurogenic bladder. The mean \pm SD difference of residual urine volume measured by ultrasound and catheterisation in the first group of SCI patients was 29 ± 7 ml, while it was 47 ± 11 ml in the second. There was no significant difference of residual urine volume measured by ultrasound and catheterisation in both groups of SCI patients ($P > 0.05$).

DISCUSSION

The PRV is an important investigation in the management of voiding dysfunction^[4]. During the last decade, there has been a significant improvement in the development of bladder ultrasonography^[2]. The new portable bladder scanner (BVI 3000) used for this study is one of these new equipment.

Our results found no significant difference between the ultrasound and catheterisation PRV in SCI patients with neurogenic bladder. These results are similar to those obtained by others^[5,6]. Cardenas et al^[5] examined SCI patients with a hyperreflexic bladder by the bladder scanner (BVI 2000) and found that there was no significant difference between ultrasound and catheterisation PRV. Massagli et al^[6] used a bladder scanner (BVI 2000) to compare intermittent catheter volumes in 16 adults with a neurogenic bladder and found that there was no difference between experienced and novice examiners.

Table 1

Demographic data, mean \pm SD of PRV and mean difference of PRV by ultrasound and catheterization in 39 SCI male patients with neurogenic bladder

Parameters	SCI Patients with Hyperreflexic Bladder	SCI Patients with Hyporeflexic Bladder
Number	21 patients	18 patients
Mean age \pm SD (years)	51 ± 4.1	49 ± 3.2
Mean ultrasound \pm SD PRV (ml)	170.1 ± 3.7	299.0 ± 21.0
Mean catheterisation \pm SD PRV (ml)	197.2 ± 5.8	321.0 ± 31.0
P value	>0.05	>0.05
	NS	NS
Mean difference of PRV (ml) of both techniques	29 ± 7 ml	47 ± 11 ml

NB. PRV = postvoid residual urine volume; SCI = spinal cord injury; Pvalue > 0.05 ; NS = non-significance value between ultrasound PRV (ml) and Catheterisation PRV (ml)

In 1990, Ireton et al^[7] studied 11 spinal cord injury patients with a bladder machine (BVI 2000). In that study, there was significant correlation between results of bladder scan and urethral catheterisation. Revord et al^[8] scanned 24 men with a neurogenic bladder with the BVI 2000 model. Repeated measures in the same patients did not increase accuracy, and no changes were noted regardless of the experience of the examiners. Alnaif and Drutz^[9] showed that the ultrasound PVR measurements were the most accurate when the readings were below 50 ml. The readings between 50 and 150 ml was 27% accurate. If an accurate measurement of PVR is necessary, catheterisation remains a more reliable method.

We consider that the bladder scan is a non-invasive and non-infective technique and is as good as a urethral catheter for the estimation of residual urine volume. The bladder scan results are reliable and have a good correlation with the results of urethral catheterisation. It is a technique that does not involve any aseptic precaution with saving of materials such as sterile gloves and other sterile materials. However, there are some problems with this portable bladder scanner. The battery needs recharging after 6 hours of continuous use. The use of the bladder scanner is limited in the presence of an indwelling or a suprapubic catheter as they invalidate calculations.

REFERENCES

1. Coombes GM, Millard RJ. The accuracy of portable ultrasound scanning in the measurement of residual urine volume. *J Urol* 1994; 152:2083-2085.
2. Stollar ML, and Millard RJ. The accuracy of a catheterised residual urine. *J Urol* 1989; 141:15-16.
3. Harrison NW, Parks C, Sherwood T. Ultrasound assessment of residual urine in children. *Brit J Urol* 1975; 47:805-814.
4. Ding YY, Sahadevan S, Pang WS, Choo PW. Clinical utility

- of a portable ultrasound scanner in the measurement of residual urine volume. *Singapore Med J* 1996; 37:365-368.
5. Cardenas DD, Kelly E, Krieger JN and Chapman WH. Residual urine volume in patients with spinal cord injury: measurements with a portable ultrasound instrument. *Arch Phys Med Rehabil* 1988; 69:514 -516 .
 6. Massagli TI, Cardenas DD and Kelly EW. Experience with portable ultrasound equipment and measurement of urine volumes: inter-user reliability and factors of patient position. *J Urol* 1989; 143:969:971.
 7. Ireton RC, Krieger JN, Cardenas DD et al. Bladder volume determination using a dedicated portable ultrasound scanner. *J Urol* 1990; 143:909-911.
 8. Revord JP, Opitz JJ, Murtagh Pand Harrison J. Determining residual volume using a portable ultasonographic device. *Arch Phys Med Rehabil* 1993; 74:457-462.
 9. Alnaif B and Drutz HP. The accuracy of portable abdominal ultasound equipment in measuring postvoid residual volume. *Int Urogynecol J Pelvic Floor Dysfunc* 1999; 10:215-218.