A meta-analysis comparing suprapubic and transurethral catheterization for bladder drainage after abdominal surgery

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Background: Although bladder drainage is widely used for general surgical patients undergoing laparotomy, there is little consensus on whether suprapubic or transurethral catheterization is better.

Method: A systematic database search was undertaken to find all studies of suprapubic catheterization. Randomized controlled trials were identified for inclusion. Endpoints for analysis were bacteriuria, patient satisfaction and recatheterization rates. A meta-analysis was performed using fixed-effect or random-effect models as appropriate, depending on heterogeneity.

Results: After abdominal surgery, transurethral catheterization is associated with significant bacteriuria (relative risk (RR) = 2.02, \(P < 0.001\), 95 per cent confidence interval (c.i.) 1.34 to 3.04) and pain or discomfort (RR = 2.94, \(P = 0.004\), 95 per cent c.i. 1.41 to 6.14). Recatheterization rates using the transurethral method were not increased significantly (RR = 1.97, \(P = 0.213\), 95 per cent c.i. 0.68 to 5.74) with heterogeneity between studies.

Conclusion: The suprapubic route for bladder drainage in general surgery is more acceptable to patients and reduces microbiological morbidity.

Introduction
Bladder drainage after abdominal surgery allows monitoring of urine output and prevents postoperative urinary retention. This can be achieved by transurethral (TUC) or suprapubic catheterization (SPC). Bladder drainage is particularly relevant in general surgery because damage to pelvic parasympathetic nerves\(^1\)–\(^3\) and the creation of posterior dead space in colonic procedures (disturbing vesical nerve supply and support) may delay return of normal bladder function. Although the suprapubic route is preferred by cardiothoracic\(^4\),\(^5\) and gynaecological surgeons\(^6\)–\(^10\), and despite favourable literature\(^1\)–\(^3\),\(^11\)–\(^18\), abdominal surgeons in many countries have not adopted this technique. Perceived benefits of SPC are reduced infection, control and monitoring of return of normal voiding, reduced need to recatheterize, avoidance of risk of urethral stricture and improved patient satisfaction. This review focuses on the benefits and disadvantages of both methods.

Methods
Medline, Embase and the Cochrane databases were searched using the keywords ‘suprapubic catheteris(z)ation’, ‘transurethral catheteris(z)ation’, ‘suprapubic cystostomy’ and ‘bladder drainage’. Three readers then reviewed studies for relevance to general, gynaecological, urological or cardiothoracic surgery. Randomized controlled trials, non-randomized prospective and retrospective trials and review articles were examined. Only randomized controlled trials were included in the meta-analysis. Study design, technique (including randomization) and endpoint similarities were analysed. Potential disagreements were resolved by discussion between readers. Only studies involving general surgical patients were included.

A meta-analysis was performed using suitably robust and similar studies within the freeware suite Review Manager 4.2 (The Cochrane Collaboration, Oxford, UK). Either a fixed-effect model or a random-effects model was used to calculate the relative risk (RR) for particular endpoints. The RR was chosen because it does not require the use of an approximation for zero when it appears and allows meaningful comparison with a recent Cochrane review\(^19\). Random effects analysis was performed if the original fixed-effect study showed significant heterogeneity either via \(\chi^2\) or \(I^2\) analysis. A cut-off of \(P < 0.050\) was required for statistical significance of the overall RR but even moderate
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heterogeneity ($I^2 > 50$ per cent or $P < 0.010$) was deemed significant and an indication to perform a random-effects analysis.

**Results**

Eight randomized controlled trials\(^1–3,11–15\) were found that directly compared TUC and SPC in patients undergoing abdominal surgery, but only six were included in the meta-analysis because of concerns in two trials over randomization\(^2\) and methodological differences\(^11\) (Table 1). One further randomized controlled trial was identified that compared two techniques of SPC\(^16\) and was disregarded. Endpoints considered in the studies were significant bacteriuria, clinical features of urine infection, failure to void normally after surgery, recatheterization and patient satisfaction. Two review articles\(^17,18\) and one Cochrane Review meta-analysis\(^19\) were found that described the use of the two catheter techniques in general, orthopaedic and gynaecological surgery. Randomized controlled trials were included in the meta-analysis if the study techniques and endpoints were suitably similar.

**Randomized controlled trials in general surgery**

Sethia et al.\(^12\) compared TUC and SPC on urinary tract infection and failure to return to normal voiding in 66 patients undergoing colectomy, panproctocolectomy or ‘other laparotomy’. After randomization, TUC was carried out immediately before surgery and SPC was performed extraperitoneally by the surgeon during the operation. All patients received one dose of cephalosporin and metronidazole on induction of anaesthesia, and antibiotics were continued if there was clinical or microbiological evidence of infection. Urinary tract infection was defined by a catheter specimen of urine (CSU) yielding more than $10^4$ colony forming units per millilitre (CFU/ml) or a midstream specimen of urine (MSU) yielding more than $10^5$ CFU/ml. Significantly fewer positive cultures occurred in the SPC group. No patient failed to void after catheter removal in the SPC group compared with five in the TUC group.

A similar study by O’Kelly et al.\(^11\) compared the two techniques in abdominal surgery of unspecified type in 62 patients with similar catheter placement times and techniques, and definition of positive culture criteria. A further endpoint of patient satisfaction was considered. Although infection rates were not different between the two groups, the SPC group experienced significantly less pain.

Ratnaval et al.\(^3\) randomized 50 men undergoing colorectal surgery to SPC and TUC and assessed urinary retention, frequency of voiding, recatheterization and urinary tract infection. The only significant difference was a reduced urinary frequency in the SPC group. Neither frequency of voiding nor the CFU concentration required to define positive culture were explained, so this study was

<table>
<thead>
<tr>
<th>Authors (year)</th>
<th>No. of patients</th>
<th>Operations</th>
<th>Endpoints</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sethia et al.(^12) (1987)</td>
<td>66</td>
<td>Colectomy, Panproctocolectomy, Other laparotomy</td>
<td>UTI, Recatheterization</td>
<td>Reduced UTI in SPC group</td>
</tr>
<tr>
<td>O’Kelly et al.(^13) (1995)</td>
<td>57</td>
<td>Major abdominal surgery</td>
<td>Urinary sepsis, Pain, Failure to void</td>
<td>SPC more acceptable</td>
</tr>
<tr>
<td>Ratnaval et al.(^3) (1996)</td>
<td>50(^*)</td>
<td>Pelvic colorectal surgery</td>
<td>UTI, Normal voiding, Recatheterization</td>
<td>More frequent voiding in TUC group</td>
</tr>
<tr>
<td>Botsios et al.(^14) (1997)</td>
<td>173</td>
<td>Elective abdominal surgery</td>
<td>Bacteriuria and haematuria, Recatheterization, Pain</td>
<td>SPC favoured in bacteriuria, recatheterization and pain</td>
</tr>
<tr>
<td>Perrin et al.(^7) (1997)</td>
<td>108</td>
<td>Rectal surgery</td>
<td>Significant bacteriuria, Patient acceptability</td>
<td>SPC superior in both groups</td>
</tr>
<tr>
<td>Baan et al.(^15) (2005)</td>
<td>146</td>
<td>HPB, Gastro-oesophageal colon, Central vascular</td>
<td>UTI, Patient satisfaction</td>
<td>No difference found</td>
</tr>
</tbody>
</table>

\(^*\)Only male patients. UTI, urinary tract infection; SPC, suprapubic catheterization; TUC, transurethral catheterization; HPB, hepatopancreato biliary.
omitted from the meta-analysis for significant bacteriuria; however, recatheterization rates were included.

Botsios et al.\textsuperscript{14} studied bacteriuria, recatheterization, haematuria and pain in 180 patients undergoing elective abdominal surgery. Again, after randomization catheterization was performed before or during surgery. The TUC technique resulted in significantly increased pain, recatheterization and pyuria. Pyuria was not consistently analysed in other studies, so this part of the data set was not included in the present meta-analysis.

Perrin et al.\textsuperscript{1} studied 108 male and female rectal surgery patients and described the effect of both techniques on significant bacteriuria and patient satisfaction. The main difference here was the use of tinidazole and/or ticarcillin as antibiotics during induction of anaesthesia. However, randomization, catheter placement protocols and definition of bacteriuria were similar to those of other studies. SPC was found to be significantly better in terms of both bacteriuria and patient satisfaction.

Finally, the most recent randomized controlled trial involving patients having an elective laparotomy took place in The Netherlands and compared urinary tract infection rates and patient satisfaction\textsuperscript{15}. The study included 106 patients undergoing laparotomy for hepatobiliary and aortoiliac procedures. A definition of urinary sepsis was made on the basis of positive culture and corroborative clinical features. The authors initially found no difference in urinary tract infection rates between the two groups, but on closer inspection almost half of the urinary tract infections in the SPC group occurred in patients who were later to undergo recatheterization via the transurethral route. This is discussed in more detail later. This study found no difference in rates of urinary tract infection, recatheterization or patient satisfaction between the two techniques.

Shapiro et al.\textsuperscript{11} studied similar endpoints in 38 patients who had failed to micturate 12 h after surgery. Although otherwise well designed, this study was not included owing to potential selection bias. The study by Rasmussen et al.\textsuperscript{2} was excluded owing to concerns over adequate randomization.

Cochrane review

A recent Cochrane review\textsuperscript{19} on bladder drainage in patients undergoing a variety of different surgical procedures compared SPC with TUC and indwelling urethral catheterization with intermittent urethral catheterization. Trials included general surgical, gynaecological and orthopaedic patients, with subgroup analysis of men and women in each trial and type of operation. Only three trials involving abdominal surgery were included in the subgroup analysis for bacteriuria (symptomatic and asymptomatic). Trials not included were those of Ratnaval et al.\textsuperscript{3} and Rasmussen et al.\textsuperscript{2} because of unclear randomization mechanisms. Unlike the present article, the Cochrane review included the trial of Shapiro et al.\textsuperscript{11}. The most recent randomized controlled trial by Baan et al.\textsuperscript{15} was not cited. In a comparison of 14 studies, the Cochrane analysis found that bacteriuria (symptomatic and asymptomatic) in the TUC group was significantly higher than in the SPC group, with an RR of 2.60 (95 per cent c.i. 2.12 to 3.19). In eight studies, recatheterization was more likely after TUC (RR = 4.72, 95 per cent c.i. 2.94 to 7.56), and more patients experienced pain or discomfort with that technique. The present article updates the Cochrane meta-analysis and provides a review that has particular relevance to abdominal surgery.

Meta-analysis

Bacteriuria

Five trials\textsuperscript{12–15} were included to construct contingency tables, from which a fixed-effect meta-analysis was performed. The studies were deemed not heterogeneous from the \( \chi^2 \) test, so a random-effects analysis was not required. All studies used positive catheter or urine specimens with at least 10\textsuperscript{4} CFU/ml; the main differences between the studies were in definition of urinary tract infection and whether clinical features, including pyrexia and abdominal pain, were included. All studies required a positive culture, so a meta-analysis would measure only the presence of significant bacteriuria of a clinically important organism; however, these features have been shown to increase morbidity in their own right, without knowledge of clinical status\textsuperscript{20}. A fixed-effect meta-analysis yielded an RR of 2.02 (95 per cent c.i. 1.34 to 3.04, \( P < 0.001 \)) for significant bacteriuria in the TUC group compared with the SPC group (Fig. 1). The test for heterogeneity was not significant at the 90 per cent level (\( \chi^2 = 7.49, P = 0.112 \)). SPC can therefore be said to bring about a significant reduction in catheter and urinary tract colonization.

An important point in the construction of this analysis is the inclusion of the data from the paper by Baan et al.\textsuperscript{15}. These authors described a crossover group in which patients originally randomized to SPC were later recatheterized by TUC; if these patients then developed urinary tract infection, this was assigned to the SPC group.

In the present analysis, the primary data of these authors was used for patients randomized to each group on an intention to treat basis in order to increase the external validity of the analysis. A per protocol analysis, excluding
patients who required recatheterization, yielded a higher RR with even less heterogeneity (RR = 2.48, 95 per cent c.i. 1.58 to 3.87, \( P < 0.001 \); \( \chi^2 = 4.72, P = 0.032 \)); this is discussed in more detail later.

Recatheterization

Six trials involving general surgical patients assessed recatheterization as an important endpoint in the management of bladder drainage. Fig. 2 shows the rates of recatheterization among the trials from which a fixed-effect analysis yields an RR of 1.83 (95 per cent c.i. 1.03 to 3.33, \( P = 0.040 \)) for TUC versus SPC. The test for heterogeneity is, however, significant at the 90 per cent level (\( \chi^2 = 10.38, 5 \text{ d.f., } P = 0.070, I^2 = 51.8 \text{ per cent} \)) for comparing recatheterization rates between SPC and TUC groups. A subsequent random-effect analysis still predicted an increased, but not significant, risk of recatheterization in the TUC group of 1.97 (95 per cent c.i. 0.68 to 5.74, \( P = 0.213 \))(Fig. 2).

Pain and discomfort

Pain or discomfort is mentioned in four trials involving general surgical patients. Three find in favour of SPC, while Baan et al. found no difference between the groups. The Baan et al. data distinguished between pain in the abdomen and at the urethra. Although those authors used an average pain score for their results, the RR still agrees with their opinion that there was no difference in patients’ experience of pain between methods. A test for heterogeneity between the four studies was positive (\( \chi^2 = 7.31, P = 0.063, 3 \text{ d.f.} \)), so

![Fig. 1](image-url) A fixed-effect meta-analysis of bacteriuria in patients with suprapubic and transurethral catheterization. Values in parentheses and whiskers are 95 per cent confidence intervals. Test for heterogeneity: \( \chi^2 = 7.49, 4 \text{ d.f., } P = 0.110, I^2 = 46.6 \text{ per cent} \). Test for overall effect: \( Z = 3.34, P = 0.0008 \). RR, relative risk; SPC, suprapubic catheterization; TUC, transurethral catheterization

![Fig. 2](image-url) Random-effect analysis of recatheterization rates in patients with suprapubic or transurethral catheterization. Values in parentheses and whiskers are 95 per cent confidence intervals. Test for heterogeneity: \( \chi^2 = 10.38, 5 \text{ d.f., } P = 0.065, I^2 = 51.8 \text{ per cent} \). Test for overall effect: \( Z = 1.24, P = 0.210 \). RR, relative risk; SPC, suprapubic catheterization; TUC, transurethral catheterization

### Table: Meta-analysis of bacteriuria

<table>
<thead>
<tr>
<th>Study</th>
<th>TUC</th>
<th>SPC</th>
<th>RR (fixed)</th>
<th>Weight (%)</th>
<th>RR (fixed)</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sethia et al.12</td>
<td>16 of 34</td>
<td>2 of 32</td>
<td>7.50</td>
<td>7.53 (1.88, 30.18)</td>
<td>1987</td>
<td></td>
</tr>
<tr>
<td>O’Kelly et al.13</td>
<td>3 of 29</td>
<td>3 of 28</td>
<td>11.11</td>
<td>0.97 (0.21, 4.39)</td>
<td>1995</td>
<td></td>
</tr>
<tr>
<td>Botsios et al.14</td>
<td>2 of 88</td>
<td>0 of 85</td>
<td>1.85</td>
<td>4.83 (0.24, 99.19)</td>
<td>1997</td>
<td></td>
</tr>
<tr>
<td>Perrin et al.1</td>
<td>29 of 59</td>
<td>12 of 49</td>
<td>4.70</td>
<td>2.01 (1.15, 3.50)</td>
<td>1997</td>
<td></td>
</tr>
<tr>
<td>Baan et al.15</td>
<td>8 of 71</td>
<td>9 of 75</td>
<td>31.85</td>
<td>0.94 (0.38, 2.30)</td>
<td>2005</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>56 of 281</td>
<td>26 of 269</td>
<td>100.00</td>
<td>2.02 (1.34, 3.04)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table: Random-effect meta-analysis of recatheterization

<table>
<thead>
<tr>
<th>Study</th>
<th>TUC</th>
<th>SPC</th>
<th>RR (random)</th>
<th>Weight (%)</th>
<th>RR (random)</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sethia et al.12</td>
<td>5 of 34</td>
<td>0 of 32</td>
<td>9.97</td>
<td>10.37 (0.60, 180.33)</td>
<td>1987</td>
<td></td>
</tr>
<tr>
<td>O’Kelly et al.13</td>
<td>2 of 29</td>
<td>1 of 28</td>
<td>12.99</td>
<td>1.93 (0.19, 20.12)</td>
<td>1995</td>
<td></td>
</tr>
<tr>
<td>Botsios et al.14</td>
<td>8 of 88</td>
<td>0 of 85</td>
<td>10.06</td>
<td>16.43 (0.96, 280.24)</td>
<td>1997</td>
<td></td>
</tr>
<tr>
<td>Perrin et al.1</td>
<td>4 of 59</td>
<td>3 of 49</td>
<td>21.15</td>
<td>1.11 (0.26, 4.71)</td>
<td>1997</td>
<td></td>
</tr>
<tr>
<td>Ratnaval et al.3</td>
<td>7 of 26</td>
<td>2 of 24</td>
<td>20.91</td>
<td>3.23 (0.74, 14.06)</td>
<td>1997</td>
<td></td>
</tr>
<tr>
<td>Baan et al.15</td>
<td>4 of 71</td>
<td>9 of 75</td>
<td>24.92</td>
<td>0.47 (0.15, 1.46)</td>
<td>2005</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>30 of 307</td>
<td>15 of 293</td>
<td>100.00</td>
<td>1.97 (0.68, 5.74)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2 Linear and logarithmic correlation coefficients for relative risk versus year of publication for each endpoint. No significant correlation was demonstrated.

<table>
<thead>
<tr>
<th>Endpoint</th>
<th>Linear correlation coefficient</th>
<th>Log correlation coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacteriuria</td>
<td>−0.771</td>
<td>−0.717</td>
</tr>
<tr>
<td></td>
<td>(−0.984, 0.350)</td>
<td>(−0.980, 0.450)</td>
</tr>
<tr>
<td></td>
<td>0.128</td>
<td>0.173</td>
</tr>
<tr>
<td>Recatheterization</td>
<td>−0.442</td>
<td>−0.686</td>
</tr>
<tr>
<td></td>
<td>(−0.923, 0.577)</td>
<td>(−0.962, 0.283)</td>
</tr>
<tr>
<td></td>
<td>0.381</td>
<td>0.312</td>
</tr>
<tr>
<td>Pain/discomfort</td>
<td>−0.829</td>
<td>−0.921</td>
</tr>
<tr>
<td></td>
<td>(−0.996, 0.649)</td>
<td>(−0.998, 0.352)</td>
</tr>
<tr>
<td></td>
<td>0.171</td>
<td>0.080</td>
</tr>
</tbody>
</table>

Values in parentheses are 95 per cent confidence intervals.

A random-effect meta-analysis was performed for rates of pain or discomfort between the groups, yielding an RR of 2.94 (95 per cent c.i. 1.41 to 6.14, \(P = 0.004\)) for TUC versus SPC (Fig. 3).

Observation of the forest plots suggested a possible improvement in the management of TUC with time. Correlation coefficients were calculated for each outcome to test the assumption of a relationship between RR and year of publication; these are presented in Table 2. No improvement in management of TUC over time was demonstrated.

**Discussion**

Postoperative morbidity and mortality related to urinary tract and bladder drainage are common in many surgical patients, including those having general abdominal surgery. However, monitoring urine output and preventing postoperative urinary retention are essential, so a technique of bladder drainage that minimizes infection, recatheterization and discomfort and enables a controlled return of normal voiding is desirable. While both transurethral and suprapubic routes of bladder drainage have been used for many years, there is no consensus among general surgeons on which is superior.

While other reviews have discussed TUC versus SPC in patients undergoing gynaecological, cardiothoracic or orthopaedic operations, the present meta-analysis deals only with those having abdominal surgery. The relevance of this relates to the effect of different operations on the urinary system. Cardiac surgery with extra-corporeal circulation affects postoperative voiding with a high rate of urinary retention. This may be partly because of ischaemia of the urethra leading to early stricture formation. In gynaecological surgery, the proximity of the urological and reproductive organs is often suggested as a reason for intraoperative damage to pelvic nervous tissue, causing postoperative voiding difficulties. In general, abdominal surgery damage to the urinary neurovascular supply seems less likely, so it is appropriate that this group of patients should be considered separately when comparing morbidity from the two catheterization techniques.

The primary endpoints in this meta-analysis were bacteriuria, need for recatheterization and patient satisfaction. Infection is the most important of these, and all the trials discussed had some data on this. The difficulty in comparing infection rates relates to the definition of infection. A minimum requirement is culture of a significant amount of an appropriate pathogen on agar; for the catheterized patient \(10^4\) CFU per ml is deemed significant and, for the non-catheterized patient, \(10^5\) CFU per ml. All the trials
used appropriate definitions for the concentration of organisms on culture, but only Baan et al.\textsuperscript{15} sought correlation with infective symptoms or signs. They had a crossover group who had recatheterization with TUC when calculating rates of infection for the SPC group on an intention to treat basis. They were also the only authors to report a higher rate of recatheterization after SPC. Patients who require recatheterization are at high risk of infection, and recatheterization rates depend on many factors, such as surgical complication rates. Therefore it seems prudent to use a per protocol analysis and only include data in the meta-analysis from the non-crossover group, in keeping with the methodology of other trials included in the meta-analysis. Nevertheless, an intention to treat method has more external validity; this analysis still shows clearly that bacteriuria is more common in general surgical patients catheterized urethrally and this has already been shown to be a significant morbidity in its own right.\textsuperscript{20} In this updated meta-analysis, the RR for bacteriuria was similar to that described in the recent Cochrane review\textsuperscript{19} (RR = 2.60, 95 per cent c.i. 2.12 to 3.18, \(P < 0.001\)), but with a lower set point.

The risk of recatheterization was shown to be higher in the TUC group with a fixed-effect meta-analysis, but with moderate heterogeneity. The more conservative random-effect model yielded an RR favouring SPC, but not at the 95 per cent significance level. Inspection of the forest plot shows that the outlier in the data is that of Baan et al.\textsuperscript{15}. It is not clear why only this trial showed a higher recatheterization rate in the SPC group. Recatheterization was noted in their study but not defined clearly as an endpoint; the study was otherwise well planned and randomized. Why the catheter was replaced was not stated, and the authors concentrated on infection and patient satisfaction as their primary concerns, but they did record the number of each group who were recatheterized. A fixed-effect analysis of recatheterization relaxing the stringent criteria of the present study on heterogeneity to the 95 per cent level yielded an RR for TUC versus SPC of 1.86 (95 per cent c.i. 1.03 to 3.36, \(P = 0.038\)) with heterogeneity analysis \(\chi^2 = 4.4, P = 0.065\), 4 d.f., \(I^2 = 51.8\) per cent. This suggests that, while the case is not quite proven for recatheterization rates being reduced for SPC, a single large, well designed trial in general surgical patients may answer this question. It is plausible that SPC results in less recatheterization for failure to return to normal voiding as the urethral anatomy is not disturbed during insertion of the catheter, there is less bacteriuria and return to normal voiding can be controlled by clamping the catheter and measuring the residual volumes by sonography. The Cochrane reviewers\textsuperscript{19} noted that recatheterization was increased overall with TUC (RR = 4.72, 95 per cent c.i. 2.94 to 7.56, \(P < 0.001\)) if other surgical patients were included. However, the present meta-analysis of appropriately selected trials of general surgical patients did not allow a firm conclusion on this point.

Four trials discussed subjective measures, such as pain or discomfort. While inclusion of the Baan et al.\textsuperscript{15} data presented a meta-dataset with significant heterogeneity, the subsequent random-effect meta-analysis still showed a statistically significant increase in pain or discomfort experienced in patients catheterized urethrally. All trials used pain scoring systems, with number of patients and days of pain being recorded in a systematic manner. Most trials clearly showed that patients preferred SPC, generally because of the urethral symptoms of TUC both while the catheter is in place and after its removal. The effect of having an unnatural conduit in the abdominal wall was not deemed significant, presumably because of its temporary nature.

SPC was performed following induction of anaesthesia via an extraperitoneal route. This might be thought a nuisance in colorectal procedures, but it was not mentioned by the authors of any study included here. Some noted complications, such as uroperitoneum\textsuperscript{18}, but this was encountered in patients with unrecognized bladder diverticulas. Complications are not thought to be due to technical difficulty; the procedure is generally thought to be relatively simple and within the skills of a junior trainee, especially in the anaeasthetized patient during laparotomy, when moderate bladder distension can be achieved without discomfort.

It has not been possible to evaluate the relative risks of urethral stricture after the two methods of catheter insertion. However, stricture is a known complication of TUC, especially in men, and especially if the catheter is in place for more than a few days. Urethral stricture after SPC has not been reported and intuitively seems improbable.

Both significant bacteriuria and patient dissatisfaction are increased when patients undergoing abdominal surgery are catheterized via the urethra. SPC may result in fewer recatheterizations, but this has not been convincingly proven and requires a further randomized controlled trial for elucidation. For the present, general surgeons should consider using SPC as a cleaner and more comfortable method of bladder drainage.

**Acknowledgements**

The authors thank Dr Ruth Pickering, Southampton University, for her advice on statistical matters.

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Published by John Wiley & Sons Ltd
www.bjs.co.uk British Journal of Surgery 2006; 93: 1038–1044
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