A Study of Bacteruria In Giza School children Using Simple Screening Tests

Thesis

submitted for partial fulfillment of Master degree in pediatrics

By

Ahmed Salah Younes

M.B., B.Ch., 2002

Benha University, Faculty of Medicine

Under Supervision of

Prof. Dr. Magid Ashraf Abdel-Fattah

Professor of Pediatrics

Ain Shams University, Faculty of Medicine

Assist. Prof. Dr. Ahmed Abdullah Mohammed

Assistant Professor of pediatrics

Ain Shams University, Faculty of Medicine

Assist. Prof. Dr. Ayman Asaad Ibrahim

Assistant Professor of Microbiology & Immunolog

Ain Shams University, Faculty of Medicine

Faculty of Medicine

Ain Shams University

2011

دراسة بكتيريا المسالك البوليه في أطفال المدارس بمحافظة الجيزه بإستخدام فحوصات معملية بسيطة

رسالة

توطئة للحصول على درجة الماجستير في طب الاطفال

مقدمه من

الطبيب / أحمـد صـــلاح يونــس

بكالوريوس الطب والجراحة

كلية الطب- جامعة بنها

تحت إشراف

الأستاذ الدكتور / ماجــد أشـــرف عبـد الفتــاح

أستاذ طب الأطفال

كلية الطب- جامعة عين شمس

دكتور / أحمــد عبــد الله محمــد

أستاذ م. طب الأطفال

كلية الطب- جامعة عين شمس

دكتور / أيمــن أسعــد إبراهيـــم

استاذ م.الميكروبيولوجيا الطبيه والمناعه

كلية الطب- جامعة عين شمس

كلية الطب

جامعة عين شمس

٢٠١١

Contents

List of Abbreviations

AAP	**:**	American academy of pediatrics
ABU	**:**	Asymptomatic bacteruria
CFU	**:**	Colony forming units
CLED agar	**:**	Cystine –Lactose-Electrolyte-Deficient agar
CXR	**:**	chest X-ray
DMSA	**:**	Dimercaptosuccinic Acid
ESRD	**:**	End stage renal disease
GFR	**:**	Glomerular filtration rate
IVP	**:**	Intravenous Pyelography
LE	**:**	Leukocyte esterase
TMP – SMZ	**:**	Trimethoprim-Sulfamethoxazole
UPEC	**:**	UropathogenicEscherichia coli
UTI	**:**	Urinary tract infection
VUR	**:**	Vesico-Ureteric Reflex

List of Tables

List of Figures

Introduction and Aim of work

Urinary tract infection (UTI) in infancy and childhood can interfere with kidney function and growth. This may explain some of the clinical problems such as polyuria and electrolyte disturbances encountered during infection as well as some of the long term complications in childhood ***(Verrier – Jones, 2005).***

Urinary tract infections in children are probably the most common bacterial infections. However, urinary tract infection continues to be underdiagnosed, despite its association with renal scarring and thus hypertension, renal failure and other sequalae. Low detection reflects the varied difficulties encountered when establishing a diagnosis, some of which could be eliminated by a simple and reliable method for preliminary investigation of children's urine screening. Prevention of asymptomatic bacteruria, pyelonephritis and renal scarring is widely recommended ***(Rushton, 2002).***

There are several rapid tests for the detection of UTI in children. These include Leukocyte esterase, nitrate test and catalase test. Dipstick urine analysis was considered an adequate screening tool in UTI cases. However, caution must be taken in interpreting factors that could affect the results of urine dipstick. Also, leukocyte esterase dipstick urine test was considered as a useful screening test that could be used in population based studies ***(Abu Ghoush, 2008).***

The aim of this study is to assess the prevalence of significant bacteruria in school children in Giza governorate using simple methods for testing urine and comparing the results with those of standard urine culture techniques.

Prevalence of Bacteruria and UTI

Definition

The term bacteriuria refers to the presence of bacteria in urine. It implies that these bacteria are from the urinary tract and not contaminants from the skin, vagina or the prepuce that have been added to sterile urine. The term includes renal and bladder bacteriuria. Bacteriuria can occur with or without pyuria ***(Schaeffer, 2007).***

Significant bacteriuria is defined as the presence of 100,000 or more of the same organism per ml of clean catch midstream urine sample ***(Cattell, 2005).***

Prevelance

Urinary tract infections (UTIs) occur in 3-5% of girls and 1% of boys. In girls, the first UTI usually occurs by the age of 5 yr. After the first UTI, 60-80% of girls will develop a second UTI within 18 months. In boys, most UTIS occur during the 1st yr of life; UTIs are much more common in uncircumcised boys. The prevalence of UTIs varies with age. During the 1st yr of life, the male: female ratio is 2.8-5.4: 1. Beyond 1.-2yr, there is a striking female preponderance, with a male: female ratio of 1: 1 0.

UTIs are caused mainly by colonic bacteria. In females, 75-90% of all infections are caused by Escherichia coli, followed by Klebsiella spp. and Proteus spp. Some series report that in males older than 1 yr of age, Proteus is as common a cause as E. coli; others report a preponderance of gram-positive organisms in males. Staphylococcus saprophyticus and enterococcus are pathogens in both sexes. Viral infections, particularly adenovirus, also may occur, especially as a cause of cystitis. UTIs have been considered an important risk factor for the development of renal insufficiency or end-stage renal disease in children. Some researchers have questioned the importance of UTI as a risk factor, because only 2% of children with renal insufficiency report a history of UTI. This paradox may be secondary to better recognition of the risks of UTI and prompt diagnosis and therapy ***(Elder, 2007).***

Pathogenesis Of Urinary Tract Infection

In majority of patients, UTIs are the result of colonization of urine with fecal bacteria, which grow aerobically (***Ragnar, 2004).***

1- Common Organisms Causing UTI and Bacteriuria:

I -E. coli

Uropathogenic E. coli (UPEC) is responsible for approximately 90% of urinary tract infections (UTI) seen in individuals with ordinary anatomy ***(Todar, 2007).***

In community acquired infection the prevalence of E. coli is about 65 percent, while in patients with recurrent infections and in hospital inpatients the frequency of E. coli isolation is reduced to about 45 percent and the frequency of mixed infection is increased ***(Sussman, 2005).***

Uropathogenic E. coli have P fimbriae that adhere to α-D-Gal-4-β-D-Gal receptors (the P blood group) on mucosal cells in the urethra and the ureters, thus facilitating establishment of bacteriuria and further transport to the kidneys ***(Ragnar, 2004)***

Approximately 1% of the human population lacks this receptor, and its presence or absence indicates an individual's susceptibility to E. coli urinary tract infections. Uropathogenic E. coli produce alpha- and beta-hemolysins, which cause lysis of urinary tract cells ***(Todar, 2007)***.

They also have the ability to form K antigen and capsular polysaccharides which resist immune factors and antibiotic therapy and are often responsible for chronic urinary tract infections ***(Ehlrich et al., 2005).***

Diagnosis:

- Morphology: Gram negative bacilli, motile, some strains are capsulated.
- Cultural characters: Facultative anaerobes grow on simple media. On

MacConkey's medium, they produce rose-pink colonies due to lactose fermentation. E. coli strains causing urinary tract infection produce haemolysis on blood agar.

- Biochemical activity: Ferment glucose, lactose, maltose, mannite, sucrose and salicin with production of acid and gas. They are indole positive, Voges-Proskauer negative, Methyl Red positive and citrate, urease and H_2S negative.
- Serological characters: E. coli possess O (somatic) and H (flagellar) antigens, many pathogenic E. coli possess K (capsular) antigen. The enteropathogenic E. coli possess O antigens with numerical designations e.g. 26, 55, 111, 119…etc ***(El Mashad, 2007).***

<u>II - Klebsiellae:</u>

Klebsiellae are normal inhabitants of the intestine and respiratory tract. They are saprophytes in soil and water. Some may cause disease in man ***(El Mashad, 2007).***

Diagnosis:

- Morphology: Klebsiellae are nonmotile, rod-shaped, gram-negative bacteria with a prominent polysaccharide capsule. This capsule provides resistance against many host defense mechanisms ***(Obiamiwe &Leonard, 2009).***
- Cultural characteristics: They give pink colonies on MacConkey media ***(El Mashad, 2007).***
- Biochemical reactions: Klebsiellae are lactose-fermenting, urease-positive, and indole-negative organisms, although K.oxytoca and some strains of K.pneumoniae are exceptions. Klebsiellae do not produce hydrogen sulfide, and they yield positive results on both Voges-Proskauer and Methyl Red tests ***(Obiamiwe&Leonard, 2009).***

<u>III - Proteus:</u>

Proteus species are normal inhabitants in the human intestine. They cause infection only when they leave the intestine. Two important species are P.vulgaris and P.mirabilis ***(El Mashad, 2007)***.

Diagnosis:

- Morphology: Gram negative bacilli, very pleomorphic and highly motile ***(El Mashad, 2007).***
- Cultural characteristics: Facultative anaerobes. On nutrient agar, they give colonies which swarm in successive waves over the surface ***(El Mashad, 2007).***
- Biochemical reaction: It is oxidase-negative, but catalase- and nitrase-positive. Specific tests include positive urease (which is the fundamental test to differentiate Proteus from Salmonella) and phenylalanine deaminase tests ***(Ryan, 2004).***

IV - Pseudomonas:

The organism has a predilection to moist environments, primarily as water borne and soil borne organisms. Pseudomonas species have been found in soil, water, plants, and animals; Pseudomonas aeruginosa colonization occurs in more than 50% of humans, and is the most common pseudomonal species ***(Selina&Ralph, 2010).***

Diagnosis:

- Morphology: Gram negative motile bacilli.
- Cultural characters: Aerobe, grow on nutrient agar leading to greenish colorations of medium due to its diffusible exopigment which consists of pyocyanin (blue) and pyoverdin (yellow – green fluorescent). Cultures have sweet grape like odour. Some strains haemolysis blood.
- Biochemical activity: P.aeruginnosa is oxidase positive and does not ferement any sugar. Acid is produced from glucose by oxidation only.
- Virulence factor: Pilli, exotoxin and enzymes (elastase and protease), that facilitate invasion, exotoxin A causes tissue necrosis ***(El Mashad,***

2007).

2- Uncommen Organisms Causing UTI:

(A) Mycobacterium tuberculosis:

The spread to the kidneys from the lungs, bone or GIT foci is usually hematogenous. The true incidence of renal tuberculosis may be underestimated, because radiologic findings may be absent and diagnosis is made by urine culture. Genital tuberculosis is usually secondary to renal tuberculosis infection ***(Khan et al., 2008).***

The initial renal focus is usually a small tubercle in the glandular and cortical arterioles. With the passage of time, these lesions progress to form necrotizing lesions. The disease spreads to the renal tubules and renal medulla, in which further tubercles develop. Eventually, the kidney, may become fibrotic and scarred ***(Khan et al., 2008).***

Bladder TB is secondary to renal TB and usually starts at the ureteral orifice. It initially manifests as superficial inflammation with granulation. Fibrosis of the ureteral orifice can lead to stricture formation with hydronephrosis or scarification (ie, golf-hole appearance) with vesicoureteral reflux ***(Soliman et al., 2007).***

(B) Chlamydia and Mycoplasma:

These organisms are not routinely grown in aerobic cultures but have been implicated in genitourinary tract infections ***(Schaffer, 2007).***

(C) Gastrointestinal pathogens as:

Salmonella, Shigella and Campylobacter occasionally infect the urinary tract ***(Lohr et al., 2008).***

(D) Viral infections of the urinary tract:

Adenovirus is a cause of acute hemorrhagic cystitis and it is the only viral agent likely to be encountered as a urinary tract pathogen ***(Lohr et al., 2008).***

(E) Fungal infections of the urinary tract:

The most frequent form of fungal infections is caused by Candida species. Most such infection occurs in patients with indwelling Foley's catheter who are receiving broad spectrum antibacterial therapy and in patients with corticosteroid therapy ***(Nina et al., 2008).***

➢ Microbial Virulance Factors:-

1. Somatic (O) antigenic lipopolysaccharides (endotoxins):

Lipopolysaccharides have wide ranging activities as virulence factors and their endotoxic activity is more directly involved in the pathogenesis of urinary tract infection. In animal models endotoxins induce shedding of bladder epithelial cells. Endotoxin also interferes with ureteric peristalsis ***(Sussman, 2005).***

2. Fimbriae:

The most important mechanism for attachment of E. coli is mediated by fimbriae. P-fimbriated bacteria can bind to glycolipid receptors, which are antigens in the P blood-group system. Individuals with more such receptors available on uroepithelial cells have the highest risk of symptomatic UTI ***(Jodal, 2007).***

3. Capsular (K) Antigen:-

K antigen is a capsular polysaccharide which shields bacteria from complement lysis and enhances persistence of bacteria in the kidneys of experimental mice ***(Rushton, 2002)***

4. Adherence:

E. coli can adhere to a wide range of cells other than erythrocytes which suggests that adhesion plays a role in the colonization of epithelia and thus in virulence ***(Sussman, 2005).***

5. Resistance to the serum bactericidal effect:

In the presence of fresh human serum, many strains of E. coli are killed following activation of complement. Resistance to such killing action is another property that has been related to virulence of Gram-negative bacteria in UTI and bacteremia ***(Rushton, 2002).***

6. Haemolysins:

The relation between haemolysin production and pathogenicity of E. coli has long been recognized and the association between haemolysin production and virulence is now well established ***(Sussman, 2005).***

7. Iron Acquisition:

Most bacteria require iron for optimal growth and metabolism and have developed mechanisms to acquire iron when there is limited supply. Iron-binding capacity, mediated by proteins such as aerobactin, has also been shown to be associated with increased virulence in epidemiologic studies ***(Rushton, 2002).***

8. Urease:

P. mirabilis and P. vulgaris are known as uropathogens. They produce a powerful urease that splits urea into carbon dioxide and ammonia which is locally toxic to the kidney. It also alkalinizes the urine and has a tendency to aggregate and form infection stones (stag-horn calculi) ***(Sussman, 2005).***

- **Host Factors Associated with Urinary Tract Infection and Bacteruria**