Bladder ultrasound scanning for the measurement of post-void residual urine volume

Note: This brief discusses the use of ultrasound in patients who have had stroke or spinal cord injury. Application to other types of patients is not considered.

Introduction

Post-void residual (PVR) urine volume is the volume remaining in the bladder immediately after completion of voiding. The measurement of PVR urine volume is an important component of continence assessment and bladder management during bladder retraining programs for patients with spinal cord and brain disorders which cause bladder dysfunction. Measurement of PVR urine volume provides quantitative feedback to the patient and the rehabilitation team about the effectiveness of the voiding technique. A volume of more than 100mL is an indication for intermittent catheterization, while a volume of 100mL or less is generally considered as an acceptable result of bladder retraining.

Description and role of the technology

The standard method of determining PVR urine volumes is intermittent catheterization, which is associated with increased risk of urinary infection, urethral trauma and discomfort for the patient. Bladder ultrasound scanning has been introduced as an alternative, noninvasive method, to avoid the potential complications of intermittent catheterization.

Using this method, PVR urine volume can be measured immediately after a patient voids (if necessary, between scheduled catheterizations), which increases feedback about voiding technique used during bladder retraining.

Early studies of ultrasound in this application were done using large scanners, which were relatively immobile. These ultrasound methods required separate calculation of the total bladder volume and of the PVR urine volume.

During the last decade there have been significant developments in bladder ultrasonography.

Portable, battery-powered ultrasound devices have been developed specifically for the noninvasive measurement of total bladder volumes and/or PVR urine volumes. They consist of a hand-held ultrasound transducer (scanhead) and a base unit with a display screen. The scanhead is placed on the patients’ abdomen (suprapubic area) and aimed toward the bladder. The unit automatically calculates and displays the bladder volume.

Extreme obesity, severe abdominal scarring, pregnancy, muscle spasms, abdominal herniation and abdominal breathing may interfere with bladder ultrasound scanning and prevent accurate measurement.

The main question concerning the use of an ultrasound device to assess the PVR urine volume during bladder retraining is whether this method can accurately identify patients with more than 100mL of urine in their bladders.

Available data on efficacy

In the last five years, four controlled studies have been conducted to determine whether bladder ultrasound scanning for the measurement of PVR urine volume during bladder retraining in stroke patients and spinal cord injured patients is as accurate as the measurement obtained by catheterization. The reported results are not directly comparable (see Table 1) as the studies used different equipment, patient populations, sample sizes, and methods of calculation. All of these investigations were accuracy studies, using patients as their own controls.

Results of these studies suggest that ultrasound measurements of PVR urine volume have some limitations in regard to accuracy, but compare favorably with measurements obtained by catheterizations. The investigators conclude that bladder ultrasound assesses PVR urine volumes with acceptable accuracy and recommend its clinical use to avoid bladder overdistension and unnecessary catheterization.

Opinion from radiologists in Alberta, with expertise in ultrasonography, is that although it is not as accurate as intermittent catheterization, bladder ultrasound scanning is effective for the measurement of PVR urine volume. This method is considered easier and faster to perform than catheterization. There is also some opinion that more accurate results are obtainable through separate calculation than those that are automatically calculated by available ultrasound devices.
Other issues

• In the studies available for review, there was considerable variation in the training protocols that were used. Institutions using or proposing to adopt this method should have in place standardized training protocols, directed by approved ultrasonographers.
• Institutions should also develop and use a standard protocol for bladder scanning, validate its accuracy under local operation conditions and adopt appropriate quality assurance procedures.
• In the reviewed studies there is little information on the relative cost of bladder ultrasound scanning for this application, though the cost of a portable scanner is low (less than $10,000). The main cost advantages of this method compared with intermittent catheterization appears to be through savings in catheterization equipment and nursing time.
• The decrease in the number of catheterizations would be expected to improve patient comfort and reduce the risk of infection, though these matters were not addressed in the studies available for review.

Conclusions

The available information suggests that although not as accurate as intermittent catheterization, bladder ultrasound scanning is an acceptable method to determine PVR urine volume in patients who have had a stroke or spinal cord injury.

Institutions using this technique should have appropriate training and operating protocols in place and be aware of its accuracy under local practice condition.

Further information available from:

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