



Title: Bladder Scanner Use Prior to Catheterization: A Clinical Review

Date: 21 April 2008

Context and policy issues:

Patients with urine retention, neurogenic bladder or elderly patients in the long-term care setting may need placement of a catheter to remove the urine remaining in the bladder after urination, to decrease the build-up of urine in the bladder, or to measure the extent of postvoid residual (PVR) urine volume.¹ Intermittent catheterization remains the gold standard for precise measurement of PVR volumes. On the other hand, the procedure is uncomfortable and any passage of a catheter can introduce bacteria into the urinary tract and could be associated with an increased risk of urinary tract infection (UTI) and urethral trauma.^{1,2} Among the strategies that are used to prevent catheter-related UTI, avoiding unnecessary catheterization and removing the catheter as soon as possible are most effective.²

While not all urethral catheterizations can be avoided, some of them are unnecessary, especially those performed to evaluate urine retention (UR).¹ A dated way to determine whether the bladder was completely empty was to palpate and percuss the suprapubic area; this is the most inaccurate method of determining bladder volume.³ Another technology adopted to assess the PVR urine volume is by bladder ultrasound scan,¹ which has been demonstrated to be quick, reliable, noninvasive, easy to use and cost-effective.^{4,5} The conventional stationary ultrasonography provided a more accurate estimate of PVR volume than did the portable device, but the latter is more convenient to use, easy to transport, can be performed by minimally trained personnel and has an acceptable accuracy for clinical use.^{4,6}

The purpose of the current report is to examine whether the use of bladder scanners has an impact on reducing the number of catheterizations and the related UTIs.

Research questions:

1. Is there any evidence that bladder scanner use prior to catheterization results in a reduction in infection rates?

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2. Is there any evidence that bladder scanner use prior to catheterization results in a reduction in the rate of catheterization?

Methods:

A limited literature search was conducted on key health technology assessment resources, including PubMed, The Cochrane Library (Issue 1, 2008), University of York Centre for Reviews and Dissemination (CRD) databases, ECRI, EuroScan, international HTA agencies, and a focused Internet search. Results include articles published between 2003 and March 2008, and are limited to English language publications only. Filters were applied to limit the retrieval to health technology assessments, systematic reviews, meta-analyses, clinical studies, and observational studies.

Summary of findings:

One HTA report, one randomized trial and one observational study were identified through the literature review. No systematic reviews and meta-analyses were identified.

Health technology assessments

One HTA report evaluated the clinical and cost-effectiveness of portable ultrasound devices in PVR urine volume measurement for patients with urinary incontinence, urinary retention, neurogenic bladder and elderly patients in long-term care settings, who might need catheterization.¹ Seventeen non-randomized studies were included in this report. Of these, most concluded that portable bladder ultrasound was reasonably accurate. Even though the scanner over- or underestimated PVR volume, the mean errors were within the acceptable limits. There was good agreement between portable bladder ultrasound and catheter estimates of bladder volumes. Four studies examined negative health outcomes avoided and found that the number of unnecessary catheterizations was reduced by 20%-47% and the number of UTIs were decreased by 38%-50% after the implementation of portable bladder ultrasound. In summary, all but one study advocated the use of portable bladder ultrasound as an alternative to catheterization.

An economic model in this review showed that about 169 catheterizations and one UTI were avoided daily in a typical complex continuing care (CCC) facility. The total annual expected cost with the portable bladder ultrasound scanner was estimated at C\$24 per CCC facility per day while the total annual expected cost without the bladder scanner was estimated at C\$679 per CCC facility per day. The difference in costs is mostly attributable to the decrease in the number of catheterizations with the adoption of the portable bladder ultrasound scanner technology. The total annual cost to a CCC facility (including catheter costs, nurse time, and UTI treatment costs but excluding device costs) was estimated at C\$35,770 with the adoption of the bladder scanner technology. Without the adoption of the technology, the cost to a typical CCC facility was estimated at C\$247,835.

Randomized controlled trials

Araki et al. evaluated the effectiveness of a portable ultrasound bladder scanner in the measurement of PVR urine volume among 30 patients after resection of rectal cancer.⁷ Fifteen patients each were randomly assigned to a bladder scanner group and an intermittent bladder catheterization group. The mean number of catheterizations in the study group was 2.1 per patient, while it was 19.4 per patient in the control group. It was reported that bladder scanning

reduced the frequency of catheterization by 38% as compared with the patients in the control group, with 17.4 catheters saved for each patient. The authors concluded that the bladder scan could protect patients from the discomfort and urethral injury which might have been caused by bladder catheters. However, the study was of poor quality. It did not provide details on patient randomization but labeled itself as a randomized trial, nor specify if there is a reference test to verify the results from the bladder scan. P values, confidence intervals, or standard deviations were not presented in their report, so the significance of the between-group differences cannot be determined. The figure of “38%” is questionable as well, as there was limited data provided in the study and this figure cannot be reproduced.

Observational studies

Lee et al. reported an evaluation of the differences among rates of unnecessary catheterization, UR and UTI before and after implementing a bladder ultrasound program to assess urine volume.⁸ The participants were all patients over 18 years of age who were hospitalized in two neurosurgical units of a medical center in Taiwan. There were 168 patients in the study group (after implementing bladder scan) and 76 patients in the control group (before implementing bladder scan). In the study group, based on the urine volume measured by ultrasound, nurses decided whether they needed to catheterize patients. There was no reference test to verify the results of the bladder scan. In this study, catheterization was defined as “unnecessary” when a PVR volume was less than 100 mL, or urine volume was less than 300 mL after inability to void over a period of time. The rates of these two kinds of unnecessary catheterization were 21.3% and 14.0% respectively in the control group (a total of 35.3%), and 3.5% and 3.5% respectively in the study group (a total of 7%). The UTI rates in the control group and the study group were 3.47% and 2.87% respectively - the rate decreased by 17.29% after bladder ultrasound scanning was implemented. The p value was not reported and therefore it is unclear whether this difference is statistically significant. The authors concluded that the bladder ultrasound program was successful and could be used to manage patients with urination disorders in neurosurgical units.

Limitations

- The vast majority of the published studies examined merely the diagnostic accuracy of bladder ultrasound scan, but not other clinical relevant outcomes (i.e. the role of bladder scanner on reducing unnecessary catheterization and UTIs). Therefore, only a limited number of studies met our inclusion criteria and were included in the report.
- Only one RCT was identified and the quality was poor. The quality of the included observational studies was also poor.
- The patient populations under investigation were all adults. The use of bladder scanning was not evaluated among pediatric patients and therefore, its effect in this patient group cannot be determined.
- Information was identified only for portable ultrasound devices; no information was identified for stationary ultrasound devices.
- Only English-language studies were considered.

Conclusions and implications for decision or policy making:

The evidence available related to the role of bladder ultrasound scanning to reduce unnecessary catheterizations and related UTIs was limited. Also, the quality of some studies was low due to insufficient details and reporting errors in the articles.

All the included studies examined the portable ultrasound devices among adult patients who needed catheter placement for various reasons. There was a trend of reduced number of catheterizations and UTIs when bladder scanning was introduced prior to catheter insertions, although it is unclear whether this reduction was statistically significant. Despite of the lack of compelling evidence, the existing studies suggested that bladder ultrasound scanning was reasonably accurate in measuring PVR volume when compared to intermittent catheterization, and it diminished negative health outcomes. This technology was suggested to be cost saving as well.

No study examined the effects of a stationary ultrasound machine. This may be due to the decreased use of such devices after portable ultrasound scanners were introduced in recent years. One previous study by Huang et al.⁶ compared the accuracy of stationary ultrasound equipment with portable ultrasound and indicated that even though stationary equipment was more accurate in estimating PVR volume than the portable equipment, the portable ultrasonography was more convenient to use and had an acceptable accuracy for the targeted condition.

In the future, more well-designed clinical trials are needed to provide compelling evidence about the impact of bladder scanning in patients who need catheterizations.

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