Indwelling urethral catheters in adults

Edward Calleja MD, MRCS(Ed)

HST Urology, Urology Department, Mater Dei Hospital
Email: edward.calleja@gov.mt

Educational aims

- To understand the indications for catheterisation in adults.
- To understand the basic parts which constitute a catheter.
- To understand the limitations in order to make the best choice for each individual patient.
- To recognise catheter associated complications with a special focus on catheter associated urinary tract infection, its management and simple preventive measures.

Key words
Indwelling urethral catheters, catheter associated urinary tract infection, complications, prevention.

This article focuses on indwelling urethral catheters in adults, their indications for the short and long term use, the types of urinary catheters available in Malta, an overview of the basic structure of a catheter, and the complications of urinary catheter insertion and maintenance. An attempt has been made to address in some depth the most common complication of indwelling catheters – catheter associated urinary tract infection in terms of pathophysiology and its management. Simple but crucial recommendations in catheter maintenance have been provided as prevention is the key in reducing the incidence of catheter associated urinary infections.

Introduction

An indwelling urethral catheter is a tube that is inserted through the urethra to allow bladder drainage. Urinary catheters date back to around 3000 BC, in that period river reeds, onion stems, straw and rolled up palm leaves were used to drain the bladder. The discovery of metals like gold, silver, copper, brass and lead, provided the opportunity to shape them into many different types of tubes and curves to achieve urinary drainage.[1] All of these had very serious complications with high morbidity and mortality. In the early 1900 latex was discovered and used to develop a catheter with a separate channel that could be used to inflate a balloon and this marked a stepping stone in catheter design.

Indications for urinary catheterisation[2,3,4]

1. Acute and chronic urinary retention.
2. Neurological disorders that affect bladder emptying.
3. Strict urinary output charting during long surgical procedures, in certain medical circumstances (ex: sepsis, decompensated heart failure) and emergency situations (ex: shock).
4. As a means to deflate the bladder during certain surgical procedures to prevent iatrogenic injury.
5. Patients undergoing certain urological procedures like transurethral resection prostate, urethroplasty etc.
6. In bed bound incontinent patients that developed ulcers in order to avoid direct contact of urine with the wound.
7. In cases of gross haematuria for bladder irrigation.
8. To facilitate continence and maintain skin integrity (when conservative treatment methods have been unsuccessful).
9. Radiological investigations ex: urethrography, cystogram etc.

Short-term versus long-term catheterisation

The definition of short and long-term catheterisation varies in the medical literature. In Malta, our practice is that a short term catheter is considered to last less than 28 days whilst a long term catheter is considered to last up to a maximum of 42 days.

Key points

- Promote high fluid intake (produces continuous downward flow flushing down bacteria).
- Cranberry intake are not effective in preventing urinary tract infection in people with indwelling catheters.[4]
- A catheter has a lifespan, change the catheter regularly.
- Hand hygiene is a must before and after catheter manipulation.[16]
- Keep the drainage bag always below the bed level. Always empty the urinary leg bag when this is three quarters full so to minimise reflux of bacteria and prevent infection.
- Treat constipation (high fluid intake, increase fibre intake, and promote exercise. Recommend laxatives if conservative management fails) as this can lead to inappropriate pressure on the drainage lumen leading to urinary reflux.[16]

Indications for short-term catheterisation[2,3,4]

1. During surgical operations and post-operation recovery care.
2. For precise monitoring of urine output in acute illness (ex: shock, decompensated chronic heart failure etc.).
3. For relief of acute or chronic urinary retention.
4. Intravesical instillation of medication (ex: chemotherapy, immunotherapy etc.).
5. To allow bladder irrigation.
6. For intermittent catheterisation.

Indications for long-term catheterisation[2,3,4]

1. Patients with bladder outflow obstruction and multiple medical co morbidities who are unsuitable for transurethral resection of the prostate.
2. Neurological bladder when intermittent catheterisation is not possible.
3. To protect any skin breakdown or ulceration from contact with urine in bed bound patients which ultimately leads to wound infection and impaired healing.
4. Patient choice after discussing all possible options.[5]
5. Intractable incontinence when all other measures have been tried and failed.

The catheter jigsaw puzzle parts

It is of utmost importance to know of the various parts which constitute a catheter. This knowledge leads to a judicious selection of the ideal catheter size, balloon size and material type for each individual patient and simultaneously reduce catheter-related complications, such as encrustation and blockage.[5]

1. Number of channels

A one channel catheter, as the name implies has only one channel. One can use it for intermittent catheterisation, collection of midstream urine and intravesical instillations.[2] A two channel catheter has an additional channel dedicated for the inflation of a balloon which anchors the catheter in the bladder. The three channel has a channel for urinary drainage, one for inflating the balloon and one for continuous bladder irrigation. This catheter is primarily used following certain urological procedures or in cases of gross haematuria.

2. Catheter material

Latex[2,3,4,6,7]

Latex catheters are typically used for short term as they encrustate easily. Some people have latex allergic reactions and they are contraindicated in these patients. Their main advantage is their flexibility.

Modern latex catheters are usually coated using PTFE (Teflon), Silicone elastomer and hydrogels. These various coatings protect the urethra against latex, they are more biocompatible preventing encrustation and decrease urethral irritation.

Silicone (100%)[2-4,6,7]

Silicone catheters are long term catheters. They have numerous advantages over latex catheters. They are hypoallergenic, more biocompatible leading to reduced encrustations, stiffer, they have thinner walls and a wider drainage lumen. One of the main draw backs is their permeability - the balloon spontaneously deflates. In addition on deflating the balloon there is a greater risk for developing a cuff which can result in uncomfortable catheter removal or urethral trauma. These types of catheters are more expensive than latex.

Antimicrobial

The catheter surfaces are reinforced with antimicrobial properties (on the inside, or on the outside, or both locations) leading to inhibition of bacterial growth and a decrease in catheter associated urinary tract infections.[8] There are silver coated and nitrofurazone coated antimicrobial catheters each having different properties.

Silver-coated catheter

Silver-hydrogel coated catheters are available in latex and silicone. It exerts its antimicrobial properties by binding to sulphur, oxygen and nitrogen containing groups and displaces other metal ions. Its bioavailabilty is reduced by many urinary factors.[9] They may reduce the risk of catheter-associated bacteriuria in hospitalised patients during short-term catheterisation (less than one week)[4] but lose their effect if the catheter is kept longer.

Nitrofurazone-coated catheter

Nitrofurazone exerts a similar action to nitrofurantoin. When compared to silicone catheter there was no statistical difference if the catheter was kept long term with respect to the incidence of urinary tract infections. They may reduce this risk in short-term catheterised patients (less than one week) similar to silver coated catheters.[10] The potential risk for antibiotic resistance is still unknown.[11]

3. Balloon Size

The balloon size is indicated at the catheter connection area and varies according to the manufacturing company. The standard practice involves inflating the balloon around 10 millilitres. Larger volumes can lead to unnecessary complications like bladder irritation and inappropriate urine drainage.

4. Catheter diameter size and length

The external diameter of the catheter is indicated by French Gauge usually available in even numbered widths from 6 to 24. An unnecessary large catheter implies more pressure on the inner lining of the urethra with impairment of paraurethral gland secretions leading to an increased risk of catheter associated urinary tract infection.

Complications of urinary catheterisation

Despite catheterisation being a routine medical procedure, even when done with an absoulte aseptic and sound technique it can be associated with various complications that can lead to patient discomfort, morbidity and health financial burden. Complications include:[2,4]

1. Catheter associated urinary tract infection (the most common complication).
2. Trauma to the urethra or bladder from incorrect insertion leading to increased risk of urethral stricture formation.
3. Blockage secondary to encrustations.
4. Urinary stones.
5. Catheter dislodgement.
6. Gross haematuria.
7. Pain.
8. Urine can leak around the catheter. There are many factors that can lead to this common complaint like blockage of the catheter (secondary to encrustations, blood clots or kinking of the tube), bladder spasms, constipation, wrong balloon size and urinary tract infections.

Colonisation and biofilms

Biofilms form when bacteria attach to surfaces (metal, plastic, living tissue etc.) in aqueous environment and to themselves via cell to cell adhesions (mediated through quorum sensing – bacterial communication). In addition a matrix is created that will enhance the process. Bacteria move up the catheter as an extending biofilm on the external surface of the catheter. After forty-eight hours of catheterisation, most catheters are colonised with bacteria, thus leading to possible bacteruria and its complications.[12]

Turbulent urinary flow in the catheter lumen promotes bacterial seeding and colony formation. Increasing fluid intake will increase urine flow down the catheter ultimately decreasing the colonisation process.

Catheter associated urinary tract infection

Catheter associated urinary tract infection is the major nosocomial infection and an economic health burden.[13] For patients with indwelling urethral catheters, a count of $\geq 10^5$ cfu/mL is diagnostic of bacteriuria.[14]

Catheter associated urinary tract infection can lead to cystitis, ascending urinary tract infection, in males it can cause prostatitis and epididymo-orchitis. Some rare complications that may arise are endocarditis and septic arthritis.[2,3] The most common organism is Escherichia coli followed by Staphylococcus, Enterococcus, Pseudomonas, Klebsiella and Proteus.[2,3,13,14]

Patients with indwelling catheters should not be given prophylactic antibacterial therapy. Asymptomatic bacteriuria should not be treated with antibiotics. This inappropriate use of antibacterial therapy is likely to produce antibiotic resistance.[15]

Antibiotic treatment should only be indicated for symtpomatic bacteriuria (fever and systemic upset).[14] Prior to initiating antibiotics a urine for culture and sensitivity should be taken so that treatment can be adjusted according to sensitivity. It is of utmost importance to consult with a microbiologist and urology specialist in those patients that have recurrent catheter urinary tract infections.

Taking a urinary sample

Any catheter in situ for more than one week must be changed prior to sampling as the bacteria in the tube will affect the result and is not representative of the bladder microorganisms. If the catheter has been in situ for less than one week one can sample through the designated sampling area (this is located in the upper part of the drainage bag tube and is made of rubber) via a syringe.[4]

Conclusion

Urinary catheterisation is a common intervention not without serious complications. Catheterisation should only be undertaken when indicated and there should be careful judgement on the indwelling time to reduce the risk of complications. By adhering to basic maintenance principles as outlined above, one can provide effective care and prevent catheter-associated complications.

References

1. Rabie E. Abdel-Halim. Urethral Catheters: A Historical Review Saudi Medical Journal 1990; 11 (2): 87-88
2. Reynard J. Oxford Handbook of Urology. 2nd edition. Oxford University Press; 2009
3. Wein AJ. Campbell-Walsh Urology. 10th edition. Saunders, Elsevier Inc; 2012
4. Geng V. Evidence-based Guidelines for Best Practice in Urological Health Care Catheterisation Indwelling catheters in adults Urethral and Suprapubic. EAU guidelines office; 2012
5. NICE Urinary incontinence – the management of urinary incontinence in women. CG40 Full guideline. RCOG Press; 2006.
6. Madigan E. Care of Patients with Long-Term Indwelling Urinary Catheters. Online Journal of Issues in Nursing. 2003; 8(3).
7. Curtis J. A comparative assessment of three common catheter materials. Dow Corning Corporation. Kluwer Academic Publishers; 2008
8. Lawrence E. Materials for urinary catheters: a review of their history and development in the UK. Med Eng. Phys. 2005 Jul; 27(6):443-53.
9. Liedberg H. Assessment of silver-coated urinary catheter toxicity by cell culture. Urol Res (1989) 17:359-360
10. Lee SJ. A comparative multicentre study on the incidence of catheter-associated urinary tract infection between nitrofurazone-coated and silicone catheters. Int J Antimicrob Agents. 2004 Sep; 24 Suppl 1:S65-9.
11. Cottenden A, Management using continence products. In: Abrams P, et al. eds. Incontinence. 4th ed. Paris; 2009
12. Proal A. Understanding biofilms. May 2008. http://bacteriality.com/2008/05/26/biofilm/
13. Jacobsen S.M. Complicated Catheter-Associated Urinary Tract Infections Due to Escherichia coli and Proteus mirabilis. Clin. Microbiol. Rev. 2008;21:26-59
14. Grabe M. Guidelines on Urological Infections European Association of Urology guidelines. EAU guidelines office; 2010
15. Chris S. Guidelines for the Care of Urinary Catheters Policy. NHS Tees, Esk and Wear Valleys NHS Foundation Trust; 2009
16. Community Health Oxfordshire Clinical Quality and Governance Group Clinical Guidelines for the management of urinary incontinence for the adult patient, 2009.