

Urinary catheterization from benefits to hapless situations and a call for preventive measures

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ABSTRACT

Catheter-associated complications are common, expensive, and often preventable by reducing unnecessary catheter usage. These complications range from most common nosocomial infection to uncommon conditions such as urethral diverticula and ischemic necrosis of the penis. Often, removal of a single known essential cause may be sufficient to prevent a disease. This review raises issues associated with urinary catheterization and emphasizes on the need of preventive measures a physician should take to reduce disappointing situations. The main objective of this literature review is to intercept or oppose unwanted catheter use and thereby, the disease processes associated with urinary catheterization. There is well-described literature available on catheter-associated urinary tract infection, but little is known about noninfectious complications resulting from catheter use; therefore, we also tried to draw attention on these unusual complications.

Keywords: Catheter-associated urinary tract infection, Iatrogenic, urinary catheterization

Introduction

Urethral catheterization is a widespread practice in our medical field. Recent prevalence survey revealed that urinary catheter is the most common indwelling device, with 17.5% patients in 66 European hospitals having urinary catheter and 23.6% in 183 US hospitals.^[1,2] There are no such prevalence data available in the Indian context; however, these data are expected to be higher than Western countries. Common complications of urethral catheterization are urinary tract infections (UTIs), paraphimosis, and urethral stricture. Rare complications of prolonged catheterization include mechanical bladder perforation, iatrogenic hypospadias, aberrant Foley's placement, urethral diverticula.

Indwelling urinary catheter is considered short term if they are *in situ* for <30 days and considered long term when *in situ* for 30 days or more.^[3] Indwelling catheter used in acute care facilities is usually short term while chronic catheters are mostly for spinal

cord injury, neurological and musculoskeletal disorders impairing walking or bladder control, and persons with urinary retention unfit for surgery.

This review addresses only indwelling urinary catheterization and will not discuss intermittent catheters for men and women or external catheters for men. This review discusses common and uncommon complications a physician can encounter in his/her day-to-day practice. In addition, we also try to draw attention on preventive measures to avoid associated complications.

Catheter-associated Urinary Tract Infection

Catheter-associated UTI (CAUTI) is the most common catheter-associated complication. It is duration of catheterization that determines the development of bacteriuria. The daily incidence of acquiring pathogenic bacteria in a patient with urinary catheter is 3–10% of catheterization, representing a cumulative risk of 100% after 30 days.^[4] Enteric pathogens (*Escherichia Coli*) are most commonly responsible organisms, but *Pseudomonas* species,

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Access this article online

Quick Response Code:



Website:
www.jfmpc.com

DOI:
10.4103/2249-4863.197261

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How to cite this article: Garg G, Chawla N, Gogia A, Kakar A. Urinary catheterization from benefits to hapless situations and a call for preventive measures. J Family Med Prim Care 2016;5:539-42.

Enterococcus species, *Staphylococcus aureus*, coagulase-negative staphylococci, *Enterobacter* species, and yeast are also known to cause urinary infection. Prevention of these infections attributable to these devices is an important goal of health-care infection prevention programs. Overall, 71 pathogens were isolated from the urine culture of 64 patients with CAUTIs. *Candida* spp. (28.2%), *Pseudomonas aeruginosa* (18.3%), and *Klebsiella* spp. (15.5%) were the most frequently isolated microorganisms.^[5]

The 2009 Infectious Disease Society of America guidelines define CAUTI in patients whose urinary catheter (urethral, suprapubic, or condom) has been removed within previous 48 h by the presence of symptoms or signs compatible with UTI with no other identified source of infection along with 1000 or more colony-forming units/ml of one or more bacterial species.^[3]

Several evidence-based guidelines offer proposals for the development and maintenance of preventive programs for CAUTI.^[3,6] Approaches to prevention include avoidance of catheter use, policies for catheter insertion and maintenance, catheter selection, surveillance of CAUTI and catheter use, and recommendation for quality indicators. There must be sufficient staffing and staff education, together with access to adequate supplies. There should be a detailed documentation of urinary catheter use, including indication and dates of insertion and removal should be established.

The single most important intervention to prevent CAUTI is to avoid unnecessary use of indwelling catheters. There are only limited accepted indications for catheters use as follows: (1) monitoring of urine output in acutely ill patients, (2) perioperative use in selected surgeries –urology surgeries, surgery on contiguous genitourinary tract– large volume infusion and diuretic during surgery and intraoperative monitoring of urine output, (3) acute urinary retention and obstruction, (4) to facilitate healing of pressure sores and skin grafts in selected patients with urinary incontinence, and (5) at patient's request to improve comfort. A systemic review of catheter discontinuation strategies for hospitalized patients reported that the intervention of “computerized stop order” to facilitate prompt removal of unnecessary catheters reduced the duration of catheter use by 1.06 days and decrease the CAUTI by 53%.^[7]

Good hand washing before and after catheter care has got prime importance in CAUTI prevention. Silver alloy- and nitrofurazone-impregnated catheters may reduce the risk of catheter-associated bacteriuria for short-term use. However, no adequate studies have been done of antimicrobial catheters for long-term use.^[8]

As the Indian population between 65 and 85 years will rise rapidly in coming years, chronic illnesses would also become more common. Therefore, the problem of how to manage and prevent catheter-associated bacteriuria and CAUTI will become more relevant in coming years.

Iatrogenic Paraphimosis

Paraphimosis is uncommon medical condition where foreskin becomes trapped behind the glans penis and it cannot be reduced. The condition frequently occurs after penile examination, urethral catheterization, or cystoscopy. If this condition persists for several hours or there is any sign of decreased blood supply, it could lead to gangrene and should be treated as a medical emergency.

Paraphimosis can be avoided by bringing the foreskin into its reduced position after retraction is no longer necessary. It can be effectively treated by manual manipulation of swollen foreskin which involves compressing the glans and moving the foreskin back in its normal position with the aid of a lubricant, cold compression, and local anesthesia. If this fails, then edematous tissue can be relieved surgically with dorsal slit.

Urethral Stricture

Urethral stricture is a medical condition which usually affects men because of long length of the urethra in men. Trauma such as saddle injury, direct trauma to penis, and urethral catheterization can lead to anterior urethral stricture. In addition, urethral stricture can also occur following prostate surgery, removal of kidney stones, or after any other instrumentation. The most important preventive measure to avoid urethral stricture following catheterization is to liberally instill lubricating jelly into the urethra and to use the smallest possible catheter necessary for shortest period. A study from China showed that the most common type of iatrogenic stricture was urethral instrumentations in 80 patients (46.51%). Mean stricture length was 3.3 ± 2.54 cm and the longest strictures were those caused by intravesical instillation.^[9]

Urinary Bladder Perforation

Urinary bladder perforation associated with indwelling catheterization is a rare complication and can be life-threatening.^[8] Intraperitoneal perforation of the urinary bladder typically manifests with abdominal pain with guarding due to peritonitis.^[10] However, diagnosis of urinary bladder perforation is often difficult because symptoms are nonspecific and vague.^[11] Sometimes, incongruity between bladder irrigation and recovery of saline through the Foley can be suggestive of bladder perforation.^[12] There have been few case reports in the literature regarding urethral rupture of the urethra due to Foley's catheterization.^[13]

Iatrogenic Hypospadias

Iatrogenic hypospadias is a rare clinical entity. Prolonged indwelling urethral catheter produces downward pressure which may be due to improper size of Foley's catheter and improper technique of securing catheter which interferes with blood

supply of urethra causing ischemic effects. Reported literature showed that hypospadias can develop anytime between 1 month and 16 years after urethral catheterization.^[12] Small caliber catheters are preferred to prevent iatrogenic hypospadias as they do not put pressure on urethral mucosa or glands and iatrogenic hypospadias. Iatrogenic hypospadias is a rare clinical condition. There are limited data available about the incidence of catheter-induced iatrogenic hypospadias. Andrew *et al.* reported a similar injury on 16 neurologically ill patients.^[14]

Aberrant Foley's Placement

Accidental placement of a Foley balloon within the ureter is a rare complication of urethral catheterization, with only seven cases reported in the medical literature.^[15]

Patients present with variable presentations, such as persistent urine leakage, groin discomfort^[16] or pain, and back pain.^[17] It can further lead to hydronephrosis if catheter fully blocks the ureteral orifice.^[18] Placing the urethral catheter when urinary bladder is empty increases the risk of abnormal placement.^[19]

On imaging computed tomography with or without contrast, it can delineate the Foley's balloon in the ureter which will be hypodense structure filled with water attenuation. On magnetic resonance imaging (MRI), T2 sequel hyperintense images will be seen in the ureter.

Foley's catheter placement should be checked before balloon inflation. If there is any doubt regarding the placement, then balloon should be deflated and catheter is to be gently pulled out, taking care not to rupture the urethra. In extreme cases, surgery may be required. In cases of ureteral injury, stent placement or surgical correction may be required depending upon the extent of injury and location of injury.^[20]

Urethral Diverticula

Urethral diverticulum is defined as a saccular dilatation extending from the true urethral lumen. It can be acquired or congenital. Mostly, it is acquired ranging from 67% to 90%.^[21] Acquired diverticulum develops because of indwelling urethral catheter, trauma, infection, surgical treatment of hypospadias, or urethral stricture.^[22] The gold standard for evaluating diverticula is MRI of the genitourinary area.^[23] Many patients require surgical correction for treatment of diverticula. Cinman *et al.*^[24] managed seven patients of diverticulum with nonoperative symptomatic treatment. All of them had small asymptomatic urethral diverticulum. He was successful in avoiding surgery with a mean of 3.2 years of follow-up.^[25]

Ischemic Necrosis of the Penis

Ischemic necrosis of the penis is a rare complication and usually develops secondary to Fournier's gangrene, or due to external penile compression from hair, rings, or other

compressions. Diabetes, chronic renal failure, peripheral vascular disease, thrombocytopenia, priapism, herpes simplex type 1 infection, warfarin therapy have been associated with glans necrosis.^[24,26] The ischemic necrosis of glans penis following urethral catheterization is a rare entity. Till date, roughly 15 cases have been reported.^[27]

The submeatal portion of urethra, being a minimally expandable area, is the most common site of ischemic stricture, following endoscopic urethral surgery, and the same region was zone of necrosis described in a case report by Nacey *et al.*^[27] Conservative management has not been successful and partial or total penectomy is often required.

Conclusion

The goals of a physician should be to promote, to preserve, and to restore health when it is impaired. These goals come to life in the term "prevention," and urinary catheter-associated complications can also be prevented by the judicious use of indwelling catheter and early and timely removal of the same.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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