American College of Radiology
ACR Appropriateness Criteria®
Lower Urinary Tract Symptoms: Suspicion of Benign Prostatic Hyperplasia

Variant: 1 Lower urinary tract symptoms. Suspicion of benign prostatic hyperplasia. Initial imaging.

Procedure	Appropriateness Category	Relative Radiation Level
US kidneys retroperitoneal	May Be Appropriate	O
US pelvis (bladder and prostate) transabdominal	May Be Appropriate	O
TRUS prostate	Usually Not Appropriate	O
Fluoroscopy voiding cystourethrography	Usually Not Appropriate	☢☢
Radiography abdomen	Usually Not Appropriate	☢☢
Fluoroscopy retrograde urethrography	Usually Not Appropriate	☢☢☢
Radiography intravenous urography	Usually Not Appropriate	☢☢☢
MRI pelvis without and with IV contrast	Usually Not Appropriate	O
MRI pelvis without IV contrast	Usually Not Appropriate	O
CT abdomen and pelvis with IV contrast	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis without IV contrast	Usually Not Appropriate	☢☢☢
CT abdomen and pelvis without and with IV contrast	Usually Not Appropriate	☢☢☢☢

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Summary of Literature Review

Introduction/Background

Lower urinary tract symptoms (LUTS) in men have multiple causes that can be broken down into storage, voiding, and postmicturition symptoms that are due to a wide range of neurogenic and non-neurogenic factors. These symptoms may be due to bladder outlet obstruction (BOO) caused by benign prostatic enlargement (BPE) or abnormal bladder detrusor function (overactivity or underactivity) [1]. BPE results from benign prostatic hyperplasia, a histologic diagnosis of benign proliferation of prostatic stromal and epithelial tissue [2]. BPE associated with LUTS has prevalence as high as 50% to 75% of men who are ≥50 years of age, and up to 80% of men who are >70 years of age [3].

Initial assessment of LUTS includes obtaining relevant medical history, performing a focused physical examination, and assessing symptom severity by one of several validated questionnaires. The International Prostate Symptom Score (IPSS) is used most commonly in the United States, and other validated questionnaires include the International Consultation on Incontinence

Questionnaire and the Danish Prostate Symptom Score. These scores identify dominant symptoms (storage or voiding) and can be used to monitor response to therapy. Voiding charts (eg, frequency-volume chart) can be created by the patient to actively record several days of voiding time and volume. A physical examination should include an abdominal examination for bladder distention, a detailed genitourinary examination for any stricturing disease or urethral mass, a digital rectal examination to assess prostate size, and a neurological examination of the perineum and lower limbs. Digital rectal examination can be inaccurate for volume estimation and cancer detection and is most useful for identifying an enlarged prostate with volume >50g [4]. Initial laboratory analysis may include prostate serum antigen level if desired, following appropriate shared decision-making discussion. Urinalysis can be obtained to evaluate for urinary tract infection, glucosuria and proteinuria as cause of urinary frequency, and microhematuria. Urinalysis results may lead to an additional workup beyond the scope of this topic [1,2,5]. Pressure flow urodynamics is considered the reference standard for determining the underlying cause of LUTS and differentiating between storage and voiding abnormalities.

Watchful waiting with lifestyle modifications is appropriate for patients without bothersome symptoms. For patients with moderate to severe symptoms, medical therapy with α1-adrenoceptor antagonists is a first-line therapy. The 5α-reductase inhibitors can be helpful for patients with prostate volume >40 mL [6]. The muscarinic receptor antagonists and phosphodiesterase type 5 inhibitors can be used for storage symptoms [6]. Transurethral resection of the prostate is the standard surgical treatment for prostate volume 30 to 80 mL, with surgery or transurethral holmium laser enucleation for prostate volume >80 mL [6]. Other interventional options include laser ablation, transurethral needle or microwave ablation, transurethral resection, and prostate artery embolization. Treatment decisions vary by prostate volume and patient comorbidities [6,7].

Discussion of Procedures by Variant

Variant 1: Lower urinary tract symptoms. Suspicion of benign prostatic hyperplasia. Initial imaging.

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A. Radiography Abdomen

Radiographs do not directly image the prostate and are of low diagnostic yield in patients with LUTS [8]. A distended bladder may be visible on radiographs as a pelvic mass; however, the timing of last void is usually unavailable, making this appearance a finding of uncertain significance. Bladder stones can be identified on radiographs.

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B. Radiography Intravenous Urography

Intravenous urography is now rarely performed as it has been replaced by CT urography at most centers [9]. Positive yield of intravenous urography for BOO is <15% [10,11]. In patients with stones, hematuria, or atypical history, CT urography may be considered for further evaluation [12].

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C. Fluoroscopy Retrograde Urethrography

Retrograde urethrography does not directly image the prostate or provide adequate evaluation of prostate size. It may be useful if urethral stricture is considered as a cause of urinary obstruction.

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D. Fluoroscopy Voiding Cystourethrography

Voiding cystourethrography does not directly image the prostate or provide adequate evaluation of prostate size. It may be useful if urethral stricture is considered as a cause of urinary obstruction.

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E. TRUS Prostate

Grayscale transrectal ultrasound (TRUS) is the most commonly used modality to image the prostate. Although more invasive, TRUS measurement of prostate volume is more accurate than digital rectal examination or pelvic US [13,14], though correlation between TRUS and pelvic US is consistent when bladder volumes are <400 mL [15]. Prostate volume has low correlation with initial symptoms [16] but may predict symptom progression and response to 5α-reductase inhibitors, as well as guide surgical procedures [6]. The addition of spectral Doppler assessment is not helpful to differentiate benign from malignant areas [17], and further study of prostate arterial resistive index measurement is needed to determine clinical usefulness [18].

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F. US Pelvis

US is the preferred method to assess bladder volume and postvoid residual over catheterization and can be performed with a specific bladder scan unit or pelvic US. A measurable postvoid residual can be seen with both BOO and decreased detrusor function. Although no current postvoid residual threshold value can diagnose BOO or guide treatment [1,2], a persistent postvoid residual >100 mL or increasing postvoid residual over time may predict acute urinary retention, poor response to medical treatment, and deterioration of symptoms [1,19].

Pelvic US can assess intravesical prostatic protrusion, which is postulated to contribute to BOO by ball-valve mechanism disrupting flow of urine at the bladder neck [20,21]. Measurement of prostate protrusion into the bladder lumen from its tip to the bladder wall at the prostate base is broken down into 3 grades: grade I, ≤5 mm; grade II, 6 to 10 mm; and grade III, >10 mm. A higher grade can predict BOO [21,22] and a likelihood of voiding trial failure after catheterization for acute urinary retention [23]. Intravesical prostatic protrusion is a better predictor than prostate volume of obstructive symptoms [19,24]. A study of 157 patients, of which 48 had BOO by urodynamics, identified by receiver operator curve analysis an optimal cutoff of 10.8 mm protrusion for identifying patients with BOO [25]. Accurate measurements require bladder volume between 100 and 200 mL as volumes >400 mL have inaccurate measurements and are possibly due to displacement of the prostate [15]. The intravesical prostatic protrusion measurement can also be performed during TRUS with similar results [26,27].

US measurement of bladder wall thickness includes the entire width of the bladder wall, whereas detrusor wall thickness measures the hypoechoic muscle between the more echogenic mucosa and adventitia. A study of 157 patients, of which 48 had BOO by urodynamics, identified optimal cutoff of 3.7-mm wall thickness for identifying patients with BOO by receiver operator curve analysis [25].

Although detrusor wall thickening has been shown to increase in BOO, the ratio of bladder to detrusor thickness depends on degree of bladder filling [28]. US-estimated bladder weight can be calculated from bladder volume and wall thickness, assuming a spherical shape. This value may also correlate with BOO and acute urinary retention [29,30].

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G. US Kidneys Retroperitoneal

Routine imaging of the upper urinary tract with renal US is not usually indicated in uncomplicated LUTS [1,2,31]. In patients with elevated creatinine, stones, hematuria, urinary tract infection, or other complicating history, US of the kidneys and retroperitoneum may be considered for further evaluation.

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H. CT Abdomen and Pelvis

There is little relevant literature on the use of CT in the initial evaluation of LUTS that are due to BPE, either with or without intravenous contrast. The prostate volume can be estimated with measurements in 3 planes and ellipsoid formula calculation and/or postprocessing software with high correlation with TRUS prostate volume measurements [32]. Prostate volume may be helpful to predict response to medical therapies and may help determine surgical technique [2]. CT has decreased soft-tissue contrast compared with US and MRI, limiting its assessment of zonal anatomy [31]. In patients with stones, hematuria, urinary tract infection, or other complicating history, CT urography may be considered for further evaluation.

Variant 1: Lower urinary tract symptoms. Suspicion of benign prostatic hyperplasia. Initial imaging.
I. MRI Pelvis

There is little relevant literature on the use of MRI in the initial evaluation of LUTS that are due to BPE. The role of MRI in evaluation for prostate cancer is discussed in the ACR Appropriateness Criteria® topic on "Prostate Cancer-Pretreatment Detection, Surveillance, and Staging" [33]. The high-contrast soft-tissue resolution on multiplanar T2 sequences allows for greatest delineation of zonal anatomy, which can be used to assess both total gland volume and zonal volume and can better evaluate the specific locations of enlargement and benign prostatic hyperplasia type to help guide treatment [34]. Prostate volume may be helpful to predict response to medical therapies and may help determine surgical technique [2]. Semiautomated volume analysis of 503 patients showed positive correlation of increased total and central gland volume with increasing age and serum prostate antigen level [35]. In 61 patients undergoing prostatectomy, there was correlation of measurements on preoperative MRI, including total prostate volume, transitional zone volume, and intravesical prostatic protrusion, with total IPSS. The transitional zone volume was the only predictor for total IPSS based on multiple regression analysis [36]. Detailed classification of the BPE pattern may be helpful for pre- and post-treatment assessment of patients undergoing prostatic artery embolization [37]. The differentiation of benign BPE changes from prostate adenocarcinoma in the transition zone remains challenging and an area of continued research; however, MRI has higher sensitivity for adenocarcinoma than other imaging modalities if malignancy is a consideration (see the separate ACR Appropriateness Criteria® topic on "Prostate Cancer-Pretreatment Detection, Surveillance, and Staging" [33]). It is also useful for guidance of tumor sampling on TRUS by implementing fusion of the MRI and real-time US imaging, beyond standard biopsy technique [38].

Summary of Recommendations

- **Variant 1**: US pelvis (bladder and prostate) transabdominal or US kidneys retroperitoneal may be appropriate for the initial imaging evaluation of lower urinary tract symptoms secondary to probable benign prostatic hyperplasia. These procedures are equivalent alternatives if the US kidneys retroperitoneal protocol includes bladder assessment (ie, only one procedure will be ordered to provide the clinical information to effectively manage the patient's care).

Supporting Documents

The evidence table, literature search, and appendix for this topic are available at https://acsearch.acr.org/list. The appendix includes the strength of evidence assessment and the final rating round tabulations for each recommendation.

For additional information on the Appropriateness Criteria methodology and other supporting documents, please go to the ACR website at https://www.acr.org/Clinical-Resources/Clinical-Tools-and-Reference/Appropriateness-Criteria.

Appropriateness Category Names and Definitions

Appropriateness Category Name	Appropriateness Rating	Appropriateness Category Definition
Usually Appropriate	7, 8, or 9	The imaging procedure or treatment is indicated in the specified clinical scenarios at a favorable risk-benefit ratio for patients.
May Be Appropriate	4, 5, or 6	The imaging procedure or treatment may be indicated in the specified clinical scenarios as an alternative to imaging procedures or treatments with a more favorable risk-benefit ratio, or the risk-benefit ratio for patients is equivocal.
May Be Appropriate (Disagreement)	5	The individual ratings are too dispersed from the panel median. The different label provides transparency regarding the panel's recommendation. "May be appropriate" is the rating category and a rating of 5 is assigned.
Usually Not Appropriate	1, 2, or 3	The imaging procedure or treatment is unlikely to be indicated in the specified clinical scenarios, or the risk-benefit ratio for patients is likely to be unfavorable.

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, because of both 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 with 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 (e.g., region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as “Varies.”

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