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ULTRA SOUND SCANNING AND BLADDER URINE MEASUREMENT

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Abstract

This paper focuses to investigate the accuracy of an ultrasound scanner for the measurement of bladder urine volume. In this study using a bladder scanner 100 estimations of bladder volume were made in 75 male and 25 female patients. The instillation volumes of saline instilled into the collapsed unit after saline instillation into the bladder via, cystoscopy were compared with those estimated by a Bladder Scan ultrasound unit after saline instillation into the bladder. The mean volumes of saline instilled via cystoscopy and estimated by the Bladder Scan were 99.55 ± 6.75 and 115.47 ± 8.49 ml, respectively. The intraclass correlation showed a good correlation ($r=0.860$, range 0.803-0.899). The results of this study suggest that this ultrasound scanner can serve as a useful tool to measure bladder urine volume with satisfactory accuracy.

Keywords: Cystoscopy, Correlation, Bladder Volume.

Introduction

Measurement of urine amount by catheterization is a common urologic practice for the assessment of residual urine volume. However, catheterized urine amount is not sufficiently accurate to represent the true urine volume [1]. In addition, urethral catheterization is a relatively invasive procedure. A new ultrasonic for non-invasive measurement of the bladder volume has been reported [2]. In an attempt to investigate the accuracy of this new scanner, we conducted this study.

Materials and Methods

The ultrasound machine used in this study is powered by a 7-2V NiMH battery pack with 6 hours of continuous use. The ultrasound unit consists of a B-mode, detachable, easily cleaned 2-MHz ultrasound frequency scan head with a 120°

scan angle and an LCD (liquid crystal display) screen. The range of volume which can be measured by this instrument is between 0 And 999 ml: the axial resolution is 1.5 mm. and the radial resolution is 2⁰. The scan head is placed on the suprapubic region. The LCD screen displays the bladder position and volume. The unique aiming icon guides the user to a suitable placement of the scan head. The inner scanner is rotated 360⁰ to detect water and perivesical tissues.

In total, 100 urological patients (75 males and 25 females) were enrolled in this study. During cystoscopy, the bladder was collapsed and emptied under direct vision. To ascertain whether emptying of the bladder was complete, 20 ml of contrast medium. (Urografin) as instilled into the bladder via the cystoscope. Then the contrast medium was drained again through the cystoscope. The drainage procedures included the compression of the bladder, and bladder collapse under direct vision. No contract medium was demonstrated on subsequent KUB films in 5 male patients. This method can ensure that the bladder is completely emptied. Normal saline was re-instilled in the urinary bladder, and the bladder volume was determined using the BladderScan. According, the true bladder volume as equal to the volume of the instilled saline.

The intraclass correlation (rl) [3] between the ultrasound – measured volume and the true volume was calculated. The intraclass correlation represents the ability to accurately evaluate the bladder urine volume of the scan. To determine the impact of volume on the accuracy of the scan examination, patient were stratified into 2 groups based on the true bladder volume group 1 (true volume < 100 ml) and group 2 (true volume > 100 ml).

Results and Discussions

The mean true bladder saline instillation volume was 99.55 + 6.75 (mean + SEM; 0.310 ml). The mean difference (scan volume minus true volume) was 15.92 + 4.00 ml. It was skewed to the left, indicating that the scan data tended to overestimate the bladder volume. By intraclass correlation between the scan and true bladder volumes, the rl of the 137 total cases was 0.86 (95% confidence interval. C1, 0.80-0.89). The lower limit of the intraclass correlation data being greater than 0.75 means that the scan-estimated bladder volume was equal to the true volume. Therefore , the ultrasound scanner on accurately measure the true bladder volume.

Ultrasound estimations of bladder volumes have previously been reported [4.5]. Older real-time equipment was heavy, immobile, required calculation, and was inaccurate for extremely small or large baldder volumes [7.8]. Griffiths et al. [8]

showed different volume measurement methods and concluded that a formula for the volume of an ellipsoid provides the most accurate estimate. The necessity for specialized personnel and complex calculation limited its routine application. Previous models of scanner have been used to study the residual urine volume with a hyperreflexic bladder [2]. In comparison with 57 catheterization, there was a good correlation ($R^2 = 0.80$) between the measured volumes using the scanner and catheterization. Ireton et al. [9] also studied patients with a BVI 2000 unit and suggested a good correlation with catheter volumes ($R^2 = 0.79$). Massagli et al. [10] used a portable ultrasound machine to compare intermittent catheter volumes in adults due to neurogenic bladder, and the correlation coefficient reached 0.92. Revord et al. [11] determined residual urine volume using a portable ultrasound device and revealed a sensitivity of 90% and a specificity of 81% for volumes > 100 ml; the mean error of the scanner was -15 ml (-9%), the mean absolute error was 37 ml (28%), the sensitivity was 77% and the specificity was 81% when the intra-bladder volumes were < 200 ml. A new BVI 2500 unit showed a good correlation with true bladder volumes ($R = 0.97$) in patients [12] and [13]. In our studies, we used cystoscopy to confirm that the bladder was empty and to instill saline. This may be more accurate than measuring catheterized residual urine. The mean error of the ultrasound scan measurement was 15.9 ml (-13.77%), and the difference between these 2 measurement was statistically significant. In our study, determination of bladder volume using an ultrasound scan was more sensitive for examining a small bladder volume (< 100 ml) than a larger bladder volume (>100 ml).

Conclusion

The portable ultrasound instrument used in this study provides a proper non-invasive method to estimate bladder volume. It is highly accurate, and portable. The other advantages are that it saves time and has no risk of urinary tract infection. Ultrasound scanning is a good alternative to replace urethral catheterization for measurement of bladder volume.

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