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Recurrent Urinary Tract Infections in Women: What Is the Evidence for Investigating with Flexible Cystoscopy, Imaging and Urodynamics?

Keywords

Urinary tract infection · Recurrent urinary tract infection · Systematic review · Flexible cystoscopy · Cystoscopy · Imaging · Ultrasound · Computer tomography · Uroflowmetry · Urodynamic study

Abstract

Background/Aims/Objectives: Women with recurrent urinary tract infections (UTIs) are commonly referred to urology outpatient clinics. However, there is no clear consensus in existing guidelines as to if, or how, these should be investigated. The primary outcome was to evaluate all available literature to determine the percentage of abnormal findings in non-pregnant women with recurrent simple UTIs. Secondary outcomes were to determine the percentage that were serious, consequential or incidental findings. **Methods:** A full literature search was performed of the following databases: MEDLINE; Pubmed; Cochrane Central Register of Controlled Trials-CENTRAL; and ClinicalTrials.gov. Two assessors reviewed the articles independently. Any discrepancy was

discussed and an agreement reached. **Results:** The literature search yielded 662 titles; 652 were excluded on initial review. A further 13 studies were gathered from references of yielded papers. After full review, 12 were included for analysis. These showed that <1.5% of women investigated for recurrent simple UTIs with imaging or flexible cystoscopy had life-threatening pathology, but up to 67% had abnormal urodynamics. **Conclusions:** Women presenting with simple recurrent UTIs should have a flow rate and post-void residual measured. Cystoscopy is not warranted and imaging is unlikely to be of value in the absence of symptoms of upper tract disease or gynaecological problems.

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Introduction

Recurrent urinary tract infections (UTIs) are defined as “a frequency of at least 3 UTIs/year or 2 UTIs in the last 6 months” [1]. It is a common condition in women under 65 with an incidence of 1 in 1,000 [2]. These women are

commonly referred to urology clinics for further investigation; however, current practice on how these patients are investigated varies greatly among urologists worldwide.

The European Association of Urology guidelines state that recurrent UTIs in women should not be investigated routinely unless they are “atypical cases” but are based on evidence from a single study [1]. In comparison, the Canadian Urological Association has a guideline on recurrent UTI in women with a clear list of risk factors on those who need further investigation with both flexible cystoscopy and imaging. It suggests that the best form of imaging is CT with a pre-contrast and contrast phase but that an ultrasound plus or minus an abdominal X-ray can be used in those in whom radiation exposure is a concern. This is based on a mix of evidence from both the early 1980s and some more modern papers [3]. In the United Kingdom, neither the Scottish Intercollegiate Guidelines Network [4] nor the National Institute for Health and Care Excellence [5] has guidelines on if or how these patients should be investigated.

The American College of Radiology has also written appropriateness criteria for investigations for recurrent UTI. They suggest that imaging is usually not appropriate in uncomplicated recurrent UTIs. However, in patients with suspected bladder or urethral diverticulum, fistulas or risk factors similar to those mentioned in the Canadian Urological Association Guidelines, CT abdomen and pelvis with and without contrast is usually appropriate and MRI pelvis with and without contrast may be appropriate [6].

To this end, given the variations in practice and lack of up-to-date evidence, we aimed to conduct a literature search to evaluate the evidence for investigation of recurrent UTIs in women with cystoscopy, imaging and urodynamics.

Methods

Evidence Acquisition

Relevant trials were obtained from the following databases: MEDLINE, Pubmed, Cochrane Central Register of Controlled Trials – CENTRAL, and ClinicalTrials.gov.

The following terms were used: UTIs, urinary tract infections, recurrent UTIs, recurrent urinary tract infections, recurrent urinary tract infections in women. MeSH Term used: ((((((UTI[Title]) OR UTIs[Title]) OR urinary tract infection*[Title]) OR cystitis[Title])) AND (((recur*[Title]) OR recurrent[Title]) OR frequent[Title])).

The search included all study types but was restricted to those published in English in the last 30 years (date range

from 1988/06/11 to 2018/06/11). The references of all relevant studies were examined to find older studies of significance for inclusion.

Papers were considered for inclusion based on their title or abstract if they contained data on investigations performed for recurrent UTIs in non-pregnant women with no known urological history of upper tract disease. Data on known stones, haematuria, or risk factors for cancer was excluded. Studies were included if data containing the above could be extracted from the paper and the methodology was reliable. One specific definition of recurrent UTI or the requirement for prior microbiological testing could not be used as a criterion for study inclusion as they varied widely between papers.

Two assessors (N.S. and O.M.A) reviewed the articles independently for inclusion. Any discrepancy was discussed and an agreement reached.

Evidence Evaluation

Studies were assessed and given a level of evidence as per the Oxford Centre for Evidence-based Medicine recommendations [7].

Data Extraction

The primary outcome was to determine the percentage of abnormal findings for investigations performed primarily to investigate non-pregnant women with recurrent simple UTIs. The outcomes were categorised by cystoscopy, urodynamics and imaging, which was further subdivided into ultrasound (US) and intravenous urogram (IVU).

Secondary outcomes were to determine the percentage of abnormalities that were serious (requiring urgent intervention); consequential (requiring surveillance or elective intervention); or incidental findings. These outcomes were also classified by age <50 years where possible.

Results

Literature Search

The literature search yielded 662 titles of which 652 were excluded following examination of title or abstract, as they did not report on investigating recurrent UTIs in women. A further 13 studies were gathered from the references of the yielded papers, even if they were over 30 years old as they were deemed significant, given the citations (Fig. 1).

Characteristics of Studies

The characteristics of included studies and data extraction are depicted in Table 1. The characteristics of excluded studies: 11 studies were excluded after the review of the full manuscript. Data was not extractable in 2 studies [20, 21]. One study was focusing at the incidence of recurrent UTIs and did not report on investigation findings [2]. Seven studies did not provide a breakdown in their data to dif-

ferentiate: recurrent UTI patients from septic inpatients [22], haematuria [23–25] or gender [26–28]. The last study was a review [29].

Urodynamics

Two reliable papers were identified for the use of urodynamics in investigating recurrent UTIs. Numbers of urodynamic abnormalities could be extracted from one paper [9]. The only comparable data that could be extracted from both papers was post-void residual and flow rate (Table 2). Post-void residual is described as present or absent as this is as much detail as Hijazi and Leitsmann [9] reports.

Cystoscopy

Seven studies were identified from which data on women who had cystoscopy purely for recurrent UTIs could be extracted (Table 3). Of the 151 abnormal findings, only 19 (2.89%) were of clinical importance (Table 4).

Imaging

Eight papers reliably reported imaging findings for women with recurrent UTIs, some for more than one imaging modality. Six papers reported IVU findings, 2 reported abdominal X-ray findings and 2 reported ultrasound (Table 5). The abnormalities are reported in Table 6.

Discussion

Summary of Main Findings

This is the first systematic review that focused on the evidence for investigating women with recurrent UTIs. We aimed to evaluate the role of flexible cystoscopy as a primary investigation in this cohort of patients. We found that up to 50% of urodynamics were abnormal and that 2.89% of cystoscopies and 5.6% of imaging studies had findings requiring further action.

Given how frequently women with recurrent UTIs are referred to urology, there is very limited literature on how they should be investigated. At present, there are only 12 published studies that explore the value of investigations for recurrent UTI in women without other risk factors [8–19] and only 3 that have been published in the last 10 years [8–10]. Of the studies that have been published, the majority are small with the largest to date involving just 163 patients [8]. Furthermore, the studies vary in their conclusions (Table 7), making it difficult to know what is best practice.

Fig. 1. Flowchart for the article selection process.

Urodynamics

Urodynamics is the investigative modality with the least literature published on its worth for women with recurrent UTI with only 2 papers with any extractable data (9 + 13) and 2 further papers with some research but no extractable data (20 + 21). Hijazi and Leitsmann [9] suggest that 67% of women with recurrent UTIs have urodynamic proven voiding dysfunction but do not indicate whether the primary reason for referral was recurrent UTI or whether it was an incidental finding in women referred for investigation of lower urinary tract symptoms. Only data for flow and residuals could be compared between the 2 papers (Table 2). Comparison suggests that a significant proportion of women with recurrent UTI have impaired urine flow (50%) and measurable post void residual (35%). However, in the study by Raz et al. [13], only 6 out of 149 (4%) had a residual >100 mL and Hijazi and Leitsmann [9] do not quantify what is meant by a positive “post-void residual.”

Given the high proportion of abnormal urodynamic findings with these small numbers of women with recurrent UTI, further research is warranted. However, evidence suggests that all women presenting with recurrent UTIs should have a flow rate and post-void residual volume measured. Given the significant number of urodynamic abnormalities reported, lower urinary tract symptoms in patients who do not have a UTI should also be investigated and managed appropriately.

Table 1. Characteristics and extractable data of included studies

Paper	Centre	Study type	Level of evidence	Definition of rUTI	Number of patients, <i>n</i>	Inclusion criteria	Exclusion criteria	Uro-dynamics	Cysto-scopy	Imaging
Pagano et al. [8], 2017	Department of Urology, Columbia University Medical Center, New York, USA	Retro-spective cohort	2b	≥3 UTIs per year/2 UTIs per 6 months	163	Women presenting between 01/2010+ 07/2014 with recurrent UTI + prior urologic history, persistent infection or failure of prophylactic measures	Congenital abnormalities, haematuria, known urological cancer, neurogenic bladder	163/163 patients included	163/163 patients included	USS: 111/163 patients CT: 22/163 patients
Hijazi and Leitsmann [9], 2016	Department of Urology, University Medical Center Goettingen, Germany	Pro-spective cohort	2b	≥3 UTIs in previous year	54	Women undergoing video urodynamics between 07/2013+02/2015 with ≥3 UTIs in previous year	Anatomic urinary tract abnormalities, immunosuppressive therapy use, pregnancy, nonbacterial urinary tract infection	54/54 patients included		
Howles et al. [10], 2012	Outpatient, Oxford Department of Urology, UK	Retro-spective cohort	2b	Not given	1,809 (15 of which were women with recurrent UTI)	Referred for flexible cystoscopy for recurrent UTI, age >16	Records not available	15/1,809 patients included (women with only recurrent UTIs as indication)		
Lawrentschuk et al. [11], 2006	Department of Urology in Austin Health, a Teaching Hospital in Melbourne, Australia	Retro-spective cohort	2b	>3 UTIs per year	118	All women having cystoscopy for recurrent UTI over the 10-year period. Results categorised by presence of risk factors (haematuria/pelvic malignancy etc.)	Spinal patients, patients with in-dwelling urinary catheters, patients with urinary tract reconstruction	74/118 patients without "risk factors" included	0/118 patients included-no record of presence or absence of risk factors	
Van Haast et al. [12], 2001	Department of Urology, Sint Lucas Andreas Ziekenhuis, Netherlands	Pro-spective cohort	2b	Uses "Uncomplicated UTI" – "those... in otherwise healthy women who have... lower tract symptoms of short duration"	100	100 consecutive women aged 18–40 referred by general practitioner with culture/dipstick evidence of recurrent lower UTI	Incomplete investigations	100/100 patients included	AXR: 100/100 patients USS: 90/100 patients IVU 16/100 patients	
Raz et al. [13], 2000	Infectious Diseases Outpatient Clinic, Haemek Medical Center, Haifa, Israel	Pro-spective case-control	3b	≥3 UTIs per year/2 UTIs per 6 months	202 (149 cases, 53 controls)	Cases: post-menopausal women with culture proven recurrent UTI as defined Controls: post-menopausal women attending gastroenterology/metabolic clinics	Indwelling catheter, immobile, significant co-morbidities	149/202 patients included (controls excluded)		

Table 1. (continued)

Paper	Centre	Study type	Level of evidence	Definition of rUTI	Number of patients, <i>n</i>	Inclusion criteria	Exclusion criteria	Uro-dynamics	Cysto-scropy	Imaging
Nickel et al. [14], 1991	Outpatient clinic, Queen's University, Kingston, Ontario, Canada	Retro-spective cohort	2b	>3 UTIs per year	186	Women age >16 referred over 5 year period with >3 UTIs in 12 months	Nil but results divided by presence + absence of risk factors (haematuria, pyelonephritis etc.)	48/186 patients without risk factors included	48/186 patients without risk factors included	48/186 included (although unclear if had USS, IVU or both)
McNicholas et al. [15], 1991	Department of Radiology, St. Vincent's Hospital, Dublin, Ireland	Cohort	2b	Not given	94	Consecutive pre-menopausal women referred for recurrent "uncomplicated" UTI	Diabetes, frank haematuria, impaired renal function			IVU: 94/94 patients USS: 94/94 patients KUB: 94/94 patients
Mogensen and Hansen [16], 1983	Outpatient Clinic, Herlev Hospital, Copenhagen, Denmark	Pro-spective cohort	2b	≥3 UTIs per year	93	All women referred over 3 year period with recurrent UTI	Painless haematuria, history of calculi, major comorbidities, neurogenic bladders	93/93 patients included		IVU: 93/93 patients included
De Lange and Jones [17], 1983	Radiology Department, University Hospital, Leiden, Netherlands	Retro-spective cohort	2b	Not given	201	All women aged 15–30 for imaging with "recurrent UTI" written on request form referred over 4 years period	Nil but results divided by presence/absence of risk factors (flank pain/haematuria/previous renal colic, etc.)			IVU: 121/201 patients without risk factors included
Fairchild et al. [18], 1982	Department of Urology, University of Washington, USA	Cohort	2b	≥1 positive urine culture	78	Women presenting with "recurrent UTI" and ≥1 positive urine culture	Nil but results divided by presence of risk factors (neurogenic bladder/raised creatinine etc.)			IVU: 47/78 patients without risk factors included
Engel et al. [19], 1980	Department of Urology, Northwestern University Medical School, Chicago, USA	Retro-spective cohort	2b	≥3 UTIs per year/2 UTIs per 6 months	153	Women seen between 1967 and 1977 with documented evidence of recurrent UTI	Neurogenic bladder, significant comorbidities, renal calculi, painless haematuria, obstructive symptoms, pyelonephritis	153/153 patients included		IVU: 153/153 patients included

Table 2. Urodynamic findings in women with recurrent UTIs

Study	Flow		Post-void residual		Detrusor abnormality		Overactive bladder		Stress incontinence	
	≥15 mL/s	<15 mL/s	no	yes	no	yes	no	yes	no	yes
Hijazi and Leitsmann [9]	34	20	25	29	27	27	39	15	33	21
Raz et al. [13]	67	82	108	41						
Totals	101	102	133	70	27	27	39	15	33	21
Abnormal, %		50		35		50		28		39

Table 3. Percentage of abnormal cystoscopies in women with recurrent UTIs

Study	All ages		Age <50	
	normal	abnormal	normal	abnormal
Pagano et al. [8]	154	9		
Howles et al. [10]	14	1		
Lawrentschuk et al. [11]	69	5		
Van Haarst et al. [12]	88	22	88	22
Nickel et al. [14]	48	0		
Mogensen and Hansen [16]	74	19		
Engel et al. [19]	58	95		
Totals	505	151	88	22
Abnormal, %		23		20

Table 4. Abnormal cystoscopic findings in women with recurrent UTIs

Serious		Consequential		Incidental	
Carcinoma	1	Stricture	15	Inflammation	115
		Colovesical fistula	1	Variant ureteric orifices	6
		Suture material	1	Bladder diverticulum	3
		Ureterocele	1	Debris	1
Totals	1		18		125
Total cystoscopies, %	0.15		2.74		19

Cystoscopy

Although this review has shown that 23% of cystoscopies performed for recurrent UTI are abnormal, the majority of abnormalities are incidental with inflammation being the main “abnormality” found. Only 1 out of 656 cystoscopies (0.15%) revealed a potentially life-threatening finding (carcinoma). There were few other findings of consequence 18 out of 656 (2.74%). Of these findings, 17 out of 18 could be identified for further investigation by clinical history (colovesical fistula and suture material),

(ureterocele), or flow studies (stricture). Therefore, given current evidence, there is no evidence for performing cystoscopy for recurrent UTI.

Imaging

The majority of studies for imaging women with rUTI investigate the use of IVU [12, 14–19], which has become historical practice. There are only 2 that report their results specifically for ultrasound and none that report specifically on CT. Regardless, of all 785 imaging studies, only 10 (1.3%)

Table 5. Percentage of abnormal imaging in women with recurrent UTIs (N.B. some patients had more than one modality of imaging)

Study	IVU		AXR		USS		All Imaging	
	normal	abnormal	normal	abnormal	normal	abnormal	normal	abnormal
Pagano et al. [8]							115	18
Van Haarst et al. [12]	14	2	100	0	85	5	94	6
Nickel et al. [14]							48	0
McNicholas et al. [15]	85	9	92	2	79	15	75	15
Mogensen and Hansen [16]	84	9					84	9
De Lange and Jones [17]	118	3					118	3
Fairchild et al. [18]	44	3					44	3
Engel et al. [19]	136	17					136	17
Totals	481	43	192	2	164	20	714	71
Abnormal, %		8.2		0.4		10.9		10.5

Table 6. Abnormal findings by severity and by imaging modality detection

Serious abnormalities	n detected/n imaged				Consequential abnormalities	n detected/n imaged				Incidental abnormalities	n detected/n imaged			
	n	IVU	AXR	USS		n	IVU	AXR	USS		n	IVU	AXR	USS
Intrarenal abscess	1	0/1	0/1	1/1	Mistaken hydro-nephrosis	1			1/1	Cyst	6	2/2	0/1	1/1
Ovarian mass	2	0/2	0/2	2/2	Staghorn	1	1/1	1/1	1/1	Hypoplastic kidney	3	2/2	0/1	1/1
Ectopic pregnancy	1	0/1	0/1	1/1	PUJ obstruction	3	3/3	0/1	1/1	Pyelonephric scarring	2	2/2	0/1	2/2
8/12 intra-uterine pregnancy	1	0/1	0/1	1/1	Intra-renal calculi	14	3/3	1/1	1/1	Large fibroid	1	0/1	0/1	1/1
Ureteric calculus	1	1/1		0/1	Post-partum dilation	2	2/2	0/2	2/2	Absent kidney	1	1/1	0/1	1/1
Hydro-nephrosis	2	1/1			Focal nephrocalcinosis	2	2/2			Duplex system	9	9/9		2/2
Renal mass	2				Calyx diverticulum with calculus	1	1/1			Calyx diverticulum	4	4/4		
					Spina bifida occulta	3	3/3			Horseshoe kidney	1	1/1		
					Bladder diverticulum	2				Ren mobilis	2	2/2		
					Ureterocele	1				Bladder debris	1			
										"Minor abnormalities"*	3			
Totals	10	2/7	0/5	5/6		30	15/15	2/5	6/6		33	23/24	0/5	8/8
Total Imaging, %	1.4					4.2					4.6			

* Renal tubular ectasia/partial duplex system/calyx diverticulum/deformed calyx/bladder trabeculation.

N.B. one abnormality not described in Van Haarst et al. [12] and three patients had more than one abnormality in Pagano et al. [8].

showed "serious" findings that would require urgent management and a further 30 (3.8%) that would require further follow-up. Of the "serious" findings, most were detected on ultrasound but missed on both IVU and abdominal X-ray. Four of the 10 "serious" findings were of gynaecological origin with 2 being pregnancies, which could have been easily diagnosed by history and urine beta-human chorionic gonadotrophin (hCG), rather than imaging. As there are such few studies on modern imaging techniques for imaging women with recurrent UTIs, further research on the subject is warranted. However, given the small number of

abnormalities in this study, it is likely that imaging should be necessary only if consequential abnormalities are suspected from history and basic investigations.

Strengths and Limitations of Review

This is the first systematic review and cumulative meta-analysis looking at this cohort of patients. The results were significant in that <1.5% of women investigated for recurrent simple UTIs with imaging or flexible cystoscopy had life-threatening pathology. However, the review is limited by the fact that over the course of more

Table 7. Conclusions of included papers

Paper	Conclusion
Pagano et al. [8], 2016	Patients should have imaging and not cystoscopy but further studies required
Hijazi and Leitsmann [9], 2016	Video urodynamics of use in recurrent UTI
Howles et al. [10], 2012	No conclusion for women with recurrent UTI subgroup
Lawrentschuk et al. [11], 2006	All women should have imaging; cystoscopy should be reserved for those with risk factors
Van Haarst et al. [12], 2001	Imaging and cystoscopy of no benefit in recurrent UTI
Raz et al. [13], 2000	No comment on the value of investigations in rUTI, just possible risk factors
Nickel et al. [14], 1991	Cystoscopy and imaging only necessary in patients with haematuria, pyelonephritis or atypical presentation. Otherwise not required.
McNicholas et al. [15], 1991	Should have USS abdomen and pelvis and plain abdominal X-ray
Mogensen and Hansen [16], 1983	Should have flow studies and cystoscopy but IVU does not often add much
De Lange and Jones [17], 1983	Imaging (IVU) only necessary in patients with risk factors
Fairchild et al. [18], 1982	Imaging (IVU) only necessary in patients with risk factors
Engel et al. [19], 1980	Imaging (IVU) only necessary in patients with risk factors

than 30 years, only a handful of papers were published on the topic despite it being one of the most common ailments in investigative urology. Nonetheless, the results of our analysis are mirrored by each of the included studies, giving strength to the findings.

Implications for Practice

Further research is warranted on the use of urodynamics and modern imaging techniques for investigating recurrent UTIs.

More centres should look at their results to strengthen the evidence on how to investigate women with recurrent UTIs.

Conclusion

Women presenting with simple recurrent UTIs should have a flow rate and post-void residual measured. Cystoscopy is not warranted in these patients and imaging is unlikely to be of value in the absence of symptoms of upper tract disease or gynaecological problems.

Disclosure Statement

The authors declare that they have no conflicts of interest to disclose.

References

- 1 Bonkat G, Pickard R, Bartoletti R, Cai T, Bruyère F, Geerlings SE, Köves B, Wagenlehner F: Guidelines Associates: Pilatz A, Pradere B, Veeratterapillay R: EAU Guidelines on Urological Infections. 2018. <http://uroweb.org/guideline/urological-infections/> (accessed May 10, 2018).
- 2 Suskind AM, Saigal CS, Hanley JM, Lai J, Setodji CM, Clemens JQ: Incidence and management of uncomplicated recurrent urinary tract infections in a national sample of women in the United States. *Urology* 2016;90:50–55.
- 3 Dason S, Dason JT, Kapoor A: Guidelines for the diagnosis and management of recurrent urinary tract infection in women. *Can Urol Assoc J* 2011;5:316–322.
- 4 Scottish Intercollegiate Guidelines Network. SIGN Guideline 88: Management of Suspected Bacterial Urinary Tract Infection in Adults. Edinburgh, SIGN, 2012.
- 5 National Institute for Health and Care Excellence. Urinary tract infections in adults (Quality Standard 90). London, NICE, 2015.
- 6 Lazarus E, Allen BC, Blaufox MD, Coakley FV, Friedman B, Fulgham PF, Goldfarb S, Hartman MS, Heller MT, Hosseinzadeh K, Oto A, Porter C, Anik Sahni V, Sudakoff GS, Verma S, Remer EM, Eberhardt SC: ACR Appropriateness Criteria®: Recurrent Lower UTIs in Women. American College of Radiology, 2014. <https://acsearch.acr.org/docs/69491/Narrative/> (accessed February 27, 2017).
- 7 Phillips B, Ball C, Sackett D, Badenoch D, Straus S, Haynes B, Dawes M: Oxford Centre for Evidence-based Medicine – Levels of Evidence. Updated by Howick J March, 2009.

- 8 Pagano MJ, Barbalat Y, Theofanides MC, Edokpolo L, James MB, Cooper KL: Diagnostic yield of cystoscopy in the evaluation of recurrent urinary tract infection in women. *Neurourol Urodyn* 2017;36:692–696.
- 9 Hijazi S, Leitsmann C: Clinical significance of video-urodynamic in female recurrent urinary tract infections. *Int J Womens Health* 2016;8:31–34.
- 10 Howles S, Tempest H, Doolub G, Bryant RJ, Hamdy FC, Noble JG, Larré S: Flexible cystoscopy findings in patients investigated for profound lower urinary tract symptoms, recurrent urinary tract infection, and pain. *J Endourol* 2012;26:1468–1472.
- 11 Lawrentschuk N Ooi J, Pang A, et al: Cystoscopy in women with recurrent urinary tract infection. *Int J Urol* 2006;13:350–353.
- 12 van Haarst EP, van Andel G, Heldeweg EA, et al: Evaluation of the diagnostic workup in young women referred for recurrent lower urinary tract infections. *Urology* 2001;57:1068–1072.
- 13 Raz R, Gennesin Y, Wasser J, et al: Recurrent urinary tract infections in postmenopausal women. *Clin Infect Dis* 2000;30:152–156.
- 14 Nickel JC, Wilson J, Morales A, Heaton J: Value of urologic investigation in a targeted group of women with recurrent urinary tract infections. *Can J Surg* 1991;34:591–594.
- 15 McNicholas MM, Griffin JF, Cantwell DF: Ultrasound of the pelvis and renal tract combined with a plain film of abdomen in young women with urinary tract infection: can it replace intravenous urography? A prospective study. *Br J Radiol* 1991;64:221–224.
- 16 Mogensen P, Hansen LK: Do intravenous urography and cystoscopy provide important information in otherwise healthy women with recurrent urinary tract infection? *Br J Urol* 1983;55:261–263.
- 17 De Lange EE, Jones B: Unnecessary intravenous urography in young women with recurrent urinary tract infections. *Clin Radiol* 1983;34:551–553.
- 18 Fairchild TN, Shuman W, Berger RE: Radiographic studies for women with recurrent urinary tract infections. *J Urol* 1982;128:344–345.
- 19 Engel G, Schaeffer AJ, Grayhack JT, Wendel EF: The role of excretory urography and cystoscopy in the evaluation and management of women with recurrent urinary tract infection. *J Urol* 1980;123:190–191.
- 20 Salinas J, Virseda M, Méndez S, Menéndez P, Esteban M, Moreno J: Abdominal strength in voiding cystometry: a risk factor for recurrent urinary tract infections in women. *Int Urogynecol J* 2015;26:1861–1865.
- 21 Rodrigues P, Hering F, Campagnari JC: Involuntary detrusor contraction is a frequent finding in patients with recurrent urinary tract infections. *Urol Int* 2014;93:67–73.
- 22 Aslaksen A, Baerheim A, Hunskaar S, et al: Intravenous urography versus ultrasonography in evaluation of women with recurrent urinary tract infection. *Scand J Prim Health Care* 1990;8:85–89.
- 23 Goldberg RP, Sherman W, Sand PK: Cystoscopy for lower urinary tract symptoms in urogynecologic practice: the likelihood of finding bladder cancer. *Int Urogynecol J Pelvic Floor Dysfunct* 2008;19:991–994.
- 24 Fowler JE Jr, Pulaski ET: Excretory urography, cystography, and cystoscopy in the evaluation of women with urinary-tract infection: a prospective study. *N Engl J Med* 1981;304:462–465.
- 25 Fair WR, McClellan BL, Jost RG: Are excretory urograms necessary in evaluating women with urinary tract infection? *J Urol* 1979;121:313–315.
- 26 Kumar V, Patel HR, Nathan SM, Miller RA, Lawson AH: Do we need to perform cystoscopy on all adults attending urology centres as outpatients? *Urol Int* 2004;73:198–200.
- 27 Lewis-Jones HG, Lamb GH, Hughes PL: Can ultrasound replace the intravenous urogram in preliminary investigation of renal tract disease? A prospective study. *Br J Radiol* 1989;62:977–980.
- 28 Jagjivan B, Moore DJ, Naik DR: Relative merits of ultrasound and intravenous urography in the investigation of the urinary tract. *Br J Surg* 1988;75:246–248.
- 29 Chew LD, Fihn SD: Recurrent cystitis in non-pregnant women. *West J Med* 1999;170:274–277.