Childhood urinary tract infections: an evidence-based approach

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Abstract

Urinary tract infections (UTIs) are a common childhood problem and a frequent reason for presentation in both primary care and hospital settings. Severity ranges from simple cystitis to pyelonephritis; symptoms may be typical of urinary tract infection or may be non-specific. Decision-making can be challenging in the acute setting and when planning follow-up. Clinicians need evidence to correctly answer questions such as: What method of sampling is most reliable? Can I rely on dipstick urinalysis to diagnose a UTI? Are infants particularly at risk of meningitis during UTI and should I obtain cerebro-spinal fluid and what imaging will aid my management of this child? Even experienced clinicians vary in their answers to these clinical questions. Through a case-based approach, this article aims to help clinicians make these decisions, highlighting well-established guidance, in addition to newly published evidence.

Keywords Childhood UTI; evidence based medicine; imaging; long-term follow up; urinalysis dipsticks; urine sampling

Introduction

It's 7 pm and you are the paediatric registrar on call in a busy district general hospital. You receive a call from a GP working in the local out-of-hours centre. She would like some advice about a 4 month-old boy who has been vomiting and was unsettled earlier in the day. His parents felt that he was hot to touch and recorded a temperature of 39.1 °C at home with a forehead thermometer. The infant has now settled with some paracetamol but is feeding less than usual, and the GP has recorded the temperature as 38.5 °C with a tympanic thermometer. The family have tried to catch a urine sample but missed twice.

What advice can you give the GP?

Management of the febrile child

Fever in under 5's: assessment and initial management (NICE Clinical Guideline CG160)

This infant has an unexplained fever of more than 38 °C and NICE guidance is available to guide management. Of particular importance is the initial detection of life-threatening features. Once a diagnosis has been made, then appropriate condition-specific management can be initiated.

Recording temperature

Measuring temperature in young children is an essential component of the initial assessment. Parents will often report that a child "feels hot" and this perception should be taken seriously. However the gold standard is an infra-red tympanic thermometer, chemical dot thermometer or electronic thermometer placed in the axilla. Forehead chemical thermometers are unreliable and should not be used by healthcare professionals.

Categorization of risk: the "traffic light" system

Triage and management of children with fever should be directed by their risk of serious illness i.e. whether they are green (low risk), amber (intermediate risk) or red (high risk)

Height of the fever should not be used in isolation in older children to identify those with serious illness but it is worth remembering that:

- infants under 3 months of age with a fever over 39 °C are at high risk of serious illness
- children between 3 and 6 months of age with fever are at least in the intermediate risk group for serious illness.

Vomiting and reduced feeding are non-specific symptoms, but in an infant these put the child at least at intermediate risk of serious illness.

Clinicians should also look for signs suggestive of specific diseases such as meningococcal sepsis, meningitis and urinary tract infection (UTI).

Triage and assessment

You agree with the GP that the child should attend your hospital for review. The GP feels that the infant is currently well enough to travel with his parents in the family car and does not need an ambulance. The family arrives at the children's admission unit at 8:30 pm.

The nursing team triages the infant and find that he is febrile at 38.8 °C, measured with an axillary thermometer and report that he was unsettled on examination. His heart rate is 165/minute and respiratory rate is 50/minute, his saturations are 98% and his blood pressure is 95/55 mmHg.

After triage, you take a history from the parents and begin your assessment. Bobby was born at full term after an uncomplicated pregnancy with normal antenatal scans. He has been growing well, with no other medical problems since birth. When he urinates he has a good stream. The rest of the family is well although his 4 year-old sister has a viral upper respiratory tract infection and likes to cuddle Bobby a lot. On examination, he is now settled with Mum. He is mildly coryzal but has a clear chest and aside from his fever and heart rate has an otherwise normal examination. He is moving his legs well and has a soft abdomen with no masses. He is not irritable or mottled and is well-hydrated.

In summary, you have a febrile infant with intermediate risk of serious illness and no clear source of infection. You are considering a possible diagnosis of UTI so you decide to do a partial septic screen and obtain a urine sample. Unfortunately, whilst you are putting an iv cannula into Bobby, a clean-catch urine is missed.

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Consultant telephone call and consideration of UTI

At this point you get a call from the paediatric consultant on call, who would like an update on their patients. With regard to Bobby, your consultant feels that a urine sample is essential this evening and advises that if you can't get a clean catch, you obtain a sample by suprapubic aspiration. When the procedure is explained to the parents, they are reluctant to go ahead. They would like to know if this approach is really necessary and whether another method can be tried instead.

Urine sampling methods

Waiting for a urine sample in a small child can be a frustrating time for children and parents in hospital or the local practice. NICE guidance (CG54) recommends collecting a urine sample by the clean catch method but if this is unobtainable, non-invasive methods such as urine collection pads may be used. If this is not possible, then invasive measures such as urethral catheterization or suprapubic aspiration may be used.

In 2011, the American Academy of Paediatrics (AAP) updated its guidance on urinary tract infections in children aged 2—24 months. They recommend only suprapubic or catheter samples be used due to concerns over high rates of contamination from bag samples in this age-group. An associated technical report noted that, compared to suprapubic aspiration, catheterization was associated with greater success rates in obtaining samples, lower pain scores and was both highly sensitive (95%) and specific (99%). Bag samples have an unacceptable high false positive rate and can only be used to rule out a UTI. Unfortunately no mention is made of clean catch or nappy pad samples.

A large UK primary-care study on urine collection in acute unwell children under 5 years of age has shown a higher contamination rate of 12.2% for nappy pads compared to clean catch samples (1.3%)

Urine dipstick and microscopy results

You persist with the clean catch method and obtain a urine sample. Dipstick urinalysis is strongly positive for leucocyte esterase but negative for nitrites. You send the urine to the laboratory and, as urgent microscopy shows pyuria. You decide this is enough evidence of a urinary tract infection to start IV antibiotics as Bobby has had a number of vomits.

Interpretation of urine results in young children (NICE & AAP)

Dipstick urinalysis

Dipstick urinalysis is inexpensive and results are interpretable within minutes. However, caution should be used when using these tests in small children.

Nitrites are produced when bacteria convert urinary nitrates to nitrites. Urine may require an incubation period before nitrites are detectable on dipstick. In small children who empty their bladder frequently, this may result in lower test sensitivity. This test is very specific however, so if nitrites are present in a clean catch sample, infection is highly likely.

Urinalysis detects leucocyte esterase, the enzyme produced by leucocytes and has good sensitivity where UTI is likely. However, its specificity is lower because other conditions may cause leucocytes to be present in the urine e.g. streptococcal infections, Kawasaki disease or even exercise.

Urine microscopy

In the child presenting with features of UTI:

- bacteriuria indicates likely UTI and antibiotics should be started
- pyuria on microscopy indicates likely UTI

In **afebrile**, **asymptomatic** children, bacteriuria without pyuria suggests asymptomatic bacteriuria, which is more common in school-aged girls but also found in infants.

Urine culture

In general, genuine UTIs will yield a pure growth of a single urinary pathogen on urine culture. Exact concentrations of colony-forming units (CFUs) depend on the method of sampling, time urine has spent in the bladder and other factors. Mixed growth or skin flora usually indicates contamination.

Your SHO asks whether you plan to do a lumbar puncture (LP) as he has heard of infants with *Escherichia coli* meningitis following urinary sepsis. During your assessment, you feel that Bobby had no signs of meningitis or sepsis and appeared more settled than at triage so you decide that there is currently no indication for LP.

LP in infants with urinary tract infections

A diagnosis of meningitis or encephalitis should be considered in any febrile child. Young infants can be challenging to assess and clinicians are rightly concerned not to miss this serious diagnosis. The decision to obtain cerebrospinal fluid (CSF) via LP should be considered with care as the procedure is not without risk and can be traumatic for both child and family.

NICE advise that LP should be considered in:

- children of all ages who have high risk (red) features and its use should be guided by the clinical assessment.
- children under 1 year who have fever without apparent source with one or more intermediate (amber) features, unless deemed unnecessary by an experienced paediatrician.

Clinicians are often concerned about the possibility of bacteraemia and subsequent meningitis in young infants with a febrile urinary tract infection. Whilst is it generally accepted practice to perform a full septic screen including LP in febrile neonates, there is a wide variety of practice when treating older infants.

Schnadower et al retrospectively studied 1895 infants between the age of 29 and 60 days of age. Infants were assigned "low risk" status if they appeared well, were not dehydrated, were not in respiratory distress, had no concomitant high-risk disease and had no high-risk features in their medical history. Of 1206 "low-risk" infants, only 1 (0.1%) had possible meningitis and even this result was not definitive.