15

Nosocomial Urinary Tract Infections

Sonia Isabel Cuervo Maldonado and Jorge Alberto Cortés Luna
Universidad Nacional de Colombia, Bogotá
Colombia

1. Introduction

Healthcare-associated urinary infection is one of the most frequent infections and it is responsible for more than 40% of nosocomial or healthcare-associated infections (HAIs) and nursing homes for the elderly. The complexity and diversification of health services currently offered has motivated an enlargement in literature about infectious complications that may happen in each one of these scenarios; and according to the recommendations from literature since 2007 (1), in this chapter, urinary tract infection will be approached as a result of the care provided at hospitals or nosocomial care (NUTI).

Due to the fact that most of NUTIs are associated to urinary tract instrumentation, i.e. secondary to either indwelling or intermittent vesical catheterization, cystoscopies or any invasive urologic procedures, or to nephrostomy tube placement, this chapter will emphasize in the most recurrent complication derived from the use of these medical devices: urinary catheter-associated bacteriuria (UCAB).

2. Epidemiology

The risk to acquire a NUTI depends on: location of Urinary Catheter (UC), catheterization's period of time, catheter care measures and host's susceptibility. 13.2 % of inpatients, 4.9% in nursing homes for the elderly and 3.9% of home care patients have urinary catheters (14). After just one catheterization of the urinary tract, infection rates vary from 1% to 5% to 100% in patients who have indwelling urinary catheter with open drainage system. Likewise, and regardless of the use of closed drainage system, more than 20% of patients with urinary catheters might become infected when mishandling of closed drainage system (3, 4). Among risk factors that increase acquiring a catheter-associated urinary tract infection (CAUTI) are: advanced age, debilitating disease and postpartum.

In the National Nosocomial Infections Surveillance in United States, between 1992 and 1997, data from 112 medical intensive care units was includes with 181.993 patients and 715.930 patient-days of follow up. They found 14.177 HAIs, where NUTI was the most frequent diagnosis, with 31% of the cases, followed by nosocomial pneumonia and primary bloodstream infection (5).

Information about the epidemiology of nosocomial infections is provided in developing countries by the International Nosocomial Infection Control Consortium (INICC). This multicenter, international surveillance system proceeded data in 2008 about 98 intensive care units around the world. Those units belonged public and private hospitals in 18 countries in Latin-America, Africa, Asia and Europe. Between 2002 and 2007 a total of 1212

NUTI were reported in 202.311 patient-days, with a median rate of 6.49 per 1.000 catheter-days. Those ICU that had medical and neurosurgical patients had the highest rates, with 9.63 and 8.29 infection per 1.000 catheter-days, respectively (6). Previous studies have shown that different kinds of patients had different rates of infections because of different risk factors that need to be addressed with different control strategies.

Urinary Catheter-associated NUTIs are caused by a variety of pathogens: *E. coli, Klebsiella, Proteus, Enterococcus, Pseudomonas, Enterobacter, Serratia and Candida.* Many of these microorganisms constitute intestinal flora, but they can also be acquired through cross contamination from other patients or hospital personnel, or through exposure to contaminated solutions or non-sterile equipment. NUTIs produced by *Serratia marcescens y Pseudomonas cepacia* have great epidemiologic meaning since its isolation from catheterized patients clearly suggest that they are obtained from exogenous flora, as normally these organisms are not part of the intestinal flora.

Secondary becteremia for NUTI can be present even in a 4% of the patients and it occupies the second place among bacteremias of secondary cause; it has even been related to mortality rates ranging from 13 to 30%, nonetheless, in a study performed in a ICU to determine the impact on UC use in death outcomes, it showed that once all confounding variables were controlled, mortality was not higher in patients with UC --mortality in ICU patients OR 0,846 (IC 95% 0,695-1,086) versus mortality in hospitals OR 0,949 (IC 95% 0,763-1,181) -- (7).

3. Urinary catheters (UC)

Every year, millions of UCs are used in the different hospital services: Intensive Care Units (ICU), rehabilitation, neurology, neurosurgery and internal medicine, also in nursing homes for the elderly. Approximately, 25% patients in hospitals use UCs, considering the following criteria for its use:

1. Surgery
2. Urine output measure
3. Urine voiding when urine retention; generally caused by processes of urinary tract obstruction.
4. Urinary incontinence (8).

The majority of urinary tract complications are second to bacteriuria production. Trauma and urethritis are other less frequent complications.

A urinary catheter is a device which has been used since 1927, when Frederick E.B. Foley introduced it to control post-surgical bleeding in prostatectomy (9). From 1927 until 1950, UCs were used as open drainage system, i.e., urine made contact with air when drained, this led to 100% of the patients with open drainage system to develop bacteriuria at the fourth day of use (10). From 1950 to 1960, another system was implemented. This system used a drainage tube connected to a bag which collected urine, thus leading to the origin of closed drainage system. In this case, 100% of the patients developed bacteriuria at the thirtieth day of use. (9, 11)

Urinary catheters are classified as per:

1. Place of insertion.
2. Period of catheterization.
3. Material

Regarding the first, they can be urethral, suprapubic or nephrostomy catheters. As for the period of catheterization, there are two kinds, one for long-term catheterization, usually

with indwelling Foley catheters, and for short-term catheterization, nelaton intermittent catheters are commonly used. And finally, catheters can be made in latex, silicone or Teflon, they can be latex or silicone-covered and some are coated with an antiseptic or antibiotic. They also have different diameters.
The majority of nosocomial CAUTIs are produced by bacteria which come from patient's own colon, which is known as endemic infection, whereas epidemic or secondary infection can be explained by different causes: incorrect aseptic techniques for equipment such as cystoscopes, contaminated irrigation solutions or contaminated disinfectants used for cleaning before catheter insertion, and the most recurrent: cross –transmission through hospital personnel hands.

4. Pathogenesis

NUTI production is often multifactorial, the main mechanisms to describe the process are:

4.1 Defense process and urinary infection

An average urinary tract has defense mechanisms to prevent or minimize interaction between epithelial cells and bacteria. Though a large amount of infectious agents that cause UTI previously colonize the periurethral area, the urethra represents the first obstacle for these agents to reach the bladder. Had the microorganism gone through the urethra and entered the bladder, micturition will purify 99.9% of these bacteria with the help of uromodulin and oligosaccharide -which are present in urine-, by a neutralizing action. However, a biofilm may remain adhered to the vesical mucosa, in which case, glycosaminoglycan inhibits bacterial adherence to epithelial cells. Still, in the case that these cells become infected; an acute inflammatory response is produced as a result of cytokine liberation of the infected epithelial cells. The last protecting instance of epithelial cells is an exfoliation process through which microorganisms are removed from the host. Antibody production and host cellular response contribute to a slower reaction, thus helping in the last states of acute infection.

4.2 Biofilms and urinary catheters

UC use can interfere with some of these natural defense mechanisms. Catheters increase urethral colonization by uropathogens, especially in women. Both, inner and outer catheter surfaces are niches where bacteria adhere to creating a biofilm which covers and protects bacteria from urinary flow and polymorphonuclear action.
A biofilm is a microorganism community that permanently adheres to biological or inert surfaces and it is embedded in a matrix of extracellular polymeric substances modifying growing and genetic transcription phenotypes. Bacteria constitute biofilms in especially high-stress environments, e.g. fast and turbulent flow milieus, which in return increases adhesion of floating cells on surfaces. Once a biofilm is formed and the exopolysaccharide matrix has been secreted by cells, the resultant structure is highly viscoelastic and resistant to mechanical breaking. Hence, the nature in structure and physiological attributes of biofilm's constituent organisms provide an inherent resistance to antimicrobial agents. (12)

4.3 Handling and care precautions of urinary catheters

Another factor encouraging CAUTIs in health care institutions is a failure in the draining system, therefore, large amounts of bacteria remain in the bladder and catheter presence interrupts interaction between glycosaminoglycan and epithelial cells. (11)

4.4 Hematogenous or lymphatic dissemination

It is important to remember that certain microorganism reach the kidney through bloodstream dissemination from a distant organ. The most common microorganisms in this particular scenario are: *S. aureus*, Candida, *Salmonella* and some species of *Pseudomonas*, for this reason, isolation of any of these in urine always suggests two possible sources: urinary tract or a source different from the kidney compromising it through hematogenous dissemination.

To summarize, CAUTIs at health care institutions can be present in four ways (13):

1. Early extraluminal: By direct inoculation of microorganisms in the bladder at the moment of UC insertion.
2. Late extraluminal: By microorganisms ascending from perineum to urethra and to catheter's outer surface.
3. Intraluminal: Due to closed-drainage system failure or when collected bag is contaminated.
4. In rare opportunities by hematogenous dissemination as a consequence of a systemic disease with kidney as target organ.

The final consequence of the interaction between host's defense mechanism and colonizing microorganisms in patients with UC is the presence of bacteria in urine or bacteriuria.

The majority of infectious agents causing catheter-associated bacteriuria originate in patient's own intestinal flora, which at the same time can be regular inhabitants of the colon, or exogenous, as in healthcare-associated infections (HAIs). As in UTI's pathogenesis, enterobactericeae can colonize periurethral areas of non-catheterized patients, especially women. Exogenous microorganisms can colonize UC through means of care personnel manipulation or less frequent circumstances, as in polluted products.

5. Risk factor for bacteriuria development

Asymptomatic bacteriuria is common but its prevalence among general public varies significantly with age, gender, and the presence of genitourinary tract alterations. Bacteriuria risk for catheterized patients is approximately 25% and its significance in relation to provide or not antimicrobial treatment in the asymptomatic patient is debatable considering that 80% of short-term catheterized patients receive antimicrobial treatment for a different purpose than that of a UTI. (14)

In a multivariate analysis and observations of 1474 catheterized patients, Platt et al., found nine independent risk factors for catheter-associated bacteriuria development. (15)

1. Period of catheterization
2. Lack of urinometer usage
3. Collector bag colonized by microorganisms
4. Diabetes mellitus
5. Lack of antibiotic usage
6. Mishandling in UC procedures
7. Female gender
8. Abnormal creatinine
9. Incorrect catheter care

5.1 Period of catheterization

According to UC usage standards, catheterization periods vary:

1. Surgery: 1-7 days

2. Cardiac output measure: 7-30 days
3. Urinary retention: 1-30 days
4. Urinary incontinence: >30 days

Period of catheterization is the main risk factor for associated bacteriuria development. Once UC is inserted, bacteriuria increases at the rate of 3 to 10% per day of UC permanence (catheter day) and, it is estimated that by the thirtieth catheter day, 100% of catheterized patients will present bacteriuria. For this reason, it is important to divide the period of catheterization in: (i) Short-term, for less than 30 days; and (ii) Long-term, for more than 30 days. In addition, bacteriuria may be asymptomatic or some symptoms may be identified having a real UTI.

5.2 Short-term catheterization

Between 15 to 25% of inpatients might have a UC for an average period of 2-4 days and approximately 10 to 13% of them will develop bacteriuria in comparison to 1% of non-catheterized inpatients that develop bacteriuria. The most common infectious agent found in these patients is *E. coli*, besides *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Proteus mirabilis*, *Enterobacter sp.*, *Staphylococcus epidermidis*, *Staphylococcus aureus* and *Candida* species. In general, only one microorganism is isolated in the urine culture but 15% can be polymicrobial. Colony count can show a meaningful bacteriuria of equal or more than 10^5 bacteria. In general, this bacteriuria, aside from the colony count, is accompanied with pyuria. Most short-term UC associated bacteriuria are asymptomatic, nonetheless, lower urinary symptoms and fever may be present even in 30% of these patients and less than 5% will develop bacteremia. The impact of short-term UC associated bacteriuria on mortality is not clear and results from studies have shown to be contradictory.

5.3 Long-term catheterization

Long-term catheterization is needed for urinary incontinence in women, lower urinary tract obstruction in men as a consequence of prostatic hyperplasia and prostate carcinoma, and to urinary obstruction in postrenal failure in women secondary to cervical carcinoma, aside from neurogenic bladder related to spinal cord trauma both in men and women.

Bacteriuria incidence tends to be similar to that observed in hospitals (3 to 10% per day), hence, most patients will have bacteriuria at the end of 30 catheter days. Bacteriuria prevalence is a consequence of:

1. Bacteriuria incidence which is similar to that observed in short-term catheterization, by gram-negative and gram-positive bacteria, with an average permanence of a different infectious agent every two weeks.
2. Some bacteria residing for weeks and months in the urinary tract, like *E. coli* and *Providencia stuartii*.

Colony count is generally meaningful with 10^5 colonies or more and more than two infectious agents are present in more than 95% of long-term catheterization patients.

The most common infectious agents identified in these patients are *E. coli, P. aeruginosa, P. mirabilis, Providencia stuartii y Morganella morganii,* the latter two in less frequency. Most frequent complications are symptomatic bacteriuria, obstruction, urinary stones, periurethral infection, chronic kidney disease, renal failure and cancer when catheter is used over several years.

5.4 Therapy of asymtomatic bacteriuria

There is no need for rutinary microbiological studies in catheterized patients presenting asymptomatic bacteriuria or funguria, or those who have had treatment for that condition. Recommendation A-1 from CDC's (Control Diseases Centers) guidelines for bacteriuria prevention (16).

Antimicrobial treatment can be considered for women who have persistent asymptomatic bacteriuria after catheter removal. Recommendation B-1 (17).

6. Nosocomial urinary tract infection (NUTI) diagnosis

Besides presenting symptoms or not, a urine test and a urine culture are necessary to confirm either bacteriuria or NUTI. In table 3, CDC and NHSN diagnosis criteria for UTIs are shown (26).

7. Bacteriuria complications treatment

Several clinical manifestations can be present in patients with asymptomatic bacteriuria associated with UC usage.

- Cystitis is manifested through changes in the macroscopic characteristics of urine and it is combined with suprapubic pain, polakiuria, dysuria, urinary urgency, and vesical tenesmus, these latter symptoms are present when patients do not have sequelae of spinal shock. In the case a patient is catheterized due to spinal shock sequelae, the most recurrent symptom is associated with the change of macroscopic characteristics of urine (odor, color, and transparency). Urine culture and bacteria's in vitro susceptibility to certain antibiotics should be considered for the choice of antibiotherapy, which can range from 7 to 10 days.
- If the patient presents with fever, it is strongly recommended to exclude any other plausible cause for this symptom; if fever seems to be secondary to pyelonephritis caused by UC, then a 14-21 day treatment is implemented depending on the severity of the infectious process and on the susceptibility of the infectious agent.
- Candiduria is present in long-term catheterization patients that have had antibiotics previously. *Candida* presence in urine should be taken as possible hematogenous dissemination to kidney or other different organs. When candiduria is a result of candidemia or a disseminated candidiasis, it is recommended to exclude a systemic infection to determine the period of antimycotic treatment (18). Most of the times, candiduria is asymptomatic, but it can include complications such as a bladder or renal pelvis fungal bezoar, perinephric abscess and disseminated candidiasis. Treatment for asymptomatic candidiasis associated to UC is not clear, however, 40% of candiduria ends after UC removal and 20% does when UC is changed; this is a B-III recommendation (18). For asymptomatic patients who persist with candiduria and require catheter, several therapeutic strategies have been proposed. Bladder irrigation with 50 to 200 μg/mL of amphotericine B can clear funguria temporarily and it is not a frequent recommendation (recommendation C-III) (18); systemic use of fluconazole 200 mg/d for 14 days has demonstrated microbiological cure. Antimycotic treatment in patients with asymptomatic candiduria is not totally defined, but treatment is recommended when undergoing genitourinary surgical procedures. Even with apparent microbiological cure by UC removal or with systemic treatment, relapse is common, even more when there is still UC use.

Urinary tract infection	Clinical criteria	Laboratory criteria
Symptomatic NUTI At least one of the following:	1. At least one of the following signs or symptoms, without any other cause; fever >38ºC, urinary urgency, frequency, dysuria or suprapubic pain and criteria 1 from laboratory 2. At least one of the following signs or symptoms, without any other cause; fever >38ºC, urinary urgency, frequency, dysuria or suprapubic pain, and from laboratory criteria 2, one of the given criteria. 3. For children under 1, at least one of the following signs or symptoms, without any other cause; fever >38ºC or rectal hypothermia <37ºC, apnea, bradycardia, dysuria, lethargy or vomit, and the same 1 and 2 laboratory criteria respectively.	1. Urine culture with less than two microorganisms and colony count of $\geq 10^5$ 2. Positive leukocyte esterase; pyuria >10 leukocytes per hogh magnification field; >3 erythrocytes per hight magnification field; positive urine Gram in a non-cytospinned sample; two urine cultures with the same microorganism and a colony count of $\geq 10^2$ in a patient with previous effective antibiotherapy and a count of $\leq 10^5$; medical diagnosis or proper medical treatment for UTI.
Asymptomatic bacteriuria At least one of the following:	1. Patient with previous case of catheterization within the last 7 days and who has not fever, urinary urgency, dysuria or suprapubic pain, and laboratory criteria 1. 2. Patient who has not had UC in the previous 7 days to the first urine cultura, and that has not presented fever, urinary urgency, frequency, dysuria or suprapubic pain, and laboratory criteria 3.	3. Two positive urine cultures of $\geq 10^5$ with less than 2 microorganisms and showing the same microorganisms.

Urinary tract infection	Clinical criteria	Laboratory criteria
Other UTIs (kidney, urether, bladder, urethra, or retroperitoneum) At least one of the following:	1. Abscess or evidence of infection at direct, intraoperative or histological examination. 2. At least two of the following signs or symptoms, without any other cause; fever >38ºC, focused pain or pain in the implicated place, and at least one of the following; purulent drainage, or any of the laboratory criteria 2-5. 3. For children under 1, at least one of the following signs or symptoms, without any other cause; fever >38ºC or rectal hypothermia <37ºC, apnea, bradycardia, dysuria, lethargy or vomit, and at least one of the following; purulent drainage, or any of the laboratory criteria 5-8.	4. Positive culture from any fluid different from urine. 5. Positive blood culture from suspected infection site. 6. Compatible image with infection (CT scan, NMR, Scintigraphy) 7. Medical diagnosis of infection 8. Adequate medical treatment for infection.
Comments: The culture taken from the tip of a UC is not laboratory criteria for NUTI diagnosis. Urine samples should be obtained using the proper technique, i.e. clean technique or catheterization. With children, samples must be taken from catheterization or suprapubic puncture; urine collected from perineal bag is not accepted. Circumcision-associated infections should be informed as such.		

Source: Bibliographic reference 26.

Table 3. NUTI diagnosis criteria.

8. Prevention guidelines

Even though not all CAUTIs can be prevented, a great number can be avoided by proper catheter use. The following care recommendations should be implemented for short-term catheterization patients:

Prevention is directed to three sources:

1. Catheter colonization precautions.
2. Once UC is inserted, bacteriuria prevention.
3. Had bacteriuria developed, its complications should be avoided.

8.1 Urinary catheter colonization precautions

The most successful approach to prevent catheter-associated bacteriuria is to implement catheter colonization safety measures.

1. Use UC only when necessary.
2. Use external devices: external urinary collectors such as condom catheters for men with urinary incontinence is a good alternative, these condoms have devices to connect them to a closed drainage system. Even though this system decreases UC use, the urine that remains in the condom can induce high bacteria concentration growth in penis skin and favor bacteriuria. Further complications can include penis skin maceration, penis ulcers and even penis gangrene when condom makes inadequate pressure in penis' body.
3. Intermittent catheterization: it is used in patients with sequelae of spinal shock or with spinal cord injury. UC insertion for urine voiding and its immediate removal every 4 to 6 hours only increases bacteriuria in 1 to 3% per catheterization. For intermittent catheterization, clean are sterile techniques have been compared. In clean technique, catheter can be used again if sterilized at high temperatures before each use, and in sterile technique, catheter is new and sterile. There were no differences regarding UTI development in any of the two techniques, however, clean technique reduced costs. The most common complications are: bleeding, urethritis, fistula, stones, and hydronephrosis.
4. Suprapubic catheter (cystostomy): many factors explain the frequency in its use.
   - Abdomen skin has lower bacteria concentration than periurethral area.
   - External obstruction of suprapubic catheters favor urine voiding through the urethra.
   - Urethral structures are not injured.

   Besides hematoma in catheter insertion site (abdominal wall), its infection and fistula, there are no other important complications.
5. Gold-coated urethral catheter, polyurethane catheter or antimicrobial catheters have been used for long presurgical periods in patients with prostatic hyperplasia diagnosis and they have shown interesting results regarding less UTIs, but it cannot be proposed as universal recommendation since cost-effectiveness and superinfection evaluation has not been fully assessed. (19-22)
6. Surgical recommendations: Especially in patients with cancer or intractable incontinence, bladder reconstruction procedures using colon or ileum segments, like in an ileal conduit diversion, bacteriuria is common, producing complications such as: acute and chronic pyelonephritis and renal failure secondary to vesicoureteral reflux.

8.2 Bacteriuria prevention (23-25)

Once UC is inserted, two strategies are recommended to prevent bacteriuria.

- Use closed drainage systems: closed drainage systems in permanent catheterized patients must always remain closed. Junctures between catheters and collecting bag drainage tube must never be opened. Urine samples must be taken through syringe puncture and all aseptic measures should be observed during sample collection.
- Remove catheter as soon as possible. Short-term catheterization has less risk of bacteriuria development.

8.3 Bacteriuria complications prevention

Several clinical trials have demonstrated that despite catheterization period, asymptomatic bacteriuria need not antibiotic therapy. Nevertheless, some situations need a particular evaluation.

1. In the case that isolated microorganisms might have high bacteremia incidence, e.g. *Serratia marcescens*
2. Patients with high risk of serious complications: pregnant women, and neutropenic and transplanted patients
3. Patients pending for urologic surgery
4. Patients with prosthesis.

In these situations, antibiotic therapy is recommended for asymptomatic bacteriuria since complication risks are greatly avoided by this means.

Antibiotherapy after catheter removal has not proven to be successful either as to prevent UTI development or to favor microbiological cure. Likewise, it has been observed that catheterized patients with untreated asymptomatic bacteriuria clear it by just catheter removal. From prevention guidelines for CAUTIs, the following summary presents the main recommendations (16).

8.4 Main recommendations for catheter-associated urinary tract infection prevention – Summary—

Category I. Strongly recommended to adopt

- Personnel should be given training emphasizing on correct insertion techniques and catheter care measures.
- Urinary catheters should be used only when necessary and left in place only for as long as necessary.
- Promote handwashing and disinfection.
- Insertion should be done by persons who know the correct aseptic technique using only sterile equipment.
- Catheters should be appropriately assured to avoid urethral traction.
- Closed drainage system should always remain sterile.
- Use aseptic techniques for urine sample collection.
- Urine flow drainage should be kept free.

Category II. Moderately recommended to adopt

- Periodic training should be provided to people in charge of catheters.
- Small catheters should be chosen over catheters with larger diameters.
- Avoid irrigation unless needed to prevent or control obstruction.
- Daily meatal care with povidone-iodine should be avoided.
- Catheters should not be changed at fixed intervals

Category III. Weakly moderated to adopt

- Alternative draining techniques should be considered before resorting to catheterization.
- Substitute collecting system when sterile closed drainage has been violated.
- Separate infected and uninfected catheterized patients.
- Routine bacteriologic surveillance should be avoided.

9. Summary

Urinary infection is the main nosocomial infection and is it associated to urinary catheter use. Urinary catheters favor bacteriuria development, which is more frequent when catheterization period exceeds 30 days. The most effective solution to decrease bacteriuria appearance is to use catheters only when strictly necessary. By reducing catheterization time and implementing closed drainage systems, bacteriuria risk can be highly controlled when catheterization is needed. Bacteriuria can be asymptomatic, thus not needing antibiotherapy. Should bacteriuria complications arise with urinary tract infection symptoms, antibiotherapy will highly depend on cystitis and pyelonephritis diagnosis, in either event, length of treatment will range between 10 and 21 days. Other strategies aimed to bacteriuria prevention have been implemented and they are mainly intended to provide education and training to all medical personnel, paramedics and family or people in charge of catheterized patient's care.

10. Annex – prevention guidelines for catheter-associated urinary tract infection- CAUTI (16)

- Recommendations

1. PERSONNEL
   - Only persons (hospital team, family or patients) who know the correct insertion technique and catheter aseptic maintenance should handle catheters. Category I
   - Periodic training should be provided to hospital personnel taking care of catheters focusing on correct techniques and possible complications during catheterization. Category II
2. CATHETER USE
   - Urinary catheters should only be used when strictly necessary and removed as soon as possible. They should not be used for patient-care personnel convinience. Category I.
   - For selected patients, alternative urinary draining methods can be used, e.g. condom catheter, suprapubic catheter and intermittent catheterization. Category III.
3. HANDWASHING
   - Handwashing is imperative just before and after catheter manipulation. Category I
4. CATHETER INSERTION
   - Catheters must be inserted using proper aseptic technique and sterile equipment Category I.
   - Gloves, gauze, periurethral cleansing antiseptic solution, and single-use packet of lubricant should be used for insertion purposes. Category II.
   - Use as small a catheter as possible with good drainage consistency to avoid urethral trauma. Category II.
   - Urethral catheters should be properly secured after insertion to prevent movement and urethral traction. Category I.
5. CLOSED STERILE DRAINAGE
   - A closed sterile drainage system should always be mantained. Category I.
   - Catheter and drainage tube should never be disconnected. Category I

- If aseptic technique breaks, catheter disconnects from collecting bag or draining tube breaks, collecting system should be replaced using aseptic technique after disinfecting catheter and tube juncture. Category III.

6. IRRIGATION
   - Irrigation should be avoided unless obstruction anticipates. Category II
   - Catheter-tube juncture should be disinfected before disconnection. Category II
   - Irrigation solution and siringe must be disposable. Category I
7. SAMPLE COLLECTION
   - Use sterile syringe Category I
   - Large urine volumes for special analysis can be obtained aseptically from drainage bag. Category I
8. URINARY FLOW
   - Urine flow should be kept free. Category I
   - For unobstructed flow drainage Category I

   a. Disconnection between catheter and draining tube should be avoided.
   b. Draining bag should be cleared regularly using a separate collecting container for each patient.
   c. Poorly functioning or obstructed catheters need to be irrigated or replaced if necessary.
   d. Draining bag must be kept below patient's bladder.
9. MEATAL CARE WITH SOAP AND WATER OR WITH POVIDONE-IODINE
   - Daily cleansing with antiseptic solutions or soap and water do not reduce NUTI probability. Category II
10. CATHETER CHANGE INTERVAL
    - Catheters should not be changed at fixed intervals. Category II
11. SPATIAL SEPARATION OF CATHETERIZED PATIENTS
    - To diminish cross infection among uninfected and infected patients, they should be separarated Category III
12. BACTERIOLOGIC SURVEILLANCE
    - Routine bacteriologic surveillance is not recommended for catheterized patients. Category III

11. References

[1] Siegel JD, Rhinehart E, Jackson M, Chiallero L, and the Healthcare Infection Control Practices Advisory Committee, 2007. Guideline for isolation precautions: Preventing tranmission of infection agents in healthcare settings, June 2007 Consulta 24 de agosto de 2007. Available at: http://www.cdc.gov/incidod/dhqp/pdf/isolation 2007.pdf

[2] Platt R, Polk BF, Murdock B, Rosner B: Risk factors for nosocomial urinary tract infection. Am J Epidemiol 1986;124:977-85

[3] Warren JH. Catheter Associated Urinary Tract Infections. Inf Dis Clín N Am. 1997; 11(3): 609 – 622

[4] Kunin CM, McCormack RC. Prevention of catheter induced urinary tract infections by sterile closed drainage. N Engl J Med 1966;274:1155-62

[5] Richards MJ, Edwards JR, Culver DH, Gaynes RP. Nosocomial infections in medical intensive care units in the United States. National Nosocomial Infections Surveillance System. Crit Care Med. 1999;27: 887-92

[6] Rosenthal VD, Maki DG, Mehta A, Alvarez-Moreno C, Leblebicioglu H, Higuera F, et al. International Nosocomial Infection Control Consortium report, data summary for 2002-2007, issued January 2008. Am J Infect Control. 2008;36: 627-37

[7] Johnson JR, Kuskowski MA, Wilt TJ. Systematic review: antimicrobial urinary catheters to prevent catheter associated urinary tract infection in hospitalized patients. Ann Intern Med 2006 Jan 17;144(2):116-26

[8] Gariballdi RA, Burke JP, Dickman ML,SmithCB. Factors predisposing to bacteriuria during indwelling urethral catheterization. N Engl J Med 1974; 291:215-8

[9] Foley FEB. A hemostatic bag catheter. A one piece latex rubber structure for control of bleeding and constant drainage following prostatic resection. J Urol 1936;35:134-139

[10] Clec´h Ch, Schwebel C, Français A. Does catheter associated urinary tract infection increase mortality in critical ill patients? Infec Cont Hosp Epidemiol 2007; 28: 1367-73

[11] Slade N, Gillespie WA. The urinary tract and the catheter. Infection and other problems. New York: Weiley, 1985:63

[12] Tambyah PA, Halvorson Kt, Maki DG. A prospective study of pathogenesis of catheter associated urinary tract infections. Mayo clín Proc 1999; 74: 131 – 136

[13] Desautels RF, Walter CW, Graves RC, Harrison JH. Technical advances in the prevention of urinary tract infection. J Urol 1962;87:487-90

[14] Mooney BS, Garibaldi RA, Britt MR. Natural history ogf catheter-associated bacteriuria(colonization, infection, bacteremia): implication for protection. In: Proceedings of the 11th International Congress of Chemotherapy and the 19th Interscience Conference on Antimicrobial Agents and Chemotherapy. Boston. October 8-12, 1979. Washington DC, American Society of Microbiology 1980:1083-85

[15] Platt R, Polk BF, Murdock B, Rosner B: Risk factors for nosocomial urinary tract infection. Am J Epidemiol 1986;124:977-85

[16] Wong ES, Hooton Th. Guidelines for prevention of catheter associated urinary tract infections. Consulta 24 de agosto de 2002. Disponibe en: www.cdc.org

[17] Nicolle LE, Bradley S, Colgan R, Rice JC, Schaeffer A, Hooton Th. Infectious Disease Society of America Guidelines for the diagnosis and treatment of asymptomatic bacteriuria in adults CID 2005;40(5): 643-654

[18] Pappas P, Rex JH, Sobel JD, Filler SG, Dismukes WE, Walsh ThJ, Edwards JE. Guidelines for treatment of Candidiasis. CID 2004; 38(2): 161-89

[19] Trautner BW, Hull RA, Darouiche RO. Prevention of catheter associated urinary tract infection. Curr Opin Infect Dis 2005 Feb; 18(1):37-41

[20] Jahn P, Preuss M, Kernig A, Seifer-Hahmer A, Langer G. Types of indwelling urinary catheters for long term bladder drainage in adults. Cochrane Database Syst Rev 2007July 18; (3):CD 004997

[21] Crouzet J, Bertrand X, Venier AG, Badoz M, Husson C, Talon D. Control of the duration of urinary catheterization: impact on catheter associated urinary tract infection. J Hosp Infect 2007 Nov; 67(3):253-7

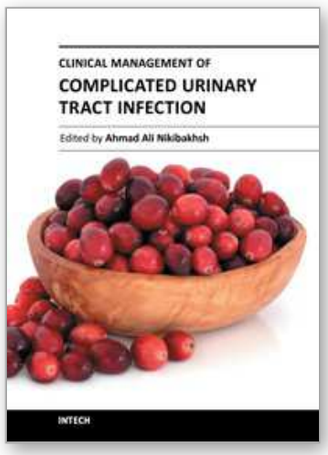
[22] Madigan E, Neff DF. Care of patients with long term indwelling urinary catheters. Online J Issues Nurs 2003;8(3):7

[23] Kass EH. Asymptomatic infections of the urinary tract. Trans Assoc Am Physicians 1956;69:56-63

[24] Saint S, Lipsky BA. Preventing Catheter related bacteriuria. ¿Should We? ¿Can We? ¿How? Arch Intern Med, 1999; 159: 800 – 806

[25] Donlan R, Costerton J. Biofilms: Survival mechanisms of clinically relevant microorganisms. Clin Microbiol Rev. 2002; 15 (2): 167-193

[26] Horan T, Andrus M, RN, BA, CIC, Dudeck Margaret. CDC/NHSN surveillance definition of health care associated infection and criteria for specific types of infections in the acute care setting. Am J Infec Cont 2008;36(5): 310-313



Clinical Management of Complicated Urinary Tract Infection
Edited by Dr. Ahmad Nikibakhsh

ISBN 978-953-307-393-4
Hard cover, 294 pages
Publisher InTech
Published online 06, September, 2011
Published in print edition September, 2011

Complicated urinary tract infections (cUTIs) are a major cause of hospital admissions and are associated with significant morbidity and health care costs. Knowledge of baseline risk of urinary tract infection can help clinicians make informed diagnostic and therapeutic decisions. Prevalence rates of UTI vary by age, gender, race, and other predisposing risk factors. In this regard, this book provides comprehensive information on etiology, epidemiology, immunology, pathology, pathogenic mechanisms, symptomatology, investigation and management of urinary tract infection. Chapters cover common problems in urinary tract infection and put emphasis on the importance of making a correct clinical decision and choosing the appropriate therapeutic approach. Topics are organized to address all of the major complicated conditions frequently seen in urinary tract infection. The authors have paid particular attention to urological problems like the outcome of patients with vesicoureteric reflux, the factors affecting renal scarring, obstructive uropathy, voiding dysfunction and catheter associated problems. This book will be indispensable for all professionals involved in the medical care of patients with urinary tract infection.

How to reference
In order to correctly reference this scholarly work, feel free to copy and paste the following:

Sonia Isabel Cuervo Maldonado and Jorge Alberto Cortés Luna (2011). Nosocomial Urinary Tract Infections, Clinical Management of Complicated Urinary Tract Infection, Dr. Ahmad Nikibakhsh (Ed.), ISBN: 978-953-307-393-4, InTech, Available from: http://www.intechopen.com/books/clinical-management-of-complicated-urinary-tract-infection/nosocomial-urinary-tract-infections

INTECH
open science | open minds

InTech Europe
University Campus STeP Ri
Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447
Fax: +385 (51) 686 166
www.intechopen.com

InTech China
Unit 405, Office Block, Hotel Equatorial Shanghai
No.65, Yan An Road (West), Shanghai, 200040, China
中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
Phone: +86-21-62489820
Fax: +86-21-62489821

IntechOpen