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Urinary Catheters (General Overview, Different Types, Indication, and Troubleshooting Common Catheters Problem in the Ward)

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1. Introduction

Urethral catheters have been used to drain the bladder for 3500 years. Treatment of acute urine retention was known and recorded in ancient Egyptian papyrus since 1500 BC as they used transurethral bronze tubes, reeds, straws, and curled-up palm leaves. The word Catheter is inspired by the ancient Greek term "kathetér" which means "to thrust into or to send down". The style of the urethral catheter developed over time and the current familiar balloon-based-self retaining catheter was designed by Dr Frederic Foley in 1929. Before that time, catheters were only used to treat acute urinary retention but now Catheters are used for a number of indications which will be explored in more depth later in this article. [1]

2. Materials of Catheter

Historically, many different materials were used in catheter synthesis and changed over time, the first recorded synthetic catheter was in the 1500s and was made from indwelling-wax impregnated cloths catheter moulded in sliver sound to reduce the incidence of injury during repeated catheterization. [1] Since 1930, catheters are made from latex (Foley catheter). Recognition of the complications associated with latex catheters, such as biofilm formation or allergy, led to the evolution of silicone or Teflon catheters.

3. Indication for Catheterization

The main use of urinary catheter overages was in urine retention (acute or chronic) but now we are using them for various reasons in different specialties. Starting with urology in addition to the previous indication, urinary catheters are used as a treatment for urinary incontinence in males and females, 3-way catheter is used for bladder irrigation in patients with severe haematuria and clot retention, with neurogenic bladder patient indwelling catheterization are used to protect both kidneys from vesical-ureteric reflux, injection of intravesical medication like mitomycin or BCG in case of bladder cancer as part of the investigation of bladder function as in urodynamic or in case of bladder injury to perform cystogram to insure the bladder integrity. In the intensive care unit and Coronary Care Unit (CCU), catheters are needed to hourly monitor patients' urinary outputs which would be vital in their management. Moreover, orthopaedic patients with limited mobility may need a catheter post operatively. In addition to that catheters are used to assist in the management of perineal or sacral wound in incontinent patients to keep the patient dry which will promote healing, and neurologically impaired patients may need a catheter if other methods of toileting are contraindicated.

- **Types of catheters**

As catheterisation became more common, different catheter types were developed in response to different indications for catheterisation and different challenges that can be encountered during catheterisation. Different diameter sizes are used to suit most of the patients' urethral diameter and length including all ages. Sizes are starting from 6 **FR** up to 24 FR and each size has an associated colour near the balloon part according to international standards for labelling catheters to make it easy to differentiate (figure 1) . There are several catheter types in common use today which we have outlined below:

- Single lumen catheters: these do not remain in the bladder and are removed as soon as they have been used. They may be used for intermittent self-catheterisation or for the administration of drugs into the bladder.
- 2-way catheters: these contain 2 channels; **one** to inflate the balloon and one to drain the urine.
- 3way catheters: these contain an extra channel to allow irrigation from outside in case of haematuria.

Catheters may also be classified according to their tip, as there is a rounded tip with a distal lateral opening to drain clear urine, whistle tip which contains the distal wide opening and allows draining of viscous fluid but increases the risk of trauma, coudé and Tieman tip which are very useful for males with enlarged prostate, high bladder neck and urethral strictures (Figure 1), (Figure 2) [2].

Colour	Size	Indication
	6 Fr	Paediatric
	8 Fr	
	10 Fr	
	12 Fr	Adult female
	14 Fr	
	16 Fr	Adult male
	18 Fr	
	20 Fr	Haematuria (clot retention)
	22 Fr	

Figure 1: Showing different catheters sizes associated with corresponding colours and most common indications

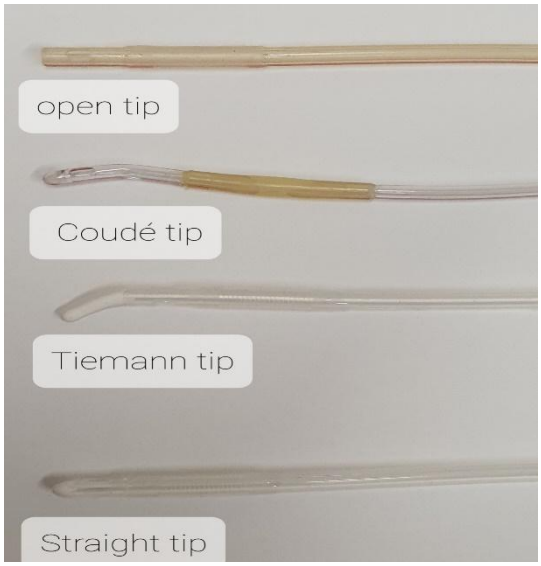

Figure 2: Showing different types of catheter

- **Routes of catheter insertion**

The two most common routes for urinary catheter insertion: are urethral and suprapubic. For the urethral route, local anaesthetic or other lubricant gel is placed into the urethra and the catheter will be inserted into the bladder through the urethra. For an indwelling urethral catheter, the catheter is secured by the inflation of a water-filled balloon (typically 10ml but can vary depending on catheter specifications).

Urethral catheters may be intermittent, short or long term. For intermittent catheterisation, the patient or carer is taught to pass a catheter which is removed immediately after the bladder has been emptied.

Whether an indwelling catheter is short or long term will depend on the indication for the catheter and the catheter material. Typically, a latex catheter may remain in place for up to 4 weeks. A silicone (or other long-term catheters) may remain in place for up to 12 weeks before being exchanged. [3]

Suprapubic catheters are inserted through the abdomen into the bladder and left in situ. Suprapubic catheters can be inserted under general, epidural, or local anesthesia. There are several indications for suprapubic catheterisation including urethral stricture or injury, traumatic hypospadias from a prolonged urethral catheter, bladder neck fibrosis following radiotherapy for prostate cancer, more suitable option for long-term catheter, and patient preference. Although suprapubic catheter has got a lot of indications, it has some contraindications including uncorrected coagulation abnormalities due to the high risk of bleeding, previous abdominal or pelvic surgery due to potential bowel adherence of bowel to the bladder which will increase the risk of bowel perforation, and pelvic cancer with or without radiation due to possible adhesions.

In addition to the previous routes, there is another way of intermittent catheterisation through the suprapubic area (Mitrofanoff procedure) in which intermittent catheters are used to empty the bladder through a small channel from the bladder to outside. Usually, this channel is made of the appendix or piece of the small bowel and by using a tunnelling technique a one-way valve is formed to provide continence. This way is mostly used with children who have congenital neurogenic bladder to help them have good urinary control and acceptable lifestyle, also in patients with spinal cord injuries or wheelchair users who find it difficult to use the toilet and prefer a suprapubic catheter to indwelling urethral **or** intermittent self-catheterisation. Mitrofanoff is contraindicated in patients who are known to have high-pressure chronic retention as it can lead to urine reflux into the kidneys and a patient with small bladder capacity.

- **Pros and cons of different ways of catheter insertion**

Catheter insertion is aimed mainly to empty the bladder, but every way of catheter insertion has its advantages and disadvantages. Intermittent catheterisation has the advantage of not having an indwelling catheter and may help preserve patient comfort, body image, and sexual function. A further advantage of intermittent catheterisation is that it is used only when needed with lower rates of urinary tract infection. There are also potential disadvantages of urethral injuries, strictures,

bladder perforation, recurrent bladder stone formation, and rare presentation of a missed catheter inside the bladder.

On the other hand, indwelling catheterisation provides more stability with no need to insert a catheter for the patient a few times every day which could be uncomfortable for some patients. However, indwelling catheterization also has a higher risk of urinary tract infection, in addition to urethral injury, fistula, urethritis, sphincter erosions, traumatic hypospadias, bladder stones, bladder cancer, and difficulty with sexual intercourse when it is in place. While the suprapubic catheter has the advantage of being more comfortable, easy to manage, less likely to get blocked, easier to have sexual intercourse while it is in place, and easier to be changed, however; it has some problems as it could need an operation to be inserted in the first time, some urine leaking through the urethra and patient has the risk of having wound infection.

- **Which route of catheter insertion has got the lower rates of urinary tract infection**

The risk of having recurrent urinary tract infection with different catheter types has always been subject of debate, researches have been attempted to prove which way of catheter infection has got the lower risk of urinary tract infection. In December 2019, Garbarino, et al have published a retrospective study for patients in orthopedic departments in Northwell Health and the Cleveland clinic who needed a catheter insertion after total knee arthroplasty surgery, and it showed that there was a lower risk of urinary infection with intermittent catheterization [4]. Another network metanalysis review published in July 2017 by Han, et al, comparing the urinary tract infection rates associated with transurethral indwelling catheterisation, suprapubic catheter, and clean intermittent catheterization in the postoperative setting; the results showed that for short term duration (<5 days) there is no difference in urinary tract infection rates. However, for long-term duration (> 5 days) suprapubic and intermittent catheterization showed a lower risk of urinary tract infection than indwelling catheterization. [5]

In view of the above, it is worth remembering the HOUDINI protocol which is used to decide if the urinary catheter should be removed or not based on specific criteria aiming to decrease the risk of unnecessary catheter-associated urinary tract infection. The protocol was developed by Adams et al in 2012. The acronym stands for **H**aematuria (gross), **O**bstruction, Urological surgery, **D**oes the patient have pressure ulcer and catheterised to assist in the healing of an open sacral or perineal wound, **I**nput& output are critical for patient management or hemodynamic instability, **N**eurogenic bladder dysfunction, or chronic indwelling catheter and **I**mmobilisation due to physical constraints. The protocol states that if the patient meets any of the criteria, the catheter shouldn't be removed. If the patient doesn't have any of the mentioned criteria, the catheter could be removed with proper documentation, and after care.

- **Tips for blind urethral catheter insertion**

There are a few tips to guarantee the highest success rate of blind catheter insertion. Firstly, we should start by injecting 10-15 ml lubricant anesthetic gel into the urethra and wait for 3-5 minutes before catheter insertion as this will anesthetize the urethral mucosa which will facilitate catheterization. Secondly, elongate the penis in the upright position at 60 degrees which is the line of the normal anatomical curve of the urethra. Third, ask the patient to cough and take slow and deep breaths to help him relax when the catheter approaches the bulbomembranous urethra. Fourth, complete insertion of the catheter up to the Y bifurcation to ensure that the catheter has reached the bladder as it can start draining urine beyond the membranous urethra before the bladder. By ensuring the catheter is fully inserted we avoid false inflation of the balloon in the urethra which can cause significant trauma. Fifth, in uncircumcised patients, retract the foreskin if possible before inserting the catheter and be sure to return it back to the normal anatomical position after catheterization to avoid paraphimosis. Sixth, if the attempt wasn't successful, a coudé tip catheter could be used to help the negotiation with the prostatic urethra in case of benign prostatic hyperplasia. Despite all the previously mentioned preparations before inserting the catheter, sometimes we fail to insert it. If this happens, other options should be considered like using cystoscopy or consider suprapubic catheter insertion. [6]

- **Troubleshooting of catheter insertion problems**

Most of the time insertion of a urethral or suprapubic catheter is a straightforward procedure but sometimes, it could be more difficult than expected. In this part, we will mention the challenging circumstances which could face the medical team during and after insertion of the catheter and how we can deal with them. The following table (table 1) shows the most common problems the medical team could face during the catheter insertion. [6]

Table 1: Showing potential problems, causes, and possible solutions associated with catheter insertion.

Difficulty	*Possible cause*	*Possible solution*
Difficulty locating the female urethral meatus.		• A vaginal speculum can help in location. • Use of vaginally placed finger for guidance.
Severe pain or resistance in the penile or bulbomembranous urethra.	• Mostly urethral stricture should stop immediately, as more push could lead to a false passage.	• Consider cystoscopy for catheter insertion.
Inability to pass the S-shaped bulbourethral curve.		• Consider trial with coudé tip catheter.
Resistance passing through the external	• The patient is tense and contracting the	• Ask the patient to cough and try to relax his

urethral sphincter and the bladder neck.	sphincter. • Enlarged prostate with older men. • Scarred bladder neck due to multiple prostate operations or radiotherapy of prostate cancer.	urinary muscle sphincter as if he is going to void. • If pain or resistance continues, don't push as it can cause more damage. • Try again with 12 Fr coudé tip catheter with tip directed upward.
Urine doesn't drain after insertion after full-length catheter insertion.	• Catheter holes may be blocked with gel. • The catheter is not in the right place.	• Don't inflate the balloon. • Flush the catheter with saline to ensure opening its holes. • Assess the bladder for fullness. • If you are sure the catheter position is correct, wait up to 5 minutes for it to drain.
Pain during inflating the balloon.	Catheter still in the urethra.	• Stop immediately and deflate balloon as it can cause severe urethral damage. • Be sure that the catheter is inserted up to the Y bifurcation.

Sometimes after urethral or suprapubic catheter insertion, some problems related to it start to appear which require management or even complete change of the catheter. The following table (table 2) will illustrate the most common catheter-associated problems and how they should be managed. [7]

Table 2: Showing the possible problems, causes, and solutions after catheter insertion.

Problem	*Cause*	*Solution*
Blocked/ bypassing catheter	• Bladder spasms • UTI, debris. • Bladder stones. • Blood clot. • Misplaced catheter.	• Check for UTI and treat if proved. • Flush the catheter. • Check for bladder stones.
Debris in the catheter	• UTI. • Bladder stones. • Neobladder or bladder augmentation with bowel segment.	• Check for UTI and treat if proved. • Flush the catheter with NaCl for the neobladder.
Penile discomfort with the urethral catheter.	• UTI. • catheter irritation. • traumatic hypospadias.	• Check for UTI and treat if proved. • Consider anti-muscarinic or B3 agonist for bladder irritation. • Consider suprapubic catheter if traumatic hypospadias.
Recurrent UTI (proved and symptomatic)	• Long term catheter • Recent catheter change. • Bladder stones.	• Antibiotic if symptomatic. • Treat bladder stone if present. • Consider a suprapubic catheter if the problem persists. • Consider Hipprex (+/-vitamin C) as urinary antiseptic

4. Conclusion

Urinary catheters are a very important part of medical management; almost 25% of hospital-admitted patients will need a urinary catheter at some stage for their treatment. For that we think even with the great evolution in urinary catheters, there is still a greater space for more innovation.

References

[1] Feneley RC, Hopley IB, Wells PN. Urinary catheters: history, current status, adverse events and research agenda. J Med Eng Technol.2015; 39 (8): 459-70. doi: 10.3109/03091902.2015.1085600. Epub 2015 Sep 18. Erratum in: J Med Eng Technol.2016; 40 (2): 59. PMID: 26383168; PMCID: PMC4673556.

[2] Gilbert, Brent & Naidoo, Taryn & Redwig, Frank. (2018). Ins and outs of urinary catheters. Australian journal of general practice.47.132-136.10.31128/AFP-10-17-4362.

[3] Igawa Y, Wyndaele JJ, Nishizawa O. Catheterization: possible complications and their prevention and treatment. Int J Urol.2008 Jun; 15 (6): 481-5. doi: 10.1111/j.1442-2042.2008.02075. x. Epub 2008 Apr 22. PMID: 18430150.

[4] Garbarino LJ, Gold PA, Anis HK, Sodhi N, Danoff JR, Boraiah S, Rasquinha VJ, Mont MA. Does Intermittent Catheterization Compared to Indwelling Catheterization Decrease the Risk of Periprosthetic Joint Infection Following Total Knee Arthroplasty? J Arthroplasty.2020 Jun; 35 (6S): S308-S312. doi: 10.1016/j. arth.2020.02.055. Epub 2020 Feb 28. PMID: 32192833.

[5] Han CS, Kim S, Radadia KD, Zhao PT, Elsamra SE, Olweny EO, Weiss RE. Comparison of Urinary Tract Infection Rates Associated with Transurethral Catheterization, Suprapubic Tube and Clean Intermittent Catheterization in the Postoperative Setting: A Network Meta-Analysis. J Urol.2017 Dec; 198 (6): 1353-1358. doi: 10.1016/j. juro.2017.07.069. Epub 2017 Jul 20. PMID: 28736320.

[6] Willette PA, Coffield S. Current trends in the management of difficult urinary catheterizations. West J Emerg Med.2012; 13 (6): 472-478. doi: 10.5811/westjem.2011.11.6810
[7] https: //www.nbt. nhs. uk/sites/default/files/Catheter%20troubleshooting%20guide%20NBT%202019_1. pdf.
[8] Murphy C. Innovating urinary catheter design: An introduction to the engineering challenge. Proc Inst Mech Eng H.2019 Jan; 233 (1): 48-57. doi: 10.1177/0954411918774348. Epub 2018 May 23. PMID: 29792114.
[9] Villanueva C, Hemstreet GP 3rd. Difficult male urethral catheterization: a review of different approaches. Int Braz J Urol.2008 Jul-Aug; 34 (4): 401-11; discussion 412. doi: 10.1590/s1677-55382008000400002. PMID: 18778491.
[10] Bugeja S, Mistry K, Yim IHW, Tamimi A, Roberts N, Mundy AR. A new urethral catheterisation device (UCD) to manage difficult urethral catheterisation. World J Urol.2019; 37 (4): 595-600. doi: 10.1007/s00345-018-2499-9