

Ultrasound scanning can be used to detect post-void residual urine, but health professionals need training in the benefits and risks, and how to perform it

Using ultrasound to detect post-void residual urine

In this article...

- › Patient groups at risk of urinary retention
- › Advantages of ultrasound bladder scanning over catheterisation
- › Indications and contraindications of bladder scanning

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A wide range of people may experience urinary retention, which can result in other health problems. Ultrasound bladder scanning is increasingly used to detect post-void residual urine but is not suitable for everyone. Health professionals must be trained in who is, and is not, suitable for the procedure, how it should be carried out safely and interpreting the results so appropriate treatment can be planned. This article outlines the advantages of ultrasound scanning over catheterisation, and gives an overview of the indications and contraindications of the procedure.

There are two methods of assessing post-void residual (PVR) urine volume: sterile urethral in/out catheterisation (a direct measurement of urine volume) and bladder ultrasound scanning (an indirect estimation of urine volume) (Kelly, 2004).

The use of portable ultrasound bladder scanning to detect urinary retention and incomplete bladder emptying has recently taken over from urethral catheterisation and is now considered the gold standard for measuring residual volumes of urine (Loveday et al, 2014; National Institute for Health and Care Excellence, 2012; Martin et al, 2006). Use of these scanners is becoming routine in primary and acute care settings. There are many reasons for this, including the fact that ultrasound bladder scanning is more comfortable for

the patient, carries a lower risk of infection as it is non-invasive, and relatively quick and easy to use, which saves time for staff (Choe et al, 2007).

However, there are associated benefits and risks so health professionals must:

- › Be able to identify individuals who may require a bladder scan;
- › Be trained and competent in performing the scan and interpreting the results;
- › Know what treatments are associated with results;
- › Understand the importance of maintaining the equipment to obtain accurate results.

Bladder scanners and urinary problems

A bladder scanner is used primarily as a diagnostic aid to identify incomplete emptying, urinary retention (defined as the inability to pass urine despite persistent effort (Haylen et al, 2010) and determine bladder volume in adults and children with urinary problems (Scottish Health Technologies Group, 2011; NHS Quality Improvement Scotland, 2010).

Urinary problems could result from:

- › Neurological conditions, such as multiple sclerosis, Parkinson's disease, cerebrovascular accident, spinal injuries, spina bifida, diabetes;
- › Urethral obstruction due to various reasons including benign prostatic hypertrophy, urethral strictures, prostate cancer, tumours, prolapse, urethral calculi, foreign bodies, faecal impaction;
- › Trauma, surgery or surgical manipulation of the bladder nerves;
- › Anaesthetic agents such as spinal agents;

5 key points

1 Ultrasound can be used to detect post-void residual urine

2 Ultrasound bladder scanning is considered the gold standard of detection methods

3 Care must be taken to ensure bladder scans give accurate results

4 Bladder scanners must be maintained and calibrated in line with manufacturer's instructions

5 Health professionals must be trained appropriately in how to perform, ultrasound bladder scans

FIG 1. **BLADDER ON SCREEN**



A normal ultrasound scan of the bladder of a 31-year-old woman

- » Medication such as anticholinergics, antihypertensives, antispasmodics, antihistamines;
- » Recreational/illicit drugs.

Bladder emptying can also be affected by:

- » A lack of privacy;
- » Voiding in unfamiliar places;
- » Requests to void on command;
- » Voiding with a partially or overfilled bladder;
- » Pain (Home and Community Care and Medical Aids Subsidy Scheme Continence Project, 2011).

The clinical indications for using a bladder scanner are highlighted in Box 1.

Bladder scans are non-invasive. Portable scanners usually comprise a base unit with display screen and a scanner head (ultrasound transducer). The scanner emits ultrasound waves, which pulse through the body. The intensity of the returning echo of the sound waves and the time taken to receive a signal is measured to give either a two- or three-dimensional image of the bladder (Rigby and Housami, 2009). The returning echo appears as a cross-section of the bladder on the screen (see Fig 1) (Rigby and Housami, 2009) and automatically calculates bladder and PVR measurements (Scottish Health Technologies Group, 2011).

There is no clear consensus on what is a normal or abnormal PVR urine volume. Volumes vary from 50-100ml (Darrah et al, 2009) to >300ml. Large PVRs are associated with urinary tract infections, especially in at-risk individuals such as those with a spinal cord injury or diabetes. Very large PVRs (>300ml) may be associated with increased risk of upper urinary tract dilation and renal insufficiency (Kelly, 2004).

The advantages and precautions of bladder scanning

The main benefits of bladder scanning compared with urethral catheterisation are outlined in Box 2. However, while there are many advantages, the use of a bladder scanner may not be appropriate in all situations, including if:

- » The patient is morbidly obese;
- » There is severe abdominal scarring;
- » Abdominal staples or tension sutures are in situ;
- » There is an infected abdominal wound present.

The manufacturer's recommendations should be checked for use in pregnant women and studies indicate that bladder scanning in children aged <36 months is unreliable and should be used with caution (Koomen et al, 2008; De Gennaro

BOX 1. CLINICAL INDICATIONS FOR USE OF A BLADDER SCANNER

For the clinician:

- As part of a continence assessment
- To confirm urinary retention
- To identify incomplete bladder emptying
- To assess post-void residual urine
- To assess bladder sensation level in relation to bladder volume
- In trial of void to prevent bladder distension to determine whether early removal of a catheter has been appropriate
- To assess bladder volume if a catheter is not draining
- To identify whether an indwelling catheter is blocked
- To determine bladder volume in a client with decreased urine output

For the patient:

- To identify any voiding problems before an invasive procedure is performed
- To monitor post-operative individuals

or those who are physically unable to void

- In a bladder retraining programme to determine the need to void based on bladder volume rather than time
- To assess the effectiveness of mechanical bladder emptying
- To identify the level of bladder sensation that is related to bladder volume
- To identify whether adverse side-effects of urinary retention are present with medications such as anticholinergics
- As a standard investigation for groups at risk of, for example, neurological disease, diabetes when presenting with urinary problems
- In annual monitoring of bladder function in those with chronic or progressive diseases, such as multiple sclerosis

Source: Home and Community Care and Medical Aids Subsidy Scheme Continence Project (2011)

BOX 2. BENEFITS AND ADVANTAGES OF BLADDER SCANNING COMPARED WITH CATHETERISATION

- No risk of urinary tract infection related to the procedure
- Non-invasive
- Helps maintain privacy - no need to expose genital area
- No pain/discomfort (although this may depend on skill of operator and/or the degree of retention)
- Portable
- Can be done in a community or home setting with no need to attend hospital
- No need to wear protective, sterile clothing
- Quick and easy to use
- Reliable (depending on skill of operator)
- Suitable for use with children or vulnerable adults
- Instant results and instant biofeedback for individuals
- Helps inform decision making, diagnosis and treatment

Source: Gilbert (2005)

et al, 2006). Bladder volumes were underestimated and Wyneski et al (2005) stated that significant volumes in neonates were undetected in some scanning machines.

Caution should also be taken for women in the early postpartum period - Lukasse et al (2007) indicated that when certain brands of scanners are compared, sometimes they give varying results. Caution should be taken as this could hinder identification of the true anatomical detail of the bladder. In general, the use of bladder scanners does not result in any complications but one study (Health Quality Ontario, 2006) did report potential adverse effects including skin

irritation and allergic reaction to gel and padding. However, bladder scanners themselves are deemed very safe and no epidemiological studies have shown human risks (NHS Quality Improvement Scotland, 2010).

Inaccurate bladder scan recordings

There are several reasons why a bladder scan may be inaccurate:

- » Part of the bladder extends outside of the scanned region (for example, if a large hernia or diverticula is present) or due to altered anatomy such as a displaced organ or prolapse;
- » The bladder contains substances other

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FIG 2. PORTABLE BLADDER ULTRASOUND



A portable bladder ultrasound scanner being used by a district nurse in a patient's home

- than water – for example blood clots, mucous;
- » The type of conduction gel is used is wrong or inadequate;
- » Excessive body hair prevents conduction;
- » The scanner head is unclean, cracked, broken or positioned incorrectly;
- » The scanner head is moved while machine is in operation;
- » The wrong gender is identified before scanning the patient – however for newer real-time scanners this is not identified as such a problem;
- » Poor technique is used by the health professional;
- » The patient is positioned incorrectly (not supine);
- » The patient is obese;
- » Ascites or fluid collection is in the abdominal cavity;

“The National Patient Safety Agency stated that ultrasound devices should be made available to acute and community staff, and training provided to them”

- » The scanner's battery is flat and regular service and calibration has not been carried out as per manufacturer's recommendations.
(Gilbert, 2005)

Procedure for a bladder scan

An ultrasound bladder scan should only be performed by health professionals deemed competent after being trained in carrying out the procedure, completing documentation, understanding clinical indicators and interpreting the results. The National Patient Safety Agency (2009) stated that ultrasound devices, including bladder

scanners, should be made available to acute and community staff, and training provided to them.

The patient and environment should be prepared (Box 3) and the procedure performed in line with infection prevention and control guidance.:

- » Switch on the scanner;
- » Decontaminate hands;
- » With patient in supine position and suprapubic area exposed but dignity maintained, apply ultrasound gel;
- » Place probe externally on the patient's abdomen over the site of the bladder just above the pubic bone;
- » Activate the scan by pushing the appropriate button and take an initial reading;
- » Depending on the type of bladder scanner, you may be able to take a transverse and sagittal view of the

bladder, which will result in a combined volume;

- » Take more than one scan for accuracy;
- » When complete, clean the excess gel off the patient and advise or help them to dress. Clean the scanner head following manufacturer's guidance;
- » Decontaminate hands and dispose consumables in line with infection control guidelines.

Documentation

It is vital that documentation is completed. It should be thorough, concise, legible and identify:

BOX 3. PREPARING THE PATIENT AND ENVIRONMENT

- Ask the patient for his or her consent and document this according to local policy. Ensure a written explanation is available
- Check for any allergies or contraindications pertinent to the scan
- Give the patient the opportunity to have a chaperone (see local policy)
- Ask the patient to void before the scan. Measure the urine volume
- Check the environment is safe, clean, private and suitable for performing the procedure
- Ensure the patient is in a supine position. The suprapubic area should be exposed but the patient's dignity retained
- Provide a full verbal explanation throughout the procedure to allow the patient to understand and comply with the bladder scan

- » Clinical reasons for using the bladder scanner;
- » Patient's demographics, including name, and date and time the bladder scan was performed;
- » Results of physical assessment before the scan;
- » Volume of void before scan and time since voiding;
- » Results of the scan (include a printout if available);
- » Who was notified of the results (medical staff, GP, other);
- » Treatments initiated, referrals made;
- » Patient's response to procedure;
- » Follow-up plan and care.
(HACC and MASS, 2011)

Interpreting bladder scanner results


Health professionals who perform bladder scans play a key role in identifying patients with incomplete bladder emptying by interpreting the clinical significance of a PVR volume and determining the most appropriate intervention. However, interpreting results can be complex. Further, artefacts or misrepresentation of the image can occur, especially, in individuals who are morbidly obese or have irregular bladder shapes, or women who are post-natal, as scanners will also record volumes of cystic structures within the pelvis (Mathew et al, 2007).

When assessing individuals, staff need

to able to differentiate between those who have clinically significant urinary retention that requires immediate attention and those with clinically insignificant incomplete bladder emptying. However, as has been noted, there is no consensus on normal and abnormal PVR urine. It is generally considered that a PVR of 50-100ml is adequate bladder emptying (Darrah et al, 2009), but staff should take into account other investigations and the patient's clinical presentation. If the PVR is above these parameters or the patient has other risk factors, further investigations and interventions should take place to identify appropriate treatment and management (HACC and MASS, 2011).

Health professionals reviewing results of a bladder scan need to consider the readings in association with other factors, such as:

- » Any known cause for the residual urine or any diagnosed or suspected cause of the presenting problem;
- » Whether the voiding problem is likely to be curable or incurable;
- » Whether the urinary retention is acute or chronic;
- » The correlation between the presenting symptoms, voiding problems and urine volume recordings;
- » Whether the urinary problem affects the individual's quality of life or general health and wellbeing;
- » Whether the client has incomplete bladder emptying;
- » The risk of over- or under intervention;
- » Whether the client has renal failure.



**QUICK
FACT**

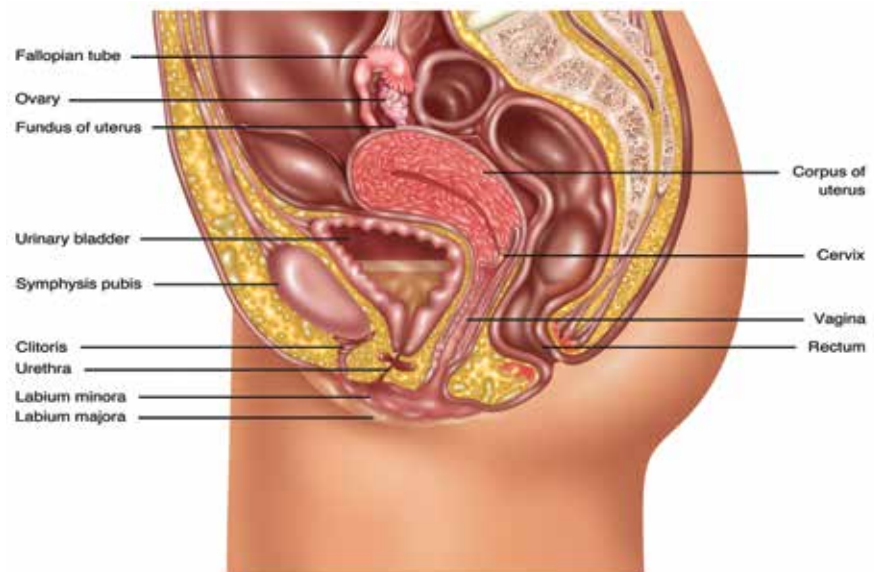
300ml PVR may be associated with upper urinary tract dilation and renal insufficiency

Equipment maintenance

Bladder scanning equipment should be maintained, treated with care and stored safely. A regular maintenance programme for checks and calibration should be in place (usually by the manufacturer) and a log kept of all engineer's tests and action taken (Rigby and Housami, 2009). To prevent adverse impact on patient care, contingency plans should be in place in case an unforeseen fault, servicing or recalibration puts the scanner out of action.

Conclusion

A plethora of evidence suggests that using bladder scans to identify PVR volumes is preferable over catheterisation (Choe et al, 2007). However, there are also concerns



This diagram shows the position of the bladder in the pelvis

that professionals need to have a degree of expertise to use this equipment. Adequate competency-based training must be given, as staff need to know the reasons for scanning individuals and the associated risks.

Portable bladder scanners are convenient, non-invasive, accurate and carry no risk of urethral trauma or infection associated with urethral catheterisation. They benefit a variety of populations and, if maintained and used correctly, are safe to use and remain the gold standard. **NT**

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