American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Lower Urinary Tract Symptoms: Suspicion of Benign Prostatic Hyperplasia**

Radiologic Procedure	Rating	Comments	RRL*
US pelvis (bladder and prostate) transabdominal	6	Consider this procedure after patient voids to measure residual urine. If there is significant residual urine, an evaluation of upper tracts is indicated. This procedure gives an estimate of prostate size and bladder wall thickness. It can also measure intravesical prostate protrusion.	O
US kidney retroperitoneal	5	The appropriateness rating could be higher for this procedure if significant residual urine is present or if renal insufficiency is present to evaluate for hydronephrosis.	O
MRI pelvis without IV contrast	3	MRI can determine prostate size, urinary bladder wall thickness, and hydronephrosis.	O
X-ray intravenous urography	2	The appropriateness rating could be higher for this procedure 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 and with IV contrast	2		O
X-ray voiding cystourethrography	2	Consider this procedure in men younger than age 50 with symptoms.	☢☢
X-ray abdomen	2	Other imaging studies are more useful.	☢☢
US pelvis (prostate) transrectal	2	Resistive indices have been shown to be elevated in BPH and to decrease after transurethral vaporization of the prostate, suggesting that resistive indices can be used to evaluate severity of BPH and monitor therapy. This procedure can assess for intravesical prostate protrusion.	O
X-ray retrograde urethrography	1	This procedure does not assess prostate size.	☢☢☢
CT abdomen and pelvis without and with IV contrast	1		☢☢☢☢
CT abdomen and pelvis without IV contrast	1		☢☢☢☢
CT abdomen and pelvis with IV contrast	1		☢☢☢☢
Rating Scale: **1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate**			***Relative Radiation Level**

LOWER URINARY TRACT SYMPTOMS: SUSPICION OF BENIGN PROSTATIC HYPERPLASIA

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Summary of Literature Review

Introduction/Background

Obstructive voiding symptoms secondary to prostate disease include hesitancy, decreased force of stream, terminal dribbling, postvoid fullness, and double voiding [1,2]. Benign prostatic hyperplasia (BPH) is the most common cause of obstructive voiding symptoms, occurring in approximately 25% of men between the ages of 40 and 49. The incidence increases to more than 80% in men between the ages of 70 and 79 [3]. Other causes of bladder outlet obstruction include urethral stricture, prostate cancer, bladder neck contracture, bladder calculi, and neurogenic disease.

Imaging is not recommended as a first-line tool in patients suspected of having lower urinary tract symptoms secondary to probable BPH. Rather, treatments including medication are initially focused on alleviating the patient's symptoms [4]. If there is no improvement in symptoms or if there are complicating factors such as hematuria, several imaging studies have been used in evaluating patients with symptoms of bladder outlet obstruction. These include radiographs, intravenous urography (IVU), urethrography, transabdominal and transrectal ultrasonography (TRUS), computed tomography (CT), and magnetic resonance imaging (MRI). 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, and detection of incidental upper-tract malignancies or stones [5].

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 the timing of the patient's last void, this finding is of uncertain value. Prostatic calcifications can be visualized and indicate glandular enlargement if they extend above the pubic symphysis [6]. Bladder calculi can also be identified, since approximately 90% of calculi are opaque [7].

IVU is performed infrequently. In patients with stones, hematuria, or atypical history, the study may be warranted. CT urography has replaced IVU in most centers [7].

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 lower urinary tract symptoms [6]. Voiding cystourethrography should be considered to evaluate for urethral strictures only in men younger than age 50 with outflow obstruction symptoms [6].

Ultrasound

Ultrasound (US) can be used to image the prostate transabdominally (through a distended bladder) or with TRUS. Both transabdominal US and TRUS are equally accurate for measuring prostate volume [5,8]. Identifying the size of the prostate is important since it helps determine the type of therapy indicated [9]. The US pattern is too nonspecific to differentiate benign from malignant prostate lesions. US can also be used to image opaque and nonopaque bladder calculi, which may be a cause of outlet obstruction or may be secondary to outlet obstruction

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and chronic retention of urine [10]. Transabdominal ultrasound can also show dilated distal ureters and urinary bladder diverticula.

The size of the enlarged prostate can be detected accurately by TRUS and MRI [5,11,12]. 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 this information has not proven clinically useful to date [5,13].

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 [14]. RI has also been shown to decrease after transurethral vaporization of the prostate, suggesting that it can be used to evaluate the severity of BPH [15] and monitor the outcomes of therapy [16]. TRUS is, however, preferred to guide lesion-directed and systematic biopsies of the prostate [5].

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 [17]. 3-D US has been shown to add anatomic information from the coronal plane, which may allow better calculation of prostate volume [18].

Secondary changes of bladder outlet obstruction, such as bladder-wall thickening, are better seen with US than with IVU [11]. Measurement of bladder-wall thickness can detect bladder outlet obstruction better than free uroflowmetry, postvoid residual urine volume, or prostate volume [19]. In the study by Franco et al [20], detrusor wall thickness and intravesical prostatic protrusion had the best diagnostic accuracy (87%) for distinguishing bladder obstruction from BPH. US can evaluate the degree of intravesical prostatic protrusion, which may guide therapy. Measurements >1 cm suggest surgical therapy may be preferable to medical therapy [21,22].

Abdominal (suprapubic) US may be used to accurately (±15%) measure residual urine volume in 90% of patients [23]. However, catheterization is probably the least expensive method to accurately assess residual urine in the bladder.

In patients with azotemia or a high postvoid residual rate, the collecting system of the kidneys should be imaged for evidence of hydronephrosis.

Computed Tomography and Magnetic Resonance Imaging

CT has not proven to be of much value in evaluating the benign enlarged prostate. Multiparametric MRI has value in prostate cancer evaluation [24,25]. However, use of MRI for the benign enlarged prostate is limited. MRI can evaluate prostate size and morphology, but 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 [5,26]. In a prospective study of 502 patients, Wasserman et al [27] 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 [5,6]. In patients with severe hydronephrosis, azotemia is almost always present, and US is indicated. In summary, although not routinely recommended, upper urinary tract imaging preferably with CT or MRI 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 [5].

Summary

- For patients who have normal renal function but suffer lower urinary tract symptoms, imaging workup should be minimal.
- US is occasionally desirable for estimating prostate size, intravesical prostate protrusion, bladder volume, and detrusor thickness prior to surgery.
- If azotemia is present, the upper urinary tracts should 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 “Varies”.

Supporting Documents

For additional information on the Appropriateness Criteria methodology and other supporting documents go to www.acr.org/ac.

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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.