

VIEWS & REVIEWS

PERSONAL VIEW

It's time to change the catheter: this ubiquitous but flawed medical device is letting patients down

The most commonly implanted medical device is also the leading cause of infection acquired in healthcare settings. Can the Foley catheter be improved on, asks **John Havard**, after 80 years largely unchanged

John Havard *general practitioner, Saxmundham Health, Lambsale Meadow, Saxmundham, Suffolk IP17 1DY, UK*

The indwelling urinary catheter was designed by Frederick Foley in the 1930s—but it's been stuck in a time warp ever since. It was originally intended only to provide haemostasis after transurethral prostatic surgery. Its inflatable balloon was unique, reliably enabling retention in the bladder. Now it is the most commonly implanted medical device, with 100 million in use in many different groups of patients around the world at any one time.¹

Unfortunately, its use risks serious pathologies that are often difficult to treat. The Foley catheter is the most common cause of infections in healthcare facilities.² Patients are so vulnerable because the catheter undermines the defences that usually protect the bladder against infection. The normal regular mechanical filling and emptying of the bladder help to wash out any bacteria that contaminate the urinary tract. The Foley catheter, with continuous drainage into a collection bag, does not allow the bladder to fill, and the retention balloon leads to a sump of residual urine below the level of the drainage eyes at the catheter's tip.

Because urine trickles through the catheter rather than flushing the urethra, bacteria can migrate unimpeded. In the bladder, the urine sump is an excellent and continuously replenished growth medium. Rapid multiplication results in enormous bacterial populations.

Another and surprisingly common problem is that when the catheter is inserted or removed the tip can damage the epithelia of the bladder and urethra.³ A recent study in a Department of Veterans Affairs medical centre in the United States found that 82 catheterised patients had 100 such traumatic episodes recorded in 16 months.⁴ Traumatized mucosal surfaces are ideal for bacterial colonisation and infection. In the UK a prospective study of catheterised patients in community care in the Bristol area found 506 emergency referrals had been recorded for 467 patients in six months.⁵ A more recent study of catheterised patients in community care reported that in an eight month

period all 43 of them had at least one complication associated with the catheter, and many had multiple, recurring problems.⁶

With good care, most patients undergoing catheterisation for up to seven days are likely to avoid infection. Bacteriuria is inevitable, however, if the catheter is in place for a month or longer. Catheter associated bacteriuria is generally asymptomatic, but serious complications can include pyelonephritis and endotoxic shock.⁷

The morbidity and costs to health services are simply unacceptable. A study of nursing home patients in Ohio found significantly higher morbidity and mortality rates in patients undergoing long term catheterisation than in matched uncatheterised controls.⁸ In one year, catheterised patients were significantly more likely to have received antibiotics and spent more time in hospital. They were also three times more likely to be dead.⁸

Many attempts have been made to prevent such infection, using apparently rational strategies, such as patients' daily use of antimicrobial agents. Paradoxically, the more comprehensive attempts have been less effective. Because the physical and financial cost of complications is so high objectives have progressed to incorporating antibiotics or biocides into catheter coatings.⁹

A perfect infection resistant catheter coating should have life-long antimicrobial activity against a wide range of potentially dangerous organisms and be resistant to colonisation by microbial biofilms. Although this should not be a problem for devices in place for just two to three days, those left for two to three months present a challenge. In addition, contact with body fluids should not affect antimicrobial activity, and most importantly coatings should not encourage resistance to antibiotics.¹⁰ It is a formidable task.

Ingenious techniques have been used to try to produce coatings that release antimicrobial agents in a controlled way, but only

two have got to market, one with a coating that contains silver and another that contains nitrofurazone.

The recent large multicentre trial in the UK funded by the Health Technology Assessment (HTA) programme of the National Institute for Health Research found that coatings that contain silver produced no significant reduction in infection rates in short term use.¹¹ There is no evidence that they are beneficial to patients undergoing long term catheterisation.

Laboratory tests with the nitrofurazone coating showed that sections of these catheters were not active against species such as *Pseudomonas aeruginosa* and *Proteus mirabilis*, which are implicated pathogens in long term catheter use. It was suggested therefore that nitrofurazone catheters would only be appropriate for use in patients who need short term catheterisation.¹² These catheters produced no significant reduction in symptomatic infection in the HTA trial, and the manufacturer withdrew the nitrofurazone catheter.

An expert panel of the Infectious Diseases Society of America has also concluded that the evidence is insufficient to recommend the use of these antimicrobial catheters.¹³ They concluded that the most effective way to reduce the incidence of catheter associated urinary tract infection is to restrict the use of catheters and remove them as soon as possible. Unfortunately, these recommendations fail to meet the needs of the many older and disabled people who have to rely permanently on an indwelling catheter and for whom no acceptable alternative system exists. We seem still to be at the stage of saying that the best way to improve the braking performance of this car is to carry less passengers.

Why in 2014 can we still not drain urine from a dysfunctional bladder without complication? Antimicrobial coatings for catheters have no future because these devices still undermine natural defences. We need a device that allows the bladder to fill and completely empty so that a sump of residual urine does not persist in the tract. Also, the catheter, particularly its tip, must not damage epithelia. Millions of older patients (and many

more coming after them) should be able to expect something better than this 80 year old device.

Competing interests: I have read and understood the BMJ Group policy on declaration of interests and am the recipient of a primary care researcher bursary from the Norfolk and Suffolk Primary and Community Care Research Office.

Provenance and peer review: Not commissioned; not externally peer reviewed.

- 1 Darouiche RO. Device-associated infections: a macroproblem that starts with microadherence. *Clin Infect Dis* 2001;33:1567-72.
- 2 Warren JW, Steinberg L, Hebel JR, Tenney JH. The prevalence of urethral catheterization in Maryland nursing homes. *Arch Intern Med* 1989;149:1535-7.
- 3 Feneley RC, Kunin CM, Stickler DJ. An indwelling catheter for the 21st century. *BJU Int* 2012;109:1746-9.
- 4 Leuck AM, Wright D, Ellingsen L, Kraemer L, Kuskowski A, Johnson JR. Complications of foley catheters—is infection the greatest risk? *J Urol* 2012;187:1662-6.
- 5 Kohler-Ockmore J, Feneley RC. Long-term catheterization of the bladder: prevalence and morbidity. *Br J Urol* 1996;77:347-51.
- 6 Wilde MH, Brasch J, Getliffe K, Brown KA, McMahon JM, Smith JA, et al. Study on the use of long-term urinary catheters in community-dwelling individuals. *J Wound Ostomy Continence Nurs* 2010;37:301-10.
- 7 Stickler DJ, Zimakoff J. Complications of urinary tract infections associated with devices used for long-term bladder management. *J Hosp Infect* 1994;28:177-94.
- 8 Kunin CM, Douthitt S, Dancing J, Anderson J, Moeschberger M. The association between the use of urinary catheters and morbidity and mortality among elderly patients in nursing homes. *Am J Epidemiol* 1992;135:291-301.
- 9 Kunin CM. *Detection, prevention and management of urinary tract infections*. 5th ed. Williams and Wilkins, 1997.
- 10 Guggenbichler JP, Boswald M, Lugauer S, Krall T. A new technology of microdispersed silver in polyurethane induces antimicrobial activity in central venous catheters. *Infection* 1999;27:s16-23.
- 11 Pickard R1, Lam T, MacLennan G, Starr K, Kilonzo M, McPherson G, et al. Antimicrobial catheters for reduction of symptomatic urinary tract infection in adults requiring short-term catheterisation in hospital: a multicentre randomised controlled trial. *Lancet* 2012;380:1927-35.
- 12 Johnson JR, Delavari P, Azar M. Activities of a nitrofurazone-containing urinary catheter and a silver hydrogel catheter against multidrug-resistant bacteria characteristic of catheter-associated urinary tract infection. *Antimicrob Agents Chemother* 1999;43:2990-5.
- 13 Hooton TM, Bradley SF, Cardenas DD, Colgan R, Geerlings SE, Rice JC, et al. Diagnosis, prevention, and treatment of catheter-associated urinary tract infection in adults: 2009 International Clinical Practice Guidelines from the Infectious Diseases Society of America. *Clin Infect Dis* 2010;50:625-63.

Cite this as: *BMJ* 2014;348:g1932

© BMJ Publishing Group Ltd 2014