CLINICAL EFFECTIVENESS OF TESTS AND INVESTIGATIONS FOR THE DIAGNOSIS OF UTI IN FEVERISH CHILDREN LESS THAN 5 YEARS OLD: SYSTEMIC REVIEW

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Medicine Master’s Degree

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To my sister, boyfriend, friends and colleagues that have been at my side during this time, for the companionship, strength and support in certain hard times.

At last, having consciousness that alone none of this would have been possible, I address a special thanks to my parents, for being models of courage, for their unconditional support, encouragement, and patience demonstrated and total aid in overcoming the obstacles along this walk when they were emerging. I dedicate this work to them.

Filipa Direito Peixoto
2. CONFLICTS OF INTEREST
The author reports no conflicts of interest.

3. ABREVIATIONS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>APN</td>
<td>acute pyelonephritis</td>
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<tr>
<td>ASB</td>
<td>asymptomatic bacteriuria</td>
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<tr>
<td>CAT</td>
<td>computed axial tomography</td>
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<td>CCT</td>
<td>controlled clinical trial</td>
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<tr>
<td>CFU</td>
<td>colony-forming unit</td>
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<tr>
<td>CI</td>
<td>confidence interval</td>
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<tr>
<td>CKD</td>
<td>chronic kidney disease</td>
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<td>CRF</td>
<td>chronic renal failure</td>
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<tr>
<td>CRP</td>
<td>C-reactive protein</td>
</tr>
<tr>
<td>CT</td>
<td>computed tomography</td>
</tr>
<tr>
<td>CUS</td>
<td>cystourethrogram</td>
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<tr>
<td>CVU</td>
<td>clean voided urine</td>
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<tr>
<td>DMSA</td>
<td>dimercaptosuccinic acid</td>
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<tr>
<td>eGFR</td>
<td>estimated glomerular filtration rate</td>
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<tr>
<td>EL</td>
<td>evidence level</td>
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<tr>
<td>ESR</td>
<td>erythrocyte sedimentation rate</td>
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<tr>
<td>ESRD</td>
<td>end-stage renal disease</td>
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<tr>
<td>GFR</td>
<td>glomerular filtration rate</td>
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<td>IM</td>
<td>intramuscular</td>
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<tr>
<td>IV</td>
<td>intravenous</td>
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<tr>
<td>LE</td>
<td>leucocyte esterase</td>
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<tr>
<td>LR+</td>
<td>positive likelihood ratio</td>
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<tr>
<td>LR−</td>
<td>negative likelihood ratio</td>
</tr>
<tr>
<td>MCUG</td>
<td>micturating cystourethrogram</td>
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<tr>
<td>MRI</td>
<td>magnetic resonance imaging</td>
</tr>
<tr>
<td>NAG</td>
<td>N-acetyl-beta-glucosaminidase</td>
</tr>
<tr>
<td>OR</td>
<td>odds ratio</td>
</tr>
<tr>
<td>RCT</td>
<td>randomised controlled trial</td>
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<tr>
<td>SD</td>
<td>standard deviation</td>
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<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>SPA</td>
<td>suprapubic aspiration</td>
</tr>
<tr>
<td>US</td>
<td>ultrasound</td>
</tr>
<tr>
<td>UTI</td>
<td>urinary tract infection</td>
</tr>
<tr>
<td>VCUG</td>
<td>voiding cystourethrogram</td>
</tr>
<tr>
<td>VUR</td>
<td>vesicoureteric reflux</td>
</tr>
<tr>
<td>VUS</td>
<td>voiding urosonography</td>
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<tr>
<td>WBC</td>
<td>white blood cell</td>
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</table>
4. ABSTRACT

4.1 Objectives:
The objectives of this systematic review are:
1. To define when investigations should be considered
2. Which methods of biological samples is required for the diagnosis of UTI in children with pathological findings such as fever without any other symptoms or signs of other sites of infection
3. To assess the need for further investigations of urinary tract’s structures

4.2 Data sources: Electronic databases were searched up to 2015.

4.3 Review methods: A systematic review was undertaken using published guidelines, studies uploaded onto online databases and reference lists of those studies. Results were analysed according predisposing factor, tests to diagnose UTI and further investigation of UTI.

4.4 Results: 13 studies met all the criteria inclusion for this research. 3 studies presented information about symptoms and signs of urinary tract infection. For the diagnosis of UTI 3 studies were included and also 3 studies were found with information for further investigations of UTI.

4.5 Conclusion: Management and diagnosis of UTI remains an important subject for further investigations. Due to the lack of consensus on the matter different countries apply different methods of diagnosis and different tactics of management for UTI.

4.6 Key words: Fever, children, urine, UTI
5. INTRODUCTION

Urinary tract infections (UTIs) can be defined as the growth of more than 100,000 colony-forming units per millilitre when it comes to a clean specimen of urine in a patient who is symptomatic. When the patient presents with more than 50,000, it’s considered sufficient due to coincidence with pyuria or bacteriuria. Pyuria is defined by the presence of 10 white blood cells per millilitre, in a clean specimen. The combination of significant pyuria and bacteriuria in a child establish UTI diagnosis. UTIs are classified through two different forms. According which structures are involved: pyelonephritis, cystitis and urethritis which are infections of the kidney, bladder and urethra, respectively, and according severity, they can be complicated versus uncomplicated. Dealing with a complicated UTI means, dealing with infections in urinary tracts with structural and/or functional anomalies or due to foreign objects like indwelling urethral catheter. When it comes to children, the categorization is simpler and practical because of the identification of UTI as first infection versus recurrent infection. Recurrent infections can be subcategorized into three stands: unresolved bacteriuria, bacterial persistence and reinfection develops. Neonates’ and infants’ UTIs are assumed as complicated, since the high combination of urinary tract malformation with simultaneous bacteremia leads to high morbidity and long-term renal insufficiency.

Urinary tract infections (UTIs) are very common within the paediatric population. Affecting approximately 7% to 8% of girls and 2% of boys during the first 8 years of life. There is a special significance in this type of infections since they are associated with high morbidity and it is not limited to the acute state. May result in renal scarring, dysfunction and renal damage. Thus is of a great importance to establish an early diagnosis for a prompt and adequate treatment. UTI may be difficult to identify because the symptoms and signs are not specific in children however children with unexplained fever of 38ºC or higher are at risk to be diagnosed with a urinary infection. Urine sample should be tested, after 24 hours at the latest, in children with this presentation.

When UTI is diagnosed by urine testing, it is, traditionally, requested a further imaging investigation of the urinary tract. Imaging is a very important tool in identifying children with underlying abnormalities or factors that put them at increased risk of recurrent UTI. This is to view the structure of the urinary tract, giving special attention to possible abnormalities that may have predisposed the child to an infection (e.g. obstruction or Vescicoureteric reflux (VUR)), as well as, to any complications of the infection. This is an advantage since there is the possibility to modify one or more of these risk factors to the child’s advantage.

This research reflects an intensive and extensive study of various clinical studies placed all over the world. It is based on a PRISMA model with the intent of gathering evidence-based information about the best methods for investigation and when we should consider a urinary tract infection diagnosis.
NICE guidelines: urinary tract infections in children was a great support of information for the development of this work, as well as, searches in online databases.

6. OBJECTIVES

The objectives of this systemic review are to define when investigations should be considered, which methods of biological samples are required for the diagnosis of UTI in children with pathological findings such as fever without any other symptoms or signs of other sites of infection. Moreover, to assess the need for further investigations of the structures and function of urinary tract.

7. METHODS

Studies were selected according their level of evidence. An exhaustive research was made to assess the highest quality of those studies. Preference being given to the randomised controlled trials or RCTs with a very low risk of bias, well conducted meta-analyses, systematic reviews of RCTs, high-quality systematic reviews of case-control or cohort studies.

Studies included were directed to the paediatric population but restricted to children under 5 years old. Studies involving children with urinary catheters in situ, with neurogenic bladders, already known to have significant pre-existing uropathies or underlying renal diseases and immunosuppressed were excluded.

Of interest are studies approaching tests to diagnose UTI such as dipstick test, urine microscopy and culture; comparison between the tests was made to evaluate which method is best to be used for the diagnosis. Also, studies referring to further investigations when UTI has been already diagnosed are of interest. Investigations to detect abnormalities in the urinary tract, for example vesicoureteric reflux or renal scarring. Focusing only in studies mentioning tests as ultrasound, dimercaptosuccinic acid scintigraphy and micturating cysourethrogram. Effectiveness of these imaging tests were assessed to detect when and to which group of children should they be performed with the aim of a better management and control of the disease.

Studies searches were developed using electronic databases, internet searches, reference lists of included papers and hand searching. The following databases were searched for diagnostic test evaluation: PubMed (2000 to November 2015), Ovid (2000 to 2015). Reference lists were, also, scanned from articles useful for this research.

7.1 Inclusion/exclusion criteria

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Full papers were obtained and screened with the possibility to be part of this review, according the inclusion criteria above stated.

**7.1.1 Ideal method of urine collection**
Study designed: Search of the NICE clinical guidelines’ reference list, online databases, such as PUBMED, to identify the best method for urine collection.

**7.1.2 Diagnosis of UTI**
Study designed: The National Library of Medicine's PUBMED system to conduct a MEDLINE search for the years 2000-2015 were searched for articles published in English, concerning the use of rapid diagnostic tests for UTI in children. The key words for the search were: urine/ urinalysis, urinary tract infections/pyelonephritis and child/preschool. Children from birth to 5 years old age were the interest group to be identified in the articles included. In addition, the reference list of those articles were scanned and some were included in this review.
Population: children younger than 5 years old with suspected UTI. Studies involving children of other ages that included some younger than 5 years old were included in this review.
Index tests: any test for the diagnosis of UTI. Studies comparing urine samples were also include.

**7.1.3 Further investigation of UTI**
Study designed: the NICE clinical guidelines: urinary tract infection in children and its reference list were revised. Also, researches on PUBMED were carried out and the most suitable to this review were included.
Population: children younger than 5 years old with suspected UTI. Studies involving children of other ages that included some younger than 5 years old were included in this review.
Index tests: any tests to investigate UTIs further.
Effectiveness of follow-up
Study designed: NICE clinical guidelines: urinary tract infection in children and its reference list were used. Also, researches on PUBMED were carried out and the most applicable to this review were included.
Population: children younger than 5 years old with suspected UTI. Studies involving children of other ages that included some younger than 5 years old were included in this review.
Index test: any imaging for evaluation and further diagnostic tests.

**7.2 Data extraction**
Extraction of data was made by a small selection of full articles, in English. The information extracted was taken by me. The material extracted was about study details (author, year, study design and objective), participant details (number of boys and girls, age range).

Data was extracted on method of urine collection, details on test performance, tests evaluated and definition of a positive test result. Information was obtained on the status of the patient (confirmation of UTI), the need for further investigation (to localize UTI, to detect scarring or reflux), details of the test (test evaluated, test performed, and definition of a positive test result) and results.

8. RESULTS

Figure 1 Flowchart of studies included
The literature searches identified over 350 references, being 88 of them from online databases and the remaining 262 are part of reference lists of other articles. A screening process proceeded and 34 studies were considered potentially relevant. Studies were excluded due to some articles being too old, others because I could not assess full articles and various studies were not suitable to be included in this review. Studies that do not meet the following inclusion criteria: children with urinary catheters in situ, with neurogenic bladders, already known pre-existing uropathies or underlying renal diseases and immunosuppressed children were excluded. Also, studies assessing diagnostic test of children older than 5 years old.

A total number of 15 studies met all the requirements of the inclusion criteria necessary for this research.

8.2 Symptoms and signs
3 studies included data on symptoms and signs in children presented with UTI.
One systematic review based in a paediatric emergency departments in Australia indicates that 5% febrile infants (0-2months) had a UTI and identified UTI in 3.3% of children with fever under 5 years old.⁴

A cohort study involving 304 children, ranked by frequency of occurrence, the clinical features of children under 5 years old with symptomatic UTI⁵. Fever (242), irritability (159), anorexia (148), lethargy (135), vomiting (127), diarrhoea (63), dysuria (45), abdominal pain (40), frequency (29).
A systemic review identified 2 studies which intent to diagnose UTI⁷. One selected children with a temperature ≥38°C or other symptoms of UTI. Showed a sensitivity less than 50% and specificity only 56%. The other study included children <2years of age with unknown source of fever. This study had a sensitivity of 95% and a specificity of 31%. This article may be helpful in ruling out disease in children aged than 2 years with fever of unknown source.

8.3 Diagnosis of UTI
An Australian study involving children from The Central Sydney Area Health service(CSAHS)⁶. Children were under 5 years old who presented symptoms/signs of UTI when in the emergency department. An urine sample was taken and analysed by frequently used nonculture tests for diagnosis of UTI. The sensitivity of those tests are described in table 1.
Table 1. Sensitivity of adjunctive tests for the diagnosis of urinary tract infection in children <5 years, according to age at presentation (Craig, J C. Irwig, L M. Knight, J F. Sureshkumar, P. Roy, LP)

<table>
<thead>
<tr>
<th>Test characteristic</th>
<th>Variable</th>
<th>Age</th>
<th>Test positives</th>
<th>Test negatives</th>
<th>Totals</th>
<th>Sensitivity (95%CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Urinalysis nitrite</td>
<td>&lt; 1 year</td>
<td>59</td>
<td>94</td>
<td>153</td>
<td>39 (31-46)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥ 1 year</td>
<td>28</td>
<td>61</td>
<td>89</td>
<td>32 (22-42)</td>
</tr>
<tr>
<td></td>
<td>Leucocyte esterase</td>
<td>&lt; 1 year</td>
<td>133</td>
<td>21</td>
<td>154</td>
<td>86 (81-92)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥ 1 year</td>
<td>75</td>
<td>15</td>
<td>90</td>
<td>83 (74-90)</td>
</tr>
<tr>
<td>Pyuria</td>
<td>&gt;10 x 10^6/L</td>
<td>&lt; 1 year</td>
<td>160</td>
<td>35</td>
<td>195</td>
<td>82 (77-87)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥ 1 year</td>
<td>109</td>
<td>10</td>
<td>119</td>
<td>91 (84-96)</td>
</tr>
<tr>
<td></td>
<td>&gt;100 x 10^6/L</td>
<td>&lt; 1 year</td>
<td>123</td>
<td>72</td>
<td>195</td>
<td>63 (56-96)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>≥ 1 year</td>
<td>100</td>
<td>19</td>
<td>119</td>
<td>83 (75-90)</td>
</tr>
</tbody>
</table>

Cl- confidence of interval

As we can see a urinary white blood cell count >10 x 10^6/L and leucocyte esterase were the most sensitive tests.

A systemic review identified twelve studies that evaluated 16 different tests and compared the diagnostic accuracy of various methods of urine sampling\(^7\). The studies compared the analysis of clean void urine (CVU) samples using suprapubic bladder aspiration (SPA) urine sample as the reference standard. In which four studies used only culture of the two samples while one study combine culture and microscopy of both samples. The sensitivity ranges ranged from 75% to 100% and specificity varied from 57% to 100% thus being a good diagnostic tool. The study combining culture and microscopy was outlying the values obtained from the other studies demonstrating a poor performance of CVU.

A meta-analysis identified 95 studies to determine whether rapid urine test for UTI were sufficiently sensitive for diagnosis and compare accuracy of dipsticks with microscopy\(^8\). Sensitivity and specificity for microscopy for gram-stained bacteria were 91% and 96%, for unstained bacteria were 88% and 92%, for urine white blood cells were 74% and 86%, for leucocyte esterase or nitrite positive dipstick were 88% and 79%, and for nitrite-only positive dipstick tests were 49% and 98%. Microscopy for bacteria gram stain had higher accuracy than other tests.
8.4 Further investigations of UTI

A cohort study involving 43 children between 1 month and 5 years old, with their first febrile episode of UTI, was undertaken in India between the years of 2011 and 2013. To identify the best imaging method to diagnose and grade VUR, which is detected in 30 to 70% of these children. 22 children (51%) had VUR. Eleven out of 14 presented dilating VUR and five out of seven children with bilateral VUR were below 2 years of age. In addition, abnormal dimercaptosuccinic acid (DSMA) scan was found positive in 21 patient. All children with dilating VUR had a positive early DSMA scan positive. The accuracy rate for the presence of VUR with a positive DMSA scan was 74%.

A systematic review reported that renal ultrasonography has a lower sensitivity for diagnosing pyelonephritis than DSMA. DSMA identified 40-92% of the patients to only 20-69% of patients identified in renal ultrasonography.

A prospective trial (part of a multicentre, randomized clinical trial) involving 309 children, between 1 to 24 month old, evaluated whether early VCUG, renal ultrasonogram and DSMA should be obtained during the first febrile UTI as some guidelines state, with the intent of better management and outcomes in young children. For 88% of the children ultrasonography was obtained within 72 hours and results were normal. In 61% of the children pyelonephritis was diagnosed, 39% underwent VCUG, one month later, had VUR; Repeated scans were obtained, six months later, for 89% of children and renal scarring was noted in 9.5% of these children. Thus, performing ultrasonogram in the acute phase of the disease has little value. Renal scans obtained at the time of illness identified pyelonephritis and the scans taken six months later identify children with renal scarring.

9. DISCUSSION

9.1 Predisposing factor

A various number of factors were found to predispose the occurrence of UTI in children. Detection of structural abnormalities, such as, renal tract obstruction, hypoplasia or dysplasia should be identified to ensure preventing actions are taken. VUR is a common anomaly of the renal tract and with a higher incidence after the first UTI. In severe cases VUR may cause renal scarring resulting in renal dysfunction. Risk factors should be understood during history taking and physical inspection of the patient.

The review showed that the first UTI is most common in infancy and affects boys most often in the first 3 months while in girls the highest incidence is after 6 months of age. Infants more often have acute pyelonephritis or upper urinary tract infections while older children frequently have lower urinary tract infections.
9.2 Symptoms and signs
Children that visited a care centre with UTIs complaint of the following symptoms/signs: fever, lethargy, irritability, vomiting, anorexia, diarrhoea, enuresis, dysuria, frequency, abdominal pain, loin tenderness, haematuria and failure to thrive. UTI is the most probable cause of fever when there is no other site of infection and there is no other diagnosis. In infants it is very hard to diagnose UTI, since the child can’t communicate during history taking and is unable to cooperate in collecting a urine sample for analysis. However, as difficult as may be, a urine sample should be obtained to determine a diagnosis as rapidly as possible, to ensure adequate treatment is administered. A prompt management is necessary since neonates’ and infants’ immune systems are weak and a delay in the treatment may lead to severe complications. It is important to mention that symptoms or signs presented by infants and children older than 3 years older are different. Infants most commonly present symptoms, such as, fever, irritability, lethargy and vomiting. In case of children older than 3 years old symptoms or signs like fever, dysuria and frequency have the highest incidence.

9.3 Urine collection
Clean catch urine collection produces a sample with good quality for those children who are able to collaborate. For those who can’t cooperate it is difficult to obtain a sample. Urine collecting pads are an optional method for obtaining a sample, although it may be associated with higher risks of contamination. Urine collection pads showed to be better than urine collection bags because they are less unpleasant for children. In children where clean catch is not obtainable because the child is uncooperative or there is difficult in getting a sample, urine collection can be done by catheterization or SPA. These should be thought last because these tests are very unpleasant for the children.

9.4 Urine testing
To diagnose UTI there are two test which are preferable used: dipstick test and microscopy, and culture. Culture should be the test of choice because it is used to identify the pathogen and its sensitivity to antibiotics. Although, very useful, the results are not ready promptly, which in turn delays the treatment. Microscopic examination for white blood cells should not be used for the diagnosis of UTI because its accuracy is no better than that of dipstick. Plus, having the same accuracy as dipstick, it requires laboratory facilities and results are delayed.

We can observe that some rapid tests are negative in a few children with urinary tract infection and therefore cannot replace urine culture. Microscopy examination of the urine for detection of bacteria after gram stain is the most accurate test, leaving aside cultures, and therefore should be used as always as possible. Moreover, if decisions falls on dipstick tests for nitrite and leucocyte esterase, these should
be used in combination, because provides more accurate results. Whenever, only of them can be used, leucocyte esterase should be preferred for the reason that is most accurate of the two.

9.5 Further investigations of diagnosis

The sensitivity of ultrasound in detecting VUR and renal scarring is inferior to that of VCUG and DSMA renal scan, nevertheless ultrasound remain as a routine test in first time UTI because it can show asymmetric kidney size, hydronephrosis and duplex kidneys. Nevertheless, ultrasound as a lower sensitivity when it comes to diagnose acute pyelonephritis when compared to other imaging tests. A systematic review identified a study from France showing that 93% of children with acute pyelonephritis had an abnormal DMSA scan. And other studies reported 42 to 86% abnormalities in DSMA scan along with the suspicion of acute pyelonephritis. Also, there were studies proving that is likely to be positive in older children than infants with both carrying acute pyelonephritis. Based on a study assessing imaging test for evaluation of UTI\textsuperscript{15}, DSMA scans should be used with other imaging test because there are some drawbacks in image analysis, such as, in inactive lesions like cysts or tumours have the tracer uptake lowered and obstructed kidney may accumulate radiotracer in its collecting system. Despite these inconveniences, DSMA scan has an excellent detection rate for the diagnosis of acute pyelonephritis. Due to the rapid response to antibiotic therapy against clinical diagnosis of acute pyelonephritis, DSMA scan should be done as soon as possible because positives studies will decrease. It is recommended by NICE guideline 47 to have DSMA scintigraphy scan done for all children of all ages, with the exception of those who respond well to treatment within 48 hours. It is essential to diagnose VUR because it is considered a risk factor for renal scarring and further renal dysfunction. Based on NICE clinical guidelines 47, MCUG to detect VUR is not routinely recommended for infants younger than 6 months who had a UTI unless the repeated ultrasound, after 6 weeks, is abnormal, is an atypical or recurrent UTI; If the children are older than 6 months but younger than 3 years, MCUG is only considered if there is a dilation on ultrasound, poor urine outflow, non E-coi infection, a family history of VUR; Children older than 3 years of age are not recommended undergoing a MCUG for detection of VUR.

10. CONCLUSION

After concluding this review, I realized that one of the struggles was to find numerous articles assessing imaging test for UTI. The number of papers screened, although to many for one person to review, were definitely not enough to produce a high level evidence study. I encountered various studies which I was unable to get the full article because paying fees subscriptions were mandatory. To develop a systematic
review with scientific relevance a number of different parameters are necessary to take into account to properly select high evidence level articles, which is a hard task to do. Passed all difficulties I was able to achieve all my objectives. The method with better-quality, cheaper and most pleasant for the child is the clean catch urine sampling. If the child is uncooperative, a urine collecting pad may be used but it is associated with some risk of contamination. SPA is used, just in case, of non-invasive methods are impractical. A urine test should be done within 24 hours for those infants and children with unexplained fever of 38°C or higher. If there is an alternative for the site of infection no urine test is required. However, if it remains unwell a sample of urine should be taken for analysis within 24 hours. No rapid urine test is sufficiently sensitive to identify all children with urinary tract infection without the need for urine culture. If culture it is unobtainable, detection of bacteriuria by microscopy gram stain should be the test of choice, for rapid results and to guide the empirical treatment of children with antibiotics.

During the acute infection phase children with atypical UTI should have an Ultrasound (US) made to assess structural abnormalities of the urinary tract, to ensure an immediate treatment. Atypical UTIs are defined by the following features: the child has a poor urine outflow, presence of an abdominal mass or abscess, increased creatinine, signs of septicaemia, when there is an unresponsive patient to the treatment to suitable antibiotics within 48 hours and if the infection is caused by non-Escherichia Coli (E.coli) organisms.

DMSA scintigraphy scan is the imaging test to detect acute pyelonephritis, although, it is not used as first line test for the diagnosis of UTI according existing guidelines.

Management and diagnosis of UTI remains an important subject for further investigations, due to the lack of consensus on the matter. Different countries apply different methods of diagnosis and different tactics of management for UTI.

11. PRACTICAL RECOMMENDATIONS

11.1 Symptoms and signs

Infants and children presenting with unexplained fever of 38°C or above with no other site of infection should have a urine sample tested after 24 hours.

If the infection has another source of infection a urine sample should not be tested.

Children showing signs or symptoms suggesting UTI should have a urine sample tested. Symptoms suggesting UTI are, from the most common to the least, the following: fever, irritability, anorexia, lethargy, vomiting, diarrhoea, dysuria, abdominal pain and frequency. Physicians should take into account that presented symptoms are different in infants and children older than 3 years old. According
Urinary tract infection in children the most common symptoms or signs in infants younger than 3 years old are the following fever, lethargy, irritability and vomiting, being abdominal pain, jaundice, haematuria and offensive urine the least common symptoms. For children older than 3 years old, fever, dysuria and frequency are the most frequent symptoms or signs.

11.2 Urine collection
Clean catch is the best urine collecting method to obtain a quality sample. If the child is not toilet trained, collecting pads or bags are recommended. Cotton wool balls, gauze and sanitary towels are not recommended as a urine collecting method. These methods are associated with high contamination rates and therefore, have influence on the results of the urine analysis. Note that when collecting pads or bags are used, the patient needs to follow the instruction of the manufacturer. If a urine sample is not collectable by non-invasive methods, catheter samples or SPA are advised. In case of SPA, an ultrasound should confirm presence of urine in the bladder.

11.3 Urine testing
For infants and children younger than 3 years old, with suspected urinary tract infection, a urine sample should be obtained and sent to urgent microscopy and culture. This is, because this group of children are at higher risk of mortality. Antibiotic treatment must not be delayed, should be started as soon as possible. Although GDC recommends microscopy to base diagnostic’s decision, this group of children with non-specific symptoms can use dipstick test when urgent microscopy is not present. If both leucocyte esterase and nitrite are positive the child should be regarded as having UTI and antibiotic treatment should be initiated. According, NICE guidelines, if nitrite is positive and leucocyte esterase is negative, antibiotic treatment should be started and a urine sample should be obtain and sent to culture. However, if leucocyte esterase is positive and nitrite is negative, antibiotic treatment should be delayed until after urine’s culture results are out, because leucocyte esterase may be indicate an infection outside the urinary tract. Cultures is beneficial and important in detecting the pathogen’s sensitivity and sensibility. Despite being the method that provides most information, it is not always performed. This is, due to the extend time it takes for the results of the culture to be out, which is always after 24 hours. Nevertheless, urine samples should be sent for culture if the child has a recurrent UTI, if does not respond to treatment within 48 hours, if acute pyelonephritis or upper urinary tract infection is diagnosed, if the child is severely ill, if both leucocyte esterase and nitrite dipstick tests are positive.

11.4 Imaging investigation
The goal of imaging is to identify structural abnormalities of the urinary tract. This is to prevent recurrent infections or renal damage.
An ultrasound should be carried out in infants younger than 6 months, that do not respond well to treatment within 48 hours or in the presence of atypical and recurrent infections. Also, used as follow up, within 6 weeks to those children responding well to treatment. A DSMA should be performed after months to children with atypical and recurrent UTI to identify possible renal parenchyma defects. However, if the child has a UTI within this 6 months, DMSA should be schedules earlier.

MCUG is performed to evaluate VUR. Should not be routinely done. In case of atypical or recurrent infection should be performed. Also, should be performed in cases that US findings are abnormal, for example dilatation is seen. When there is poor urine outflow, non E.coli infection, and family history of VUR, MCUG should be performed.

Magnetic resonance imaging (MRI) is a method that might be useful in recognizing renal parenchymal defects, but future studies are required to support the diagnostic importance of this imaging investigation.
12. REFERENCES


12. full-text.


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