

Urinary Tract Infection in Children: Role of Urological Anomalies

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ABSTRACT

Background: Urinary tract infection is one of the most common bacterial infections in pediatric group. Over the last decades the management of children with febrile urinary tract infection has become quite controversial. Although different guidelines had been designed to determine high risk cases, there is no global Consensus about imaging and follow up. In this chapter the author aim to discuss about why childhood febrile urinary tract infection is so much important, what are the main guidelines and approaches which designed for screening of high risk cases and also present the results of some studies conducted in children with urinary tract infection all around the world.

Materials and methods: By using key words a search was done in pub-med and most related manuscripts to our topic during 1990 to 2015 were selected. Then studies were categorized into 2 subgroups; researches were performed in USA, Europe and Australia and those were done in Asia. Important details of patients including prevalence of vesico ureteral reflux were emphasized.

Results: vesico ureteral reflux had been reported in 31-39% of cases in USA, 17.9- 30.7% of European, 24-39% of Australian and 18.3- 61.1 % of Asian children presented by urinary tract infection.

Conclusion: Vesico ureteral reflux is a common underlying urological anomalies that predisposes children for febrile urinary tract infections. Two main approaches which used for detection of vesico ureteral reflux in childhood urinary tract infection each have some advantages and disadvantages. Studies with uniform approaches are needed to perform in countries where long term sequelae of urinary tract infections (end stage renal disease) is still common. Results of these studies can be used for designing more practical approaches with the lowest missing of high risk patients.

Keywords: UTI; Children; Imaging; Urological abnormalities; VUR; UPJO; UVJO; PUV; Renal damage

INTRODUCTION

Urinary Tract Infection (**UTI**) is a common bacterial infection in childhood period and one of the most prevalent conditions encountered in pediatric medicine [1,2]. It's usually a straight forward clinical diagnosis relying on results of urine culture. Proper urine culture is necessary for a reliable diagnosis [1]. Different types of urine samplings in pediatric age groups are used. In toilet trained children mid-stream and in neonates, infants and non-toilet trained children samples are obtained by supra pubic aspiration, urinary catheter or urine bag. Since in infants sampling by urine bag frequently associated with bacterial contamination, sampling by supra pubic aspiration or urinary catheter is usually mandatory [3-6]. UTI can be occurred in any age with or without urological or functional abnormalities of urinary tract. Differences in age distribution and gender variations and also higher risk for long- term renal complications mainly renal cortical damage following febrile UTI have been reported [4,7-10]. Clinical manifestations usually depends on age of child, in infants nonspecific presentations are common that make the diagnosis difficult [1].

Based on new guidelines, pyuria or bacteriuria on urine analysis and urine culture associated with pure bacterial growth of >50000 colony forming units are sufficient for definite diagnosis [2]. An overall prevalence of 7% for UTI among infants presenting with fever and a pooled prevalence of 7.8% for children presenting with urinary symptoms have been estimated (11). By 7 years of age 8% of girls and 2% of boys develop at least one episode of symptomatic UTI [12]. Three to five percent of girls and 1-2% of boys, experience an episode of UTI before puberty [13]. Higher rates of febrile UTI (57%) have been found in those with Vesico-Ureteral Reflux (**VUR**) [14], and approximately 30-40% of children with UTI have reflux [15]. Furthermore, VUR is a primary cause of significant hypertension in children so measurement of BP should be part of the primary evaluation of these patients [14]. One of the best global parameters of renal health in children is somatic growth curve which fall below the normal in many children with VUR and UTI [14], and normalized with successful suppression of pyelonephritis with continuous antibiotic prevention

or surgical correction of reflux, so height and weight evaluation of these patients is necessary [16,17].

Recurrent infections, renal scarring and VUR are risk factors for the development of progressive renal damage [18]. Early diagnosis and prompt treatment of febrile children is important to prevent potential renal damage [19]. Several imaging studies for defining high risk groups (those with urinary tract malformation) have been recommended [3,20,21]. Recent guidelines have changed the study levels in relation to the age of patients and severity of clinical symptoms [21]. Imaging in childhood UTI is a challenging and controversial topic.

Imaging studies in UTI:

1) Renal Bladder Ultrasonography (**RBUS**): Sonography is a non-invasive, easy available and non- expensive method with no radiation exposure that frequently used for evaluation of upper urinary tract, but its ability for detection of urological abnormalities is limited [22]. It may miss 60% of VUR and 50% of renal cortical abnormalities noted on DMSA [23-25].

2) Voiding Cysto-Urethrography (**VCUG**): However VCUG is an invasive method that requiring catheterization and associated with radiation exposure, it is the gold standard imaging for the detection of VUR and diagnosis of Posterior Urethral Valve (**PUV**). High prevalence of late onset complications of UTI such as renal scarring and hypertension which occurred in 10-20% of cases with VUR [26], and progression of reflux nephropathy to end stage renal diseases which has been reported in 10- 25% of patients worldwide [26-29] indicate to importance of diagnosis of VUR in childhood UTI .

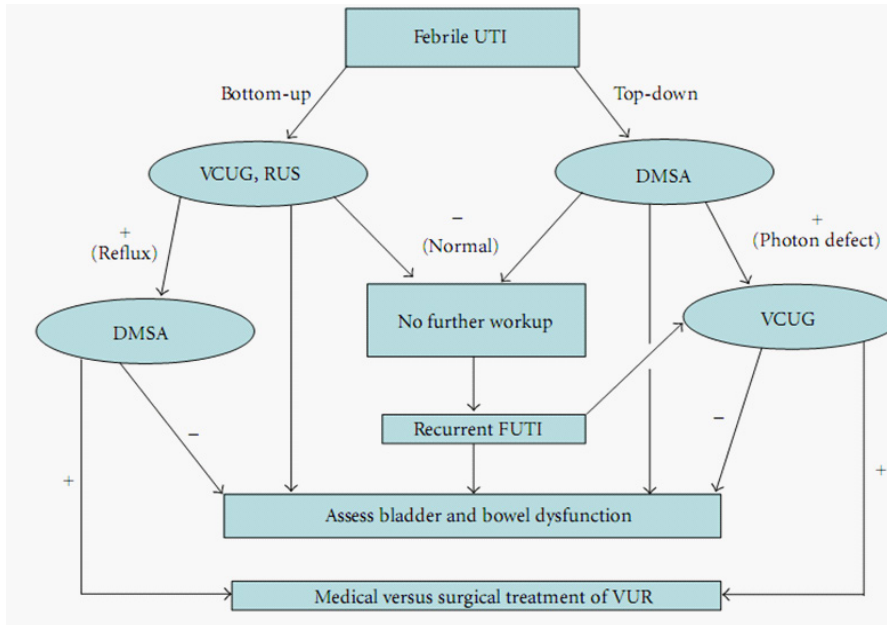
The cases with VUR are among those with the greater risk for renal damage following febrile UTI. These findings together address to importance of recognizing high risk groups; those with urological abnormalities. Guidelines designed for imaging in UTI commonly try to decrease the rate of doing VCUG without missing cases at higher risk for renal scar including those with high grades VUR.

Top -down approach focuses on identifying children at risk for renal scarring, whether or not VUR is present [22]. Based to this approach patients with pyelonephritis first undergoes **DMSA** (Demercapoto Succinic Acid) renal scan to detect renal inflammation and VCUG just recommended for those with renal cortical involvement. This approach was supported by 2 extended studies [30,31] which have reported positive scans in 66% and 85% of cases with VUR prospectively.

Bottom-up approach relies on RBUS to detect anatomical abnormalities, renal parenchymal defects or evidence of obstruction. The VCUG applies for detection of lower urinary tracts abnormalities and VUR. Then DMSA renal scan used for those with VUR and cases with evidence of renal scarring in US [32]. Figure 1 illustrates these two approaches. As just 30-40% of children with a UTI have reflux, then it seems that over 60% of VCUG tests ordered may be unnecessary [33,34]. Table 1 compares top-down versus bottom-up approaches. Some studies have recommended doing VCUG in case of abnormal US [20], recurrent infection, and atypical clinical course [21].

Table 1: Advantages and disadvantages of bottom-up versus top-down methodology [31].

	Advantage	Disadvantages	Comments
Bottom – Up VCUG	Widely available with reproducible techniques and interpretation identifies lower urinary tract correctable anomalies	Requires catheterization Does not identify all vulnerable kidneys Exposure to focused ionizing radiation May over treat case that are not clinically significant	VUR will predispose to pyelonephritis and scarring but the relationship is not 1:1 Many cases of VUR spontaneously resolve
RUS	Non-invasive No ionizing radiation Widely available	Fails to alter management as many abnormalities are now detected in utero Not a functional study	Gross anatomic assessment to complement VCUG

**Figure 1:** A schematic of the bottom-up versus top-down approach [32].

3) Tc99 DMSA scan (renal scan): DMSA scan frequently used as a method for the assessment of renal sequelae after acute febrile UTI (renal parenchymal involvement) that has the ability to detect renal scars 6 months after acute infection. It's suggested that children with normal DMSA during acute UTI have a low risk of renal damage. This imaging is highly sensitive for diagnosis of acute and chronic pyelonephritis. An abnormal DMSA associated with high grade VUR in patients with UTI increases the risk of renal lesions, whereas those with normal follow-up scan and low-grade VUR frequently have spontaneous resolution of VUR [18].

4) Diuretic renography: Many protocols for Diuretic renography are described in the literature including 99TC-DTPA, 123 I-OIH and 99 TC-MAG3 scans, the last ones is currently preferred and widely used [35]. If US demonstrates hydro nephrosis or hydro ureter, further studies should be done to identify the presence and level of obstruction [36]. Diuretic renograms are a very useful method for diagnosis and follow up of children with Uretero–Pelvic Junction Obstruction (**UPJO**). This method identifies the presence but not the cause of obstruction. Also little anatomic detail provided with diuretic renography [37,38].

MATERIALS AND METHODS

Manuscripts indexed in pub- med during 1990 to 2015 related to imagines in childhood UTI were searched by using UTI, children and urological abnormalities as main key words. Details such as age at presentation, female to male ratio, criteria for doing more imaging studies mainly VCUG and TC 99 DMSA scan, the prevalence of VUR and final results of studies were emphasized. Details of 27 papers were analyzed and used for discussion. Then studies were categorized into 2 subgroups:

- 1) Studies were performed in USA, Europe and Australia
- 2) Studies were done in Asia

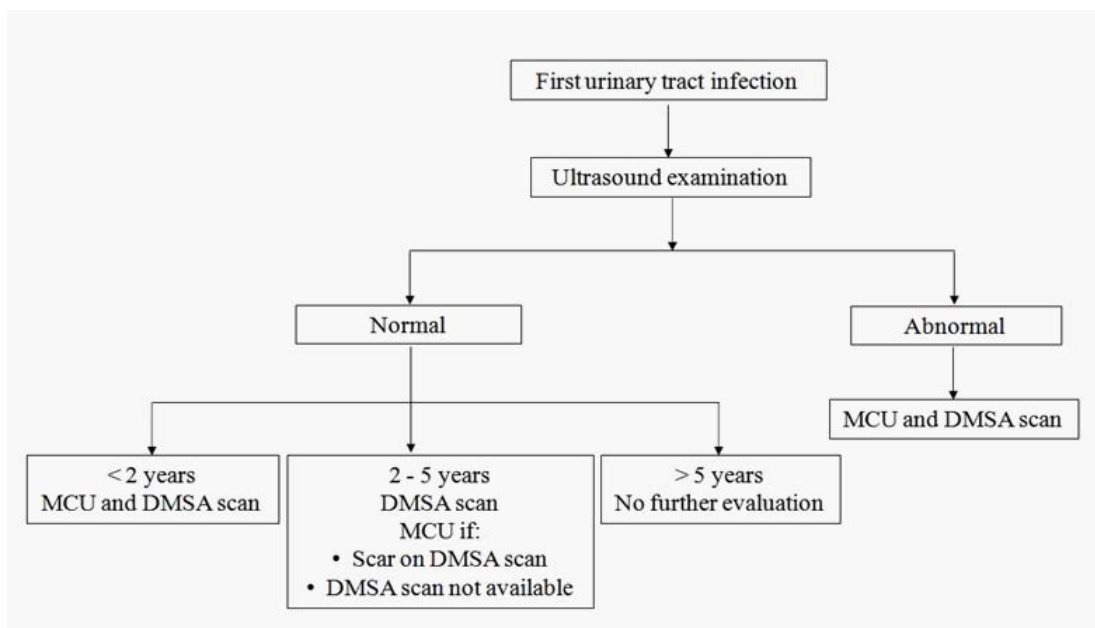
RESULTS

A lot of papers have been published a bout UTI in children .Some of these manuscripts have been focused on detection of urological anomalies that predispose to recurrent infections, and renal damage. As there is no consensus about imaging studies in children with UTI, these investigations presented different inclusion and exclusion criteria. Great differences in inclusion and exclusion criteria in these studies makes reaching a final conclusion difficult. However there is different guidelines and approaches for imaging studies in childhood UTI [15,22,32,39-43], making a decision based on guidelines is sometimes difficult because some guidelines focus on protocol for specific age groups of children [15] and almost all of these guidelines don’t present any instruction for repeated afebrile UTI which is a common entity in children with recurrent infections. Table 2 and flow chart 1 show details of some of these guidelines.

Table 2: Summary of the NICE and AAP imaging guideline after a febrile UTI [64].

	PCR	NIC	AAP (Levels of evidence)
Renal and bladder US	All children with UTI	Children younger than 6 months and older children with a recurrent or an "atypical" UTI (Occurring in a seriously ill child, poor urine flow, abdominal or bladder mass, raised serum creatinine, septicemia, lack of response to a 48 h treatment with antibiotics or an infections with a non-E coli organism)	All children with UTI (Grade C)
VCUG	Children under 1 year of age and, in those between 1 and 2 only if the US or DMSA were abnormal, or in case of recurrent UTI	Infant below the age of 6 months if they have had an " atypical" UTI and in those with recurrences	If hydro nephrosis obstruction, scarring or signs of high grade VUR on US (grade C)
DMSA	All children with UTI	Four to 6 months after the UTI in children younger than 3 years with a recurrent or 'atypical' UTI	Not recommended, further evaluation should be performed after a recurrent infection (Grade X)

AAP: American academy of pediatrics ; **DMSA:** dimercaptosuccinic and acid scan; **NICE:** National institute for health and care excellence; **RCP:** Royal college of physicians, London; **US:** ultrasound; **UTI:** Urinary tract infection; **VCUG:** Voiding cystourethrogram; **VUR:** Vesicoureteral reflux.



Flow chart 1: Guideline of Indian Pediatric Nephrology Group and Indian Academy of Pediatrics For imaging studies in childhood UTI (41).

Of 27 studies which were evaluated, (Table 3,4) [30,31,44-68] (Table 3,4) a part of them just included infants (age group ≤ 24 months) [30,31,44-46], and some included approximately all age groups of children with UTI [46-49,51,55,56,59,61,62,67]. These manuscripts mainly had focused on detection of VUR, and just a few investigations had considered evaluation for other urological anomalies including urinary tract obstructions [48,51,55,61,62]. Studies were done in USA had reported VUR in 31-39% of cases, while those were done in Europe found VUR in 17.9% [31] to 30.7% [47] of patients. Studies in Australia were reported VUR in 24% [68] to 39% [58] of cases. Studies were performed in Asian children had reported a very wide range of VUR, the lowest prevalence for VUR in children with UTI was 18.3% [57] and the highest prevalence was 61.1 % [58].

Table 3: Details of studies were done in fields of pediatric UTI in United States, Europe and Australia.

Authors (country)	Number of enrolled cases	Age at presentation	F/M ratio	Indications for imaging studies	Prevalence of VUR, and urinary obstruction	Final conclusion
1)Hoberman et al. [44]* (USA)	309	1 -24 months	276/33(8.3)	First febrile UTI	39% had VUR	renal scarring was noted in 9.5 of cases 6 months after infection
2) Hansson et al. [45] (Sweden)	2309	<2 yr	1.1/1	Febrile UTI in Age<2 years	36% of girls and 24% of boys had VUR	VUR was the most common urological anomalies
3) Merrick et al. [47] (Scotland)	3646	≤14 yr	2.8/1	if further urinary tract infections were confirmed or suspected	30.7% of cases who underwent VCUG had VUR	Most children with renal damage did not have hydro- nephrosis
4) Caillaud et al. [46] (France)	202	1month -18year	-----	First febrile UTI and those with a serum procalcitonin level >1 ng/L and/or abnormal renal US	7.5% had high grade VUR	No cases of high-grade VUR were missed by their recommended protocol
5)Zajackowska et al. [48] (Polish)	207	1-18 years (8.8 ± 0.4yr)	3.5/1	Hospitalized cases of UTI (76.8% of cases had recurrent UTI)	29.5% and 8.5%	Renal scar is a common finding in cases with VUR (64%)
6) Majd et al. [52] (USA)	94	-----		All cases with febrile UTI	31% had VUR	Acute pyelonephritis in the absence of VUR is common
7) Rosenberg et al. [68] (Australia)	65	-----	-----	Acute febrile UTI	24%	Abnormal DMSA identifies most children with significant VUR
8) Ditch field et al. [58] (Australia)	150	Age <5yr	-----	First UTI	39% had VUR	VUR and renal scars occur independently of each other
9) Broadis et al. [49] (Scotland, UK)	1000	11 days to 16 years (median age 5 yr)	4.5	First UTI (27.9 % presented with Febrile UTI)	19.2% of cases who underwent VCUG had VUR 1	A top down' approach identifies majority of children who require intervention.
10) Hansson et al. [30] (Sweden)	303	<2 years	140/163 (0.85/1)	UTI<2yr (Febrile and without fever)	26% had VUR	40% of children without VUR Who had negative scans excluded from doing a VCUG by this approach
11) Preda et al. [31] (Sweden)	290	<1 year	129/161 (0.8/1)	Febrile UTI<1yr	17.9% hadVUR	No cases of high grades VUR were missed by using top down approach

Table 4: Details of studies were done in fields of pediatric UTI in Asia.

Authors (country)	Number of enrolled cases	Age at presentation	F /M ratio	Indication s for imaging studies	Prevalence of VUR and urinary obstruction	Final conclusion
1) Ajdinovic et al. [53] (Japan)	201	7 months -7 years	127/74(1.4/1)	acute UTI(febrile UTI)	58.7% had VUR	Scarring was significantly more common in kidneys with than those without VUR
2) Fong et al. [54] (Hong Kong)	94	Neonate-8 years	21/73 (0.28/1)	All patients below 5 years old	23% had VUR	There were strong associations between VUR, recurrent UTI and renal scarring.
3) Wu et al. [55] (Taiwan)	597	≤14yr	-----	≤14yr admitted due to UTI	33.2% and 7.5% had obstruction	The most common urological anomaly was VUR
4) Jothilakshmi et al. [50] (India)	262	-----	-----	All children with an abnormal US	20% had structural anomalies	VCUG indicated in all boys <2 years .1/3 of anomalies will be missed if only US is done.
5) Adibi et al. [66] (Iran)	90	2-12 yr	Gender was not mentioned	All children 2-12 yr with UTI	61.1% had VUR	The sensitivity and specificity of US in diagnosis of VUR were 70.9% and 51.4% respectively,
6) Taneja et al . [51] (India)	1974 children	< 12yr	2.9/1	all children suspected to UTI	19.9% VUR and 2.3% obstruction	Male gender, age < 1 yr, VUR and PUV were more common risk factors for UTI
7) Muinuddin et al. [65] (Bangladesh)	74	1-5 years	1.5/1	Febrile(36%) and afebrile UTI	43% had VUR	Children with UTI below 6 years of age have high incidence of reflux and scarring
8) Beiraghdar et al. [56] (Iran)	176	≤14yr	3.38/1	first UTI or significant bacteriuria aged ≤14yr	38.9% to 56.8% had VUR	Risk of scar was higher in the younger age group and in those with recurrent UTIs
9) Sorkhi et al [59] (Iran)	100	1-147 Months(38 ±37)	88/12 (7.3/1)	First febrile UTI	39% had VUR	DMSA scan alone or with US cannot predict VUR
10) Sayedzadeh et al. [60] (Iran)	40	one month to 5 years	27/13 (2.1/1)	protracted fever for >48 hours due to UTI	58% had VUR	normal DMSA scan can help in ruling out moderate to severe forms of VUR
11) Naseri et al. [61] (Iran)	183	3 days to 11 yr	2.5	any child except than first afebrile UTI in girls > 5yr	47.5 % and 5.5% had VUR and obstruction respectively	VUR was as common in boys as in girls
12) Koçak et al [57] (Turkey)	142	32.6 ±4.1 months	2.7/1	Hospitalized children for upper UTI	18.3% had VUR	Increased prevalence of multi- drugs resistant bacterial UTI in hospitalized cases
13) Gupta et al. [62] (India)	524	Children aged ≤13 yr	(0.45/1)	suspected to have UTI	18 of 32 case(56.2%) who underwent VCUG had VUR and 3 (9.3%) had PUV	VUR and renal scarring were more common in males

14) Narchi et al. [63] (United Arab Emirates)	43	2-24 months (Median 7.6 months)	1.85/1	Febrile UTI	37% had VUR	The NICE guidelines would have missed 63% of VUR grade≥II, a high proportion of high grades VUR, and 44% of the renal scars
15) Wu et al. [64] (Taiwan)	132	≤4 months	0.45/1	Small infants with UTI	37.8% had VUR	VUR was the most common urological anomalies
16) Mahyar et al [67] (Iran)	153	One month -12 yr	135/18 (7.5/1)	First febrile UTI	39.2%	fever>38.2C and DMSA scan are as the best predictive markers for VUR in children with their first febrile UTI

DISCUSSION

Infants and young children are at greater risk of acute renal injury with UTI. The incidence of VUR is higher in this age group and the severity of VUR is greater, with the most severe form (with intrarenal reflux or pyelotubular backflow) virtually limited to infants. American Academy of Pediatrics recommended considering UTI in infants and young children 2 months to 2 years with unexplained fever [2]. Table V presents criteria for diagnosis of UTI [41].

It's estimated that 2 years after a single UTI up to 15%, of children show evidence of renal scarring in DMSA scan [57,58,69,70]. Incidence of scarring increases in those with delayed diagnosis or recurrent infections [71,72], and children with VUR [73,74]. The main aims of the investigations following UTI are to identify patients who have the greater risks for renal scarring.

Reviewing selected studies revealed that VUR is a common finding in infants with first febrile UTI (Tables 3,4). Hansson, et al. [30] used top down approach for imaging of children ≤ 2 years with febrile and also afebrile UTI and found VUR in 26% of cases. They suggested that DMSA scan can replace VCUG as first line imaging (after US). In their series 46% of cases with abnormal renal scan didn't have VUR and all infants with high grade VUR (VUR grades 4 and 5) had abnormal scan. By this approach 40% of children without VUR who had negative scans excluded from doing a VCUG. Preda, et al. [31] used this approach for febrile UTI in children aged <1yr and found VUR in 17.9% of subjects. Like Hansson et al. [45], no cases of high grades VUR were missed by this approach.

Table 5: Criteria for diagnosis of UTI [41].

Method of collection	Colony count (Pure Culture)	Probability of infection(%)
SPA	Gram –negative bacilli: any number Gram – positive cocci: more than a few thousand	> 99%
Transurethral catheterization	>10 ⁵ 10 ⁴ –10 ⁵ 10 ³ –10 ⁴ < 10 ³	95% infection likely suspicious Repeat, infection unlikely
Clean void Boy Girl	> 10 ⁴ 3 Specimens ≥ 10 ⁵ 2 specimen ≥ 10 ⁵ 1 specimen ≥ 10 ⁵ 5 × 10 ⁴ – 10 ⁵ 10 ⁴ – 5 × 10 ⁴ < 10 ⁴	Infection likely 95% 90% 80% Suspicious, repeat Symptomatic, suspicious, repeat Asymptomatic infection unlikely Infection unlikely

Among reviewed papers the highest prevalence for VUR were reported by Adibi, et al. [66]. Their study included all children 2-12 years with UTI and determined that about 75% of cases with VUR have normal US, and 25% of missed VUR by US (cases with VUR and normal US) have moderate to severe reflux. Similar finding has been reported by Jothilakshmi, et al. [50]. They found that if in boys <2 years with UTI, doing VCUG is limited to cases with abnormal US, 1/3 of anomalies will be missed. A study in Bangladesh by Muinuddin, et al. [65] found that UTI in children younger than 6 years commonly associated with reflux and scarring.

An extended study by Merrick, et al. [47] were done that included 3646 children with at least one confirmed UTI. They aimed to define the prognostic value of imaging. Their study revealed a bimodal peak for UTI, one peak of incidence in first year of life (>50% of cases were boys), and a second peak in fourth year of age (80% of whom were girls). These patients were followed up for 1-15 (mean 7.4) years. All enrolled cases underwent abdominal ultrasound, renal scan and imaging for detection of VUR. Progressive renal damage was defined as development of new or enlargement of previous scars, a decrease in differential renal function more that 6% of previous measured value on TC99- DMSA scan, failure of renal growth and increased serum levels of Blood Urea Nitrogen (**BUN**) and creatinine. Table 6 and Table 7 show association of renal damage with hydro nephrosis on US and presence or absence of VUR with progression of renal scar respectively [47]. Although they found that dilatation of renal pelvis if associated with VUR significantly increased the risk of renal damage, majority of cases with renal damage didn't have dilated renal pelvis at presentation. The combination of dilated renal pelvis on US and VUR was associated with a high (26.8%) incidence of progressive renal damage, whereas dilated renal pelvis without VUR or reflux without dilated renal pelvis were associated with a low risk of renal damage (3.8% and 5.1% respectively). In final follow up, 20 of 29 cases (67%) with progressive renal damage had VUR, but also in 660 kidneys which did not have renal damage. Progressive renal damages were detected in 20 of 169 cases (11.8%) with abnormal renal scan at presentation and 12 of 92(13%) patients with abnormal US. They concluded that reflux is an important risk factor for progressive renal damage particularly when it associated with other factors such as repeated infections.

Table 6: Association between dilatation of collecting system on US, VUR and subsequent progressive renal damage [47].

	Dilated collecting system	No dilatation of collecting system	Difference in percentages (95% CI)	Total
<i>Reflux on MCU or IVS</i>	82	369		
<i>No (%) deteriorating</i>	22 (26.8)	19(5.1)		451
<i>No reflux on MCU or VIS</i>	286	1927	21.7 (11.8 to 31.5)	2213
<i>No (%) deteriorating</i>	11 (3.8)	17 (0.9)	2.9 (0.7 to 5.2)	2664
<i>Differences in % (95% CI)</i>	23.0 (31.1 to 32.8)	4.3 m(2.0 to 6.6)		
<i>Total</i>	368	2296		

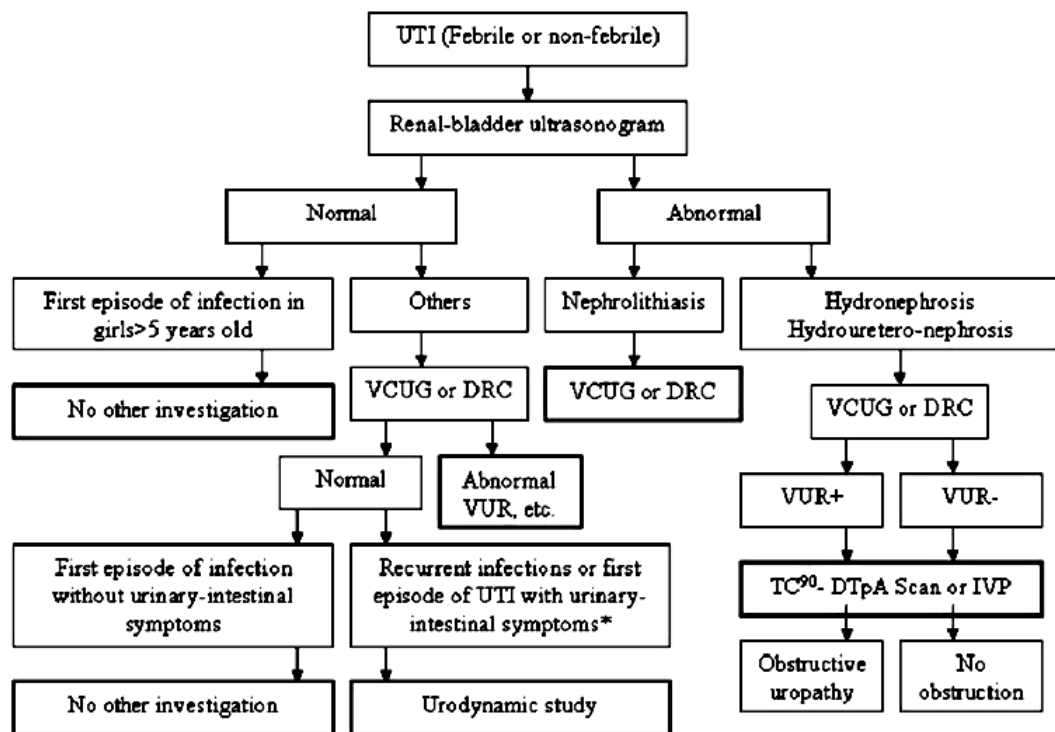
Table 7: Association between presence and absence of VUR and subsequent appearance or progression of renal scar [47].

	Girls		Boys	
	< 1 years	≥ 1 years	< 1 years	≥ 1 years
No of kidneys with no reflux was observed	74	3632	134	1174
No (%) which developed new or progressive scarring	1(1.4)	49(1.3)	5(3.7)	14(1.2)
No (%) which developed new or progressive scarring	46	897	71	265
Difference in % (95 % CI)	9 (19.6)	23(5.9)	4(5.6)	16(6.0)
	18.2 (6.5 to 30.0)	4.6 (3.0 to 6.2)	1.9 (-4.4 to 8.2)	4.8 (1.9 to 7.8)

CI: Confidence interval.

Another extended study were performed in India [53] which included 1974 children < 12 yr. Clean catch mid-stream urine samples for culture were obtained from enrolled cases over a period of 6 months. These cases presented to the pediatric surgery (234, 41.9%), pediatric medicine (238, 42.7%), pediatric intensive care unit (45, 8.1%), and pediatric emergency (41, 7.3%) departments. Totally 558 (28.3%) children had culture proven UTI and a male preponderance in cases with UTI was present (77.8%). Main predisposing factors for UTI were PUV (118, 27.6%), VUR (85, 19.9%), neurogenic bladder (22, 5.1%), UPJO (15, 3.5%), and other congenital anomalies of the urinary tract (14, 3.3%). Their study revealed that UTI is common in children with male gender, age < 1 yr, and in case of urological abnormalities such as VUR and PUV.

Naseri, et al. [61] evaluated all cases of childhood UTI for VUR except that girls > 5years with a single episode of afebrile UTI and normal US. Flow chart 2 illustrates the methods of evaluation of their cases. They found VUR as the most common predisposing factor of UTI in boys as girls (46.9% of girls and 48.9% of boys). In addition except that neonates (age ≤1 month), the most common predisposing factor in all age groups was reflux, and in male gender urinary obstruction was significantly more prevalent than females.



Flowchart 2: Flowchart for evaluation of patients with UTI [61].

CONCLUSION

Childhood UTI is more prevalent in girls than in boys; VUR is a common findings that have been detected in about 20-60% of cases. A few data is available about prevalence of urinary obstruction in children with UTI, but based on literature 2.3-9.3% of cases may have obstructive uropathies. Risk of renal scar is higher in the younger age group, those with VUR and also cases with recurrent UTIs. Using imaging studies for detection of cases high risk for progressive renal damage is a very important and challenging topic. Nowadays 2 different approaches including top down and bottom up approaches are used for determining high risk patients. The studies performed in field of pediatric UTI were very heterogeneous with different age groups of children enrolled and using different approaches and guidelines .It seems that uniform studies with similar enrolled cases and same approaches in different parts of the world especially where sequelae of UTI mainly end stage renal disease is still common should be performed to design a more practical guidelines that has the lowest missing of high risk patients.

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