

## Original Article

# Complications of intermittent catheterization: their prevention and treatment

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**Study design:** Literature review to evaluate the complications seen in patients on intermittent catheterization (IC) and intermittent self-catheterization (ISC).

**Objectives:** To find the prevalence of most complications seen in patients on IC. To study the prevention and the treatment of these complications.

**Setting:** An international literature review.

**Methods:** Most relevant articles on the subject are reviewed.

**Conclusion:** Urinary tract infection is the most frequent complication in patients performing IC. Catheterization frequency and the avoidance of bladder overfilling are amongst the most important prevention measures. Asymptomatic bacteriuria does not need to be treated with antibiotics. Long-term antibacterial prevention does seem to bear a risk of development of bacterial resistance. Previous treatment with indwelling catheters is a risk factor for chronic infection and urinary sepsis. Prostatitis is more frequently present than often thought. Epididymitis and urethritis are rare. Trauma from catheterization occurs regularly, but lasting effects are more limited. However, the prevalence of urethral strictures and false passages increases with longer use of IC. The use of hydrophilic catheters might be able to lower the urethral complication rate but additional proof through comparative studies is needed. The most important prevention measures are good education of all involved in IC, good patient compliance, the use of a proper material and the application of a good catheterization technique.

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**Keywords:** urinary bladder; catheterization; spinal cord; neurogenic bladder; urine

## Introduction

Intermittent catheterization (IC) is nowadays widely used for the urological management of patients with a neurogenic bladder due to a spinal cord lesion. The fact that bladder emptying can be achieved without foreign material remaining permanently in the lower urinary tract has shown many advantages. IC with adjunctive treatment using bladder relaxing drugs seems to be able to keep the urodynamic functions of bladder pressure and bladder compliance within safe limits even in the long term. IC is considered preferable to other forms of bladder emptying in neuropathic patients as it has less complications and a better outcome. Most authors endorse this opinion by comparing the outcome with previous treatment methods. Several studies<sup>1–3</sup> compared urological outcome in patients from 2–15 years after SCI and found

that those with indwelling catheter, transurethral or cystostomy, reflex voiding and incontinence pads had worse outcomes and more frequent and more serious complications compared to those on IC. Also in recent studies<sup>4,5</sup> the incidence of both urinary tract dilatation and vesicoureteral reflux was significantly lower in the IC group than if abdominal straining, Crede, tapping and indwelling catheter were used.

On the other hand, the introduction of a catheter several times a day can give rise to complications. This review gives data on the major complications occurring in patients on intermittent catheterization (IC) and self-catheterization (ISC). It also looks into treatment and prevention of these complications.

## Method

We looked into the most relevant literature data about complications of IC published during the last 25 years.

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## Results

One of the most frequent complications is infection of the urinary tract (UTI). Prevalence of UTI varies widely in the literature. This is due to the various methods used for evaluation, to the different techniques of IC, different frequencies of urine analysis, different criteria for infection, whether prophylaxis is used, to the group of patients studied, and other factors. Some publications give the percentage of sterile urine: between 12 and 88%.<sup>6-12</sup> Eleven per cent prevalence for asymptomatic UTI and 53% for symptomatic bacteriuria are given in different series.<sup>13,14</sup> Bakke<sup>15</sup> found in 407 patients, 252 with neurogenic bladder, during an observation period of one year, 24.5% with non-clinical UTI, 58.6% with minor symptoms, 14.3% with more comprehensive or frequent symptoms, while 2.6% claimed major symptoms. Biering-Sørensen *et al*<sup>16</sup> found in 77 SCI patients, on IC for 5 years, that 81% had been treated for at least one UTI. Twenty-two per cent had two/three UTI/year and 12% four or more UTI/year. It remains difficult, however, to get a proper estimate of the risk of infection from literature. The data differ so much, that many different factors must influence the prevalence of this complication.

In the acute stage of SCI, with proper management, urine can be kept sterile for 15–20 days without antibiotic prophylaxis, and for 16–55 days if prophylaxis is given.<sup>17-19</sup> Prieto-Fingerhut *et al*<sup>20</sup> determined in a randomized controlled trial the effect of sterile and non-sterile IC on the incidence of urinary tract infection in 29 patients after SCI. With urine analysis on a weekly basis they found in the group on sterile IC a 28.6% UTI incidence while in the non-sterile catheterization group 42.4% incidence was found. The cost of antibiotics for the sterile IC group was only 43% of the cost for those on non-sterile IC. However, the cost of the sterile IC kits was 371% of the cost of the kits used by the non-sterile IC group, bringing the total cost of the sterile program to 277% of the other program. Rhame and Perkash<sup>18</sup> published the results of UTI prevalence in 70 SCI patients in the initial rehabilitation hospitalization treated with sterile catheterization and a neomycin-polymixin irrigant. Fifty-four per cent developed an infection at an over-all rate of 10.3 infections per 1000 patient-days on IC. Bakke and Volset<sup>21</sup> studied factors that may predict the occurrence of bacteriuria and clinical UTI in 302 patients using clean IC. Predictive factors of clinical infection were low age and high mean catheterization volume in women, low age, neurogenic bladder dysfunction and nonself-catheterization in men, in addition to urine leakage in patients with neurogenic dysfunction. Bacteriuria was a risk factor of future clinical infection. Risk factors for bacteriuria were present in men: low frequency of catheterization, high age and non-self-catheterization. If antibacterial prophylaxis was used, fewer

episodes of bacteriuria were noticed, but significantly more clinical UTI were seen. Shekelle *et al* made a systematic review of risk factors for UTI in adults with spinal cord dysfunction.<sup>22</sup> In this review article they evaluated 22 studies, from which many, however, had important methodological deficiencies. They found two studies that provide evidence supporting increased bladder residual volume as a risk factor. Patients on IC had fewer infections than those with indwelling catheters. They found conflicting evidence over the value of sterile or 'non touch' catheter techniques compared with CIC. They found insufficient evidence to assess risk due to psychological, behavioral and hygiene factors, sex, level of function and time since injury.

In order to diagnose UTI, it should be recommended to obtain the urine by catheterization.<sup>23</sup> The frequency of examining urine samples differs greatly between studies. Several advocate daily use of a dipslide technique during the acute phase after SCI, once a week during the subacute phase and monthly or a few times a year in long-term care.<sup>24-26</sup> If a urine culture reveals more than 10<sup>4</sup> cfu/ml, this indicates significant bacteriuria. Pyuria alone is not considered reliable in patients with neurogenic bladder.<sup>27,28</sup> The bacteria found mostly are *E Coli*, *Proteus*, *Citrobacter*, *Pseudomonas*, *Klebsiella*, *Staphylococcus aureus* and *faecalis* in short-term cases while the same bacteria plus *Acinetobacter* and *Streptococcus faecalis* are found in the long-term IC patients.<sup>29,30</sup> *E Coli* is considered the dominant species in several studies.<sup>15</sup> The detection of *E Coli* on the periurethra corresponds in much higher percentage (93%) with bacteriuria than if other bacteria are present on the periurethra (80% or less).<sup>31</sup> *E Coli* isolates from patients who develop symptomatic UTI may be distinguished from bacteria recovered from patients who remain asymptomatic and possibly from normal fecal *E Coli*.<sup>32</sup> Urinary sepsis is fortunately rare.<sup>33,34</sup> Previous treatment with an indwelling catheter represents a special risk to develop sepsis.<sup>35</sup> In his thesis Wyndaele<sup>36</sup> found sepsis in 21 of 115 patients with SCI during the in hospital rehabilitation. The prevalence of sepsis was highest in those treated beforehand with an indwelling catheter. Factors of risk were the period of 24 h to 3 days after changing from indwelling to IC drainage when UTI was present.

Wyndaele and Maes<sup>37</sup> in their follow-up study in 69 patients with neurogenic bladder and a literature survey till 1989 on IC found justification of several conclusions concerning the relationship between IC and UTI: If catheterization is begun by patients with recurrent or chronic UTI and urinary retention, the incidence of infection decreases and patients may become totally free of infection; If symptomatic infections occur, improper practice of IC or misuse can often be found; Chronic infection persists after IC has been started, if the cause of the chronicity remains.

To prevent UTI a non-infecting technique is needed. But also some additional factors can play a role in infection prevention. Nursing education is important and educational intervention by a clinic nurse is a simple, cost-effective mean to decrease the risk of UTI's in individuals with SCI on IC who are identified as at risk.<sup>38</sup> Anderson<sup>19</sup> found a fivefold incidence when IC was done 3 times a day compared to 6 times a day. Also prevention of bladder overdistention is important.<sup>22,39</sup> Cross infection is less if IC during hospitalization is done by a catheter team<sup>40</sup> or by the patients themselves.<sup>41</sup> As residual urine plays a role in infection, attention must be made to empty the bladder completely.<sup>22</sup>

Treatment of UTI is necessary if the infection is symptomatic. Waites *et al*<sup>42</sup> treated men with SCI on IC to determine efficacy of ciprofloxacin 1 g per day for 10 days in eradicating susceptible organisms from urine, urethra and perineum. Susceptible bacteria disappeared from urine in all and were significantly reduced in perineum and urethra. However they were replaced shortly after by resistant Gram-positive cocci. This shows the importance to reserve antibiotics for symptomatic patients only and to take into account the data from the antibiogram. The value of non-treatment for chronic non-symptomatic bacteriuria throughout an hospitalization has been demonstrated.<sup>43</sup>

Whether antibacterial prophylaxis improves the infection rate has been the subject of different studies, but randomized controlled trials are scarce. Pearman<sup>44</sup> compared two groups of patients with acute SCI treated with non-touch IC and found that those who had kanamycin colistin solution instilled into the bladder at the end of each catheterization had only half the incidence of significant bacteriuria. The same effect could not be found in a comparison study with instillations of neomycin.<sup>45</sup> Ascorbic acid has been used by several authors. It is considered only useful as adjuvant therapy together with other antibacterial drugs.<sup>46,47</sup> Johnson *et al*<sup>48</sup> in a 3 months study in children on IC found a prevalence of UTI of 39% with placebo and 19% on single daily dose prophylaxis with nitrofurantoin. Anderson<sup>19</sup> found a significant reduction in infection rates when patients were treated with intravesical neomycin/polymyxin-B and low dose of nitrofurantoin, also prophylaxis with methenamine mandelate and acidification, and with methenamine hippurate resulted in a lower infection rate.<sup>15,49</sup> Cranberry juice has been evaluated recently in children on IC and showed no convincing effect on bacteriuria.<sup>31</sup> Several studies have studied the risk of developing dangerous resistance to antibiotics when given prophylactically either orally or by instillation.<sup>50-52</sup> Galloway *et al*<sup>53</sup> state that the threat of emergence of resistant organisms, the risk to patients of side effects to the antibiotics, the expense and the risk to other patients from cross infection with resistant organisms are strong arguments against prophylactic antibacterials.

An overall conclusion can not be made at this stage. However it would seem logical to use antibacterial prophylaxis only for a short time, during the initial stage of IC. It does seem to be less indicated for long-term use though it can help specific patients to lower the rate of symptomatic infections for which no well defined cause is found.

Urethritis and epididymo-orchitis have been reported in several case series (Table 1). The prevalence figures vary widely. This may be related to differences in IC technique, materials used, and investigation method. But also the primary treatment can be very important. With long-term indwelling catheter, a larger prevalence is seen.<sup>36</sup> Genital infections can lower fertility in SCI patients. Allas<sup>54</sup> performed two spermograms, one before and one after an episode of epididymitis in paraplegics on IC, and found that azospermia increased from 7 to 50% when epididymitis occurred. If IC is used to empty the neurogenic bladder, better sperm quality and better pregnancy rates have been found than with indwelling catheterization.<sup>55,56</sup>

Prostatitis can be a cause of recurrent UTI. Either acute or chronic it is difficult to diagnose in patients with neurogenic bladder and special tests have been developed for this.<sup>69,70</sup> The overall incidence was previously thought to be around 5 to 18%<sup>71</sup> but 33% may be a more realistic figure.<sup>67</sup>

Urethral bleeding is frequently seen in new patients, and occurs regularly in one-third on a long-term basis.<sup>62</sup> Trauma of the urethra especially in men can cause false passages, meatal stenosis but the incidence is rare (Table 1). The incidence of urethral strictures increases with a longer follow-up, with most events occurring after 5 years of IC.<sup>37,67</sup> Günther *et al*<sup>72</sup> in 2000 presented their results on 230 men on IC, and found urethral changes in 26.9% (3.7% strictures) when previously an indwelling catheter had been used.<sup>72</sup> In men with IC and no history of indwelling catheter the prevalence of urethral changes was 16.9% and no strictures had occurred. Moreover in 311 men, not on IC, with a history of indwelling catheter 25.4% urethral changes (2.5% strictures), and without a history of indwelling catheter, 17.9% urethral changes (1.5%) strictures were found. Urethral changes were also documented in SCI men on IC for an average of 5 years, using one single re-usable silicone catheter for an average of 3 years (from 1 to 7 years).<sup>73</sup> Urethrograms showed 70% normal, 11% minor abnormalities, 15% narrowed urethra and 4% stricture that needed operation.

To prevent urethral strictures, gentle introduction of the catheter, substantial lubrication of the catheter and perhaps the use of hydrophilic catheters can play a role. Forceful manipulation during catheter insertion and significant bleeding proved important contributory factors for the development of urethral strictures in patients on IC.<sup>74</sup> The surface of the catheter is claimed to be an important factor, with less stricture development when hydrophilic catheters are used. The

**Table 1** Literature data on genitourinary complications in patients on intermittent catheterization (m = male)

| Author                                    | Total no. patients | Urethritis | Meatal stricture | Epididymitis                          | Urethral stricture |
|---|--------------------|------------|------------------|---------------------------------------|--------------------|
| Lapides <i>et al</i> <sup>8</sup>         | 100 (34 m)         | 2 m        | –                | –                                     | –                  |
| Lapides <i>et al</i> <sup>8</sup>         | 218 (90 m)         | 2 m        | –                | 2                                     | –                  |
| Orikasa <i>et al</i> <sup>57</sup>        | 26 (13 m)          |            |                  | 1                                     |                    |
| Wyndaele <i>et al</i> <sup>59</sup>       | 30 (18 m)          | 2 m        |                  | 2                                     |                    |
| Maynard Diokno <sup>59</sup>              | 28 (m?)            |            |                  | 4 (1 with infected penile prosthesis) |                    |
| Labat <i>et al</i> <sup>60</sup>          | 68 (48 m)          | 9 m        |                  | 3                                     |                    |
| Maynard Glass <sup>61</sup>               | 34 (m?)            |            |                  | 3                                     | 2                  |
| Wyndaele Maes <sup>37</sup>               | 75 (33 m)          |            | 3                | 6                                     | 7                  |
| Webb <i>et al</i> <sup>62</sup>           |                    |            |                  | 2%                                    |                    |
| Hellstrom <i>et al</i> <sup>63</sup>      | 41 (26 m)          |            |                  | 3                                     |                    |
| Kuhn <i>et al</i> <sup>64</sup>           | 22 (11 m)          |            | 1                |                                       | 1                  |
| Thirumavalan–Ransley <sup>65</sup>        |                    |            |                  | 12%                                   |                    |
| Bakke <sup>15</sup>                       | 407 (206 m)        | 1%         |                  | 1%                                    |                    |
| Perkash Giroux <sup>66</sup>              | 50 m               |            |                  | 5                                     |                    |
| Perrouin Verbe <i>et al</i> <sup>67</sup> | 159 (113 m)        |            |                  | 10% short-term<br>28% long-term       | 5.3%               |
| Waller <i>et al</i> <sup>68</sup>         | 30Sci (26 m)       |            |                  | 2                                     | 4                  |

degree of urethral inflammation by urethral cytology proved to be less in patients using hydrophilic catheters compared to PVC catheters.<sup>75</sup> No extra strictures occurred in patients on IC with hydrophilic catheters after a mean follow-up of 7 years in a study of Waller *et al*.<sup>76</sup> Such data are suggestive that there is an advantage in using hydrophilic catheters to prevent stricture formation in the long-term but comparative studies have not been published. Urethral trauma with false passages can, in neurogenic patients on CIC, successfully be treated with 5 days antibiotics and 6 weeks indwelling catheter. The false passage will disappear also on cystoscopy and IC can be safely restarted.<sup>77</sup>

Other complications such as hydronephrosis, vesico-ureteral reflux, and bladder cancer seem to relate rather to infection, bladder trabeculation, detrusor pressure or neuropathy than to IC itself.<sup>78</sup>

Bladder calculi caused by the introduction of pubic hair,<sup>79,80</sup> loss of the catheter in the bladder,<sup>81</sup> bladder perforation and bladder necrosis<sup>82</sup> have been reported as rare complications of IC.

## Conclusion

There are strong arguments that intermittent catheterization is a safe and efficacious method to treat neurogenic bladder dysfunction due to a spinal cord lesion. Complications can occur. Urinary tract infection is the most important, but prevention is possible in the short-term. Infection of the uro-genital organs seems mostly related to the primary treatment given. Trauma from catheterization occur regularly, but lasting effects are more limited. However the prevalence of urethral strictures and false passages increases with longer use of IC. The use of hydrophilic catheters might be able to lower the urethral complication rate but additional proof through comparative

studies would be welcome. Other complications of IC are occasional.

Very important are good education of all involved in IC, good patient compliance, the use of a proper material and the application of a good catheterization technique.

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