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Review

Intermittent catheterization: which is the optimal technique?

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Study design: Literature review to evaluate the practical techniques used for intermittent catheterization (IC) and intermittent self-catheterization (ISC).
Objectives: To ascertain the requirements for proper IC and ISC. To evaluate if a best technique exists.
Methods: Relevant articles on the subject are reviewed.
Conclusion: There is a wide variety of materials and techniques applied for IC and ISC. This does not seem to change the practical outcome much if the basic principles are used: good education and training, clean and atraumatic technique, good patient compliance in the long-term. There is neither one best technique nor one best material for IC. Both depend greatly on the patient's individual anatomic, social and economic state.
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Keywords: urinary bladder; catheterization; spinal cord; neurogenic bladder; urine

Introduction

Intermittent catheterization (IC) and self-catheterization (ISC) have become widely introduced during the last 40 years.[1,2]

The main aims of IC and ISC are to empty the bladder and to prevent bladder overdistension in order to avoid complications and to improve urological function. Many studies showed good results in continence with less complications leading to a better prognosis and a better quality of life in many patients with neurogenic bladder.[3–5] A literature survey of results on continence is given in Table 1.

IC and ISC are nowadays considered as the methods of choice for the management of neurological bladder dysfunction.[6] In this paper we deal with data concerning IC and ISC techniques in order to find out if an optimal technique exists. Catheterization techniques involve types of catheters, lubricants, the catheter manipulation and introduction and the rules needed for a short-term and long-term successful application.

Many types of catheters are used, eg Nelaton, O'Neil, Tiemann and Foley. They are made of rubber, latex, plastic (PVC), silicone. They may be siliconized or of Teflon coated rubber, glass or stainless steel. Some are packed in a sheet/bag,[7] others are reusable. A urethral introducer has been described which allows bypass of the colonized 1.5 cm of the distal urethra and which results in a significant lower infection rate in hospitalized men with spinal cord injury.[8] Studies comparing materials in a randomized controlled way are scarce. Some recent studies evaluate mainly different hydrophilic catheters. In an animal study in the rabbit, Lundgren *et al*[9] found that osmolality of hydrophilic catheters is important in regards to removal friction and urethral trauma. To minimize the risk of urethral trauma high osmolality catheters are recommended especially when the catheterization times are a few minutes or more. Waller *et al*[10] compared two different hydrophilic catheters in a cross-over study of 14 male spinal cord injury patients, as to the maximum friction force during the removal of the catheters after bladder emptying. The catheter with the highest osmolality (approximately 900 mOsm/kg) had much less sticking to the urethral epithelium and had a significantly lower friction force. Biering-Sorensen *et al*[11] compared two types of hydrophilic catheters and found no difference regarding the number of urethral epithelial cells on the surface of the catheters after catheterization. Wyndaele *et al*[12] evaluated the use of a hydrophilic catheter in 39 male patients with neurogenic bladder using conventional catheters over a long period of time. The hydrophilic catheter proved as easy to use but was better tolerated. Satisfaction was better especially in patients who experienced problems with conventional catheters. Some patients were unsatisfied for reasons of practical use or for economical reasons. Very recently Hedlung *et al*[13] asked for a prospective, randomized long-term multicenter study in order to reach reliable conclusions

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Table 1 Outcome of continence

Authors	*Number of patients*	*Follow-up*	*Adjunctive treatment*	*Result of continence*
Madersbacher and Weissteiner[48]	12 women	2–4 years		50% dry, other 50% some grade of incontinence
Wyndaele *et al*[49]	30 (18 m, 12 f)	3–30 months	6 anticholinergic, 1 colocystoplasty	73% continent + 13% improvement
Iwatsubo *et al*[50]	60 spinal cord lesion		Overdistension during shockphase	100% continent
McGuire and Savastano[51]	22 f	2–11 years	Surgery 27%	Continent 73%
Kornhuber and Schultz [52]	197 multiple sclerosis			Continence improved with elimination of residual urine
Wyndaele and Maes[53]	75 (69 neurogenic)	1.5–12 years	38 anticholinergics	47 dry, 22 seldom wet, 6 wet at least once a day
Kuhn *et al*[54]	22 spinal cord lesion	5 years	No	Continence did not change
Lindehall *et al*[55]	26 meningomyelocoele	7.5–12 years		24 out of 26 better
Waller *et al*[56]	30 spinal cord lesion	5–9 years	6 anticholinergics	22 dry, 8 incontinent
Vaidyanathan *et al*[57]	7 spinal cord lesion	14–30 months	Bladder relaxant drugs intravesically	84% dry, 3 dampness at awaking

f = female; m = male

concerning hydrophilic catheters. Studies comparing the use hydrophilic catheters with the use of ordinary catheters and lubricant must take into account how this lubricant jelly is used: applied on the catheter or injected into the urethra. So far one can only wait until such studies are performed before claiming the superiority of either.

Most catheters need the use of some kind of lubricants, especially in men, eg jellies or aqueous solution. Lubricants are applied on the catheter or are instilled into the urethra.[14] In some countries patients use oil[15] or just water[16] as lubricant. For those with preserved urethral sensation, a local anaesthetic jelly may be needed. These jellies would seem most effective when instilled into the urethra before catheterization. Many female patients do not use catheter lubrication. Catheters with a hydrophilic and self lubricated surface need activation with tap or sterile water.

Regarding the size of the catheters, for adults 10–14 Fr for males and 14–16 Fr for females are mostly used but bigger size/lumen may be necessary for those with bladder augmentation or cloudy urine from other origin. No studies on IC compared sizes in a randomized way. Two main techniques have been adopted, a sterile (SIC) and a clean IC (CIC). The sterile non-touch technique advocated by Guttmann and Frankel involves the use of sterile materials handled with sterile gloves and forceps. In an intensive care unit, some advocate wearing a mask and a sterile gown as well. In some centers, during a bladder training program SIC used to be done only by a catheter team, which has proven to obtain a very low infection rate.[17] Nowadays the sterile technique is mostly used only during a restricted period of time and in a hospital setting. In the majority of cases a clean technique is used.

Self-catheterization is carried out in many different positions: supine, sitting or standing. Female patients may use a mirror or a specially designed catheter to visualize the meatus.[18] After a while most women do not need these aids anymore.

The basic principles of urinary catheter introduction are well known: the catheter must be introduced in a non-infecting and atraumatic way. The requirements for this have been described before. Non-infecting means cleaning hands, using a non-infected catheter and lubricant and cleaning the meatal region before catheter introduction. Here again different ways of application exist: the use of sterile components with the catheter introduced out of the sheet into the urethra as well as the use of re-sterilized catheters introduced by hand which have been washed before. Individual variation can be found in every patient group.

Atraumatic requires a proper catheter size, sufficient lubrication, and gentle introduction through the urethra, sphincter area and bladder neck.[19,20] The catheter has to be introduced until urine flows out. Urine can be drained directly in the toilet, in a urinal, plastic bag or other reservoir. The catheter should be kept in place until urine flow stops. Then it should be pulled out slowly while gentle Valsalva or bladder expression is carried out in order to completely drain residual urine. When properly done the residual urine

should be a maximum 6 ml as demonstrated by Stribran and Fabian with phenolphthalein washing.[21] But that the daily truth can be different was shown by Jensen *et al*.[22] These authors measured residual urine repeatedly with ultrasonography and found rest urine in 70% of the catheterizations in their group of 12 patients with spinal cord lesion. The residual could exceed 50 ml and even 100 ml.

Finally, the end of the catheter should be blocked to prevent backflow of the urine or air into the bladder. Hydrophilic catheters can be left in place for a short time only to prevent suction by the urethral mucosa which may make removal difficult.

During the rehabilitation phase clean ISC (CISC) can be taught early to patients with good hand function. Wyndaele and De Taeye[23] compared the results in 25 paraplegic patients (23 men and two women) started on CISC at a mean of 35 days (7 to 85 days) post trauma with those in 48 paraplegic patients catheterized by nurses with a non-touch technique and found comparable results in final outcome of the bladder training, and infection rate. Early self-catheterization allowed the patient to go home for weekends earlier and was considered positive by the majority of those participating. Champion[24] found no bacteriological difference in urine specimens 1 year after 7 patients were changed from sterile to clean ISC.

When resources are limited, catheters are re-used for up to weeks and months. Some re-sterilize or clean them by soaking in an antiseptic solution or boiling water. Microwave to re-sterilize rubber catheters has been described by Silbar *et al*.[25] A silicone Japanese type self-catheter has proved to be reusable for a long time.[26,27] Van Hala *et al*[28] used a questionnaire in 97 patients with pediatric onset neurogenic bladders to evaluate differences between IC with a sterile new catheter and IC with re-used material. Ninety-eight per cent used a clean technique. These data suggest that re-used supplies are not related to an increased likelihood of urinary tract infection.

The frequency of catheterization needed can depend on many factors such as bladder volume, fluid intake, post-void residual and urodynamic parameters (bladder compliance, detrusor pressure). Usually it is recommended to catheterize 4–6 times a day during the acute phase after spinal cord lesion. Some will need to keep this frequency if IC is the only way of bladder emptying. Others will catheterize 1–3 times a day to check and evacuate residual urine after voiding or on a weekly basis during bladder retraining.[29] Clinical utility of a portable ultrasound device in IC has been evaluated in randomized controlled trials.[30,31] The results show that the device allows a reduction in the number of required catheterizations and is associated with a high degree of patient satisfaction.

Adjunctive therapy to overcome high detrusor pressure is often needed. Anticholinergic drugs or bladder relaxants are often indicated in patients with bladder overactivity. For those who develop a low compliance bladder, upper tract deterioration or severe incontinence injection of botulinum toxin in the bladder wall[32] or surgery as bladder augmentation[33] may be necessary. Where a too high diuresis is noted during the night due to diurnal variation of anti-diuretic hormone,[34] DDAVP can safely and effectively be used.[35] In cases of catheterization difficulty at the striated sphincter, botulinum toxin injection in the sphincter can help.[36] In individuals with tetraplegia reconstructive handsurgery may be indicated.[37] For those with poor handfunction or difficulty in reaching the meatus, assistive devices might be needed.[38]

Education is very important. Patients and carers must understand what is wrong with the bladder/sphincter and why IC is proposed for treatment. They have to learn how to catheterize properly. Teaching programmes have been successful in non-literate persons in developing countries[39] and in quadriplegic patients.[40]

It is clear that IC can improve incontinence or can make patients with neurogenic bladder continent if bladder capacity is sufficient, bladder pressure kept low, urethral resistance high enough, and if care is taken to balance between fluid intake, residual urine and frequency of catheterization.

Not all patients starting with IC continue this treatment. Some reasons for this are given in studies summarized in Table 2. Perrouin-Verbe *et al*[41] found in their global population of 159 spinal cord injury patients that only eight having practised CIC for at least 2 years stopped the technique, indicating that in spinal cord injury in most cases the definitive choice of voiding method is made within 2 years post injury. A

Table 2 Reasons for stopping intermittent self-catheterization

Authors	*Catheter free* (%)	*Incontinence* (%)	*Inconvenient* (%)	*Infection* (%)	*Physical status* (%)	*Choice of patient* (%)
Diokno *et al*[58]	17	2	2		7	
Maynard and Glass[59]	12					6
Whitelaw *et al*[60]	5		5		5	5
Webb *et al*[61]	9		3		2	2
Timoney and Shaw[62]		36				
Sutton *et al*[40]		6	6	3	3	3
Bakke[63]	10		5	4	3	
Hunt *et al*[64]	10					

main reason to stop was continuing incontinence. The first factor of acceptance of the technique was continence. The second factor of acceptance relates to the autonomy of the patients for practising IC. In their population of 50 patients Perkash and Giroux[42] have also found that four out of seven tetraplegics had stopped IC because they needed to be catheterized by others. In their study a total of 66% had stopped IC mainly after surgery on sphincter and prostate or after initiation of voiding. Bakke and Malt[43] found that among those who practiced IC independently 25.8% were sometimes and 6% always averse. Young patients and females were more averse to CIC. In 30% aversion seemed to be related to a subjective evaluation of their situation, to an emotional status and above all to non-acceptance of their chronic disability. In a recent study[44] a retrospective analysis was made on the compliance with bladder management in spinal cord injury patients. Of 38 patients on CIC at discharge 52% discontinued the method and reverted to indwelling catheter during follow-up. Dependence on care givers, spasticity interfering with catheterization, incontinence despite anticholinergic agents and lack of availability of external collective devices for female patients were the main reasons for stopping CIC.

Is IC cost-effective? There are no data about the cost and cost/efficacy as yet available. Prieto-Fingerhut *et al*[45] compared the cost of sterile and non sterile IC and found that clean IC was less costly taking into account the price of sterile sets used for IC. Grundy *et al*[46] compared the price of IC and suprapubic fine-bore catheterization after spinal cord injury and found the latter cheaper for material, average antibiotic cost and labour. Duffy *et al*[47] evaluated cost-effectiveness in a population of male residents of VA nursing homes comparing CIC and SIC. In this randomized clinical trial they found a similar outcome but less expense if a clean technique was used.

In developing countries even a very low catheterization budget may be out of reach for the majority of patients. Re-use of inexpensive catheters and the use of a local product as lubricant may bring the method within the reach of more patients.

To conclude: there is a wide variety of materials used and techniques applied for IC. This does not seem to change the practical outcome much if the basic principles are applied: good education and training, clean and atraumatic technique, good patient compliance in the longterm. It is clear that there exists neither one best technique nor one best material for IC. Both depend greatly on the patient's individual anatomic, social and economic possibilities.

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