

## Postoperative urinary tract infections in urology and gynaecology: a review<sup>1</sup>

**Norman Slade FRCS**

*Department of Urology, Southmead General Hospital  
Westbury-on-Trym, Bristol BS10 5NB*

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The rational management of postoperative infections in urological and gynaecological practice must be based on a sound appreciation of epidemiology. In the past, treatment has been haphazard and often included the blanket use of antibiotics. It is evident that there are multiple factors in the aetiology and that prophylactic chemotherapy is not the universal panacea. Indeed, although producing some reduction in infection rate, the use of antibiotics may be dangerous in certain situations where antibiotic resistant organisms may become a problem.

During the period 1955–1960, catheter drainage in Bristol, as elsewhere, was of the open variety and most patients coming to operation with sterile urine became infected within a day or so. Serial swabbing in theatres and in the wards soon revealed that the source of infection was rarely in the theatre but usually the heavily contaminated bedding and surgical ward utensils. As to the portal of entry to the urinary tract, there appeared at that time to be three possibilities. Of these the first – introduction of organisms by a contaminated catheter or cystoscope or upward carriage of organisms present in the introitus and urethra – is important where recatheterization is necessary or intermittent catheterization is practised, as in obstetrics and in some gynaecological wards postoperatively. Secondly, infection is via the drainage tube. This is by far the most common route in the immediate postoperative period. It is rapid and therefore must be very important in male patients coming to elective urological surgery where the period of postoperative catheter drainage is for a few days only. The third route – infection via the film of mucopus alongside the catheter (the pericatheter route) – is important in female patients where the short urethra and to-and-fro movement of the catheter promotes early ascent of organisms. In the male it is a slower process; but becomes important in patients requiring long periods of catheterization, either pre- or postoperatively.

Ascending infection via the drainage tube was found to be largely due to organisms of the 'hospital' variety and, therefore, multi-resistant, whereas in infections arising as a result of intermittent catheterization and also by the pericatheter route in patients with long-term indwelling catheters, the organisms responsible were more usually of the same serotype as the patient's own perineal flora and sensitive to most chemotherapeutic agents, including sulphonamides (Miller *et al.* 1958, Gillespie *et al.* 1960).

In 1929, Barrington had shown that bacteraemia could occur after bougienage in patients with infected urine and also after removal of hydrostatic bags from the bladder postoperatively (Barrington & Wright 1930). This was the explanation of the so-called 'catheter fever'. In the early 1950s, papers mainly of American origin began to appear describing gram negative septicaemia (bacteraemic shock). In 1956, after several sudden and apparently unexplained deaths in the postoperative period, we investigated patients by serial blood cultures (Slade 1958) which showed that a transient bacteraemia occurred a few minutes after withdrawal of catheters postoperatively and even in some patients after straining at first micturition or straining at stool immediately after catheter removal (Table 1). We also confirmed Barrington's work on bacteraemia after instrumentation (Barrington & Wright 1930).

It is likely that bacteraemia may progress to septicaemia, depending on the dose and virulence of the infective organism and the susceptibility of the host.

<sup>1</sup> Based on Presidential Address to Section of Urology, 25 October 1979. Accepted 3 June 1980

*Table 1. Bacteraemia after urological surgery: 73 postoperative patients (Slade 1958)*

|                              | Blood culture |          |
|------------------------------|---------------|----------|
|                              | Negative      | Positive |
| Urine sterile■(15 patients)  | 15            | 0        |
| Urine infected■(58 patients) | 49            | 9●       |

●7 had same organism in urine

Blood cultures: Immediately before catheter removal

A few minutes after catheter removal

15 minutes later

Urine cultures: Before operation

■Before catheter removal

First micturition specimen

As to the outcome of the postoperative infections, many of them resolved spontaneously provided there had been a successful outcome to the surgery, i.e. relief of the outflow obstruction. Of the many who left hospital with urinary tract infections, when seen in the outpatient department six and twelve weeks later all but a few had sterile urine whether they had had chemotherapy or not. In a series of 134 gynaecological patients of whom at least 100 were infected post-operatively, the 85 available for follow up two years later showed no sequelae and only six had urinary tract infections at that time (Slade *et al.* 1965). However, this is not to underestimate the complications and morbidity of postoperative infections in urological patients, which in 1956 (Slade 1958) included secondary haemorrhage, pyelonephritis, epididymitis and septicaemia – several of which were fatal.

How may these portals of entry be closed? Catheter-induced infection is perhaps the easiest infection to control because, by disinfection of the urethra and the immediate area around the external urinary meatus, bladder bacteriuria resulting from catheterization can largely be prevented. In maternity patients the infection rate can be significantly reduced by the introduction into the bladder of a small amount of chlorhexidine (30 ml 1/2000 solution) before removal of the catheter. Where intermittent catheterization is the practice, as in some postoperative gynaecological wards, urethral disinfection by an instillation of chlorhexidine in glycerine can reduce the infection rate considerably (Slade & Linton 1960, Gillespie *et al.* 1962). This method is also used to prevent instrumental bacteraemia in urological patients, the chlorhexidine being combined with a local anaesthetic agent (Mitchell *et al.* 1962).

To close the portal of entry provided by open drainage seemed to be a relatively simple matter of providing a closed system to prevent the ascent of organisms by the catheter lumen, either in the form of a straight system into bottle or bag with non-return valve or, where necessary, an inbuilt irrigation device to eliminate blood clots without disconnection (Gillespie *et al.* 1960). The whole success depends on the integrity of the closed system and the techniques employed when the bag or bottle is emptied or disconnection occurs for some reason. Urine sampling can be carried out through a self-sealing sleeve.

The pericatheter portal of entry is important in the short-term catheterization of female patients, and in male patients in the longer term. In 1962 (Gillespie *et al.* 1962) we introduced a catheter cuff suitably treated with antiseptic cream, which helped to prevent the to-and-fro movement of the indwelling catheter in female patients. This when combined with closed drainage resulted in a significant reduction of the infection rate in gynaecological surgery. Unfortunately, this practice has largely been discontinued due, I believe, to patient intolerance. In the male patient regular (8-hourly) catheter toilet with antiseptic creams is a helpful adjunct, but it would seem that a return to the suprapubic tube, especially the modern disposable small calibre suprapubic catheter, has a contribution to make with respect to management of patients likely to require a longer period of catheterization. Apart from other advantages, such as patient comfort and technical advantages in the management of chronic retention, the onset of bladder bacteriuria may be delayed for several days.

Hibitane bladder irrigation (100 ml 1/12 000 solution twice daily) has been used more recently (Kirk *et al.* 1979). The overall incidence of bladder bacteriuria was significantly reduced, but (surprisingly) not in the preoperative drainage periods.

In our initial series (Miller *et al.* 1958) and for those patients going to the theatre for elective surgery with sterile urine, we reduced the overall infection rate from almost 100% to under 10%. I must stress that this work was carried out in a research atmosphere, with both nursing and medical staff continually on their toes, and we have never since been able to match these figures. A short survey at Ham Green Hospital, Bristol in 1978 (unpublished) showed an overall infection rate of 19% (Table 2); this figure relates to a mean catheterization time of 4.7 days. In a much larger series in the Southmead District in 1979 (unpublished) the results clearly demonstrate that the rate of infection rises sharply for patients catheterized for more than five days (Table 3). It is noteworthy that of the infections arising in the first five days of catheterization, 80% were sensitive to sulphonamides and/or trimethoprim. It would appear that even with the most perfect conditions, with all portals of entry closed, about 10–15% of patients with initially sterile bladder urine acquire a bacteriuria in the immediate postoperative period. In this context, the work of Morris *et al.* (1976) may be significant: they were able to culture organisms from the deep portions of the resected prostatic gland in 60% of cases, although this high figure has not been confirmed by other workers (Schmidt & Patterson 1966, Smart & Jenkins 1973). Morris's work was a trial of prophylactic chemotherapy in prostatic surgery. In the fourteen patients of the control series who developed an infection the same organism was cultured from the deep prostate in half.

If organisms deeply entrenched in the prostatic ducts and released during surgery play a significant part in the development of infection, then there is justification for the prophylactic use of antibiotics; there being no other means to prevent bacteriuria developing, except perhaps by continuous bladder irrigation with antiseptic solutions.

A recent paper on prophylactic chemotherapy (Hills *et al.* 1976) referred to a postoperative infection rate of 50% without chemotherapy, which was reduced to 6% under a ten-day cover with co-trimoxazole. No details were given regarding the mean catheter time in this series. My own investigations (unpublished) have not supported this: of 118 cases in which the enucleated prostate (or prostatic chippings) were cultured for bacteria, 106 remained sterile; of the 12 patients with positive culture results, 8 had, or had recently been treated for, a urinary infection at the time of surgery; of 100 patients with sterile urine at the time of surgery, only 4 had positive cultures from the prostate, and in each of these the histology of the prostate showed acute or chronic infection.

It may be concluded, therefore, that this source of postoperative infection is unimportant except in a patient with chronic or relapsing prostatitis; in this event the diagnosis can usually be made before surgery, allowing the use of preoperative antibiotic cover.

Table 2. Ham Green Hospital, Bristol, 1978: 113 patients admitted for prostatectomy (mean catheter time 4.7 days)

|                                                                  |             |
|------------------------------------------------------------------|-------------|
| Infected on admission                                            | 15          |
| Sterile at operation                                             | 98          |
| Remained sterile                                                 | 71          |
| Received antibiotics for other reasons<br>(e.g. chest infection) | 9           |
| Infection rate (no antibiotics)                                  | 17/89 (19%) |

Table 3. Postoperative infections, Southmead District, 1979

|                                 |            |
|---------------------------------|------------|
| Catheter time 1–5 days (mean 4) | 147        |
| Became infected                 | 19 (12.2%) |
| Catheter time 6 days or more    | 66         |
| Became infected                 | 33 (50%)   |

In one surgical ward in Bristol (personal communication), 21 of 29 patients who became colonized by resistant klebsiella had indwelling catheters, and 17 of these were receiving antibiotics at the time; in another ward where the reservoir of klebsiella was smaller, 19 of the first 20 patients infected were receiving antibiotics, most commonly co-trimoxazole, ampicillin, or amoxycillin.

In a small series (unpublished) of patients on preoperative catheter drainage, we found the infection rate was higher in those patients receiving antibiotics, but admittedly chemotherapy had been given for a number of reasons often unrelated to urinary tract infections. Malek *et al.* (1973) found that prophylactic systemic antimicrobials did not significantly reduce the incidence of postoperative infections. We have considerable reservations on the blanket use of co-trimoxazole or any other broad-spectrum chemotherapeutic agent in urological wards where colonization by resistant organisms is a potential problem.

What have we achieved over twenty years? If the morbidity existing in the 1950s (Slade 1958) is compared with that in our 1979 series (unpublished), it will perhaps be accepted that with respect to most complications progress has been made (Table 4). It would appear that in

Table 4. *Complications of acquired (postoperative) infection*

|                               | In 1956           | In 1979   |
|-------------------------------|-------------------|-----------|
| Secondary haemorrhage (major) | 5–10%             | 1–2%      |
| Bacteraemia and septicaemia   | 4 deaths<br>(45%) | No deaths |
| Epididymitis                  | 15%               | 3%        |
| Prophylactic vas ligation     | 3%                | 0%        |

elective surgery where the period of catheterization is for a few days only we have closed to a great extent the route by which the hospital resistant organisms gained access – by open drainage routes. Infections by these organisms are now usually encountered in the patient with long-term drainage. Moreover, it may be safely concluded that such infections that arise in the first two days of catheterization are due to a failure of technique in catheter management.

The current position can be summarized as follows:

- (1) Catheterization periods should be short and a scrupulous closed drainage technique practised.
- (2) For patients undergoing elective surgery the risk of infection is negligible if the catheterization time is 3 days or less.
- (3) For the uncomplicated, fit patient with acute retention, where there is no delay in coming to surgery the period of catheterization is usually less than five days and the infection rate is low. The exception is the patient admitted as an emergency over the weekend where there is no provision for an operating list on a Monday. Perhaps in these circumstances we should return to the previous practice of emergency prostatectomy, or even a postoperative no-catheter technique.
- (4) The real problem arises with chronic retention or the unfit patient with acute retention needing preoperative preparation. With regard to the former, although renal failure of moderate degree is no contraindication to surgery there still remains the problem of the atonic bladder in the postoperative period. There are very good indications for the use of the modern suprapubic catheter both in cases of chronic retention and in unfit patients with acute retention where a period of assessment and therapy before surgery is necessary. With a few basic precautions the technique of suprapubic catheterization may be less traumatic in the hands of junior staff than that of urethral catheterization. Certainly in the management of chronic retention it has obvious advantages, although it is far from certain that the onset of bacteriuria is greatly delayed. If the present 10–15% infection rate could be held with the catheter period extended from five to ten days, a significant advance could be made.

With regard to bladder irrigation with disinfectant solutions, the results of our recent work with chlorhexidine have been slightly disappointing (Kirk *et al.* 1979). There is obviously a great opportunity for research in this field using different regimes and different disinfectants, not forgetting that use of chlorhexidine, although not effective against gram positive cocci, has never in our experience produced resistant bacterial strains.

Our original work (Miller *et al.* 1958, Gillespie *et al.* 1960) on the use of antimicrobial solutions in drainage bags was carried out with formalin in glass drainage bottles, and this may partly account for the initially excellent results we cannot quite achieve today. There is further scope here for clinical research for an effective and safe preparation suitable for use in the modern drainage bag.

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