

**Recurrent Lower Urinary Tract Infections in Women
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
1. Griebeling TL. Urologic diseases in America project: trends in resource use for urinary tract infections in women. <i>J Urol.</i> 2005;173(4):1281-1287.	Review/Other-Dx	N/A	To examine recent trends in health care use for the diagnosis and treatment of UTI in women in the United States.	The lifetime risk for UTI in women is high (>50%). Between 1988 and 1994 the overall lifetime prevalence of UTI was estimated to be 53,067/100,000 women. Prescribing patterns demonstrated an increase in the trend toward using fluoroquinolones as first line therapy for UTI, which was associated with increased costs. Composite data revealed that overall expenditures for the treatment of UTIs in women in the United States, excluding spending on outpatient prescriptions, were approximately 2.47 billion dollars in 2000. Diagnosis and treatment of UTI in women is performed in various clinical settings. Inpatient hospitalization for UTI care has generally decreased in younger women but increased in elderly women. There has been a sharp increase in emergency room use by younger women, which may reflect disparities in access to health insurance or primary care providers. Most outpatient care of women with UTIs is performed in physician offices.	4
2. Foxman B. Epidemiology of urinary tract infections: incidence, morbidity, and economic costs. <i>Dis Mon.</i> 2003;49(2):53-70.	Review/Other-Dx	N/A	To determine the incidence, morbidity and economic costs of UTIs.	No results stated.	4
3. Wagenlehner FM, Weidner W, Naber KG. An update on uncomplicated urinary tract infections in women. <i>Curr Opin Urol.</i> 2009;19(4):368-374.	Review/Other-Dx	N/A	Review recent developments in epidemiology, pathogenesis, cause, diagnosis, treatment and prevention of uncomplicated UTI and recurrent UTI in women.	Remarkable increase of antibiotic resistance is also in uncomplicated UTI. Therefore, careful use of antibiotic substances in uncomplicated UTI is increasingly important.	4
4. Hickling DR, Nitti VW. Management of recurrent urinary tract infections in healthy adult women. <i>Rev Urol.</i> 2013;15(2):41-48.	Review/Other-Dx	N/A	To address available and promising management strategies for recurrent UTI in healthy adult women.	Recurrence after UTI is common in adult women. The majority of recurrences are believed to be reinfection from extraurinary sources such as the rectum or vagina. However, uropathogenic <i>Escherichia coli</i> are now known to invade urothelial cells and form quiescent intracellular bacterial reservoirs. Management of women with frequent symptomatic recurrent UTI can be particularly vexing for both patients and their treating physicians.	4

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5. Dason S, Dason JT, Kapoor A. Guidelines for the diagnosis and management of recurrent urinary tract infection in women. <i>Can Urol Assoc J.</i> 2011;5(5):316-322.	Review/Other-Dx	N/A	Guidelines on the diagnosis and management of recurrent UTI in women.	No results stated.	4
6. Sheffield JS, Cunningham FG. Urinary tract infection in women. <i>Obstet Gynecol.</i> 2005;106(5 Pt 1):1085-1092.	Review/Other-Dx	N/A	Review UTI in women.	Pregnancy is a common cause of obstructive uropathy, and severe renal infections are relatively common. Because they usually arise from preexisting covert bacteriuria, experts recommend screening and eradication of these silent infections as a routine prenatal practice.	4
7. Haylen BT, Lee J, Husselbee S, Law M, Zhou J. Recurrent urinary tract infections in women with symptoms of pelvic floor dysfunction. <i>Int Urogynecol J Pelvic Floor Dysfunct.</i> 2009;20(7):837-842.	Observational-Dx	1,140 women	Prospective urogynecological study assessing women and the prevalence of UTI.	The overall prevalence of recurrent UTI was 19%. Significant positive associations of recurrent UTI were: Nulliparity with a 3.7 x (up to 50 years) increase over the prevalence for parous women and 1.8 x (over 50 years), Women with an immediate postvoid residual over 30 mL, which is significant in women over 50 years. The early age decline (18–45 years) in the prevalence of recurrent UTI might be related to increasing parity. The later increase (over 55 years) was probably due to the increasing postvoid residual effect superimposed on the nulliparity effect.	4
8. Fenwick EA, Briggs AH, Hawke CI. Management of urinary tract infection in general practice: a cost-effectiveness analysis. <i>Br J Gen Pract.</i> 2000;50(457):635-639.	Review/Other-Dx	N/A	To identify the most appropriate patient management strategy given current information for nonpregnant, adult women presenting in general practice with symptoms of uncomplicated UTI.	Empiric treatment was found to be the least costly strategy available. It saved 2 days of symptoms per episode of UTI at a cost of 14 Pounds. The empiric-and-laboratory strategy involves an incremental cost-effectiveness ratio of 215 Pounds per symptom day averted per episode of UTI. The remaining patient management strategies are never optimal.	4

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9. van Haarst EP, van Anandel G, Heldeweg EA, Schlatmann TJ, van der Horst HJ. Evaluation of the diagnostic workup in young women referred for recurrent lower urinary tract infections. <i>Urology</i> . 2001;57(6):1068-1072.	Review/Other-Dx	100 patients	To evaluate the current practice of the diagnostic workup in The Netherlands and the clinical relevancy of the outcome of various diagnostic procedures in young women referred for recurrent lower UTIs.	The response rate to the questionnaires was 92%. The standard procedures were laboratory blood tests in 56%, cystoscopy in 69%, plain abdominal x-ray in 91%, and abdominal US in 59%. Only 18% of the urologists asked every patient to make a voided urine frequency volume chart. In our group of patients, the radiologic procedures revealed only one relevant abnormality. Cystoscopy confirmed cystitis in 22 patients, but never revealed relevant findings. None of these diagnostic procedures ever contributed to the diagnosis. The 24-hour urine output was <1.5 L in 43 patients, which was considered insufficient. The individual self-reports of fluid intake were unreliable.	4
10. Mermuys K, De Geeter F, Bacher K, et al. Digital tomosynthesis in the detection of urolithiasis: Diagnostic performance and dosimetry compared with digital radiography with MDCT as the reference standard. <i>AJR Am J Roentgenol</i> . 2010;195(1):161-167.	Observational-Dx	50 patients	Comparison of diagnostic performance of digital tomosynthesis and digital radiography for detection of renal calculi with NCCT used as the gold standard.	Digital tomosynthesis performed better than digital radiography for detection of renal calculi but not for detection of ureteral calculi. Mean effective radiation dose was 0.5 mSv for digital radiography, 0.85 mSv for tomosynthesis, 2.5 mSv for low-dose MDCT, and 12.6 mSv for high-dose MDCT.	1
11. Silverman SG, Leyendecker JR, Amis ES, Jr. What is the current role of CT urography and MR urography in the evaluation of the urinary tract? <i>Radiology</i> . 2009;250(2):309-323.	Review/Other-Dx	N/A	To review the current role of urography in the post-IVU era and provide expository summaries of CT urography and MRU, while addressing the rationale, techniques, effectiveness, indications, and vulnerabilities of these newer modalities that have now become primary in imaging the urinary tract.	CT urography is the current heir apparent to IVU, but because of its potential advantages, MRU may 1 day be the urographic test of choice particularly in young patients and patients who need repeated examinations.	4
12. Caoili EM, Cohan RH, Korobkin M, et al. Urinary tract abnormalities: initial experience with multi-detector row CT urography. <i>Radiology</i> . 2002;222(2):353-360.	Review/Other-Dx	65 patients	Comparative study on findings from CT urography, urinalysis, cystoscopy and/or ureteroscopy, and/or surgery to determine the usefulness of MDCT urography in detecting urinary tract abnormalities.	MDCT urography depicted many clinically diagnosed urinary tract abnormalities, including 15/16 uroepithelial malignancies, 5 congenital anomalies, 5 urinary tract calculi, and 18 calyceal and/or papillary, 30 renal pelvic and/or ureteral, and 25 bladder abnormalities. All abnormalities were detected on transverse images. MDCT urography is a useful method for detecting urinary tract abnormalities.	4

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13. Dillman JR, Caoili EM, Cohan RH. Multi-detector CT urography: a one-stop renal and urinary tract imaging modality. <i>Abdom Imaging</i> . 2007;32(4):519-529.	Review/Other-Dx	N/A	Review indications, specific techniques, image reconstruction/reformatting, detection of pathology, and pitfalls related to CT urography.	While the concept of CT urography has been utilized for nearly a decade, there is still no universally accepted technique.	4
14. Amar AD, Das S. Vesicoureteral reflux in women with primary bladder diverticulum. <i>J Urol</i> . 1985;134(1):33-35.	Review/Other-Dx	12 patients	To describe management of women with chronic UTI, vesicoureteral reflux and vesical diverticulum.	Ureteral reimplantation after excision of the bladder diverticulum and repair of the bladder wall was successful in eradicating reflux in 5 patients. Bladder diverticula may perpetuate reflux and their detection is important in planning treatment.	4
15. Portnoy O, Kitrey N, Eshed I, Apter S, Amitai MM, Golomb J. Correlation between MRI and double-balloon urethrography findings in the diagnosis of female periurethral lesions. <i>Eur J Radiol</i> . 2013;82(12):2183-2188.	Review/Other-Dx	17 patients	To evaluate the correlation of MRI findings with double-balloon urethrography in diagnosing female urethral diverticula and other periurethral lesions.	17 females (mean age 44 years, range 20–69) were included in the study. Diverticula were diagnosed by both modalities (9 cases), by neither (6 cases, 88% correlation) by MRI alone (1 case) and by double-balloon urethrography alone (1 case). Among diverticula, correlation of number, complexity, location and demonstration of connection to urethra was 89%, 67%, 67%, and 56%, respectively. Alternative diagnosis solely by MRI included vaginal wall cysts (3 cases), endometriosis (1 case) and ectopic ureter (1 case). No periurethral lesion was found by either modality in 2 cases. The correlation between MRI and double-balloon urethrography in diagnosing female periurethral lesions is very good for anatomical delineation of diverticula. MRI, which does not involve radiation, may also indicate alternative diagnoses that can contribute to proper patient management.	4

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16. Lawrentschuk N, Ooi J, Pang A, Naidu KS, Bolton DM. Cystoscopy in women with recurrent urinary tract infection. <i>Int J Urol</i> . 2006;13(4):350-353.	Observational-Dx	118 patients	Retrospective study to determine if women with recurrent UTI warrant cystoscopy to exclude an abnormality of the lower urinary tract. Also, to correlate imaging and risk factors with cystoscopic findings to determine their predictive value in finding pathology.	NPV of imaging was 99% and significant (P<0.01). Women with no risk factors for UTI had a NPV of 93% for normal cystoscopy (P>0.05). PPV was low for imaging and risk factors in predicting cystoscopy findings. In the study, 8% of women had significant abnormalities detected during cystoscopy with most over 50 years. Women without risk factors for recurrent UTI and with normal imaging could have a cystoscopy omitted. Younger women are less likely to have pathology and this must be factored into decisions to perform cystoscopy.	3
17. Craig WD, Wagner BJ, Travis MD. Pyelonephritis: radiologic-pathologic review. <i>Radiographics</i> . 2008;28(1):255-277; quiz 327-258.	Review/Other-Dx	N/A	Review imaging of pyelonephritis.	CT, when performed before, immediately after, and at delayed intervals from contrast material injection, is the preferred modality for evaluating acute bacterial pyelonephritis. CT is also preferred over conventional radiography and US for assessing emphysematous pyelonephritis.	4
18. Stojadinovic M, Micic S, Milovanovic D. Ultrasonographic and computed tomography findings in renal suppurations: performance indicators and risks for diagnostic failure. <i>Urol Int</i> . 2008;80(4):389-397.	Observational-Dx	49 women and 26 men	To identify and quantify clinical variables which predisposed incorrect diagnosis based on US and CT findings in the patients with suppurative renal infections.	Incorrect diagnosis based on US record only depended on the suppurative entity. In the presence of pyonephrosis only, the risk of incorrect diagnosis was reduced for 4 times [OR = 0.25], and in presence of emphysematous infections the risk increased 19.5 times (OR = 19.49). Perinephric abscesses which were not seen on US were those associated with pyonephrosis, abscesses <6 cm and gas-forming abscesses. The diagnosis of abscesses considerably varied in the cases of unilocular purulent collections compared to complex purulent collections (chi(2) = 8.177, P=0.004). Overall, the risk for incorrect diagnosis is about 14 times higher using US only (OR = 14.5), while CT reduced the risk of it for about 37 times (OR = 0.027).	3

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19. Majd M, Nussbaum Blask AR, Markle BM, et al. Acute pyelonephritis: comparison of diagnosis with 99mTc-DMSA, SPECT, spiral CT, MR imaging, and power Doppler US in an experimental pig model. <i>Radiology</i> . 2001;218(1):101-108.	Observational-Dx	35 piglets (70 kidneys)	To compare the sensitivity and specificity of technetium-99m dimercaptosuccinic acid SPECT, spiral CT, MRI, and power Doppler US for the detection and localization of APN by using histopathologic findings as the standard of reference.	Histopathologic examination revealed pyelonephritis in 102 zones in 38 kidneys. Sensitivity and specificity for detecting pyelonephritis in the kidneys were 92.1% and 93.8% for SPECT, 89.5% and 87.5% for MRI, 86.8% and 87.5% for CT, and 74.3% and 56.7% for US. Sensitivity and specificity for detecting pyelonephritis in the zones were 94.1% and 95.4% for SPECT, 91.2% and 92.6% for MRI, 88.2% and 93.5% for CT, and 56.6% and 81.4% for US. The pairwise comparison of these modalities showed no statistically significant difference among them except for US. Technetium-99m dimercaptosuccinic acid SPECT, spiral CT, and MRI appear to be equally sensitive and reliable for the detection of APN; power Doppler US is significantly less accurate.	2
20. Pollack HM, Banner MP, Martinez LO, Hodson CJ. Diagnostic considerations in urinary bladder wall calcification. <i>AJR Am J Roentgenol</i> . 1981;136(4):791-797.	Review/Other-Dx	19 patients	Review of the causes of bladder wall calcifications with emphasis on the clinical and radiographic features.	A correct diagnosis is possible by combining history, clinical examination, lab and radiograph; Cystoscopy with biopsy is almost necessary.	4
21. Browne RF, Zwirewich C, Torreggiani WC. Imaging of urinary tract infection in the adult. <i>Eur Radiol</i> . 2004;14 Suppl 3:E168-183.	Review/Other-Dx	N/A	Review imaging of UTI in adults.	CT is now accepted as a sensitive modality for diagnosis and follow-up of complicated renal tract infection. Contrast-enhanced CT allows different phases of excretion to be studied. Nuclear medicine has a limited role in the evaluation of UTI in adults. MRI has a limited but increasing role.	4
22. Stunell H, Buckley O, Feeney J, Geoghegan T, Browne RF, Torreggiani WC. Imaging of acute pyelonephritis in the adult. <i>Eur Radiol</i> . 2007;17(7):1820-1828.	Review/Other-Dx	N/A	Review on the role of CT and MRI techniques in the imaging of APN and its complications.	Imaging may not only aid in making the diagnosis of APN, but may help identify complications such as abscess formation.	4

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23. Lim SK, Ng FC. Acute pyelonephritis and renal abscesses in adults--correlating clinical parameters with radiological (computer tomography) severity. <i>Ann Acad Med Singapore</i> . 2011;40(9):407-413.	Observational-Dx	130 patients	To evaluate the correlations between clinical and biochemical parameters with radiological severity of CT diagnosed APN and renal abscesses, thereafter defining clinical predictors to identify patients with severe APN or renal abscesses.	130 patients were included in the study. Male gender, older age, presence of diabetes mellitus and unobstructing renal stones were significantly associated with severe APN or renal abscesses. Clinical and biochemical parameters that were associated with more severe disease include a higher leucocyte count and C-reactive proteins, left neutrophil shift, thrombocytosis or thrombocytopenia, low serum albumin, acute renal impairment and bacteremia. The percentage of patients had positive urine and blood cultures were 40.8% and 30.7% respectively. Of these patients, 97.9% had severe APN or renal abscesses on CT imaging had diabetes mellitus, hypotension, acute renal failure or leucocyte count of >20K.	4
24. Jin DH, Lamberton GR, Broome DR, et al. Effect of reduced radiation CT protocols on the detection of renal calculi. <i>Radiology</i> . 2010;255(1):100-107.	Observational-Dx	57 patients	To determine, using calculi placed in cadaver kidneys, the effect of reduced radiation dose (100, 60, and 30 mAs) on the sensitivity and specificity of MDCT for detection of renal calculi.	Decreasing tube charge from 100 mAs to 30 mAs did not significantly alter the detection of renal calculi.	1
25. Kavanagh D, Neary P, Dodd JD, Sheahan KM, O'Donoghue D, Hyland JM. Diagnosis and treatment of enterovesical fistulae. <i>Colorectal Dis</i> . 2005;7(3):286-291.	Observational-Dx	30 patients	To describe diagnosis and treatment of enterovesical fistulae in a retrospective study. CT, cystoscopy, endoscopy and barium enema were examined.	The commonest investigations (n, % positive) included CT (15, 80%), cystoscopy (16, 87.5%), endoscopy (11, 54.5%) and barium enema (8, 50%). There were 20 inflammatory and 10 neoplastic etiologies. Classical urinary symptoms were only evident in 50% of patients with confirmed fistulae. Authors recommend CT scanning as the optimum imaging modality before surgical intervention. Surgical treatment in a specialized unit remains the most effective treatment of enterovesical fistulae.	3
26. Yu NC, Raman SS, Patel M, Barbaric Z. Fistulas of the genitourinary tract: a radiologic review. <i>Radiographics</i> . 2004;24(5):1331-1352.	Review/Other-Dx	N/A	Review imaging of genitourinary tract fistula.	Imaging plays a crucial role in delineating the anatomy and extent of the fistulous tract. In addition to direct endoscopic techniques and traditional contrast-enhanced studies under fluoroscopy, cross-sectional modalities such as CT, MRI, and US have gained increasing support. The volumetric and multiplanar capabilities of MRI and modern CT systems, in particular, may maximize diagnostic yield.	4

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27. Fontanilla T, Minaya J, Cortes C, et al. Acute complicated pyelonephritis: contrast-enhanced ultrasound. <i>Abdom Imaging</i> . 2012;37(4):639-646.	Review/Other-Dx	48 patients	To describe in detail the contrast-enhanced US findings in APN, and to determine if abscess and focal pyelonephritis may be distinguished.	No results stated.	4
28. Granata A, Andrulli S, Fiorini F, et al. Diagnosis of acute pyelonephritis by contrast-enhanced ultrasonography in kidney transplant patients. <i>Nephrol Dial Transplant</i> . 2011;26(2):715-720.	Observational-Dx	56 patients	To evaluate the diagnostic value of contrast-enhanced US in APN compared with MRI as the reference test.	37/56 patients (66.1%) resulted positive for APN with the reference test, gadolinium-enhanced MRI. 35/37 patients showed positive results for APN with contrast-enhanced US, and 19 patients showed negative results for APN with both MRI and contrast-enhanced US: sensitivity 95% (CI 82–99), specificity 100% (CI 83–100), accuracy 96% (CI 88–99), PPV 100% (CI 90–100), NPV 90% (CI 71–97) and K statistics 0.92 (P<0.01).	2
29. Mitterberger M, Pinggera GM, Colleselli D, et al. Acute pyelonephritis: comparison of diagnosis with computed tomography and contrast-enhanced ultrasonography. <i>BJU Int</i> . 2008;101(3):341-344.	Observational-Dx	100 patients	To assess the value of contrast-enhanced US with the contrast pulse-sequence technique for detecting renal parenchymal changes in APN, compared with contrast-enhanced CT as the reference standard.	On contrast CT, 84 patients (84%) had renal parenchymal changes suggestive of APN; on contrast US, 82/84 (98%) showed renal parenchymal changes, and APN was correctly diagnosed. 76 patients (90%) had unilateral and 8 (10%) had bilateral APN, and in 2 (2%) with APN the diagnosis could not be confirmed by US/contrast pulse-sequence (false-negative). No false-positive findings were detected on US/contrast pulse-sequence, which had a sensitivity of 98%, a specificity of 100%, a PPV of 100%, and a NPV of 89%.	3
30. Martina MC, Campanino PP, Caraffo F, et al. Dynamic magnetic resonance imaging in acute pyelonephritis. <i>Radiol Med</i> . 2010;115(2):287-300.	Observational-Dx	442 consecutive renal MRI examinations (279 diagnostic and 163 follow-up) performed in 285 patients	Retrospective study to evaluate the role and clinical impact of dynamic MRI in the diagnosis and follow-up of APN.	MRI showed signal abnormalities suggestive of APN in 125/244 (51.2%) patients with native kidneys. Abscesses were present in 40/123 (32.5%) positive cases. During follow-up, complete normalization of MRI signs in 86/103 patients; 17/103 (16.5%) cases evolved into fibrosis and scarring. In 15/35 (42.8%) patients with transplanted kidney, MRI was positive for APN. Renal MRI is an effective tool for the diagnosis and follow-up of APN both in patients not at risk and those at higher risk, such as those with a transplanted kidney.	4

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31. Boyadzhyan L, Raman SS, Raz S. Role of static and dynamic MR imaging in surgical pelvic floor dysfunction. <i>Radiographics</i> . 2008;28(4):949-967.	Review/Other-Dx	N/A	To review the role of static and dynamic MRI in surgical pelvic floor dysfunction.	The recent development of fast MRI sequences allows noninvasive, radiation-free, rapid, high-resolution evaluation of the entire pelvis in 1 examination. The H line, M line, organ prolapse classification system, which is applied to dynamic MRI, allows consistent standardization and grading of various forms of pelvic floor dysfunction. In addition, the H line, M line, organ prolapse system clearly defines and differentiates between the 2 main components of pelvic floor dysfunction: pelvic floor relaxation and pelvic organ prolapse. In addition to serving as an objective diagnostic tool in patients with surgical pelvic floor dysfunction, MRI has tremendous potential to be used as a research tool in trying to understand the pathophysiology of these complex disorders.	4
32. Woodfield CA, Krishnamoorthy S, Hampton BS, Brody JM. Imaging pelvic floor disorders: trend toward comprehensive MRI. <i>AJR Am J Roentgenol</i> . 2010;194(6):1640-1649.	Review/Other-Dx	N/A	To review the relevant anatomy and sonographic, fluoroscopic, and MRI options for evaluating patients with pelvic floor disorders.	Disorders of the pelvic floor are a heterogeneous and complex group of problems. Imaging can help elucidate the presence and extent of pelvic floor abnormalities. MRI is particularly well suited for global pelvic floor assessment including pelvic organ prolapse, defecatory function, and pelvic floor support structure integrity.	4

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33. Foster RT, Amundsen CL, Webster GD. The utility of magnetic resonance imaging for diagnosis and surgical planning before transvaginal periurethral diverticulectomy in women. <i>Int Urogynecol J Pelvic Floor Dysfunct.</i> 2007;18(3):315-319.	Observational-Dx	27 women with urethral diverticulum	To report the value of MRI in the evaluation of urethral diverticulum in women.	The mean time from onset of symptoms to diagnosis of a urethral diverticulum was 47 months. 7 (26%) women had a history of 1 or more prior diverticulectomies, and 8 (30%) had prior incontinence or other urethral surgery. 21 (78%) had undergone a preoperative MRI, which detected the diverticulum in all cases. In 3 women, multiple other prior imaging studies had failed to identify the diverticulum despite clinical suspicion of its presence. MRI revealed an unsuspected intradiverticular carcinoma in 1 patient. 26 women were treated with periurethral diverticulectomy, and 1 patient was treated with cystourethrectomy. Average follow-up was 9 (range 1–60) months. No patients had significant intraoperative complications. One patient was diagnosed (by MRI) with a recurrent diverticulum. The use of preoperative MRI altered the management in 15% of patients. Furthermore, this study cohort had a long duration of complex symptoms with one-third having had prior urethral surgery. The use of MRI allows for accurate diagnosis and improved surgical planning.	3
34. Ravichandran S, Ahmed HU, Matanhelia SS, Dobson M. Is there a role for magnetic resonance imaging in diagnosing colovesical fistulas? <i>Urology.</i> 2008;72(4):832-837.	Review/Other-Dx	22 patients	To assess the role of MRI in the investigation of patients with probable colovesical fistulas.	MRI correctly identified the presence of a fistula and defined the underlying etiology in 18/19 patients. Colovesical fistula was correctly excluded in 1 of 19 patients. The remaining 3 patients were either unfit for surgery or refused.	4

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35. Tang YZ, Booth TC, Swallow D, et al. Imaging features of colovesical fistulae on MRI. <i>Br J Radiol.</i> 2012;85(1018):1371-1375.	Review/Other-Dx	40 cases	To quantify the MRI characteristics of these fistulae.	There were 40 cases of colovesical fistulae. On MRI, the fistula morphology consistently fell into 3 patterns. The most common pattern (71%) demonstrated an intervening abscess between the bowel wall and bladder wall. The second pattern (15%) had a visible track between the affected bowel and bladder. The third pattern (13%) was a complete loss of fat plane between the affected bladder and bowel wall. MRI correctly determined the underlying aetiology in 63% of cases.	4
36. Shokeir AA, El-Diasty T, Eassa W, et al. Diagnosis of ureteral obstruction in patients with compromised renal function: the role of noninvasive imaging modalities. <i>J Urol.</i> 2004;171(6 Pt 1):2303-2306.	Observational-Dx	149 patients (110 had bilateral obstruction and 39 had obstruction of a solitary kidney), 259 renal units	Prospective study to compare the role of NCCT, MRU, and combined KUB and US in the diagnosis of the cause of ureteral obstruction in patients with compromised renal function. The gold standard included retrograde or antegrade ureterogram, ureteroscopy and/or open surgery.	The definitive cause of ureteral obstruction was calculous in 146 and noncalculous in 113 renal units. The site of stone impaction was identified by NCCT in all 146 renal units (100% sensitivity), by MRU in 101 (69.2% sensitivity), and by combined KUB and US in 115 (78.7% sensitivity). Ureteral strictures were identified by NCCT in 18/65 cases (28%) and by MRU in 54/65 (83%). Overall of the 113 kidneys with noncalculous obstruction the cause could be identified by MRU in 101 (89% sensitivity), by NCCT in 45 (40% sensitivity), and by combined KUB and US in only 20 (18% sensitivity) with a difference of significant value in favor of MRU (P<0.001). In patients with renal impairment due to ureteral obstruction NCCT has superior diagnostic accuracy for detecting calculous causes of obstruction but MRU is superior for identifying noncalculous lesions.	3

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37. Regan F, Kuszyk B, Bohlman ME, Jackman S. Acute ureteric calculus obstruction: unenhanced spiral CT versus HASTE MR urography and abdominal radiograph. <i>Br J Radiol.</i> 2005;78(930):506-511.	Observational-Dx	64 patients	To compare the performance of unenhanced spiral CT to the combination of HASTE MRU and KUB in patients suspected of having acute calculus ureteric obstruction.	The presence of perirenal fluid, presence and level of ureteric obstruction and calculi were assessed on both techniques. 44/64 (69%) patients had acute calculus ureteric obstruction based on clinical, radiographic or surgical findings. MRU showed perirenal fluid in acute ureteric obstruction (77%) with a greater sensitivity than CT showed stranding (45%). The combination of fluid and ureteric dilation on MRU showed a sensitivity of 93% (CT 80%), specificity of 95% (CT 85%), and accuracy of 94% (CT 81%). There were 61 findings of either fluid or ureteric dilatation on MRU in 44 acutely obstructed kidneys compared with 37 similar findings on CT (P<0.005). Although there was excellent reproducibility (Kappa≥0.75) in the finding of perirenal fluid on MRU, there was only fair interobserver agreement (Kappa<0.4) regarding perirenal stranding on CT. MRU/KUB showed ureteric calculi in 21/29 (72%) of patients with calculi seen by CT. Overall, MRU/KUB revealed 2.4 abnormalities per acutely obstructed ureter compared with 1.8 abnormalities detected by CT.	3
38. Leyendecker JR, Barnes CE, Zagoria RJ. MR urography: techniques and clinical applications. <i>Radiographics.</i> 2008;28(1):23-46; discussion 46-27.	Review/Other-Dx	N/A	To review techniques and clinical applications of MRU.	MRU is clinically useful in the evaluation of suspected urinary tract obstruction, hematuria, and congenital anomalies, as well as surgically altered anatomy, and can be particularly beneficial in pediatric or pregnant patients or when ionizing radiation is to be avoided.	4

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39. Chang YL, Lin AT, Chen KK. Presentation of female urethral diverticulum is usually not typical. <i>Urol Int.</i> 2008;80(1):41-45.	Review/Other-Dx	14 patients	Retrospective study. A report on the authors' experience on the diversity of presenting symptoms and signs of female urethral diverticula.	Recurrent UTI, urinary incontinence, palpable suburethral mass, vaginal tenderness, and dysuria are the 5 major presenting symptoms and signs. The diagnostic rate of voiding cystourethrography during video-urodynamics, double-balloon urethrography and MRI were 10/10 (100%), 6/6 (100%) and 10/11 (90.9%) respectively. The presenting symptoms and signs of female urethral diverticula are often diverse and easily overlooked. High suspicion of this disorder, detailed history-taking and physical examination are essential for detecting urethral diverticulum in females.	4
40. Chou CP, Huang JS, Wu MT, et al. CT voiding urethrography and virtual urethroscopy: preliminary study with 16-MDCT. <i>AJR Am J Roentgenol.</i> 2005;184(6):1882-1888.	Review/Other-Dx	14 CT voiding urethrography exams on 13 men	To demonstrate CT voiding urethrography and CT virtual urethroscopy. CT voiding urethrography examinations were prospectively performed.	The full urethral structure was clearly shown by CT voiding urethrography and virtual urethroscopy in all patients. The results of CT voiding urethrography and conventional methods correlated closely with the urethral diseases being imaged.	4
41. Chou CP, Levenson RB, Elsayes KM, et al. Imaging of female urethral diverticulum: an update. <i>Radiographics.</i> 2008;28(7):1917-1930.	Review/Other-Dx	N/A	Review the anatomic and pathologic features of female urethral diverticulum. Also, discuss and illustrate various diagnostic methods for evaluating female urethral diverticulum.	Modern imaging techniques, including US, MRI, voiding CT urethrography, and virtual urethroscopy, can help precisely identify a female urethral diverticulum, locate its orifice, and differentiate it from other paraurethral pathologic conditions.	4

**Recurrent Lower Urinary Tract Infections in Women
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
42. Goldman SM, Fishman EK, Gatewood OM, Jones B, Siegelman SS. CT in the diagnosis of enterovesical fistulae. <i>AJR Am J Roentgenol.</i> 1985;144(6):1229-1233.	Review/Other-Dx	20 enterovesical fistulae	To report enterovesical fistulae documented by CT.	20 enterovesical fistulae identified by CT were caused by diverticulitis (9), carcinoma of the rectosigmoid (2), Crohn disease (3), gynecologic tumors (2), bladder cancer (1), cecal carcinoma (1), prostatic neoplasia (1), and appendiceal abscess (1). The CT findings included intravesical air (90%), passage of orally or rectally administered contrast medium into the bladder (20%), focal bladder-wall thickening (90%), thickening of adjacent bowel wall (85%), and an extraluminal mass that often contained air (75%). The fistulae secondary to diverticulitis, rectosigmoid neoplasms, carcinoma of the bladder, and uterine tumors involved the left and/or posterior aspects of the bladder. Those from Crohn disease of the terminal ileum or cecal and appendiceal lesions implicated the right lateral or anterior aspects of the bladder. CT proved to be an important new method in the diagnosis of enterovesical fistulae.	4
43. Najjar SF, Jamal MK, Savas JF, Miller TA. The spectrum of colovesical fistula and diagnostic paradigm. <i>Am J Surg.</i> 2004;188(5):617-621.	Review/Other-Dx	12 patients	To evaluate this condition over a 12-year period with special emphasis on its clinical presentation, etiologic factors involved, and modalities used to verify its diagnosis.	Underlying etiologies were diverticular disease (75%), colon cancer (16%), and bladder cancer (8%). Pneumaturia (77%) was the most common presentation, followed by urinary tract infections, dysuria and frequency (45%), fecaluria (36%), hematuria (22%), and orchitis (10%). The ability of various preoperative investigations to identify a colovesical fistula were: CT (90%), barium enema (20%), and cystography (11%), whereas cystoscopy, intravenous pyelogram, and colonoscopy were nondiagnostic. All patients underwent single- or multiple-staged repair of the fistula.	4

**Recurrent Lower Urinary Tract Infections in Women
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
44. Amis ES, Jr., Cronan JJ, Pfister RC, Yoder IC. Ultrasonic inaccuracies in diagnosing renal obstruction. <i>Urology</i> . 1982;19(1):101-105.	Review/Other-Dx	192 renal US examinations	To review the many reported sonographic causes of false positive and false negative diagnoses of renal obstruction and discuss some recent observations on the renal sinus.	Renal US is an excellent screening examination for suspected urinary tract obstruction. Its usefulness is based on the ability to detect hydronephrosis. However, it must be recognized that a significant number of conditions exist which can mimic or produce dilatation of the collecting system without urinary tract obstruction. Similarly, obstruction without hydronephrosis, although infrequent, exists. Situations causing either false positive or false negative renal sonograms are discussed. Renal sonography suggesting hydronephrosis should be followed with additional diagnostic studies to confirm or exclude obstruction. Similar persistence should be used when obstruction is strongly suggested clinically, and US fails to demonstrate hydronephrosis.	4
45. Denton T, Cochlin DL, Evans C. The value of ultrasound in previously undiagnosed renal failure. <i>Br J Radiol</i> . 1984;57(680):673-675.	Review/Other-Dx	56 patients (109 kidneys)	To assess the value of US in previously undiagnosed renal failure.	All hydronephroses were accurately detected on US. 80% were due to obstruction, but showed no features that distinguished them from other causes of hydronephrosis. A diagnostic pathway is suggested.	4
46. Kamholtz RG, Cronan JJ, Dorfman GS. Obstruction and the minimally dilated renal collecting system: US evaluation. <i>Radiology</i> . 1989;170(1 Pt 1):51-53.	Review/Other-Dx	370 patients	To assess the significance of the US demonstration of grade 1 hydronephrosis.	In 80 patients, there was a clinical suspicion of renal obstruction. Grade 1 hydronephrosis was observed in 33 of the 80 patients, and obstruction was confirmed in 17 of those 33 patients (51.5%). In 290 patients, US was performed for reasons other than a suspicion of renal obstruction. Grade 1 hydronephrosis was observed in 37 of the 290 patients. 3 of the 37 patients were excluded from further consideration due to lack of follow-up. Obstruction was confirmed in 2 of the remaining 34 patients (6%). It appears that grade 1 hydronephrosis is significant when the clinical question of renal obstruction is raised.	4

**Recurrent Lower Urinary Tract Infections in Women
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
47. Choe JH, Lee JY, Lee KS. Accuracy and precision of a new portable ultrasound scanner, the BME-150A, in residual urine volume measurement: a comparison with the BladderScan BVI 3000. <i>Int Urogynecol J Pelvic Floor Dysfunct.</i> 2007;18(6):641-644.	Observational-Dx	89 patients	To determine the relative accuracy of a new portable US unit, BME-150A, and the BladderScan BVI 3000, as assessed in comparison with the catheterized residual urine volume.	The US measurements were compared with the post-scan bladder volumes obtained by catheterization in the same patients. The USs were followed immediately (within 5 min) by in-and-out catheterizations while the patients were in a supine position. There were a total of 116 paired measurements made. The BME-150A and the BVI 3000 demonstrated a correlation with the residual volume of 0.92 and 0.94, and a mean difference from the true residual volume of 7.8 and 3.6 mL, respectively. Intraclass correlation coefficients for the accuracy of the 2 bladder scans were 0.90 for BME-150A and 0.95 for BVI 3000. The difference of accuracy between the 2 models was not significant ($P=0.2421$). There were 6 cases in which a follow-up evaluation of falsely elevated post-void residual urine volume measurements on the US studies resulted in comparatively low catheterized volumes, with a range of differences from 66 to 275.5 mL. These cases were diagnosed with an ovarian cyst, uterine myoma, or uterine adenomyosis on pelvic US. The accuracy of the BME-150A is comparable to that of the BVI 3000 in estimating the true residual urine volumes and is sufficient enough for us to recommend its use as an alternative to catheterization.	3

**Recurrent Lower Urinary Tract Infections in Women
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
48. Ray AA, Ghiculete D, Pace KT, Honey RJ. Limitations to ultrasound in the detection and measurement of urinary tract calculi. <i>Urology</i> . 2010;76(2):295-300.	Observational-Dx	60 patients	To evaluate differences in stone measurement using CT and US.	Compared with CT, US overestimated stone size, an effect that was more pronounced with smaller calculi. The mean stone measurement on CT was 7.4 +/- 4.4 mm and on US it was 9.2 +/- 4.5 mm ($P=.018$). For stones ≤ 5 mm, US measurements were a mean of 1.9 +/- 1.2 mm greater than CT ($P<.001$). US and CT measurements were discordant for 60% of stones ≤ 5 mm. Discordance was associated with US measurement of skin-to-stone distance ($P=.018$), but not body mass index ($P=.189$) or location within the urinary tract ($P=.161$). Review of the literature revealed that US has a pooled sensitivity and specificity of 45% and 94%, respectively, for the detection of ureteric calculi and 45% and 88%, respectively, for renal calculi.	3
49. Sheafor DH, Hertzberg BS, Freed KS, et al. Nonenhanced helical CT and US in the emergency evaluation of patients with renal colic: prospective comparison. <i>Radiology</i> . 2000;217(3):792-797.	Observational-Dx	45 patients	To compare nonenhanced helical CT with US for the depiction of urolithiasis.	Diagnoses included 23 ureteral calculi and 1 each of renal cell carcinoma, appendicitis, ureteropelvic junction obstruction, renal subcapsular hematoma, cholelithiasis, medullary calcinosis, and myelolipoma. CT depicted 22 of 23 ureteral calculi (sensitivity, 96%). US depicted 14 of 23 ureteral calculi (sensitivity, 61%). Differences in sensitivity were statistically significant ($P=.02$). Specificity for each technique was 100%. When modalities were compared for the detection of any clinically relevant abnormality (eg, unilateral hydronephrosis and/or urolithiasis in patients with an obstructing calculus), sensitivities of US and CT increased to 92% and 100%, respectively. One case of appendicitis was missed at US, whereas medullary calcinosis and myelolipoma were missed at CT.	2

**Recurrent Lower Urinary Tract Infections in Women
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
50. Viprakasit DP, Sawyer MD, Herrell SD, Miller NL. Limitations of ultrasonography in the evaluation of urolithiasis: a correlation with computed tomography. <i>J Endourol.</i> 2012;26(3):209-213.	Observational-Dx	72 patients	To determine the correlation of US compared with NCCT in detecting and determining size of stones.	There were 203 urinary calculi in 90 urinary tracts identified on NCCT imaging. The sensitivity, specificity, and accuracy of detecting specific stones on US were 40%, 84%, and 53%. Correlation between US and NCCT findings decreased with smaller stone size and ureteral location and increased with right-sided laterality. For identified stones, larger stone size discrepancies were noted in up to one-third of stones on US.	3

Evidence Table Key

Study Quality Category Definitions

- *Category 1* The study is well-designed and accounts for common biases.
- *Category 2* The study is moderately well-designed and accounts for most common biases.
- *Category 3* There are important study design limitations.
- *Category 4* The study is not useful as primary evidence. The article may not be a clinical study or the study design is invalid, or conclusions are based on expert consensus. For example:
 - a) the study does not meet the criteria for or is not a hypothesis-based clinical study (e.g., a book chapter or case report or case series description);
 - b) the study may synthesize and draw conclusions about several studies such as a literature review article or book chapter but is not primary evidence;
 - c) the study is an expert opinion or consensus document.

Dx = Diagnostic

Tx = Treatment

Abbreviations Key

APN = Acute pyelonephritis

CI = Confidence interval

CT = Computed tomography

IVU = Intravenous urography

KUB = Abdominal radiography

MDCT = Multidetector computed tomography

MRI = Magnetic resonance imaging

MRU = Magnetic resonance urography

NCCT = Noncontrast computed tomography

NPV = Negative predictive value

OR = Odds ratio

PPV = Positive predictive value

SPECT = Single-photon emission tomography

US = Ultrasound

UTI = Urinary tract infection