

Recurrent Urinary Tract Infections Due to Bacterial Persistence or Reinfection in Women—Does This Factor Impact Upper Tract Imaging Findings?



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Abbreviations and Acronyms

BMI = body mass index
CT = computerized tomography
IVP = excretory urography
RUTI = recurrent UTI
US = ultrasound
UTI = urinary tract infection

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For another article on a related topic see page 579.

Purpose: We compared the rates of upper tract imaging abnormalities of recurrent urinary tract infections due to bacterial persistence or reinfection.

Materials and Methods: Following institutional review board approval we reviewed a prospectively maintained database of women with documented recurrent urinary tract infections (3 or more per year) and trigonitis. We searched for demographic data, urine culture findings and findings on radiology interpreted upper tract imaging, including renal ultrasound, computerized tomography or excretory urogram. Patients with irretrievable images, absent or incomplete urine culture results for review, no imaging performed, an obvious source of recurrent urinary tract infections or a history of pyelonephritis were excluded from analysis.

Results: Of 289 women from 2006 to 2014 with symptomatic recurrent urinary tract infections 116 met study inclusion criteria. Mean \pm SD age was 65.0 ± 14.4 years. Of the women 95% were white and 81% were postmenopausal. Almost a third were sexually active and none had prolapse stage 2 or greater. Of the 116 women 48 (41%) had persistent and 68 (59%) had reinfection recurrent urinary tract infection. Imaging included ultrasound in 52 patients, computerized tomography in 26, ultrasound and computerized tomography in 31, and excretory urogram with ultrasound/computerized tomography in 7. Of the total of 58 imaging findings in 55 women 57 (98%) were noncontributory. One case (0.9%) of mild hydronephrosis was noted in the persistent recurrent urinary tract infection group but it was not related to any clinical parameters. *Escherichia coli* was the dominant bacteria in 71% of persistent and 47% of reinfection recurrent urinary tract infections in the most recently reported urine culture.

Conclusions: This study reaffirms that upper tract imaging is not indicated for bacterial reinfection, recurrent urinary tract infections. However, the same conclusion can be extended to recurrent urinary tract infections secondary to bacterial persistence, thus, questioning the routine practice of upper tract studies in white postmenopausal women with recurrent urinary tract infections and trigonitis.

Key Words: urinary tract infections, recurrence, female, diagnostic imaging, *Escherichia coli*

TRADITIONALLY the first step in the management of RUTIs is to determine whether the etiology of the infection is bacterial persistence (same strain) or reinfection (different strain), which greatly influences the urological workup of the patient. As stated in *Campbell-Walsh Urology*, 11th edition, bacterial persistence refers to RUTI caused by the “reemergence of bacteria from a site within the urinary tract (same bacteria)” and “infections that occur at close intervals” whereas bacterial reinfection is caused by “new infections from bacteria outside the urinary tract” occurring at “varying and sometimes long intervals.”¹ “Although adult patients with bacterial persistence are relatively uncommon, their identification is important because they represent the only surgically curable cause of recurrent UTIs. A systematic radiological and endoscopic evaluation of the urinary tract is mandatory.”¹

Radiological evaluation includes CT, cystoscopy, kidney and bladder US, and retrograde urography.¹ Recommended tests include US of the genitourinary tract, and CT, IVP and cystoscopy for more detailed assessment.² In contrast, when reinfection is the cause of RUTI, radiological evaluation of the upper tracts is not indicated.^{2,3} Important correctable upper tract findings include “infection stones, unilateral infected atrophic kidneys, ureteral duplication, ectopic ureter, foreign body, unilateral medullary sponge kidney, infected communicating cysts of renal calyces and papillary necrosis.”¹

As part of a value improvement project we reviewed upper tract imaging findings in a large cohort of women with RUTIs due to bacterial persistence or reinfection. We sought to determine how often correctable upper tract pathology was discovered and what predisposing factors were present, if any.

METHODS

This retrospective study used an institutional review board approved, prospectively maintained database tracking the outcome of women with symptomatic RUTIs. Women with RUTIs (3 or more uncomplicated UTIs in 12 months documented on urine culture with a midstream urine bacterial count of at least 1×10^5 cfu/l for each culture while the patient was symptomatic)⁴ and trigonitis findings on office cystoscopy were included in this database.⁵ Excluded were women with no upper tract evaluation, an upper tract imaging report but no images available for review and/or no urine culture results available for review from the referral source. Also excluded were those with a known etiology of RUTIs (complicated RUTIs) such as women who performed clean intermittent catheterization and those on an indwelling catheter or with a history of pyelonephritis, greater than stage 2 anterior compartment prolapse or

neurogenic bladder.⁶ Children and pregnant women were excluded from analysis.

Patients with RUTI underwent extensive evaluation, including history, physical examination, urine culture, cystoscopy and 1 or more upper tract studies. Collected demographic data included race, BMI, gravidity, parity, prior urine culture results of infecting strains to distinguish persistence vs reinfection, diabetic status, immunosuppression status (corticosteroids, immunosuppressant medications or chemotherapy), menopausal status, sexual activity, degree of cystocele, history of pyelonephritis and history of kidney stones. Data were acquired through electronic medical records (Epic, Verona, Wisconsin) by a reviewer not involved with patient care. Imaging studies in the electronic medical records were from imaging performed at our institution. When imaging had been performed elsewhere, images were fully loaded into the electronic medical records and, therefore, were available for review.

All findings during office flexible cystoscopy were documented with photographs that were recoverable for review in the electronic medical records. All women in this cohort had trigonitis, defined as chronic mucosal inflammation of the trigone and not pseudomembranous trigonitis or squamous metaplasia of the trigone (see figure). Trigonitis was diagnosed by the same experienced urologist and/or by physician assistants trained in female pelvic medicine and reconstructive surgery.^{7,8}

Upper tract imaging was obtained with renal US, CT or IVP. In regard to key radiological findings PubMed® was queried for the search terms “urinary tract infections” and “classification or pathology or radiography or ultrasonography.” The search yielded 1,013 results from 1980 to 2015. Articles not in English or about acute UTIs, and those related to men, children or pregnant women were excluded from analysis. Relevant textbooks and cited reports were also reviewed.

Based on this literature review a list of key radiological findings reported with RUTIs was prepared, including hydronephrosis, ureteral duplication, renal lesions (tumors, cysts, diverticula and lesions that could not be characterized), kidney stones, pyelonephritis and perinephritic inflammation. Each imaging study with an abnormal finding was reviewed to confirm the official radiology report. Bacterial persistence and reinfection were analyzed based on bacterial strains and the minimum interval between 2 positive urine cultures.

Descriptive statistics were calculated using the mean \pm SD for continuous measures, and the frequency and percent for categorical measures. The Fisher exact test was used to test for associations between kidney stone history and kidney stone findings. All analyses were performed with SAS®, version 9.4.

RESULTS

From 2006 to 2014, 289 women with RUTI were prospectively entered into a database and selected for this upper tract evaluation study. A total of 173 women met our study exclusion criteria, including 8 with neurogenic bladder, 5 on clean intermittent

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