Canadian Urological Association Best Practice Report: Catheter use

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Introduction

Catheters are widely used for urinary retention or incontinence and neurogenic lower urinary tract dysfunction (NLUTD). This includes intermittent catheterization (IC), indwelling urethral catheters, and suprapubic catheters. Both intermittent and indwelling catheterization provide means for long-term, effective urinary drainage with the aim to protect the upper urinary tract, improve urinary continence, and minimize urinary tract complications.[1] However, urinary catheters can be associated with an increased risk of urinary tract infections, incontinence, calculi, and compromised kidney function.

IC is generally the gold standard method of bladder drainage. Although technology has progressed in the field of catheter design, material, and technique, there is limited high-quality evidence and few good practice recommendations around catheter usage in chronic conditions such as NLUTD. Our objective was to review the evidence around the use of long-term urinary catheters in patients with chronic conditions and make practice recommendations for physicians in Canada who manage catheters in this population. We pay specific attention to the current best evidence of the available techniques, design, material, and practices of intermittent self-catheterization and its position in the treatment pathway.

Methods

This best practice report provides a brief and comprehensive discussion of studies examining catheter management for impaired bladder emptying in the setting of neurogenic and non-neurogenic lower urinary tract dysfunction. It is based on data obtained from numerous published meta-analyses and original studies identified through a literature search using PubMed, Medline, and the Cochrane Library database. The bibliographies of relevant articles were also searched to avoid exclusion of important studies. The following narrative review concentrates on systematic reviews, related guidelines, and comparative studies. Articles included in this statement were reviewed using methodology consistent with the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) for evidence synthesis and recommendations.

1. Types of catheters

The indications for urinary catheterization may be prolonged and sometimes irreversible (Table 1). There are two important populations that tend to require catheters. First, approximately 5–10% of residents of long-term care facilities in Canada have bladder dysfunction managed with chronic catheterization.[2] Second, people with NLUTD from a neurologic lesion may need catheters because of failure to store and/or empty urine from the bladder (which results in incontinence and/or urinary retention).

1.1. Indwelling catheterization (urethral or suprapubic)

Optimal bladder management is selected according to anatomical factors and patients' preferences. Indwelling catheters are often used initially after a spinal cord injury (SCI), however, patients are recommended to transition to IC if possible.[3] Despite the problems associated with indwelling catheters, many patients with a SCI adopt these catheters over time. Long-term use of indwelling catheters is often recommended as the last resort, except for quadriplegic patients with impaired dexterity or those who are bedridden, or in situations where IC is difficult or impossible.[4]

Suprapubic catheterization (SPC) offers certain advantages compared to urethral catheters: it may improve independence, facilitate engagement in sexual activities, and decrease the risk of epididymitis.[1] Some studies have sug-

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Table 1. Common uses for chronic urinary catheters
Bladder outflow obstruction
Neurogenic lower urinary tract dysfunction
Management of urinary incontinence
Patient preference
Healing of decubitus ulcer
Disease management (e.g., urinary diversion, monitoring diuresis)

Adapted from Gammack, 2002.[70]

Table 2. Advantages of IC over indwelling urinary catheters
Reduced risk of common indwelling catheter-related complications (such as dislodged catheter, urethral erosion)
Reduced risk of UTIs
Less of a barrier to intimacy and sexual activity
Potential for reduced lower urinary tract symptoms between catheterizations

Adapted from Newman & Willson, 2011.[41] IC: intermittent catheterization; UTI: urinary tract infection.

gested that SPC is associated with a reduced risk of bacteriuria and better patient satisfaction when compared with urethral catheters.[5,6] Regular followup and surveillance continue to be the backbone of this strategy in order to minimize associated morbidity and improve prognosis.

1.2. IC

IC is accepted worldwide as a standard of care for patients with incomplete bladder emptying. When IC was introduced for SCI patients in the 1940s, nurses initially performed it using an aseptic technique, requiring sterile gloves, single-use catheters, and disinfectant cleaning solution. In the 1970s, Lapides suggested that sterility was not important for preventing urinary tract infections (UTIs) and impractical for patients; he proposed clean IC (IC that includes only hand washing and regular genital hygiene).[7] The bladder is drained regularly several times during the day, simulating the physiological bladder filling/emptying cycle. This can also prevent adverse health outcomes, such as recurrent UTIs, urinary incontinence (UI), skin complications, and chronic kidney injury. Compared to indwelling catheters, IC can reduce the risk of mechanical urethral erosion, bladder cancer/stones, and urosepsis (Table 2).

Despite being preferable to an indwelling urinary catheter, IC can have challenges, such as pain, UTI, and urethral trauma. Recent studies reported urethral stricture rates in IC users of 4–13%, even with the use of hydrophilic-coated catheters.[8] Despite the medical advantages of IC, only 37% of patients remain on this form of bladder management over time.[9]

Factors such as catheter coating and design, reuse, and who performs the catheterization make selection of the ideal catheter difficult. The available literature does not provide convincing evidence regarding the effectiveness of any particular catheter design, technique, or strategy.

2. Catheter-related complications

2.1 Catheter-associated infection

The Infectious Disease Society of America (ISDA) released international clinical practice guidelines for the diagnosis, prevention, and treatment of catheter-associated UTI (CA-UTI) in 2010.[10] This widely accepted guideline defines CA-UTI as the presence of symptoms or signs compatible with UTI with no other identified source of infection, along with ≥10^3 colony-forming units (cfu)/ml of ≥1 bacterial species in a single catheter urine specimen or in a midstream urine specimen from a patient whose urethral, suprapubic, or condom catheter has been removed within the previous 48 hours. Signs and symptoms compatible with CA-UTI include the new onset or worsening of fever, rigors, altered mental status, malaise, or lethargy with no other identified cause; flank pain; costovertebral angle tenderness; acute hematuria; pelvic discomfort; and in those whose catheters have been removed, dysuria, urgent or frequent urination, or suprapubic pain or tenderness. In patients with SCI, increased spasticity, autonomic dysreflexia, or sense of unease are also compatible with CA-UTI. The IDSA guideline does not recommend interpretation of pyuria for defining CA-UTI, differentiating catheter-associated asymptomatic bacteria (CA-ASB) from CA-UTI or serving as a threshold for antimicrobial therapy.[10] CA-ASB is defined by the ISDA as the presence of ≥10^5 cfu/ml of ≥1 bacterial species in a single catheter urine specimen in a patient without symptoms compatible with UTI.[10] The incidence of CA-ASB in those with indwelling catheters is 3–8% per day, with CA-ASB being nearly universal by 30 days.[11] As such, the ISDA recommends against the routine screening of CA-ASB, with the exception of selected clinical situations, such as pregnant women.[10]

If there is clinical suspicion of CA-UTI, specimen collection should occur prior to antimicrobial therapy and proceed according to method of bladder management. In general, a catheterized urine specimen is preferable to voided sample, as it avoids contamination with periurethral microbes. Patients with indwelling catheters should have their catheter exchanged with immediate collection of a specimen following insertion of the new catheter. This approach has been demonstrated to enhance clinical improvement, minimize symptoms duration, and reduce the frequency of infection relapse.[12] In the setting of chronic urinary catheterization, the level of colonization is commonly >10^5 cfu/mL;[13,14] therefore, culture alone is inadequate for diagnosis of infection. In general, a clinically significant UTI with a chronic indwelling catheter requires consideration of clinical symptoms and severity of illness plus laboratory confirmation (urine culture

$>10^2$ cfu/mL).[15] In cases of short-term catheterization, it is considered acceptable to obtain a specimen aseptically through the catheter port. Specimens should never be collected from a catheter drainage bag.

Method of bladder management remains of paramount importance for reduction of CA-ASB and CA-UTI.[10] IC is associated with fewer CA-UTI when compared to other modalities and should, therefore, be used whenever possible.[16] When IC is not possible, a closed catheter drainage system should be used to reduce CA-ASB and CA-UTI in those with short- or long-term indwelling catheters. Data are insufficient to recommend SPC over urethral catheterization for long-term prevention of CA-ASB and CA-UTI.[10]

Impact of IC catheter type and material on UTIs

Hydrophilic vs. uncoated catheters

Two recent systematic reviews and meta-analyses explored the risk of UTI associated with hydrophilic catheters (HC) in comparison to polyvinyl chloride catheters (PVC) in adult patients with NLUTD. Shamout et al reported less frequent UTIs with HC, but this was not statistically significant and there was no significant difference in terms of bacteriuria.[17] Rognoni et al reported significantly less UTIs with single-use HC compared to multiple-use PVC catheter (risk ratio [RR] 0.84; 95% confidence interval [CI] 0.75–0.94), with the estimated risk reduction to be 16%.[18] This confirmed the meta-analysis results of Li et al (five studies, 462 subjects), which demonstrated a significantly lower UTI incidence in the hydrophilic group (odds ratio [OR] 0.36; 95% CI 24–54%; p<0.0001).

Two prospective randomized controlled trials (RCTs) evaluated UTI risk in children with neurogenic bladder.[19,20] While Defoor et al reported a significant lower risk of UTI in the HC group even with single-use PVC catheter (9.1% vs. 51.5% UTIs per person-year; p=0.003),[19] Kiddoo et al found no difference in incidence of symptomatic UTI between HC and multiple-use PVC catheters.[4]

Hydrophilic vs hydrophilic catheters

Only one study (27 patients) compared three different types of HC catheters (Lofric, EasiCat, and Flocath). No significant difference in bacteriuria incidence between these three catheters.[21]

Prelubricated vs. non-pre-lubricated catheters

Ginnantoni et al found that prelubricated catheters (Instantcath) significantly reduce the incidence of UTI (7.4% vs. 22.2%) and bacteriuria (14.8% vs. 33.3%) when compared to standard PVC catheters.[22]

Antimicrobial-coated catheter vs. non-antimicrobial-coated catheters

Antibiotic and silver-coated catheters appear to only be effective in reducing bacteriuria and UTIs in the short-term. Long-term use of antibiotic and silver-coated catheters increases the risk for antimicrobial resistance and silver toxicity;[23] therefore, these are not recommended for routine use.

Impact of IC catheterization technique on UTIs

Clean vs. aseptic

When analyzing IC techniques, there was a significant reduction in the incidence of UTIs with aseptic vs. clean techniques. However, there was no difference in bacteriuria between these techniques.[17,24]

Single-use vs. multiple-use

Studies have estimated that risk of UTI associated with multiple-use catheters is about 70–80%, whereas the risk with single-use catheters is about 40–60%.[25] A recent RCT evaluated the risk of UTI and bacteriuria among spina bifida patients who used either single-use PVC catheters or reused PVC catheters. There was no significant difference in terms of bacteriuria (32.4% vs 23.7%; p=0.398) or UTIs (35.2% vs. 36.8%; p=0.877) between these two methods of IC.[26]

Summary

In the era of rapidly advancing medical technology, the contemporary urinary catheter has changed very little since its introduction in the 1930s.[27] A number of catheter coatings and physical alterations have been developed in an attempt to prevent biofilm production, CA-bacteriuria and CA-UTI. Unfortunately, no effort has been proven unequivocally successful in clinical studies.[28] The IDSA does not recommend antimicrobial (silver or antibiotic)-coated or hydrophilic urinary catheters for the reduction of CA-ASB or CA-UTI.

2.2 Urethral complications

2.2.1 Urethral trauma

Microscopic hematuria, gross hematuria, and quantity of epithelial cells left on a catheter after removal have all been used as markers of urethral trauma in the literature. However, definitions of microscopic hematuria have included 1–5 red blood cells (RBCs) per high-powered field, >10 RBCs per high-powered field, and a simple positive dipstick for blood.[29-31] Other studies have used only macroscopic bleeding episodes as an indication of urethral trauma.[29,32]

Impact of IC catheter type and material on urethral trauma

Hydrophilic vs. uncoated catheters

There are six RCTs assessing hematuria in patients using either hydrophilic or standard PVC catheters.[19,29-33] Only one of the RCTs identified a significant decrease in gross bleeding episodes with a hydrophilic catheter vs. a PVC catheter.[32] This difference was not reported in any of the other RCTs.[19,29-31,33] However, three RCTs identified a significant decrease in microscopic hematuria in patients using a hydrophilic catheter vs. non-hydrophilic catheter, with an unknown clinical significance.[30,31,33]

Hydrophilic vs. hydrophilic

Three RCTs directly compared different types of hydrophilic catheters. (Speedicath®, Lofric®, Easicath®, and Flocath®).[21,34,35] No difference was seen with regards to microscopic or macroscopic hematuria. However, one study demonstrated a significantly higher withdrawal friction force with Lofric vs. Speedicath using number of epithelial cells on the catheter after removal as a marker of urethral trauma.[34]

Prelubricated vs. non-prelubricated catheters

Two RCTs were identified in the literature comparing prelubricated (Instacath) vs. uncoated PVC catheters.[22,36] In both studies, the results demonstrated that a gel-lubricated, non-hydrophilic catheter was superior to the PVC catheter in terms of microscopic hematuria[36] and epithelial cell counts.[22,36]

Impact of IC catheterization technique on urethral trauma

Catheter practices (single-use vs. reuse)

Vapnek el al compared hydrophilic-coated catheters (single-use) vs. PVC catheters (multiple use) and reported significant less hematuria in the hydrophilic-coated group (27% HC vs. 35% PVC).[30] However, this comparison includes two variables (catheter coating and reuse), which makes interpretation difficult.

Summary

Hydrophilic catheters may cause less urethral trauma with decreased microscopic hematuria, decreased bleeding episodes, and fewer epithelial cells on the removed catheter. There is no clear advantage of one hydrophilic catheter vs. another in the literature. Furthermore, evidence concerning catherization practices (single-use vs. multiple-use) is inadequate and biased by the use of different catheter materials. The information is still limited, and further studies are needed in order to enhance the data on this issue.

2.2.2. Urethral strictures

The repetitive trauma of IC may lead to urethral stricture formation. The occurrence of strictures in this population has been estimated to be anywhere from 4.2%[37] to as high as 25%.[38] Due to the length of time often required for stricture formation in this population, the available literature is limited. The paucity of information makes direct comparison of PVC, hydrophilic, and prelubricated catheters extremely challenging. Five studies were identified in the literature that looked at stricture formation in the IC population.[19,37-40]

Impact of catheter type and material on urethral strictures

Hydrophilic vs. uncoated catheters

Though the data on microscopic hematuria, bleeding episodes, and epithelial cell counts would seem to indicate increased trauma with the non-hydrophilic catheters, and thus increased stricture formation, this in not actually reflected in the available literature. Four of the studies did not identify any difference in the rate of stricture formation between hydrophilic and non-hydrophilic catheters.[19,38-40] The other study did not look at a direct comparison of the two.[37]

Catheter size

Only one study compared stricture formation between two different catheter sizes. There was no significant difference in urethral stricture rate between two most frequently used catheter sizes (12 and 14 Fr).[38]

Summary

Urethral stricture formation is a complex process and trying to isolate which catheter type may predispose to stricture formation is difficult. Many of the patients in these trials have had indwelling catheters for substantial periods of time early in their treatment, which potentially could have an effect on subsequent rates of stricture formation. In addition, patients in these trials are using various sizes of catheters and may have varying degrees of detrusor sphincter dyssynergia or prostatic enlargement, which may contribute to catheter trauma. Though hydrophilic catheters appear to cause less urethral trauma, there is no data to indicate there is a decreased rate of urethral strictures based on the type or size of catheter used for IC.

3. Patient perspective

IC enhances both bladder-emptying and storage function, relieving associated symptoms that would otherwise impair quality of life (QOL).[41] Furthermore, IC lessens restrictions

on daily activities; promotes patient independence; and improves sleep, social functioning, and overall QOL.[42-44]

The success of IC requires that it is acceptable to the patient upfront, and that the patient is satisfied with treatment and compliant with it long-term. That, in turn, requires appropriate and skilled education, support, and long-term followup by the healthcare team.[41,43] Initial uptake and success may be further impacted by patient factors, such as gender, body habitus, and manual dexterity, and by external factors, such as caregiver support and access to materials. Long-term compliance is ensured when the goals listed above are met, when interference with daily activities is minimized, and when complications and adverse effects of IC are avoided, including pain, urethral trauma, stricture formation, and UTIs. If these criteria are met, patient satisfaction is ensured, resulting in improved QOL and perceived quality of care.[45] Unfortunately, such ideal circumstances are not always realized, and many patients describe IC having a negative impact on QOL owing to social and psychological disturbance and UTIs.[43,46] One small, cross-sectional survey of 44 patients reported that only half were completely satisfied with IC.[47] In the NLUTD population, patients may revert to indwelling catheters, particularly those with greater disability requiring external support, younger patients, and those with persistent incontinence between catheterization (especially women who cannot use external collection devices).[44]

Examining the impact of IC on QOL is challenging, given the heterogeneous population of patients employing it and the multiple factors that impact QOL in these patients beyond just their use of IC. As an example, patients with SCI generally report their QOL to be worse than age- and sex-matched controls.[48] Gender differences may further impact outcomes: females have a more difficult time accessing the urethra, while men have a more difficult time with passage into the bladder.[42] A validated patient-reported outcome (PRO) measure has been developed to examine the impact of IC on QOL, however, it has been used in only one study.[49] Other authors have adapted or modified various existing questionnaires and/or incorporated simple measures, such as visual analog scales, or employed a qualitative approach for the assessment.[42,43,50] The important improvements that impact QOL in patients undertaking IC appear to be those related to urinary symptoms, independence, self-confidence, social relationships, and access to work activities.[50] In qualitative analysis, QOL was influenced by gender, lifestyle, frequency and duration of IC, technical difficulties, type of catheter used, comorbidities, and individual predispositions.[43]

High patient satisfaction and improved QOL has also been confirmed in established IC cohorts. Kessler et al studied a mixed neurogenic and non-neurogenic population of patients who had been performing IC for a mean of five years with an average frequency of three times per day using visual analogue scales to assess pain and interference with daily activities, and the Medical Outcomes Study SF-12 to evaluate QOL.[42] The majority of patients found IC to be easy or very easy (72/92, 78.3%), and reported little or no interference with work or other daily activities (76/92, 82.6%); moreover, nearly 90% (80/92) reported no or minimal pain with IC. QOL was improved in 60% (56/92) based on questionnaire used. While this study is limited by a hybrid population, positive selection bias, use of a non-validated questionnaire, and lack of baseline data, it confirms that IC is a worthwhile strategy that is well-accepted long-term and can improve patients' QOL.

Impact of catheter type and material on patient perspective

Hydrophilic vs. uncoated catheters

Two comparative studies in children with spina bifida demonstrated a preference for single-use HC vs. standard reusable PVC catheters.[51,52] Qualitative research confirms this preference in community-dwelling adults; however, some patients express concern about the economic and environmental impact of single-use catheters.[53] In the review by Shamout et al,[17] the following observations were made regarding studies evaluating patient satisfaction and preferences:

1. Seven of nine RCTs comparing HC vs. non-HC catheters reported significantly higher satisfaction and/or preference for HC catheters;
2. Two of two RCTs demonstrated patient preference for prelubricated vs. non-prelubricated catheters;
3. HC catheters may be favored over prelubricated catheters; however, only one study with only 29 patients compared them;
4. Preferences may exist between various brands of HC catheters; and,
5. In the only study using a validated QOL questionnaire, compact catheters were preferred over non-compact catheters by 63% of 125 NLUTD patients.[54] Four other RCTs showed no significant difference.

Impact of catheterization technique on patient perspective

While many studies have compared catheterization techniques and materials, robust QOL data is lacking in the majority of these. Clean IC is less time-consuming and less costly compared to aseptic IC, and it improves patient QOL.[55] There is no data comparing QOL in patients reusing catheters vs. single-use PVC catheters.

Summary

IC reduces or removes the risks associated with indwelling catheters and enhances independence and social and

psychological well-being. Single-use HC catheters appear to be preferred by most patients.

4. Economic perspective

A total of eight health economic analysis comparing different types of IC were identified. All of them were cost utility analyses (CUAs) assessing the cost-effectiveness in the U.K.,[56,57] Japan,[58] the U.S.,[59] Italy,[60], Brazil,[61] and Canada.[62,63] Each uses local input variables where possible. For the purpose of this best practice report, we will focus on the Canadian studies, as they are more relevant to our healthcare system.

Impact of catheter type and material on economic perspective

Hydrophilic vs. uncoated catheters

HC catheters have an estimated cost of $7.02 in Canada.[64] The Canadian analyses compared the cost-effectiveness of HC catheters to uncoated single-use catheters (UC),[62,63] while Health Quality Ontario[62] also included re-use of UC catheters. They both use a Markov decision model and the index patient was a person with SCI. One study simulated a lifetime horizon, while Health Quality Ontario[62] selected a five-year horizon. Both models factor in antibiotic resistance, but there are some differences in which catheter-related outcomes are modelled. The studies model long-term sequelae of UTIs and catheterization, which include various renal complications, bladder stones, and urethral damage. However, Health Quality Ontario[62] only include short-term consequences of symptomatic UTIs, with the latter suggesting a more conservative estimate. In terms of number of catherization per day, Welk et al base their analysis on four catheters used per day,[63] while Health Quality Ontario [62] assumed five per day.

Health Quality Ontario[62] only takes the perspective of the healthcare system, while Welk et al[63] also included a societal perspective. They included health-related QOL (HRQOL) gains that capture indirect health-related factors associated with IC (i.e., pain related to IC, steps and time needed for the IC process).[63] These values are based on the study by Averbeck et al that generates health state utilities using an internet-based time tradeoff (TTO) survey in a U.K. and Canadian population.[65] This allows the inclusion of utilities for user preferences in the incremental cost-effectiveness ratio calculation.[63] IC with HC becomes more economically attractive in these scenarios, as increased patient satisfaction leads to a lower cost per quality-adjusted life-year (QALY). When comparing IC with HC vs. UC, they found HC catheters likely to be cost-effective. They predicted a gain of 0.72 QALYs at an additional cost of $48 016, leading to an ICER of $66 634/QALY.[63]

Health Quality Ontario[62] found that the lowest cost intervention, reusing single-use UC catheters (one/week), had the highest probability of being cost-effective against all other comparators. This stems from marginal differences in QALYs found between catheter types and high HC catheter costs.

Impact of catheterization technique on economic perspective

Clean vs. aseptic

Randomized controlled trials have compared aseptic to clean IC in different settings, such as perioperative patients, veterans in long-term care homes, and patients with SCI.[66-68] A review of the literature specifically relevant to neurogenic bladder patients found the aseptic technique was associated with 277% higher costs compared to the clean technique.[69] None of these studies demonstrated a significant difference in UTIs.

Catheter practices (single-use vs. reuse)

Various techniques have been employed to clean and store the catheter between uses, and generally a new catheter is used either each day or each week. Estimates from Health Quality Ontario suggest that a year's supply of uncoated intermittent catheters that were reused throughout the day and then discarded costs approximately $558, while using a new catheter for each catheterization costs approximately $2232.[62] The primary variable influencing cost-effectiveness was the significant cost differences of the catheters used in the two different scenarios. While there are conflicting opinions on whether catheter reuse results in a different UTI risk, this has little effect on the model, as UTI is generally considered to be a brief, time-limited condition. Limitations of this economic analysis include a lack of prior research addressing catheter reuse and the fact that this analysis did not consider patient acceptability/satisfaction.

Summary

In summary, the use of HC catheters for IC is cost-effective over a lifetime horizon. Aseptic technique was associated with higher costs compared to the clean technique. Reuse of catheters appears to be a cost-effective approach; however, these results should be interpreted with caution, given the limited availability of data and the large difference in resource use.

5. Conclusions

Our summary recommendations are shown in Table 3.

IC is the gold standard for the management of failure to empty the bladder. When necessary, an indwelling catheter may be considered, and in most cases, a SPC is preferable to a long-term indwelling urethral catheter. Optimal catheter

Table 3. Summary recommendations

Section	Recommendation	Strength of statement	Quality of evidence
Type of catheter	We recommend individualizing the selection of appropriate bladder management strategy (IC, indwelling urethral, or suprapubic catheter) in accordance with anatomic factors, bladder characteristics, motor and cognitive functions, patient preference, and associated quality of life.	Strong	Moderate
Catheter-related complications: UTIs	We recommend using intermittent catheters over indwelling catheters for long-term use due to a lower risk of UTIs. Routine use of antimicrobial coated catheters is not recommended.	Strong	Moderate
Catheter-related complications: UTIs	For those using intermittent catheters, we suggest using single PVC (as opposed to multiple-use PVC), and special hydrophilic-coated catheters or pre-lubricated catheters, as they may decrease the frequency of UTIs.	Weak	Low
Catheter-related complications: Urethral trauma	We suggest using hydrophilic catheters, as they may cause less urethral trauma.	Weak	Moderate
Catheter-related complications: Urethral trauma	There is no evidence to suggest that the type of intermittent catheter impacts urethral stricture formation.	Weak	Weak
Patient perspective	We recommend offering hydrophilic or pre-lubricated catheters to patients because of an improved bladder related QOL.	Strong	Moderate
Economic analysis	We suggest offering patients, if possible, HC catheters, as they are cost-effective compared to single-use uncoated catheters due to the decreased incidence of UTIs and increased QOL.	Moderate	Moderate

HC: hydrophilic-coated; IC: intermittent catheterization; QOL: quality of life; UTI: urinary tract infection.

material, cleaning method, and/or catheterization technique remain controversial topics in urology.

The preferred IC strategy varies by settings and practices. There is no evidence that there is one best catheter for all patients. Selection of the ideal IC type/technique is a complex balance between patient's motor functions, acceptance of the procedure, QOL, and the economic implications. Whenever possible, hydrophilic-coated or prelubricated catheters should be proposed to the patient as the first treatment option because they appear to lower the risk of UTI, may result in less urethral trauma, and have higher convenience and ease of use compared to conventional uncoated catheters.

Reuse of catheters may still be considered in specific clinical scenarios, however, the patient should be made aware there are concerns regarding efficacy and that there is limited evidence to support cleansing techniques for a single-use product. Long-term cost-effectiveness of single-use HC catheters was established from the perspective of several international healthcare systems.

Debate continues to linger regarding the best catheter material and/or technique in which upper urinary tract deterioration can be prevented while minimizing treatment-related morbidity. Therefore, further high-quality RCTs are warranted.

Competing interests: Dr. Campeau has been an advisory board and speakers' bureau member for Astellas and Pfizer; has received grants/honoraria from Allergan, Astellas, and Pfizer; and has participated in clinical trials supported by Pfizer. Dr. Baverstock has been a speaker for Allergan, Astellas, BSCI, and Pfizer; and has participated in clinical trials supported by Astellas and Pfizer. Dr. Carlson has been an advisory board member for Astellas and Pfizer; has received travel honoraria from Allergan; and has participated in clinical trials supported by Astellas and Pfizer. Dr. Elterman has been an advisory board and speakers' bureau member for Allergan, Astellas, Boston Scientific, Duchesnay, Ferring, Medtronic, and Pfizer; has received grants/honoraria from Boston Scientific and Pfizer; and has participated in clinical trials supported by Astellas, Boston Scientific, and Medtronic. Dr. Hickling has been an advisory board member for Pfizer; a speakers' bureau member for Allergan, Astellas, and Pfizer; has received grants/honoraria from Allergan, Astellas, and Pfizer; and has participated in clinical trials supported by Astellas. The remaining authors report no competing personal or financial interests related to this work.

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