

Assessment of the Urinary Tract Infection (UTI) in Patients Suffered from Diabetes

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Abstract

Diabetes mellitus is a major risk factor for urinary tract infections (UTIs) and is also associated with increased risk of certain complicated UTIs such as emphysematous pyelonephritis (EPN), emphysematous pyelitis (EP), emphysematous cystitis (EC), xanthogranulomatous pyelonephritis (XGP), renal/perirenal abscess, and renal papillary necrosis (RPN). Such conditions are potentially life-threatening and require prompt evaluation and management. Hence based on above findings the present study was planned for Assessment of the Urinary Tract Infection in Patients Suffered from Diabetes.

Total 50 cases diagnosed with Diabetes who have culture positive UTI were enrolled in the present study. The present study was planned in Department of General medicine, ICARE Institute of Medical Sciences and Research & Dr. Bidhan Chandra Roy Hospital, Haldia, West Bengal, India. The study was conducted from the duration of one year.

The data generated from the present study concludes that diabetes predisposes humans to the risk of urinary tract infections due to the changes in bladder function and in circulation. The high prevalence of asymptomatic bacteriuria in diabetics, this condition could represent one of the causes leading to an unexplained worsening of the glycosuria in some patients.

Keywords: Urinary Tract Infection, Diabetes, UTI, Infection, etc.

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Introduction

Urinary Tract Infections, also known as UTIs is an infection in the urinary tract that is commonly caused by microbes such as fungi, bacteria, and virus, of which, bacteria is the most common cause. A UTI can occur in any region of the urinary system and is more common in women than men. This condition can be extremely painful and can affect the bladder, kidneys, ureters and the urethra. The consequences of this condition can get serious if the UTI spreads to the kidneys.

A urinary tract infection (UTI) is an infection that affects part of the urinary tract. When it affects the lower urinary tract it is known as a bladder infection (cystitis) and when it affects the upper urinary tract it is known as a kidney infection (pyelonephritis). Symptoms from a lower urinary tract infection include pain with urination, frequent urination, and feeling the need to urinate despite having an empty bladder. Symptoms of a kidney infection include fever and flank pain usually in addition to the symptoms of a

lower UTI. Rarely the urine may appear bloody. In the very old and the very young, symptoms may be vague or non-specific. [1]

The most common cause of infection is *Escherichia coli*, though other bacteria or fungi may sometimes be the cause. Risk factors include female anatomy, sexual intercourse, diabetes, obesity, and family history. Although sexual intercourse is a risk factor, UTIs are not classified as sexually transmitted infections (STIs). Kidney infection, if it occurs, usually follows a bladder infection but may also result from a blood-borne infection. Diagnosis in young healthy women can be based on symptoms alone. In those with vague symptoms, diagnosis can be difficult because bacteria may be present without there being an infection. In complicated cases or if treatment fails, a urine culture may be useful. [2]

In uncomplicated cases, UTIs are treated with a short course of antibiotics such as nitrofurantoin or trimethoprim/sulfamethoxazole.

Resistance to many of the antibiotics used to treat this condition is increasing. In complicated cases, a longer course or intravenous antibiotics may be needed. If symptoms do not improve in two or three days, further diagnostic testing may be needed. Phenazopyridine may help with symptoms. In those who have bacteria or white blood cells in their urine but have no symptoms, antibiotics are generally not needed, although during pregnancy is an exception. In those with frequent infections, a short course of antibiotics may be taken as soon as symptoms begin or long-term antibiotics may be used as a preventive measure. [3]

Lower urinary tract infection is also referred to as a bladder infection. The most common symptoms are burning with urination and having to urinate frequently (or an urge to urinate) in the absence of vaginal discharge and significant pain. These symptoms may vary from mild to

severe and in healthy women last an average of six days. Some pain above the pubic bone or in the lower back may be present. People experiencing an upper urinary tract infection, or pyelonephritis, may experience flank pain, fever, or nausea and vomiting in addition to the classic symptoms of a lower urinary tract infection. Rarely, the urine may appear bloody or contain visible pus in the urine. [4]

In young children, the only symptom of a urinary tract infection (UTI) may be a fever. Because of the lack of more obvious symptoms, when females under the age of two or uncircumcised males less than a year exhibit a fever, a culture of the urine is recommended by many medical associations. Infants may feed poorly, vomit, sleep more, or show signs of jaundice. In older children, new onset urinary incontinence (loss of bladder control) may occur. About 1 in 400 infants of 1 to 3 months of age with a UTI also have bacterial meningitis. [5]

Urinary tract symptoms are frequently lacking in the elderly. The presentations may be vague with incontinence, a change in mental status, or fatigue as the only symptoms, while some present to a health care provider with sepsis, an infection of the blood, as the first symptoms. Diagnosis can be complicated by the fact that many elderly people have pre-existing incontinence or dementia.

It is reasonable to obtain a urine culture in those with signs of systemic infection that may be unable to report urinary symptoms, such as when advanced dementia is present. Systemic signs of infection include a fever or increase in temperature of more than 1.1 °C (2.0 °F) from usual, chills, and an increased white blood cell count. [6]

Uropathogenic *E. coli* from the gut is the cause of 80–85% of community-acquired urinary tract infections, with *Staphylococcus saprophyticus* being the

cause in 5–10%. Rarely they may be due to viral or fungal infections. Healthcare-associated urinary tract infections (mostly related to urinary catheterization) involve a much broader range of pathogens including: *E. coli* (27%), *Klebsiella* (11%), *Pseudomonas* (11%), the fungal pathogen *Candida albicans* (9%), and *Enterococcus* (7%) among others. Urinary tract infections due to *Staphylococcus aureus* typically occur secondary to blood-borne infections. *Chlamydia trachomatis* and *Mycoplasma genitalium* can infect the urethra but not the bladder. These infections are usually classified as a urethritis rather than urinary tract infection. [7]

In young sexually active women, sexual activity is the cause of 75–90% of bladder infections, with the risk of infection related to the frequency of sex. The term "honeymoon cystitis" has been applied to this phenomenon of frequent UTIs during early marriage. In post-menopausal women, sexual activity does not affect the risk of developing a UTI. Spermicide use, independent of sexual frequency, increases the risk of UTIs.[4] Diaphragm use is also associated. Condom use without spermicide or use of birth control pills does not increase the risk of uncomplicated urinary tract infection.

Women are more prone to UTIs than men because, in females, the urethra is much shorter and closer to the anus. As a woman's estrogen levels decrease with menopause, her risk of urinary tract infections increases due to the loss of protective vaginal flora. Additionally, vaginal atrophy that can sometimes occur after menopause is associated with recurrent urinary tract infections.

Chronic prostatitis in the forms of chronic prostatitis/chronic pelvic pain syndrome and chronic bacterial prostatitis (not acute bacterial prostatitis or asymptomatic inflammatory prostatitis) may cause recurrent urinary tract infections in males. Risk of infections increases as males age.

While bacteria is commonly present in the urine of older males this does not appear to affect the risk of urinary tract infections. [8]

Urinary catheterization increases the risk for urinary tract infections. The risk of bacteriuria (bacteria in the urine) is between three and six percent per day and prophylactic antibiotics are not effective in decreasing symptomatic infections. The risk of an associated infection can be decreased by catheterizing only when necessary, using aseptic technique for insertion, and maintaining unobstructed closed drainage of the catheter. Male scuba divers using condom catheters and female divers using external catching devices for their dry suits are also susceptible to urinary tract infections. [9]

A predisposition for bladder infections may run in families. This is believed to be related to genetics. Other risk factors include diabetes, being uncircumcised, and having a large prostate. In children UTIs are associated with vesicoureteral reflux (an abnormal movement of urine from the bladder into ureters or kidneys) and constipation.

Persons with spinal cord injury are at increased risk for urinary tract infection in part because of chronic use of catheter, and in part because of voiding dysfunction. It is the most common cause of infection in this population, as well as the most common cause of hospitalization. Additionally, use of cranberry juice or cranberry supplement appears to be ineffective in prevention and treatment in this population. [10]

The bacteria that cause urinary tract infections typically enter the bladder via the urethra. However, infection may also occur via the blood or lymph. It is believed that the bacteria are usually transmitted to the urethra from the bowel, with females at greater risk due to their anatomy. [6] After gaining entry to the bladder, *E. Coli* are able to attach to the bladder wall and form

a biofilm that resists the body's immune response. *Escherichia coli* is the single most common microorganism, followed by *Klebsiella* and *Proteus* spp., to cause urinary tract infection. *Klebsiella* and *Proteus* spp., are frequently associated with stone disease. The presence of Gram positive bacteria such as *Enterococcus* and *Staphylococcus* increased. The increased resistance of urinary pathogens to quinolone antibiotics has been reported worldwide and might be the consequence of overuse and misuse of quinolones. [11]

Multiple bacilli (rod-shaped bacteria, here shown as black and bean-shaped) shown between white blood cells in urinary microscopy. These changes are indicative of a urinary tract infection. In straightforward cases, a diagnosis may be made and treatment given based on symptoms alone without further laboratory confirmation. In complicated or questionable cases, it may be useful to confirm the diagnosis via urinalysis, looking for the presence of urinary nitrites, white blood cells (leukocytes), or leukocyte esterase. Another test, urine microscopy, looks for the presence of red blood cells, white blood cells, or bacteria. Urine culture is deemed positive if it shows a bacterial colony count of greater than or equal to 10³ colony-forming units per mL of a typical urinary tract organism. Antibiotic sensitivity can also be tested with these cultures, making them useful in the selection of antibiotic treatment. However, women with negative cultures may still improve with antibiotic treatment. As symptoms can be vague and without reliable tests for urinary tract infections, diagnosis can be difficult in the elderly.

A urinary tract infection may involve only the lower urinary tract, in which case it is known as a bladder infection. Alternatively, it may involve the upper urinary tract, in which case it is known as pyelonephritis. If the urine contains significant bacteria but there are no

symptoms, the condition is known as asymptomatic bacteriuria. If a urinary tract infection involves the upper tract, and the person has diabetes mellitus, is pregnant, is male, or immunocompromised, it is considered complicated. Otherwise if a woman is healthy and premenopausal it is considered uncomplicated. In children when a urinary tract infection is associated with a fever, it is deemed to be an upper urinary tract infection. [12]

To make the diagnosis of a urinary tract infection in children, a positive urinary culture is required. Contamination poses a frequent challenge depending on the method of collection used, thus a cut-off of 10⁵ CFU/mL is used for a "clean-catch" mid stream sample, 10⁴ CFU/mL is used for catheter-obtained specimens, and 10² CFU/mL is used for suprapubic aspirations (a sample drawn directly from the bladder with a needle). The use of "urine bags" to collect samples is discouraged by the World Health Organization due to the high rate of contamination when cultured, and catheterization is preferred in those not toilet trained. Some, such as the American Academy of Pediatrics recommends renal ultrasound and voiding cystourethrogram (watching a person's urethra and urinary bladder with real time x-rays while they urinate) in all children less than two years old who have had a urinary tract infection. However, because there is a lack of effective treatment if problems are found, others such as the National Institute for Health and Care Excellence only recommends routine imaging in those less than six months old or who have unusual findings. [12]

In women with cervicitis (inflammation of the cervix) or vaginitis (inflammation of the vagina) and in young men with UTI symptoms, a *Chlamydia trachomatis* or *Neisseria gonorrhoeae* infection may be the cause. These infections are typically classified as a urethritis rather than a urinary tract infection. Vaginitis may also be due to a yeast infection. Interstitial

cystitis (chronic pain in the bladder) may be considered for people who experience multiple episodes of UTI symptoms but urine cultures remain negative and not improved with antibiotics. Prostatitis (inflammation of the prostate) may also be considered in the differential diagnosis.

Hemorrhagic cystitis, characterized by blood in the urine, can occur secondary to a number of causes including: infections, radiation therapy, underlying cancer, medications and toxins. Medications that commonly cause this problem include the chemotherapeutic agent cyclophosphamide with rates of 2 to 40%. Eosinophilic cystitis is a rare condition where eosinophiles are present in the bladder wall. Signs and symptoms are similar to a bladder infection. Its cause is not entirely clear; however, it may be linked to food allergies, infections, and medications among others. [13]

A number of measures have not been confirmed to affect UTI frequency including: urinating immediately after intercourse, the type of underwear used, personal hygiene methods used after urinating or defecating, or whether a person typically bathes or showers. There is similarly a lack of evidence surrounding the effect of holding one's urine, tampon use, and douching. In those with frequent urinary tract infections who use spermicide or a diaphragm as a method of contraception, they are advised to use alternative methods. In those with benign prostatic hyperplasia urinating in a sitting position appears to improve bladder emptying which might decrease urinary tract infections in this group. [14]

Using urinary catheters as little and as short of time as possible and appropriate care of the catheter when used prevents catheter-associated urinary tract infections. They should be inserted using sterile technique in hospital however non-sterile technique may be appropriate in those who self catheterize. The urinary catheter set up should also be kept sealed. Evidence does

not support a significant decrease in risk when silver-alloy catheters are used. [15]

For those with recurrent infections, taking a short course of antibiotics when each infection occurs is associated with the lowest antibiotic use. A prolonged course of daily antibiotics is also effective. Medications frequently used include nitrofurantoin and trimethoprim/sulfamethoxazole (TMP/SMX). Methenamine is another agent used for this purpose as in the bladder where the acidity is low it produces formaldehyde to which resistance does not develop. Some recommend against prolonged use due to concerns of antibiotic resistance.[3]

Diabetes mellitus is a major risk factor for urinary tract infections (UTIs) and is also associated with increased risk of certain complicated UTIs such as emphysematous pyelonephritis (EPN), emphysematous pyelitis (EP), emphysematous cystitis (EC), xanthogranulomatous pyelonephritis (XGP), renal/perirenal abscess, and renal papillary necrosis (RPN). Such conditions are potentially life-threatening and require prompt evaluation and management. Hence based on above findings the present study was planned for Prevalence of the Urinary Tract Infection in Patients Suffered from Diabetes.

Methodology:

Total 50 cases diagnosed with Diabetes who have culture positive UTI were enrolled in the present study. The present study was planned in Department of General medicine, ICARE Institute of Medical Sciences and Research & Dr. Bidhan Chandra Roy Hospital, Haldia, West Bengal, India. The study was conducted from the duration of one year

All the patients were informed consents. The aim and the objective of the present study were conveyed to them. Approval of the institutional ethical committee was taken prior to conduct of this study.

Following was the inclusion and exclusion criteria for the present study.

Inclusion criteria: 1. Diabetic patients; 2. Sex: Both male and female; 3. Age: 18 years and above; 4. Urine culture positive cases.

Exclusion criteria: 1. Nondiabetic, 2. Pregnancy, 3. Known congenital/acquired urogenital anomaly, 4. Patients on chronic catheterization, 5. Candiduria.

Results & Discussion:

Urinary tract infections (UTIs) have been associated with diabetes for over a century. Asymptomatic bacteriuria, acute pyelonephritis and the complications of UTI are reported to be more common in patients with diabetes. [16] During the course of a lifetime with diabetes, UTIs would be ranked among the top ten concurrent or complicating illnesses by most experts and patients. [17] Diabetes is one of the top ten causes of death in the world and this fact is due especially to its complications. With the growing number of diabetic patients, the prevalence of

urinary tract infections has also increased. [18]

Hyperglycemia and hypertension is the major risk factors for initiation of chronic kidney disease but other factors, such as repeated episodes of acute kidney injury (infections, drugs, or nephrotoxins) can also contribute to its progression. [19] In diabetic patients, it is generally accepted that infections are frequent causes of morbidity and mortality. Immunologic defects contribute to the increased risk for infection: impaired neutrophil function, low levels of prostaglandin E, thromboxane B₂, leukotriene B₄, decreased T cell-mediated immune response, Other conditions such as incomplete bladder emptying due to autonomic neuropathy and high glucose concentration in the urine allow urinary colonization by microorganisms. [20] Diabetic patients are at a high risk of development of UTIs, so it is recommended that special attention is paid to them especially for the management of bacterial UTIs.

Table 1: Demographic Details

Parameters	No. of Cases
Sex:	
Males	27
Females	23
Age:	
21 – 30 years	1
31 – 40 years	3
41 – 50 years	10
51 – 60 years	15
61 & above years	21

Table 2: Distribution of gram-negative bacilli

Parameters	No. of Cases
Gram Positive	
E.coli	18
K.pneumoniae	8
P.aeruginosa	6
Citobacter spp.	3
Proteus spp.	2
Gram Negative	
E.faecalis	7
Staphylococcus aureus	4
E.faecium	2

The increased frequency of UTIs in diabetic patients is likely due to several mechanisms including the presence of glycosuria, neutrophil dysfunction and increased adherence of the bacteria to uroepithelial cells. Factors that increase the risk of UTIs in diabetes include age, metabolic control, diabetic nephropathy, autonomic neuropathy and vascular complications. [21]

Emphysematous complications in the kidney or the bladder are likely to be due to the presence of organisms that rapidly ferment glucose and produce carbon dioxide. Impaired transport of metabolic end products due to impaired tissue perfusion in diabetes may also contribute. [22]

The pathogenesis of XGP is still obscure. In this condition, renal tissue is destroyed and replaced by hard, yellow xanthogranulomatous material. Suggested etiologies of XGP include chronic renal obstruction and infection, alterations in lipid metabolism, lymphatic obstruction, and renal ischemia. Patients with XGP commonly have diabetes or immunodepression. [23-24]

Renal abscess is an uncommon infection of the urinary tract. It can develop by one of two general mechanisms: Hematogenous spread and ascending infection from the bladder. [25] Diabetes mellitus is a risk factor for the development of renal abscess in association with ascending infection. Anatomical abnormality in the urinary tract such as vesicoureteral reflux and renal stones is usually present. Perinephric abscess usually occurs because of disruption of a corticomedullary renal abscess or an obstructing renal pelvic stone. [26-27]

Urinary tract infection can be uncomplicated or complicated. Uncomplicated UTI can be asymptomatic bacteriuria, cystitis, pyelonephritis, in men and nonpregnant women, also prostatitis in

men. Complicated UTI can be symptomatic episodes of cystitis or pyelonephritis in men or women with an anatomic predisposition to infection, with a foreign body in the urinary tract, or factors predisposing to a delayed response to therapy. There can be a relapse or reinfection. A relapse is a recurrent infection with an organism similar to the pretherapy isolate, usually following persistence of the organism in the genitourinary tract. A reinfection is a recurrent infection with a new organism. The quantitative criteria of at least 10⁵ CFU (colony forming units)/mL are generally appropriate for the microbiological identification of complicated urinary infection. Bacteriuria is more common in diabetics than in non-diabetics due to a combination of host and local risk factors. [28] Some microorganisms become more virulent in a high glucose environment. Therefore, screening for UTI in diabetic patients is very important to enable bacteriuria to be properly treated. [29] There is a significant correlation between duration of diabetes and UTI. [30] Changes in host defense mechanisms, the presence of diabetic cystopathy and of microvascular disease in the kidneys may play a role in the higher incidence of UTI in diabetic patients. As diabetics are more prone to UTI, it is necessary to pay special attention to early diagnosis and treatment. [31]

Conclusion:

The data generated from the present study concludes that diabetes predisposes humans to the risk of urinary tract infections due to the changes in bladder function and in circulation. The high prevalence of asymptomatic bacteriuria in diabetics, this condition could represent one of the causes leading to an unexplained worsening of the glycosuria in some patients.

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