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STUDY ON THE INCIDENCE AND BACTERIOLOGY OF CATHETER ASSOCIATED URINARY TRACT INFECTION (CAUTI)

Microbiology

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ABSTRACT

Background : Urinary tract infection (UTI) is common ailment worldwide with female predominance. Catheter associated urinary tract infection (CAUTI) is the most common healthcare related infection commonly used in urinary obstruction and incontinence in critically ill patients with prolonged indwelling catheterization means more than 30 days, which is almost invariable in all patients within 14 days of catheterization which increases morbidity and mortality and treatment expenses. Approximately 80% of nosocomial UTI is CAUTI. CAUTI may be asymptomatic and symptomatic. 2–4% cases may develop bacteraemia. Organisms responsible for CAUTI is similar to UTI as *Escherichia coli* the commonest than proteus, Pseudomonas, Klebsiella, Enterobacter, Enterococci, Candida, Serratia and rarely with *Delftia tsuruhatensis*, *Achromobacter xylosoxidans* and few others. CAUTI can be multibacterial. In CAUTI infective organisms form biofilm and propagate from there. *E. coli* is the most common isolate of CAUTI but *Enterobacter cloacae* exhibit highest biofilm production. CAUTI organisms are more antibiotic resistance than UTI. Even due to extensive use of antibiotics now Extended Spectrum Beta Lactamase (ESBL) producing CAUTI organisms are isolated from catheter biofilm.

KEYWORDS

UTI, catheterization, CAUTI, biofilm

INTRODUCTION:

A hospital is considered as a temple of healing. People come here with a hope to get rid of their maladies and get back to the road of health and well being.

Unfortunately, sometimes the hospital itself imparts some new infection to patients, these infections are neither overtly present nor incubating at the time of admission .These result from organisms endemic to the institution and are mostly due to a breach of universal safety precautions.

This is sad and unacceptable.
Catheter associated Urinary Tract Infection (CAUTI) is one of the most common HAI(hospital acquired infection). Indwelling urinary catheters are standard medical devices utilized in both hospital and nursing home settings to relieve urinary retention and urinary incontinence. The most common urinary catheter in use is the Foley indwelling urethral catheter, a closed sterile system that is comprised of a tube inserted through the urethra and held in place by an inflatable balloon to allow urinary drainage of the bladder.

Due to the frequent and sometimes unnecessary use of indwelling catheters during hospitalization in about 21 to 50% of patients, many patients are placed at risk for complications associated with the use of these devices. A study of 1,540 nursing home residents determined that the risk of hospitalization, length of hospitalization, and length of antibiotic therapy were three times higher in catheterised residents than in noncatheterised residents. The most notable complication associated with indwelling urinary catheters is the development of nosocomial urinary tract infections (UTIs), known as catheter-associated UTIs (CAUTIs). Infections of the urinary tract associated with catheter use are significant not only due to their high incidence and subsequent economic cost but also because of the severe sequelae that can result. Multiple risk factors can affect the occurrence of CAUTI. These include quality of aseptic technique, duration of catheterisation, appropriate hand hygiene and care of catheter. Pooled incidence rates for CAUTI in India are beyond 90 th percentile (P90) threshold of CDC/NHSN VAP rates and was, therefore, a matter of prime concern. There could be a possibility that demography and prevalent hospital care delivery system in developed countries are different than those of developing countries, which results in better infection control policies and implementation measures in US as compared to the developing countries. Therefore, it is recommended to cautiously interpret the evidence, especially when mapping national quality indicators with established threshold of developed nations likewise in the present study, before any priority-setting and policy decisions.

Escherichia coli, Klebsiella pneumoniae Proteus, Pseudomonas aeruginosa, Staphylococcus aureus, Coagulase negative Staphylococcus and Streptococcus faecalis are the usual causative agents. Mixed infection is quite common.

CAUTI can lead to such complications as prostatitis, epididymitis, orchitis, cystitis, pyelonephritis, gram-negative bacteremia, endocarditis, vertebral osteomyelitis, septic arthritis, endophthalmitis, and meningitis. Complications associated with CAUTI cause discomfort to the patient, prolonged hospital stay and increased cost and mortality.

Indira Gandhi Institute of Medical Science, Patna being a tertiary health care centre, rate of catheter insertion is quite high, due to various indications. However, in my knowledge, no study has been done to address this issue in this area**.**

So, This study is performed to gain knowledge about the incidence and bacteriology of CAUTI and antibiotic sensitivity pattern of the isolates.

MATERIALS AND METHODS :

This study was conducted in the department of Microbiology, Indira Gandhi Institute of Medical Science, Patna. The patients admitted in the Department of Obstetrics & Gynaecology (O&G)and Department of Surgery of IGIMS Patna, who required catheterisation for more than 48 hours and had no clinical or laboratory evidence of preexisting Urinary Tract Infection(UTI) were used as cases after taking an informed consent.

CASE DEFINITION:

Patients admitted to the Department of Obstetrics and Gynaecology (O&G) and Department of Surgery, IGIMS who were scheduled to be catheterised for more than 48 hours and who were not having any clinical or laboratory features of UTI. Demographic and relevant clinical data of patients is to be noted.

Definition of CAUTI: The new appearance of bacteriuria $>10^3$ CFU/mL in urine aspirated from the collection port is considered to represent nosocomial CAUTI. It has previously been shown that isolation of $>10^3$ CFU/mL is highly predictive of CAUTI; if intercurrent antimicrobial therapy is not given to the patient, the level of bacteriuria uniformly rises to $>10^5$ within 24-48 hours. Bacteria usually isolated are Escherichia coli, Streptococcus faecalis, Staphylococcus aureus, Staphylococcus epidermidis, Klebsiella spp, Pseudomonas aeruginosa and Proteus mirabilis.

EXCLUSION CRITERIA :

Patients under the age of 18 years
Pregnant patients
Those with known allergy to latex or silicone.

MATERIALS REQUIRED:

MEDIA:

- Nutrient Agar
- Mac Conkey agar
- Blood Agar
- Muller Hinton Agar
- SIM Agar
- Phenylalanine agar
- Triple sugar iron agar /TSI
- Citrate agar
- Christensen urease agar

STAIN: Gram's stain
REAGENTS : Kovac's reagent,5 % ferric chloride ,different antibiotic discs for sensitivity testing
GLASSWARE : Test tubes, glass slides, coverslip, petridishes, autopipette

METHOD

On entry into the study, demographic and clinical data bearing on risk for CAUTI were collected. These include

1. Age/sex
2. Presenting complaints
3. Any UTI features, frequency, urgency of micturition, dysuria ,fever, suprapubic tenderness (if present, case excluded from study)
4. Structural urologic disease
5. H/O Diabetes Mellitus, Hypertension
6. Any other systemic diseases
7. Immunosuppresive therapy
8. ICU confinement
9. Recent Surgery
10. Purpose for catheterization
11. Any known allergy

A faint line is to be made across the catheter-collection tube junction at the outset and inspected, permitting continuous assessment of the integrity of closed drainage. After 48 hours of catheterization the patient will be questioned regarding discomfort or symptoms associated with catheter (pain, sense of urgency or dysuria) and the patient's record will be reviewed for fever and other data suggesting infection; antimicrobial therapy given will also be recorded. Catheter care was done by trained nurses, assuring compliance in each of the following areas (1) integrity of the tamper-evident line; (2) no other breaks in the closed drainage system; (3) immobilization of the catheter, taped to the thigh; (4) position of the catheter tubing below the level of the patient but above the bag, (5) position of the collection bag, below the level of the patient but off the floor; (6) intact clamp on the collection bag and (7) protection of the drainage port.

Microbiologic procedures:

On entry into the study and at the end of 48 hours, approximately 3 milliliters of urine was aspirated from the sampling port of the catheter with a sterile syringe and collected in a sterile test tube, first disinfecting the port with spirit and allowing the spirit to dry; Each specimen was immediately brought to the laboratory(within an hour) (if delay was unavoidable, sample stored in an icebox) and cultured using a technique capable of detecting 1 colony-forming unit (CFU) per milliliter. The sample was simultaneously inoculated on Nutrient agar, MacConkey agar and predried sheep blood agar plates. The plates were put in incubator for 24-48 hours .The remaining urine was examined under microscope for pus cells .After aerobic incubation at 37°C for 24 to 48 hours, any colony formation was looked for. If no colony occurred ,report was sterile. Each colony type was enumerated and fully identified using standard techniques and criteria.

Carbohydrate fermentation test : This is done on Triple Sugar Iron agar media which shows Lactose, Glucose and Sucrose fermentation, acid production and gas formation, it also gives information regarding Hydrogen sulphide formation.

IDENTIFICATION OF BACTERIA

In order to identify and classify gram negative bacteria, morphological and cultural characteristics, motility, sugar fermentation, indole production, hydrogen sulphide production and citrate utilization test were taken into consideration.

Escherichia coli

It forms circular,1-3mm diameter, low convex, smooth and pink (indicating lactose fermentation) colonies on MacConkey Agar. Identifying features:

OBSERVATION

In the present series 135 patients of suspected catheter associated urinary tract infection (CAUTI) were studied. Out of which male patients were 81 and female patients were 54. Out of these 135 patients, only 22 patient's samples showed bacterial growth and remaining samples of 113 cases were found sterile (samples did not show any growth).

Table No.- 1 Number of patients investigated and the growth of bacteria from urine samples.

No. of patients investigated			No. of urine sample examined		
Male	Female	Total	No. of sample showing no bacterial growth	No. of sample showing bacterial growth	Total
81	54	135	113	22	135
			83.7%	16.3%	

It is clear from the above table that 83.7% of the urine samples from clinically suspected cases of CAUTI have not shown any bacterial growth. The incidence of CAUTI is found to be 16.3% in this study.

Table No. -2 Sex incidence of clinically suspected and bacteriologically confirmed cases of U.T. I

Sex	No. of samples showing no bacterial growth	No. of sample showing bacterial growth	total
Male	74 (91.3%)	7 (8.64%)	81
Female	39 (72.2%)	15 (27.78%)	54

The above table shows the incidence of catheter associated urinary tract infection (CAUTI) in male and female. From the table it is clear that the incidence of CAUTI is more in females.

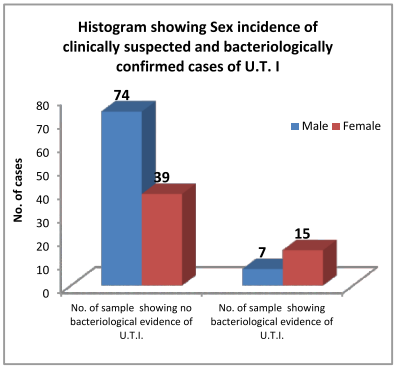
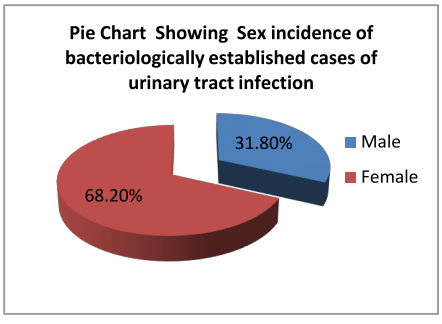


Table - 3 Sex incidence of bacteriologically established cases of urinary tract infection.

Total No. of sample showing bacteriological evidence of U.T.I.	Male	Female
22	7 (31.8%)	15 (68.2%)

It is evident from the above table, that the incidence of urinary tract infection (CAUTI) in bacteriologically confirmed cases in both the sexes varies considerably. In males it was found 31.8% whereas in females it was 68.2%



DISCUSSION

CAUTI (Catheter associated urinary tract infection) is one of the most common Hospital acquired infection(HAI). Due to frequent use of indwelling urinary catheters, many patients are exposed to the risks associated, significantly increasing the morbidity with the length of hospital stay and the cost of treatment.

Many factors increase the probability of acquiring CAUTI. These include quality of aseptic technique, indication and duration of catheterization, nutritional status of the patient, comorbidities of the patient, catheter care and hand hygiene of the provider.

The incidence of CAUTI varies from 21% (in short term) to 50% (for long term) catheterization.

Bacteria involved are Escherichia coli,Klebsiella spp,Proteus spp, Pseudomonas aeruginosa, Streptococcus faecalis, Staphylococcus aureus as well as CONS (Coagulase negative Staphylococcus like Staphylococcus epidermidis, Staphylococcus saprophyticus).

Multiple infections are quite common with increasing incidence of organisms resistant to commonly used drugs.

Of prime importance is differentiating CAUTI from asymptomatic bacteriuria. The latter often initiates unnecessary antimicrobial therapy which causes more harm than good and also contributes to the emergence of resistant strains.

So routine screening of all catheterized patients is not recommended. Only those patients who develop symptoms pertaining to UTI like suprapubic tenderness, fever (in absence of any obvious source), unexplained hypotension or delirium are tested.

Similarly, it is imperative to differentiate CAUTI from non specific cystitis which may cause symptoms simulating UTI, which is self limiting and often occurs because of irritation due to the presence of a foreign body (catheter in this case).This may also initiate unnecessary antimicrobial therapy with the resultant sequelae.

So, the crux is, antimicrobials are to be used only when both of the following crieteria are met:

1. Symptoms suggestive of UTI.
2. Confirmation by microscopy and culture,complete with antibiotic sensitivity testing.

However there are two important exceptions to the above mentioned rule:

1. Pregnancy – Asymptomatic bacteriuria may lead to acute pyelonephritis in the late second or early third trimester, hence antibiotic treatment is warranted.
2. People undergoing invasive genitourinary procedures.

The present work is the result of bacteriological examination of 135 urine samples obtained from patients clinically suspected to be suffering from CAUTI.

The patients included in the study were those who were admitted in The Deptt. of Surgery and The Deptt. of Obstetrics and Gynaecology (O&G) of Indira Gandhi Institute of Medical Science, Patna, and who had undergone elective surgery.

Table no. 1 shows clearly that as many as 83.7% of the samples suspected of CAUTI, have not shown any bacteriological evidence of infection and hence do not require treatment by antibacterials. CAUTI could be confirmed in only 16.3% cases .

Among females, 27.78% of suspected cases were confirmed whereas in case of males only 8.64% of cases were confirmed, indicating a clear cut preponderance of females in CAUTI. This is likely to be due to the shorter urethra which predisposes to ascending infection either by motile organisms or by reflux during menstruation.

With respect to the total number of confirmed cases of CAUTI, the incidence is 68.2% for females and 31.8% for males.

Out of the total 22 confirmed cases, 17 were affected by single organisms and 5 were affected by multiple organisms, indicating that the incidence of monomicrobials was much higher (77.3%). The incidence of polymicrobial CAUTI was much higher in females (4 out of 5) i.e. 80% than males (1 out of 5) (20%).

Out of 5 samples showing multimicrobial infection including both males and females ,no sample has shown infection with more than 2 organisms .

The total number of isolates were 22 in the present series of work. Escherichia coli was the leading pathogen comprising 54.5% followed by Klebsiella spp - 31.8%.

These were followed by Streptococcus faecalis, Coagulase negative Staphylococcus (CONS), Pseudomonas spp and Proteus spp in descending order, with incidence of 13.63%, 9.1%,9.1% and 4.5% respectively.

It is further revealed that Escherichia coli was found to be associated with other organisms in 33.33% cases, whereas for Klebsiella, it is 42.85%. Streptococcus faecalis was associated with other organisms in 66.67% cases and CONS was in 50% cases. Pseudomonas and Proteus were not found in association with other organisms in this study.

For males, the incidence was found to be highest for Escherichia coli (37.5%) followed by Klebsiella (25%), Pseudomonas, Proteus and Streptococcus faecalis (12.5% each). No case of CONS was found in male patients in this study.

For females too, Escherichia coli had the highest incidence (47.3%) followed by Klebsiella, CONS, Streptococcus faecalis and Pseudomonas (26.3%, 10.52%, 10.52% and 5.26% respectively).

There have been tremendous change in the sensitivity pattern of drugs over the years.

Ciprofloxacin and Cotrimoxazole which were quite effective in the past showed poor results in this study. Amoxyclav also showed a declining trend.

Gentamycin, Imipenem were found to be most effective for gram negative organisms like Escherichia coli, Klebsiella, Pseudomonas and Proteus. Levofloxacin also showed good results for Escherichia coli. For Pseudomonas Cefoperazone and Piperacillin-Tazobactum along with Imipenem showed promising results.

For Gram positive organisms like (Coagulase negative Staphylococcus, Streptococcus faecalis) Penicillin G, Teicoplanin, Linezolid and Vancomycin were uniformly effective.

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