Measuring the efficacy of antimicrobial catheters

In this article...

- Details of the Cochrane review on catheter-associated UTI
- The Catheter Trial: recent research on reducing infection risk
- Implications for future practice

Keywords: Catheter/Infection/Hospital patients

- This article has been double-blind peer reviewed

The Catheter Trial was undertaken to establish whether antiseptic and antimicrobial-coated catheters were effective in reducing catheter-related infection.

Catheter-associated urinary tract infection (CAUTI) is the second most common cause of hospital-acquired infection worldwide. These infections can lead to significant morbidity, increase length of hospital stay and incur large healthcare costs (Umscheid et al, 2011); CAUTI cost the NHS approximately £25m a year (Plowman, 1999).

Urethral catheterisation is commonly used in the care of patients in hospital; around 15-25% of the 14.5 million patients admitted to NHS England hospitals are catheterised at some point during their stay (Gould et al, 2010). The risk of developing bacteriuria from a catheter increases by 3-6% each day the catheter is in situ, resulting in approximately 50% of hospitalised patients who are catheterised for longer than 7-10 days developing significant bacteriuria (Stamm, 1998). Women, older patients and those with comorbidities are more likely to be affected (Stamm, 1998).

It has been estimated that 20% of patients with bacteriuria develop symptomatic urinary tract infection (Garibaldi et al, 1982) and, while bloodstream infection occurs in fewer than 1% of cases, it is associated with a high (30%) mortality rate (Bryan and Reynolds, 1984). The presence of bacteriuria in patients in hospital with an indwelling catheter is a potential source of cross-infection, particularly in critical care units, with an estimated risk per episode of 15% (Johnson et al, 2006).

Previous evidence

Two widely available antiseptic or antimicrobial-coated catheters are silver alloy-coated latex catheters and silicone ones.

Strategies to reduce CAUTI

Hospital-acquired infections account for significant morbidity and mortality and are linked to high financial and personal costs so it is necessary to develop strategies to reduce their burden (Box 1).

5 key points

1. 50% of hospital patients who have an indwelling urinary catheter for 7-10 days develop bacteriuria, which increases the risk of a CAUTI.
2. CAUTI is a preventable cause of major harm to patients in hospital and incurs significant costs.
3. Antimicrobial coated or impregnated catheters were introduced to cut the risk of CAUTI, but evidence on their efficacy was inconclusive.
4. There appears to be no significant clinical benefit for using these catheters in terms of reducing CAUTI risk.
5. Preventive measures should focus on simple, inexpensive strategies.

Many hospital patients who need a catheter develop an infection as a result of catheterisation.

Acknowledgements

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References

that are impregnated with nitrofurazone. Silver and nitrofurazone are recognised as antiseptic and antimicrobial agents respectively (Franken et al, 2007).

A Cochrane reviewed the effect type of indwelling urethral catheter has on the risk of urinary tract infection in hospitalised adults who undergo short-term catheterisation. Published in 2004 and updated in 2008, the review also aimed to identify: the most cost-effective catheter in terms of cost per infection avoided, which catheter provides the most comfort to patients, and adverse effects other than urinary tract infection. All randomised and quasi-randomised controlled trials (23 in total) comparing types of indwelling urinary catheters for short-term catheterisation in hospitalised adults were included in the review and a meta-analysis was performed. The main conclusions were:

- Silver-alloy catheters appear to reduce asymptomatic bacteriuria;
- Nitrofurazone-impregnated catheters appear to cut asymptomatic bacteriuria in patients catheterised for up to a week, but there was no significant effect in those catheterised for longer.

However, the Cochrane review identified several major flaws in the evidence base:

- Most studies were of poor to moderate quality in terms of risk of bias;
- Almost all studies used the presence of bacteriuria on microbiological examination as the outcome measure for a diagnosis of CAUTI, without specifying whether it was symptomatic or linking to a clinical decision to treat with antibiotics;
- Multiple definitions of bacteriuria were used across the studies;
- The cost effectiveness of antimicrobial catheters was unclear.

While silver-alloy coated and antibiotic-impregnated catheters appear to be more effective than standard catheters in reducing the likelihood of bacteriuria occurring, more evidence of their efficacy is necessary before they can be considered for routine use in the UK health service. Despite this lack of robust evidence, some UK hospitals have adopted these fairly expensive catheters for routine use on their wards.

**The Catheter Trial**

**Table 1: Catheter Trial: Baseline Characteristics**

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Silver-alloy catheter (n = 2,097)</th>
<th>Nitrofurazone catheter (n = 2,153)</th>
<th>Standard PTFE catheter (control, n = 2,144)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean, years (SD)</td>
<td>59 (16)</td>
<td>59 (16)</td>
<td>59 (16)</td>
</tr>
<tr>
<td>Female gender (%)</td>
<td>1,319 (63)</td>
<td>1,333 (62)</td>
<td>1,525 (62)</td>
</tr>
<tr>
<td>Comorbidities associated with increased CAUTI risk (eg diabetes, immunosuppression, urological disorder (%))</td>
<td>547/2,084 (26)</td>
<td>546/2,138 (26)</td>
<td>581/2,136 (27)</td>
</tr>
<tr>
<td>Prophylactic antibiotics before catheterisation (%)</td>
<td>1,529 (73)</td>
<td>1,537 (71)</td>
<td>1,547 (72)</td>
</tr>
<tr>
<td>Duration of catheterisation, median, days (IQR)</td>
<td>2 (1-3)</td>
<td>2 (1-3)</td>
<td>2 (1-3)</td>
</tr>
<tr>
<td>Duration of hospital stay, median, days (IQR)</td>
<td>6 (3-8)</td>
<td>6 (3-9)</td>
<td>6 (3-9)</td>
</tr>
</tbody>
</table>

CAUTI = catheter-associated urinary tract infection. IQR = interquartile range. PTFE = polytetrafluoroethylene. SD = standard deviation.

The trial was undertaken in NHS hospitals only and included adult patients who needed short-term catheters (up to a period of 14 days). Male and female patients were included; people were excluded if they:

- Had pre-existing UTIs or catheters;
- Could not provide informed consent;
- Had undergone recent urological procedures (such as cystoscopy) or non-urethral catheterisation (for example suprapubic catheterisation);
- Needed long-term catheters from the outset.

The randomisation was performed by a computer generated system, which users accessed via an automated telephone service or secure website.

**Results**

The trial’s findings were published last year (Pickard et al, 2012a; 2012b). The trial recruited 7,102 patients from 24 UK NHS hospitals over 40 months (July 2007–October 2010). The final analysis comprised data from 6,394 patients; 95% of these had a catheter inserted for perioperative monitoring purposes and 75% of patients were given prophylactic antibiotics intended to cover their surgical procedure. The median duration of catheterisation was two days and the median duration of hospitalisation was six days. Baseline characteristics (for example, age, gender, comorbidities) were balanced across all three arms (Table 1).

Table 2 shows the results for the primary and selected secondary outcomes.

**Primary outcome**

The primary outcome was the number of patients with symptomatic CAUTI within...
six weeks of randomisation. The baseline incidence of this among the control group was 12.6%. Nitrofurazone-impregnated catheters achieved an absolute CAUTI risk reduction of 2.1% or relative risk reduction of 17%, while silver alloy-coated catheters achieved no absolute CAUTI risk reduction.

**Other outcomes**

In terms of microbiologically confirmed symptomatic CAUTI (the secondary outcome), the risk reduction was similar for nitrofurazone catheters as for the primary outcome; there was no risk reduction for silver-alloy catheters. For the bacteriuria outcome (whether symptomatic or asymptomatic), nitrofurazone catheters achieved an absolute risk reduction of 4% or relative risk reduction of 23%, while silver-alloy catheters did not achieve any absolute risk reduction for bacteriuria.

The trial also measured the discomfort the catheters caused; it found nitrofurazone appeared to be more uncomfortable than the standard control catheter (Table 2).

Analysis did not reveal any interactions between the risk factors and the efficacy of the catheters. Similarly, the effectiveness of the catheters did not appear to be affected by how long patients had a catheter for or where the trial took place. Silver-alloy catheters – the most expensive option – are unlikely to be cost effective. Nitrofurazone catheters are likely to be more cost effective than silver-alloy catheters but this is based on estimates associated with significant uncertainty.

**Summary**

The trial concluded that, compared with standard catheters, silver alloy-coated catheters are neither clinically nor cost effective in reducing symptomatic CAUTI in hospital patients needing short-term catheterisation. Nitrofurazone-impregnated catheters slightly reduced the likelihood of symptomatic CAUTI, but this is unlikely to be of clinical significance. This catheter was found to be more uncomfortable.

**Recommendations for practice**

CAUTI remains an important cause of healthcare-related morbidity worldwide, and effective preventive strategies should be developed. The Catheter Trial was designed to reflect clinical practice in NHS hospitals and the findings revealed there was no evidence that neither silver alloy-coated nor nitrofurazone-impregnated catheters significantly reduced symptomatic CAUTI. The results of the economic analysis for nitrofurazone catheters were more favourable, but there was a high degree of uncertainty.

For NHS organisations in which these interventions are already in use, there may be a chance to reallocate resources without losing clinical benefit. Organisations considering introducing these catheters may wish to wait for further evidence of their benefit or for alternatives. Patients, health professionals and the NHS should persist with simple strategies to prevent CAUTI: avoiding catheterisation where possible, shortening its duration, maintaining aseptic techniques and using a closed drainage system, as described in recent practice guidance documents.

**References**


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**Table 2. Catheter Trial: Primary and Secondary Outcome Results**

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Silver-alloy catheter</th>
<th>Nitrofurazone catheter</th>
<th>Standard PTFE catheter (control)</th>
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<tbody>
<tr>
<td></td>
<td>(n = 2,097)</td>
<td>(n = 2,153)</td>
<td>(n = 2,144)</td>
</tr>
<tr>
<td>Symptomatic CAUTI within six weeks of randomisation (primary outcome)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incidence (%):</td>
<td>36% (2,097)</td>
<td>223% (2,153)</td>
<td>27% (2,144)</td>
</tr>
<tr>
<td>AR difference, % (97.5% CI):</td>
<td>-1.4 (-2.7 to -0.1)</td>
<td>0.82 (0.66 to 1.01);</td>
<td>0.99 (0.81 to 1.22);</td>
</tr>
<tr>
<td>OR (97.5% CI):</td>
<td>0.99 (0.81 to 1.22);</td>
<td></td>
<td></td>
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<tr>
<td>Primary outcome with microbiological support of CAUTI (≥10⁵ cfu/ml)</td>
<td></td>
<td></td>
<td></td>
</tr>
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<tr>
<td>Bacteriuria (≥10⁴ cfu/ml)</td>
<td></td>
<td></td>
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<tr>
<td>Catheter-related discomfort while in situ</td>
<td></td>
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</tr>
<tr>
<td>Incidence (%):</td>
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<td></td>
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</tr>
</tbody>
</table>

AR = absolute risk. CAUTI = catheter-associated urinary tract infection. CI = confidence interval. OR = odds ratio. PTFE = polytetrafluoroethylene.