

**American College of Radiology
ACR Appropriateness Criteria®**

Clinical Condition:

Obstructive Voiding Symptoms Secondary to Prostate Disease

Variant 1:

Normal renal function.

Radiologic Procedure	Rating	Comments	<u>RRL*</u>
US pelvis (bladder and prostate) transabdominal	7	Postvoid to measure residual urine. If there is significant residual, evaluation of upper tracts is indicated. Gives estimate of prostate size and bladder wall thickness.	O
US kidney retroperitoneal	5	Appropriateness rating could be higher if significant residual urine is present. Evaluate for hydronephrosis.	O
X-ray intravenous urography	2	Appropriateness rating could be higher if significant residual urine is present. In patients with stones, hematuria, or atypical history, the study may be warranted. CT urography has replaced IVU in some centers.	☼☼☼
MRI pelvis without contrast	2		O
MRI pelvis without and with contrast	2		O
X-ray voiding cystourethrography	2	Consider in men younger than age 50 with symptoms.	☼☼
X-ray abdomen	2	Other imaging studies more useful.	☼☼☼
US pelvis (prostate) transrectal	2	Resistive indices (RI) have been shown to be elevated in BPH and to decrease after transurethral vaporization of the prostate, suggesting that RI can be used to evaluate severity of BPH and monitor therapy.	O
X-ray retrograde urethrography	1	Does not assess prostate size.	☼☼☼
CT abdomen and pelvis without and with contrast	1	Not indicated.	☼☼☼☼
CT abdomen and pelvis without contrast	1		☼☼☼☼
CT abdomen and pelvis with contrast	1		☼☼☼☼
<u>Rating Scale:</u> 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Clinical Condition:**Obstructive Voiding Symptoms Secondary to Prostate Disease****Variant 2:**

Increased blood urea nitrogen (BUN) and/or creatinine. (See the ACR Appropriateness Criteria® for “[Renal Failure](#)”).

Radiologic Procedure	Rating	Comments	<u>RRL</u>*
US pelvis (bladder and prostate) transabdominal	8	To evaluate for residual urine and prostate size and bladder wall thickness.	O
US kidney retroperitoneal	8	To evaluate for hydronephrosis.	O
X-ray abdomen	3	To exclude calculi. Can be used in association with US.	☼☼☼
US pelvis (prostate) transrectal	2	Can assess prostate size by transabdominal US. Resistive indices (RI) have been shown to be elevated in BPH and to decrease after transurethral vaporization of the prostate, suggesting that RI can be used to evaluate severity of BPH and to monitor therapy.	O
MRI pelvis without contrast	2		O
X-ray voiding cystourethrography	2	Consider in men younger than age 50 with symptoms.	☼☼
X-ray intravenous urography	1	Other studies better for evaluating same structures.	☼☼☼
X-ray retrograde urethrography	1	Does not assess prostate size.	☼☼☼
MRI pelvis without and with contrast	1		O
CT abdomen and pelvis without contrast	1	Not indicated.	☼☼☼☼
CT abdomen and pelvis with contrast	1		☼☼☼☼
CT abdomen and pelvis without and with contrast	1		☼☼☼☼
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

OBSTRUCTIVE VOIDING SYMPTOMS SECONDARY TO PROSTATE DISEASE

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Summary of Literature Review

Obstructive voiding symptoms secondary to prostate disease include hesitancy, decreased force of stream, terminal dribbling, postvoid fullness, and double voiding [1-2]. Benign prostatic hypertrophy (BPH) is the most common cause of prostate enlargement requiring intervention. It is estimated that by 80 years of age, 75% of men have developed BPH [1]. It has been hypothesized that age-related impairment of blood supply to the lower urinary tract is important in the development of BPH [3]. It has also been estimated that 10% of all males older than age 40 will have BPH requiring surgery before reaching age 80 [4]. Other causes of bladder outlet obstruction include urethral stricture, prostate cancer, bladder neck contracture, and neurogenic disease.

Numerous imaging studies have been used in evaluating patients with symptoms of bladder outlet obstruction. These include radiographs, intravenous urography (IVU), urethrography, both transabdominal and transrectal ultrasonography, computed tomography (CT), and magnetic resonance imaging (MRI) [1,4-14]. With the coming re-engineering of health care, selective use of these modalities will be required in order to decrease costs and practice efficient, effective medicine [15]. Benefits of imaging patients with obstructive voiding symptoms secondary to prostate disease include

determination of the presence and degree of hydronephrosis, estimation of renal function, evaluation of the bladder and prostate, detection of incidental upper-tract malignancies or stones, and medicolegal safety [16].

Radiography

Radiography cannot be used to visualize the prostate directly. A distended bladder can be visualized as a pelvic mass, but unless information is available regarding when the patient last voided, this finding is of uncertain value. Prostatic calcifications can be visualized and always indicate glandular enlargement if they extend above the pubic symphysis [17]. Bladder calculi can also be easily identified, since approximately 90% of calculi are opaque [18].

In patients with prostate cancer and bone metastases, radiographs are a valuable and inexpensive diagnostic tool. Eighty percent of bone metastases are osteoblastic, and mixed osteoblastic and osteolytic lesions are seen in another 15% of patients [17]. However, bone scintigraphy is far more sensitive in identifying bone metastases at an early stage [17].

IVU is performed infrequently, with CT/MRI urography having replaced it [18]. Retrograde urethrography is valuable to exclude urethral strictures but does not accurately assess the size of the prostate gland. Thus it is not part of the routine evaluation of patients with prostatism [17]. Voiding cystourethrography should be considered only for men younger than age 50 with outflow obstruction symptoms [17].

Ultrasound

Ultrasound (US) can be used to image both opaque and nonopaque bladder calculi, which may be a cause of outlet obstruction or secondary to the outlet obstruction and chronic retention of urine [19]. US can also be used to image the prostate transabdominally (through a distended bladder) or transrectally (TRUS). TRUS is preferred by urologists; however, both transabdominal US and TRUS are equally accurate for measuring prostate volume [16,20]. Identifying the size of the prostate is important since it helps determine the type of therapy indicated. The US pattern is still too nonspecific to differentiate benign from malignant prostate lesions. A particular problem is the difficulty in identifying isoechoic lesions.

The size of the enlarged prostate can be detected accurately by TRUS and MRI [6,11,16]. Both have an advantage in that the internal prostatic anatomy is better seen and the ratio of glandular to stromal tissue in the prostate can be determined, although to date this information has not proven clinically useful [16,21].

Recently the use of resistive index (RI) in prostate disease has been proposed as helpful. RI measured during TRUS has been found to be elevated in the transition zone of patients with BPH, but not in the peripheral or central zones and not in normal patients or those with prostate cancer [3]. RI has also been shown to decrease after

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transurethral vaporization of the prostate, suggesting that it can be used to evaluate the severity of BPH [22] and monitor the outcomes of therapy [23]. TRUS is, however, preferred to guide lesion-directed and systematic biopsies of the prostate [16].

US contrast agents have been shown to make tumors more conspicuous due to their hypervascularity, thus improving the detection rate of malignancy in contrast-enhanced targeted cases compared to sextant cases [24]. Three-dimensional (3D) US has been shown to add anatomic information from the coronal plane, which may allow better calculation of prostate volume [25].

Secondary changes of bladder outlet obstruction, such as bladder wall thickening, are better seen with US than with IVU [6]. Measurement of bladder wall thickness can detect bladder outlet obstruction better than free uroflowmetry, postvoid residual urine volume, or prostate volume [26]. In the study by Franco et al [27] detrusor wall thickness and intravesical prostatic protrusion had the best diagnostic accuracy (87%) for distinguishing bladder obstruction from benign prostatic hyperplasia. Abdominal (suprapubic) US may be used to accurately ($\pm 15\%$) measure residual urine volume in 90% of patients [5]. However, catheterization is probably the least expensive method to accurately assess residual urine in the bladder.

In patients with azotemia, the collecting system of the kidneys should be imaged for dilatation. In patients with normal renal function, this may not be necessary. However, in a study by Juul et al [28] out of 100 patients examined by both US and IVU, nine patients had hydronephrosis, with six of them having normal renal function. Four patients had unilateral hydronephrosis (all with normal serum creatinine) and five had bilateral hydronephrosis (three of them had abnormal serum creatinine).

Computed Tomography and Magnetic Resonance Imaging

CT has not proven to be of much value in evaluating the benign, enlarged prostate [14], but there are reports indicating that MRI is useful in evaluating the prostate gland [10,13]. Recently diffusion-weighted imaging has been used to differentiate between benign prostatic hyperplasia nodules and prostate cancer [29]. MRI is also useful in evaluating prostate size, although other less costly procedures, such as US, are preferred.

There is no evidence that patients with BPH have a higher incidence of asymptomatic renal cancers than the general population in the same age group; therefore, a contrast-enhanced examination to search for occult neoplasms is unwarranted [16,30]. In a prospective study of 502 patients, Wasserman et al [31] found benign renal cysts in 10%, renal cancers in less than 1%, and significant upper urinary tract obstruction in 2.6%. When patients have obstructive symptoms and renal insufficiency, US rather than contrast-enhanced examination is recommended to evaluate for hydronephrosis [16-17]. In patients with severe hydronephrosis, azotemia is almost always present, and US is indicated. In summary, while not routinely

recommended, upper urinary tract imaging is indicated in patients with BPH and one or more of the following: hematuria (including asymptomatic microscopic hematuria), laboratory evidence of renal insufficiency, history of urinary tract infection, urolithiasis, previous urinary tract surgery, or congenital or acquired renal disease [16].

Summary

- For patients who have normal renal function but suffer the symptoms of prostatism, a radiographic workup should be minimal.
- US is occasionally desirable for estimating prostate size, bladder volume, and detrusor thickness prior to surgery.
- If azotemia is present, the upper urinary tracts should definitely be evaluated with US for the presence of hydronephrosis.

Relative Radiation Level Information

Potential adverse health effects associated with radiation exposure are an important factor to consider when selecting the appropriate imaging procedure. Because there is a wide range of radiation exposures associated with different diagnostic procedures, a relative radiation level (RRL) indication has been included for each imaging examination. The RRLs are based on effective dose, which is a radiation dose quantity that is used to estimate population total radiation risk associated with an imaging procedure. Patients in the pediatric age group are at inherently higher risk from exposure, both because of organ sensitivity and longer life expectancy (relevant to the long latency that appears to accompany radiation exposure). For these reasons, the RRL dose estimate ranges for pediatric examinations are lower as compared to those specified for adults (see Table below). Additional information regarding radiation dose assessment for imaging examinations can be found in the ACR Appropriateness Criteria® [Radiation Dose Assessment Introduction](#) document.

Relative Radiation Level Designations		
Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
O	0 mSv	0 mSv
⊕	<0.1 mSv	<0.03 mSv
⊕⊕	0.1-1 mSv	0.03-0.3 mSv
⊕⊕⊕	1-10 mSv	0.3-3 mSv
⊕⊕⊕⊕	10-30 mSv	3-10 mSv
⊕⊕⊕⊕⊕	30-100 mSv	10-30 mSv
*RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (eg, region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as NS (not specified).		

Supporting Document(s)

- [ACR Appropriateness Criteria® Overview](#)
- [Procedure Information](#)
- [Evidence Table](#)

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The ACR Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those examinations generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the FDA have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.