Archives of Pediatrics and Neonatology

ISSN: 2638-5155 | Volume 4, Issue 1, 2021

DOI: https://doi.org/10.22259/2638-5155.0401005

Imaging of Children with a Urinary Tract Infection in North East England

EM Strehle[1,2]*, MP Kallingal[1], AM Ellis[2]

[1]Child Health Business Unit, Northumbria Healthcare NHS Foundation Trust, North Shields, United Kingdom.

[2]The Medical School, Newcastle University, Newcastle upon Tyne, United Kingdom.

***Corresponding Author:** Dr. EM Strehle, Consultant Paediatrician, North Tyneside General Hospital, North Shields NE29 8NH, United Kingdom.*

Abstract

***Objective:** To assess the outcome of children with a UTI who were investigated according to a guideline specific to the north east of England. The regional paediatric UTI guideline is more rigorous than the NICE guideline CG54 in relation to imaging investigations.*

***Design:** Retrospective clinical audit.*

***Setting:** Specialist emergency care hospital in Northumberland.*

***Patients:** Children between 0 and 15 years.*

***Results:** Ninety urinary tract infections occurred in 83 children during an 8-month-period. The commonest organism was E. coli (83%). Fifty-four percent of E. coli were resistant to at least one antibiotic. Forty-one percent of children received antibiotic prophylaxis after completion of treatment. Seventy-one children (86%) had a renal and bladder ultrasound scan, 43 children had a kidney DMSA scan and 28 had an MCUG.*

***Conclusion:** According to the regional UTI protocol, the 83 children should have had 176 scans (USS, DMSA, MCUG) but they only had 142 scans (81%). Twenty-one scans (15%) showed an abnormality of the renal tract. These real-world data emphasize the importance of imaging investigations in children with a UTI and the need for a user-friendly guideline.*

Introduction

Urinary tract infections (UTIs) are one of the most common causes why children are brought to their family doctor or the emergency department. The diagnosis is usually made after a clinical assessment and a urine dipstick analysis positive for leukocyte esterase and nitrite. Urine samples should be obtained via the 'clean catch' method to avoid contamination. An antibiotic is often prescribed before a urine culture result is available which can take up to 48 hours.[1] It is widely accepted that children require imaging studies of the renal tract following a UTI but controversy exists over the timing, type and number of investigations depending on the child's age, severity of illness and causative organism. Imaging studies are necessary to early identify children with an underlying structural abnormality of the renal tract which can make them prone to UTIs, e.g. vesicoureteric reflux (VUR).[2] Some children with undetected renal tract abnormalities develop chronic kidney disease (CKD) as adults, and may go on to require renal dialysis. In 2007, the National Institute for Health and Care Excellence published the detailed guideline 'Urinary tract infection in under 16s: diagnosis and management' (CG54).[3] This document received mixed reviews due to its complexity, significant changes of previous practice, and perceived lack of evidence.[4] Nevertheless, CG54 was adopted by paediatricians throughout the United Kingdom, with exception of the north east of England. In this region, an older, more practical model is followed which is likely to detect structural urinary tract abnormalities earlier but, at the same time, exposes more children to diagnostic radiation (Fig. 1).[5] Here, the results of an audit on paediatric UTI management in a specialist emergency care hospital in Northumberland (NSECH) applying this memorable algorithm, are presented.

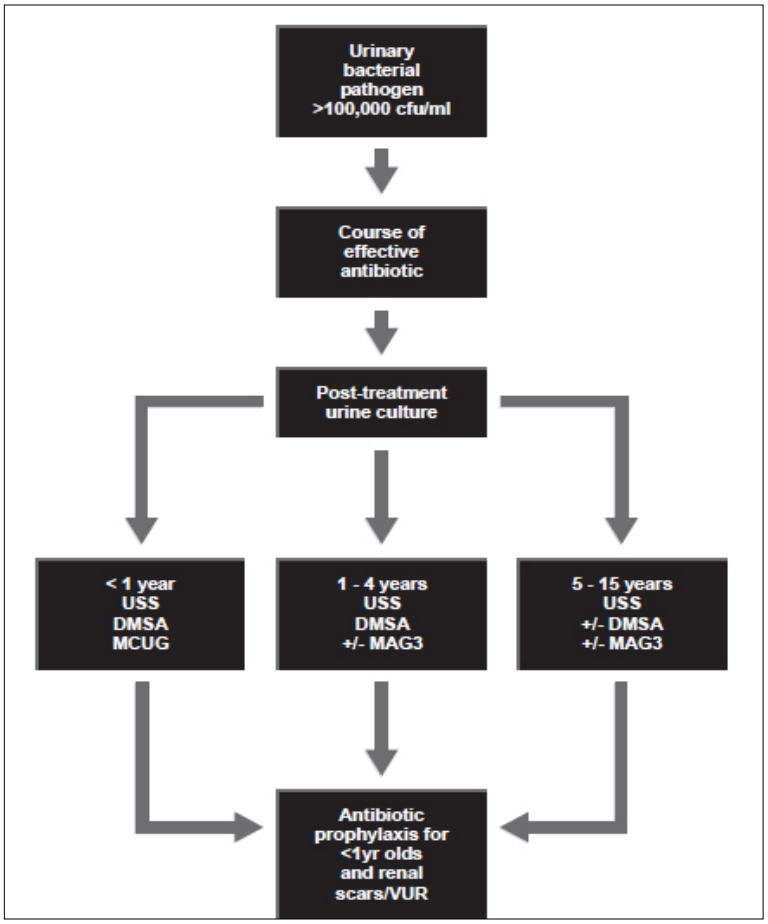

Fig1. *Flow chart depicting the clinical management of children with a UTI in the north east of England with particular emphasis on imaging studies (cfu/ml: colony-forming units per millilitre; USS: renal and bladder ultrasound scan; DMSA: dimercapto succinic acid kidney scan; MCUG: micturating/voiding cysturethrogram; MAG3: mercaptoacetyltriglycine renogram and indirect cystogram; +/-: optional investigation)*

Methods

This retrospective study was registered as a clinical audit (C3743) with the audit department of Northumbria Healthcare NHS Foundation Trust, and Caldicott approval (WO19599) was obtained. Formal ethics approval was not required. Children, who presented during an 8-month period to the paediatric emergency department and who were investigated for a possible UTI with a urine culture, were eligible for inclusion into this study. They were identified through the jobs list on the daily paediatric handover sheet. If a UTI was confirmed, further test results and other relevant data were collected from hospital databases and compiled on an Excel spreadsheet. Raw data were analysed using descriptive statistics.

Results

There were 90 recorded urinary tract infections between 1st July 2020 and 28th February 2021. Seven children (2 males, 5 females) had two infections in this time, so there was a total of 83 children. The mean age was 44 months (3.7 years), and the range was 0 to 188 months. In total there were 20 males (24%) and 63 (76%) females. *Escherichia coli* (*E. coli*) was the causative organism in 75/90 (83%) of the infections, three of these cultures grew a second organism. The other 15 infections were caused by organisms including *Pseudomonas aeruginosa, Group B streptococcus, Enterococcus faecalis, Staphylococcus aureus, Staphylococcus epidermidis, Klebsiella pneumoniae and Staphylococcus haemolyticus*. Sixty-five UTIs (72%) were treated with oral antibiotics and 21 (23%) with parenteral and oral antibiotics. Two patients received only parenteral antibiotics and two were not treated. Due to three of the cultures growing two different organisms there were 93 organisms in total; of these 50/93 (54%) were resistant to at least one antibiotic and 24 (26%) of these were resistant to more than

one antibiotic. Thirty-six organisms (39%) were resistant to Amoxicillin and 30 (32%) were resistant to Trimethoprim. Thirty-four of the 83 patients (41%) were on antibiotic prophylaxis, at least until their imaging investigations were completed. Eighteen children were on Trimethoprim, 14 on Cefalexin and two on Nitrofurantoin. Sixty-four had their first ultrasound scan and seven already had one following a previous UTI, therefore 12 children did not have an ultrasound scan. Eleven patients were found to have an abnormality on the ultrasound scan, for instance hydronephrosis or pyelonephritis. Twenty-eight children had an MCUG, seven of these were found to have unilateral or bilateral vesicoureteral reflux (up to grade IV). Forty-three children had a DMSA scan, and three of those revealed renal scarring of varying degree (Fig. 2).

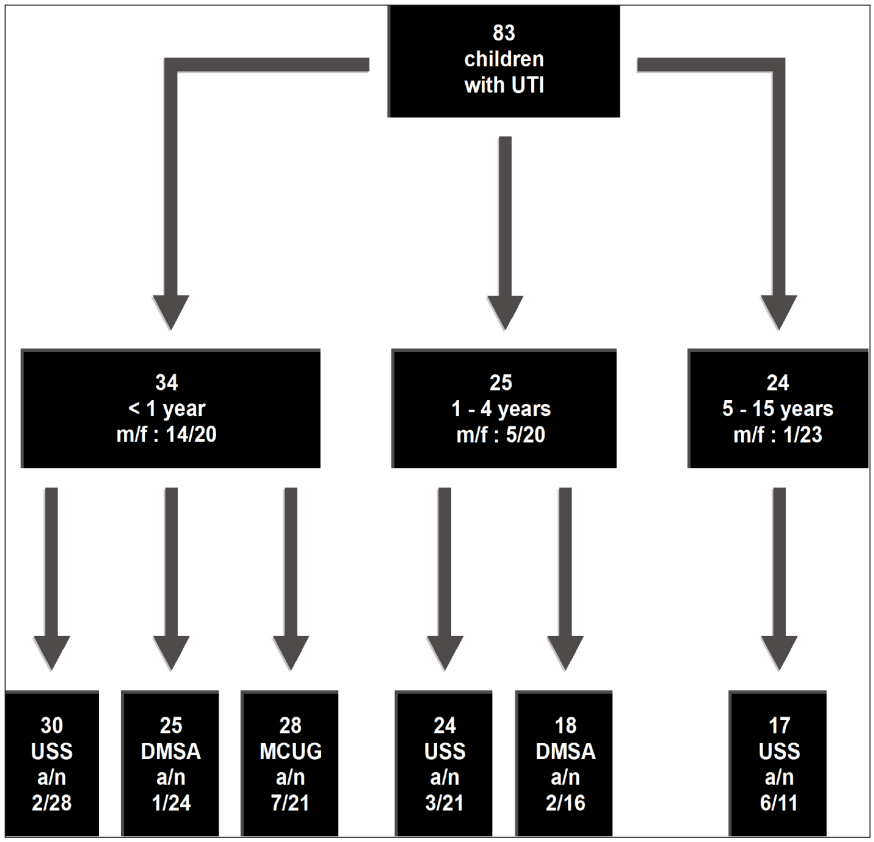

Fig2. *Diagram showing the imaging investigations performed on 83 children following treatment for a urinary tract infection in Northumberland (m/f: male/female; USS: renal and bladder ultrasound scan; DMSA: dimercapto succinic acid kidney scan; MCUG: micturating/voiding cysturethrogram; a/n: abnormal/normal)*

Discussion

This clinical audit provides real-world-data regarding the application of a UTI guideline specific to the north east of England. As well-documented in the literature, there was a female preponderance among these patients.[2] Most UTIs were caused by *E. coli* (83%), and over half of the pathogens (54%) were resistant to at least one antibiotic. When comparing the three age bands (< 1 year, 1-4 years, 5-15 years), the largest number of UTIs (41%) was diagnosed in the first year of life. According to figure 2 the 83 patients should have had a total of 176 urinary tract scans (USS, DMSA, MCUG) but they only had 142 scans (81%) which could have a number of reasons, for instance parental choice, conscious medical decision, technical difficulties or human error. Of these scans, 21 (15%) were reported as showing an abnormality of the renal tract. Forty-one percent of children were on antibiotic prophylaxis (28 < 1-year-old, 6 > 1-year-old). In infants, prophylaxis was commenced after finishing the UTI treatment and reviewed when the results of the imaging studies were available. Older children were prescribed a prophylactic antibiotic if they had significant renal scars, VUR or frequent recurrence of infection. No MAG3 scan (indirect radionuclide cystogram) was performed in this cohort. This technique can be used in older children to exclude VUR.

Over the last two years there has been a surge of high-quality reviews and guidelines on the management of UTI in children from Australia, the United Kingdom, Switzerland, Sweden and the United States which all have their merit and idiosyncrasies.[6-10] They all aim to diagnose and treat childhood UTIs promptly, detect underlying structural anomalies early and prevent kidney injury. Considering that theory and practice, as shown here, often differ, it seems prudent to err on the side of caution as far as diagnostic imaging following a paediatric UTI is concerned. A guideline that is easy to follow is more likely to be adhered to by busy healthcare professionals.

Acknowledgments

We would like to thank the doctors and nurses who looked after the young patients included in this study.

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Citation: **EM Strehle, MP Kallingal, AM Ellis.** *Imaging of Children with a Urinary Tract Infection in North East England. Archives of Pediatrics and Neonatology. 2021; 4(1): 29-32.* DOI: https://doi.org/10.22259/2638-5155.0401005