W17: Complications of neurogenic bladder

Workshop Chair: Emmanuel Chartier-Kastler, France

28 August 2018 15:30 - 17:00

Start	End	Topic	Speakers
15:30	15:35	introduction	Emmanuel Chartier-Kastler
15:35	15:45	autonomic dysreflexia	Pierre Denys
15:45	15:50	Questions	All
15:50	16:00	urethral trauma	Charalampos Konstantinidis
16:00	16:10	skin ulcers and uretroperineal fistulae	Jalesh Panicker
16:10	16:15	Questions	All
16:15	16:25	Fever and SCI: which arguments for urinary tract involvement?	Pierre Denys
16:25	16:35	Inability to catheterise through native urethra: which alternatives?	Charalampos Konstantinidis
16:35	16:40	Questions	All
16:40	16:50	ageing SCI	Jalesh Panicker
16:50	17:00	Discussion	Emmanuel Chartier-Kastler

Aims of Workshop

To describe through 10 minutes talks dedicated to producing MOOC diagnosis and management of main complications of neurogenic bladder related to spinal cord injury. This workshop is the following of the WS produced within the last two years by the NU promotion committee in the aim to produce video material.

Learning Objectives

To summarise the management of main complications of neurogenic bladder in SCI patients, based on the recent SIU ICUD SCI recommendations.

Learning Outcomes

To be able to lead and manage a multidisciplinary management of these complications.

Target Audience

Urologists and neurourologists

Advanced/Basic

Advanced

Conditions for Learning

Interactive.

Suggested Learning before Workshop Attendance

SIU ICUD recommandations 2017.

Suggested Reading

ICI guidelines 2017.

Autonomic dysreflexia
Pierre Denys

Autonomic dysreflexia is a common cardiovascular complication in high thoracic and cervical spinal cord lesion. A sudden rise in systolic blood pressure of more than 20 mm HG is the definition. Associated symptoms are headache, sweating, modification of color of the skin below and above the lesion, bradycardia and goose bumps. Autonomic dysreflexia is an exacerbated nociceptive vascular reflex. A nociceptive stimulation below the lesion induce a vasocontriction in the lower limb and the splanchnic vascular territory. Autonomic dysreflexia must be recognized to be treated and prevented because of the high risk of complications such as stroke or seizures. Pelvic stimulation, bladder filling, urodynamics, cystoscopy are usual triggers for autonomic dysreflexia and AD can be silent.

Urethral trauma
Charalampos Konstantinidis

Urethral complications are common in neurogenic patients. Especially in SCI patients, this incidence reaches approximately the 20%, over the long term. The use of urethral catheters, indwelling or intermittent is the main factor for the high incidence of this condition. Indwelling catheters are associated mainly with urethral erosion and stricture formation, while intermittent catheters usually are responsible for urethral trauma, false passages, and stricture formation. The kind of the catheter for IC (reusable vs. single-use catheters) it seems that does not influence the risk of urethral trauma.

A period of indwelling catheterization of a male urethral false passage may be an initial treatment approach. Regarding strictures, the procedure of intermittent catheterization (IC) by itself can be the stricture management by dilatation. Urethrotomy may be needed in order to establish an efficient urethral lumen. Urethroplasty and lower urinary tract reconstruction may be the endpoint approach for some patients. Ventral graft urethroplasty in male SCI patients is not recommended due to concerns about urethral diverticulum and difficulty performing IC.
A stricture can further on be additionally complicated by urethral diverticula formation. A periurethral abscess is usually the result of the infection and inflammation that is accompanying the urine stasis and an urethro-cutaneous fistula can be the final endpoint of this situation.

Urethral erosion due to prolonged use of indwelling catheterization leads to “hypospadias like” deformity in males. In females, urethra erosion may result in loss of the bladder neck and urethral wall. As an outcome a big vesicovaginal fistula is formatting. In the female SCI patients, urethral damage may occur as early as 6 months with an indwelling urethral catheter. Transvaginal, abdominal, or combined approach may be used for the surgical closure of an eroded female urethra. The use of an autologous pubo-vaginal sling, if sufficient urethral tissue is present, can be helpful. In case that there is no tissue available for, bladder neck closure and catheterizable cutaneous stoma formation may be an option. Surgery to correct urethral complications in males and in females carries a higher risk of failure in the SCI population than in the non-SCI population, due to the poor blood supply, decrease of the muscle tone, infections, and poor tissue quality. Sometimes a urinary diversion is needed in order to deal with urethral complications in this population.

Skin ulcers and uretroperineal fistulae
Jalesh Panicker

Urethral complications occur in approximately 20% of SCI patients over time. Urethral trauma with an indwelling urethral catheter is variable and depends upon the duration of use of the indwelling catheter, frequency of catheter change, catheter size and catheter care. The incidence of urethroperineal fistulae is greater

For patients with an indwelling urethral catheter. Fistulae in the setting of SCI are complex and therefore imaging such as MRI to study the track of the fistula is recommended. Fistula may arise due to urethral obstruction, catheterization, infection from poor bladder management and pressure ulcers. These underlying factors need to be addressed when planning the management of the fistula. This is because a fistula may occasionally by addressing the underlying problem alone.

However, most often surgical intervention is required. Fistula repair may not be feasible in all cases, in which a urinary diversion such as ileal conduit or suprapubic catheter may be the only options. This if particularly so in in patients with prior sphincterotomy. If the fistula is infected, abscess drainage and treatment of osteomyelitis is necessary. Up to 95% of individuals with SCI will develop pressure ulcers at some point.

Pressure ulcers are a constant and costly problem and contributing factors are partial/ complete loss of sensations, in areas of contact when seated, and incontinence. Extended periods of immobility may result in excessive tissue pressure and, ultimately, necrosis. Pressure ulcers are preventable, however when they occur may disrupt rehabilitation, and prevent individuals from working or attending school.

The sequence of pathological changes include anoxia, ischemia and necrosis, which can be reversed at the ischemic stage if the factors causing injury are identified and removed. Changes can occur in the underlying muscle and subcutaneous fat early, as these tissues are more susceptible to ischemia than the skin. Includes examining skin daily to allow for early detection, minimizing moisture and incontinence and keeping skin clean and dry, use of an individually prescribed wheelchair with a pressure redistribution cushion and regular pressure relief.

Fever and SCI wich argument for urinary tract involvement
Pierre Denys

Infectious complications are very common in SCI patients, urinary tract infection is the most common complications after discharge and at the first rank for the cause of re-hospitalisation. But asymptomatic bacteriuria is very common in patients using intermittent or indwelling catheters. Sensitive innervation of organs below the lesion can be impaired that makes difficult the diagnostic of the organ involves in the infection process. Moreover symptoms of urinary tract infection are non specific, spasticity increase, autonomic dysreflexia, .. can be present in any infection below the lesion. A pragmatic approach is helpful to determine the type and site of infection in those patients.

Inability to catheterize through native urethra: which alternatives?
Charalampos Konstantinidis

A Continent catheterizable channel (CCC) is a valuable alternative in case of inability to catheterize through the urethra. The inability may be associated with limited access to the urethra due to limited upper limb dexterity (high tetraplegia), obesity (mainly in women) or destroyed (or injured) urethra which results to difficult or impossible catheterization. Difficulty in transferring, undressing, or positioning, spinal deformity, or refractory perineal ulcers can be other conditions that CCC is indicated as well. The augmentation of the bladder at the same time depending on the bladder function, and usually is needed. The CCC may be constructed using the appendix (Mitrofanoff procedure), a retubularized short intestinal segment (Yang-Monti technique), or a similar method using the efferent limb of a Kock pouch or Indiana pouch. The cutaneous stoma is often located at the umbilicus or in the right lower abdomen. If the length of a single Yang-Monti tube is not enough, a double Yang-Monti tube or a Casale procedure ("spiral Monti") can be used. The degree of upper-limb disability in tetraplegic patients should be evaluated, and specific rehabilitation procedures may be needed before the construction of the catheterizable channel.
In case of incontinence due to urethral incompetence, bladder neck closure is necessary, while other authors support the preservation of the urethra when this is possible (after anti-incontinence surgeries) for safety reasons and access to the bladder in case of cystolithotripsy and/or difficulty in catheterization via the stoma.

The complications of all these procedures are similar to bladder augmentation, thus the addition of a CCC does not increase complications that are associated with the augmented cystoplasty, such as stone formation or UTIs. Regarding the stoma itself, incontinence may occur in approximately 12% of patients, stenosis up to 9%, and stoma revision is needed to 9-22%. Stoma-related complication rate and re-intervention rate remains high, even if experienced surgeons construct the CCC at a specialized center.

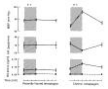
The catheterizable channel improves the QoL of these patients, as provides independence in toileting. Compliance with IC prevents stomal stenosis and is associated with fewer complications in the long-term. Lifelong follow up is needed.
In case that bladder augmentation and use of IC are not feasible, a non-continent urinary diversion (ileal conduit, ileo-vesicostomy) is an option. Vesicostomy and cutaneous ureterostomy in SCI patients is not recommended. QoL is similar in patients with ileal conduit urinary diversion and continent diversion.

Ageing SCI
Jalesh Panicker

Urological problems arising following SCI persist as the individual become older. Moreover, age-related urological changes such as benign prostatic enlargement, reduction in detrusor contractility, pelvic floor changes can result in lower urinary tract dysfunction in the older SCI patient. Longitudinal studies in a cohort of patients with SCI using reflex emptying and an external collecting device with high pressures in the lower urinary tract initially have shown a reduction in maximum detrusor pressures over time. Whether this is due to long-term effects of reduced detrusor sphincter dyssynergia or to aging is unclear. Other studies have shown increased bladder capacity, improved compliance and reduced detrusor sphincter dyssynergia over time.

Urodynamic studies are essential in understanding the problems and guiding management. Pharmacological management may be indicated with alpha-adrenergic
blockers, antimuscarinics, or beta-3-receptor adrenergic agonists. In individuals with incomplete bladder emptying or urinary retention, the preferred management option of intermittent self catheterization (ISC) may no longer be feasible because of barriers that appear with age. These include impairment of upper limb functions such as strength and coordination, change in motivation and cognitive ability and declining vision. Loss in the length of the penis with aging can lead to difficulties in

performing IC or applying a condom-drainage system. Postmenopausal changes can make the urethra more difficult to locate. Older patients may prefer a suprapubic catheter to ISC, for convenience and for preservation of quality of life.



Autonomic Dysreflexia

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Autonomic dysreflexia

- Definition
- Pathophysiology
- Signs and symptoms
- How to prevent
- How to treat

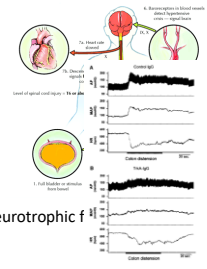
Definition

- A sudden rise in systolic and diastolic blood pressure frequently associated in bradycardia with a cut off value of 20mmHg in adults
- In SCI patients with lesion above T6
- Can be life threatening condition (seizures, myocardial infarction, stroke…)
- Systolic blood pressure is low at rest in SCI patients usually around 90 mmHg
- One of the autonomic disorders of SCI patients (postural hypotension, bradycardia, thermoregulation…)

Alexander et al. 2009 Spinal Cord, Jan;47(1):36-43. Krassioukov et al. 2012 Spinal Cord. 2012 Jul; 35(4): 201-10

Pathophysiology

- Visceral stimulation below the lesion
- Sympathetic stimulation release of NA…
- Vasoconstriction, increase of blood pressure
- Parasympathetic stimulation above T6
- Bradycardia
- And neuroplasticity +++ of the afferences (Neurotrophic f dependant)



2 wks
A : control intrathécal IgG
B : intrathécal IgG anti Trk-A

Weaver et al Prog Brain Res. 2006;152:245-63

Signs and symptoms : increase in blood pressure and bradycardia (headache)

- Below
  - Vasoconstriction
  - Cool peripheral extremities
- Above
  - Sweating
  - Piloerection
  - Flushing of the skin
  - Blurred vision
  - Pupil constriction
  - Nasal congestion

BUT CAN BE SILENT

Many causes

- UTI
- Catheter blockage
- Bladder distension
- Ejaculation/orgasm
- Labor and delivery
- Fecal impaction
- Fracture, pressure sore
- ……

- IATROGENIC
  - Cystoscopy
  - Urodynamic
  - Detrusor botulinum toxin injection
  - Penile vibratory stimulation or electrostimulation
  - Trans anal irrigation
  - Genital exam ….

Urodynamic and AD

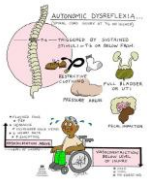
- 62% had signs or symptoms of AD during UD
- 38% had silent AD

Table 2 Changes in systolic (SBP) and dystolic (DBP) blood pressures and heart rate (HR) in patients with signs of autonomic dysreflexia during urodynamic examination

Cardiovascular values	Basic mean (SD)	Dysreflexia mean (SD)	Difference (%)	Absolute difference
SBP (mm Hg)	115 (17)	155 (32)	35·5	40 (25)
DBP (mm Hg)	64 (13)	82 (16)	31·2	17 (16)
HR (bpm)	59 (6)	53 (10)	−14·3	8 (6)

P < 0·01.

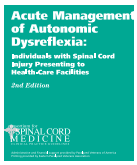
Schurch et al., JNNP. 1997 May; 62(5): 473–477; Lui et al. Spinal Cord 2013 51 863 867



- Use local anesthesia for example for cystoscopy or botulinum injection or spinal anesthesia for labor and delivery
- Monitor blood pressure for any evaluation in SCI with lesion above T6
- Avoid risk : appropriate routines for bladder and bowel management and treatment of NDO
- Educate patient, care-givers and GP's+++++

How to prevent

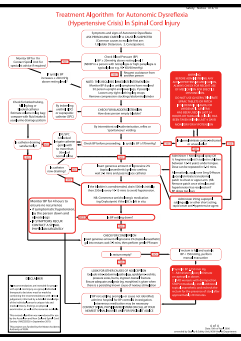
How to treat acute AD

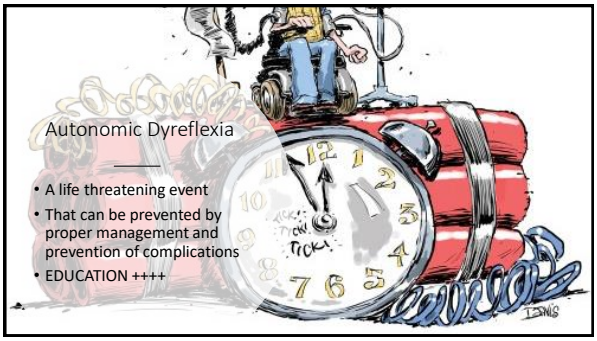


Arch Phys Med Rehabil. 2009 April ; 90(4): 682–695. doi:10.1016/j.apmr.2008.10.017.

A Systematic Review of the Management of Autonomic Dysreflexia Following Spinal Cord Injury

Andrei Krassioukov, MD, PhD, FRCPC[1,2,3], Darren ER Warburton, PhD[1,4], Robert Teasell, MD, FRCPC[5], Janice J Eng, BSc (PT/OT), PhD[1,3,6], and The SCIRE Research Team

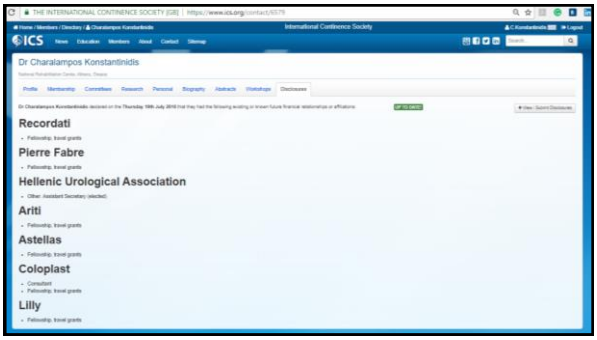




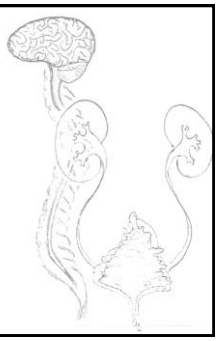
WORKSHOP 17
COMPLICATIONS OF NEUROGENIC BLADDER

URETHRAL TRAUMA

Charalampos Konstantinidis, MD, FEBU, FECSM



EAU Guidelines on
Neuro-Urology



3.4.2.5.2 Summary of evidence and recommendations for catheterisation

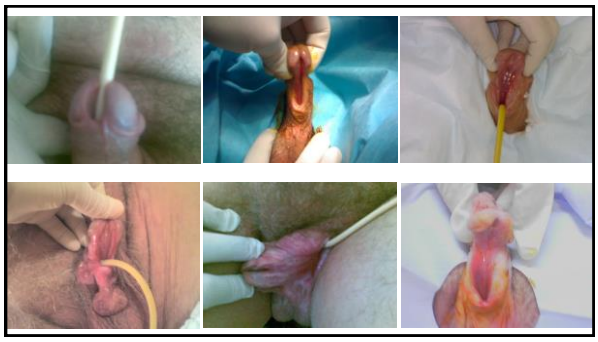
Summary of Evidence	LE
Intermittent catheterisation is the standard treatment for patients who are unable to empty their bladder.	3
Indwelling transurethral catheterisation and suprapubic cystostomy are associated with a range of complications as well as an enhanced risk for UTI.	3

Recommendations	Strength rating
Use intermittent catheterisation, whenever possible aseptic technique, as a standard treatment for patients who are unable to empty their bladder.	Strong
Thoroughly instruct patients in the technique and risks of intermittent catheterisation.	Strong
Avoid indwelling transurethral and suprapubic catheterisation whenever possible.	Strong

Catheters use is a necessity with a lot of complications and limitations
<u>but</u>
is the best management option of "neurogenic bladder" emptying that we have

Introduction

- Urethral complications are common in neurogenic patients. Especially in SCI patients, this incidence reaches approximately the 20%, over the long-term
- The use of urethral catheters, indwelling or intermittent is the main factor for the high incidence of this condition
  - Indwelling urethral catheters are associated with urethral erosion and stricture formation
  - Intermittent catheters usually are responsible for urethral trauma, false passages, and stricture formation



Indwelling Urethral Catheters - Risk Factors for erosion

- Prolonged catheterization
  - Females 6 months – 3 years
  - Males: after 1-2 months
- Catheter size (14-16Fr is recommended)
- The time interval between the catheter replacement (4-6 weeks is the optimal)
- Amount of saline for the balloon filling (no more than 10cc)
- The positioning of the catheter - Stretch of the catheter and pull over the blabber neck or urethral tissue
- Catheter material (silicone is preferable)

Indwelling Urethral Catheters - erosion

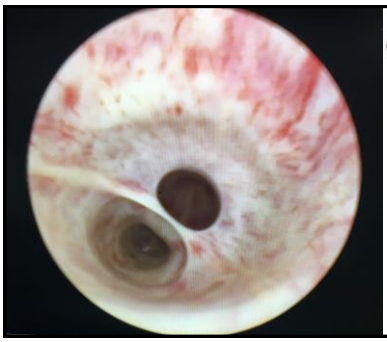
- Males: Urethral erosion due to prolonged use of indwelling catheterization leads to "hypospadias like" deformity
  - Urethroplasty: high rate of complications
  - Urethral closure and urinary diversion
- Females: Erosion may result in loss of the bladder neck and urethral wall and vesico-vaginal fistula formation
  - Transvaginal, abdominal, or combined approach may be used
  - The use of an autologous pubo-vaginal sling, if sufficient urethral tissue is present, can be helpful
  - Bladder neck closure and catheterizable cutaneous stoma formation (if there is no tissue available)

Indwelling Urethral Catheters – conservative management and prevention of complications

- Good hygiene of the urogenital area
- Increased fluid intake (>2 liters/day)
- Antimuscarinics in order to decrease detrusor overactivity and avoid incontinence over the catheter
- Catheter fixation without tension (anchoring device) may be helpful to decrease the risk of urethral erosion
- The benefit of catheter irrigation is unknown
- Daily prophylactic antibiotics are not recommended for routine use

Urethral trauma - False Passage

- Inability to reach the bladder with the catheter – urethral bleeding
- Cystoscopy for diagnosis and evaluation
- Catheterization for 3 to 6 weeks (14 - 16Fr catheter) is usually effective
- Urethroplasty is needed in rare cases

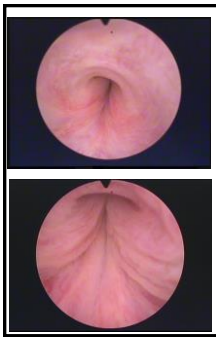


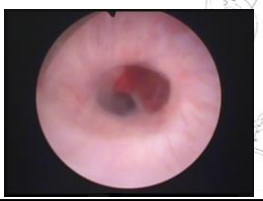
What size of IC do we need

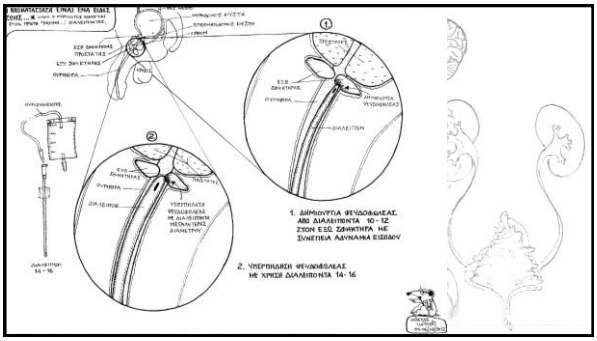
- Small size of the catheter (8-10Fr)
  - Easy to pass through the anterior urethra
  - Possible injury of bulbar urethra. At the points of resistance acts as an “arrow” and not as a “dilator”
  - Precipitate drainage inability due to the narrow lumen
  - Low axial strength, which makes difficult the passage thrugh an anatomical or functional obstruction

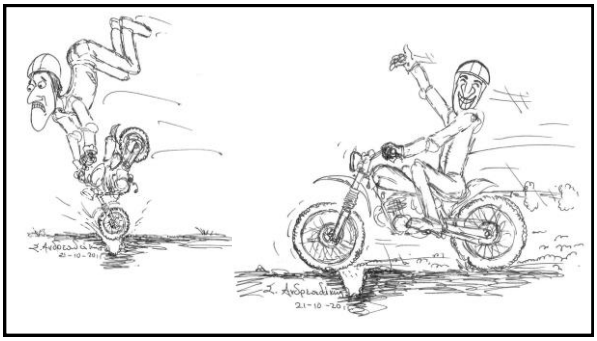
What size of IC do we need

- Bigger size of the catheter (12-14Fr)
  - Passing through the obstacles
  - Acts as a “dilator” rather than as an “arrow”
  - Precipitate drainage







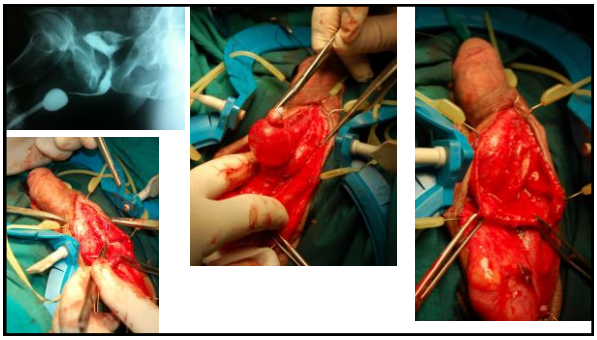


Urethral stricture

- Is the outcome of urethral tissue healing after a trauma
- The procedure of intermittent catheterization (IC) by itself can be the stricture management by dilatation
- Urethrotomy may be needed in order to establish an efficient urethral lumen
- Urethroplasty and lower urinary tract reconstruction may be the endpoint approach for some patients
- Ventral graft urethroplasty in male SCI patients is not recommended due to concerns about urethral diverticulum and difficulty performing IC

Complicated cases

- A stricture can further on be additionally complicated by urethral diverticula formation
- A periurethral abscess is usually the result of the infection and inflammation that is accompanying the urine stasis
- An urethral-cutaneous fistula can be the final endpoint of this situation



Surgical management of urethral complications in neuro-patients

- High risk of failure (in males and in females)
- High complication rate
  - poor tissue quality
  - seating position (wheelchair users)
  - poor blood supply - poor vascularization
  - decrease of the muscle tone
  - pressure ulcers
  - bacteriuria in combination with incontinence
  - infections
- Sometimes a urinary diversion is needed in order to deal with urethral complications in this population

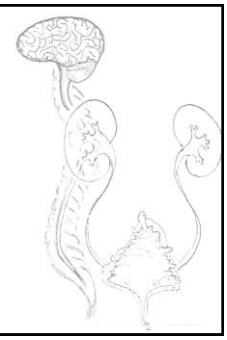
Conclusions

1. Urethral complications occur in approximately 20% of SCI patients over the long term. **[LOE 3]**
2. Intermittent catheterisation is associated with urethral strictures, diverticula, and false passages. **[LOE 3]**
3. Indwelling urethral catheterization is associated with a high rate of urethral complications, including urethral stricture, erosion, fistula, and periurethral abscess. **[LOE 3]**
4. Urethral damage in the female SCI patient may occur as early as 6 months with an indwelling urethral catheter. **[LOE 3]**
5. Reusable catheters do not increase the risk of urethral trauma compared with single-use catheters. **[LOE 3]**
6. There is insufficient evidence for whether a transvaginal, abdominal, or combined approach is better for urethral closure of an eroded female urethra. **[LOE 3]**
7. Surgery to correct urethral complications carries a higher risk of failure in the SCI population than in the non-SCI population. **[LOE 3]**
8. Urinary diversion is sometimes needed to deal with urethral complications in SCI patients. **[LOE 3]**

Recommendations

1. Clinicians should encourage women with SCI to limit indwelling urethral catheter use to less than 6 months in order to avoid the risk of urethral atrophy and erosion. **[GOR B]**
2. Clinicians should consider treating female urethral erosion with an autologous pubovaginal sling, if sufficient urethral tissue is present. **[GOR B]**
3. Clinicians should consider bladder neck closure to treat the destroyed female urethra. **[GOR B]**
4. Clinicians may consider a period of catheterization for the initial management of a male urethral false passage. **[GOR B]**
5. Urologists may consider initial management of male urethral stricture with dilation or urethrotomy. **[GOR B]**
6. Urologists may consider repeat dilation, urethrotomy, urethroplasty, and lower urinary tract reconstruction as options for male SCI patients with recurrent urethral stricture disease. **[GOR C]**
7. Urologists should avoid ventral graft urethroplasty in male SCI patients due to concerns about urethral diverticulum and difficulty performing IC. **[GOR C]**

Thank you for your attention



Urethro-perineal fistula

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W17ComplicationsNeurogenicbladder28.8.18

Jalesh N. Panicker

Affiliations to disclose†:

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Urethral complications: fistulae are rare

TABLE II. *Urologic complications*

Parameter	Catheterized	Noncatheterized	*P* Value
No. of patients	56	86	
Renal			
Recurrent pyelonephritis	7	2	0.015
Parenchymal thinning	13	4	0.0009
Urinary tract infection			
Symptomatic UTI (=1)	6	35	0.0001
Symptomatic UTI (>1)	42	11	0.0001
Urosepsis	12	7	0.023
Stones			
Bladder stones	34	10	0.0001
Renal stones	18	6	0.0001
Urethral			
Fistula (cutaneous)	5	10	0.0048
Erosion	12	6	0.0002
Stricture	13	4	0.0009
Abscess (periurethral)	5	0	0.0048
Other			
Epididymitis	12	8	0.042
Gross hematuria	23	6	0.0001
Total	202	109	0.0070

Key: UTI = urinary tract infection.

10%

Urethral complications: fistulae are rare

RETROSPECTIVE ANALYSIS OF UROLOGIC COMPLICATIONS IN MALE PATIENTS WITH SPINAL CORD INJURY MANAGED WITH AND WITHOUT INDWELLING URINARY CATHETERS

TABLE I. *Clinical parameters*

Parameter	Total	Catheterized	Noncatheterized
No. patients	142	56 (40)	86 (60)
Age at injury (yr)	34	33	35
Years of follow-up	12	12	12
Level of injury			
Cervical (high)	84	36 (43)	48 (57)
Thoracolumbar (low)	58	20 (34)	38 (66)
External sphincterotomy	63 (44)	16 (25)	47 (75)

Numbers in parentheses are percents.

N=142

Larsen et al. 1997

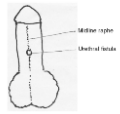
Fistula in the neurological patient

- Epithelialized track between the urethral and perineum
- Pathogenesis of fistula formation in the SCI complex
- Poorly characterized in the literature

Predisposing factors

- Chronic pressure ulcers
- Urethral obstruction
- Catheterization- indwelling > ISC
- Infection from poor bladder management
- Trauma

Ginsberg 2013



Karakus et al. 2017

Urethro-perineal fistulae

- **Periurethral abscess-** important cause

Abscess cavity contracts by healing fibrosis, leaving behind a fistulous tract

- **Strictures-** fistulae usually develop secondary to high-pressure voiding of infected urine
- Single tract or multiple tracts
- Urination usually occurs through the perineal fistulas
  "watering pot perineum"
- Fistula/ periurethral abscess may be hallmark symptom of urethral carcinoma

Pressure ulcers predispose to fistula formation

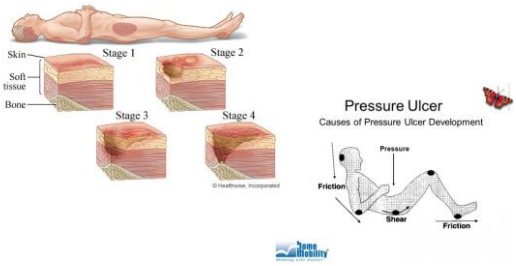


Figure 1. Large pressure ulcer involving the labia majora.

Investigations

- Urethrocystoscopy
- Urethrography
- Voiding cystourethrography
- MRI- cross-sectional study

Management

- Evaluate and manage the underlying cause
- Fistula may heal when underlying cause managed (Nassir, 2009)
- Suprapubic drainage
- Incision and drainage of abscess
- Wide excision of fistula
- Defect closed by tunica vaginalis or buccal mucosa flap
- If extensive damage- urinary diversion
- Patients with prior sphincterotomy- urinary diversion recommended (Hansen 2003)
- Evidence base poor; long-term outcome studies lacking

Urinary-cutaneous fistulae in neurological patients

Table 2. Etiology of neurogenic bladder and fistulae by fistula location

	Penile (8)	Sacral (7)	Abdominal (5)	Perineal (1)
Etiology of NGB				
Traumatic SCI	6	7	3	1
Cerebral palsy	1	0	1	0
Transverse myelitis	0	0	1	0
Syringomyelia	1	0	0	0
Etiology of fistula				
Decubitus ulcers	0	7	0	0
Infection	0	0	4	1
Condom catheter	4	0	0	0
Traumatic CIC	4	0	0	0
Pelvic trauma	0	0	1	0

CIC, clean intermittent catheterization; SCI, spinal cord injury.

Chronic neurological disease N=21

Raup et al. 2015

Urinary-cutaneous fistulae in neurological patients

Table 3. Fistula etiologies and outcomes

N	Age	Type	Injury	IUD	Cause	Size (cm)	Repair	Failure	Revision	Diversion
1	23	Abd.	CP	IC	Surg. inf.	2	Primary	Yes	None	Conduit
2	76	Abd.	TSCI	IC	Abscess	3	Primary	Yes	None	SP tube
3	38	Abd.	TML	IC	Surg. inf.	2	Primary	No	None	None
4	41	Abd.	TSCI	IC	Trauma	5	Conduit	No	None	Conduit
5	51	Abd.	TSCI	IC	Abscess	6	Conduit	No	None	Conduit
6	23	Penile	TSCI	CC	CC trauma	5	Tunica flap	Yes	BGU	None
7	56	Penile	CP	IC	IC trauma	2	BGU	Yes	BGU	None
8	50	Penile	Syr.	IC	IC trauma	4	Tunica flap	Yes	None	SP tube
9	22	Penile	TSCI	CC	CC erosion	0.5	BGU	Yes	None	SP tube
10	23	Penile	TSCI	CC	CC erosion	7	BGU	Yes	None	SP tube
11	44	Penile	TSCI	IC	IC trauma	1	Tunica flap	Yes	None	SP tube
12	57	Penile	TSCI	CC	CC erosion	3	Tunica flap	Yes	None	SP tube
13	23	Penile	TSCI	IC	IC trauma	2	Tunica flap	Yes	BGU	None
14	53	Perineal	TSCI	IC	Abscess	0.5	None	N/A	None	PU
15	46	Sacral	TSCI	IC	Decubitus	3	Primary	Yes	None	SP tube
16	22	Sacral	TSCI	IC	Decubitus	2	Primary	Yes	None	Conduit
17	28	Sacral	TSCI	IC	Decubitus	3	Conduit	Yes	Revision	Conduit C
18	42	Sacral	TSCI	IC	Decubitus	3	Conduit	Yes	Revision	Conduit C
19	44	Sacral	TSCI	IC	Decubitus	2	Conduit	Yes	Revision	Conduit C
20	41	Sacral	TSCI	IC	Decubitus	5	None	N/A	None	SP tube
21	26	Sacral	TSCI	IC	Decubitus	4	None	N/A	None	SP tube

Abd, abdominal; BGU, buccal graft urethroplasty; CC, condom catheter; Conduit C, conduit catheter; CP, cerebral palsy; IC, intermittent catheterization; IUD, initial urinary drainage; N/A, not applicable; PU, perineal urethrostomy; SP, suprapubic; Surg. inf., surgical infection; Syr., syringomyelia; TML, transverse myelitis; TSCI, traumatic spinal cord injury.

Raup et al. 2015

Retrospective review of urethral complications in the neurogenic bladder (n=18)

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Pt No.—Age	Level/Injury	Initial Management	Initial Management Complications	Reconstructive Surgery	Reconstructive Surgery Complications	Diversion
1—49	L1/L2 paraplegic/lugging catheter	Reflex void, external catheter	Urethral erosion	Urethroplasty	Fistula	Ileovesicostomy
2—49	T9 paraplegic/motor vehicle accident	Reflex void, external catheter	Urethral diverticulum with stone	Urethral diverticulectomy	Fistula	Indiana pouch
3—50	T10 paraplegic/motor vehicle accident	Reflex void, external catheter	Urethral erosion + urethrocutaneous fistula	Erosion down to pubic bone, no reconstruction		Ileal loop
4—60	Paraplegic	External sphincterotomy, external catheter	Urethral + corporal body erosion	Urethroplasty with preputial flap	Fistula	Ileal conduit
5—46	T12 paraplegic/motor vehicle accident	External sphincterotomy, external catheter	Urethral + penile prosthesis erosion	Urethroplasty with multiple flaps	Pan urethral stricture due to infection	Ileovesicostomy + bladder neck closure
6—47	T9 paraplegic/fall	External sphincterotomy, external catheter	Urethrocutaneous fistula	Urethroplasty with preputial flap	Urethral necrosis + diverticulum	Ileovesicostomy + bladder neck closure
7—37	C7 quadriplegic	External sphincterotomy, external catheter	Urethral stricture	Preputial flap urethroplasty	Urethral diverticulum + stricture	Advancement of diverticular tissue
8—33	T10/11 paraplegic/gunshot wound	Reflex void, external catheter	Urethral erosion + urethrocutaneous fistula	Urethroplasty with flap	Large bulbar urethral diverticulum	Ileovesicostomy + bladder neck closure
9—57	L2 paraplegic/lugging accident	Reflex void, external catheter	Urethral erosion + urethrocutaneous fistula	Urethroplasty dartos flap	Large urethrocutaneous fistula	Bladder augmentation, Mitrofanoff + bladder neck closure
10—42	T10 paraplegic/gunshot wound	External sphincterotomy, external catheter	Bulbar urethral stricture	Laser vision internal urethrotomy, excision + primary anastomosis	Recurrent stricture + urethrovesicovaginal fistula requiring ureteral flap urethroplasty	No
11—36	T6 paraplegic	Reflex void, external catheter	Bulbar urethral stricture	Excision + primary anastomosis	None	No
12—27	L4 paraplegic/meningomyelocele	2 Stage Turner Warwick	Pan urethral stricture + urethral erosion	Extensive urethral reconstruction	Extensive urethral stricture + diverticuli	Ileovesicostomy + bladder neck closure
13—35	T2 paraplegic/gunshot wound	Reflex void, external catheter	Urethral diverticulum	Urethral diverticulectomy	None	No
14—39	Quadriplegic/cerebral palsy	Reflex void	Distal urethral stricture	Ventral inlaid flap	Perineoscrotal abscess requiring incision + drainage, + perineal urethrostomy	No
15—34	C5/6 quadriplegic/motor vehicle accident	Indwelling Foley catheter	Urethral erosion + urethrocutaneous fistula	Scrotal flap urethroplasty	Chronic perineoscrotal abscess + fistula	No
16—42	C5/7 quadriplegic	External sphincterotomy, external catheter	Urethral erosion + urethrocutaneous fistula	Flap urethroplasty + glansplasty	Recurrent fistula of repair + buried penis requiring repeat surgery	No
17—41	T7 paraplegic	External sphincterotomy, external catheter	Urethral erosion + urethrocutaneous fistula	Urethroplasty with flap	Urethral stricture + diverticulum requiring repeat surgery	Indiana pouch
18—34	T5 paraplegic	External catheter	Complete penile skin erosion	Skin flap, Byars flap + labial scrotal advancement	None	No

Secrest et al. 2004

Follow-up

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- Only 4 of the 17 patients had a patent urethra at 3.7 years of follow-up
- In severe cases of decubitus pressure ulceration, both fecal and urinary diversion

Secrest et al. 2004

Conclusions

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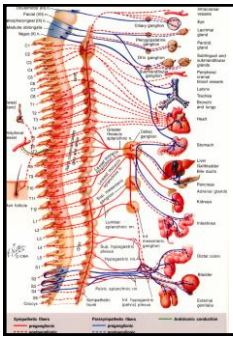
- Urethro-perineal fistulae rare
- Often associated with
- Often associated with other urethral pathologies (peri-urethral abscess, erosions, stricture), perineal pressure ulcers, catheterization- indwelling > ISC, infection from poor bladder management, trauma
- Management - treat underlying cause, repair
- Often- urinary diversion needed

Fever and SCI : which argument for urinary tract involvment

Prof Pierre DENYS
PMR Department and Neuro Urology Unit
Raymond Poincaré Hospital University of Versailles
France

Careers : Become a Urologist.



Why is it so difficult ?

- Loss of sensation depending on the level of the lesion
- Makes the diagnostic of site of infection below the level of the lesion critical
- SCI patients are at risk of many causes of infection
  - Pulmonary
  - Urinary tract
  - BUT also all the others ....
- Chronic asymptomatic bacteriuria is very frequent
- Non specific symptoms
  - Cloudy urine, chills, leakage, dysuria, fever, autonomic dysreflexia, increase in spasticity

Why we have to use antibiotics with many precautions ?

- High prevalence of MDRGNO in SCI population in acute settings but also in the community
- 41% of MDRGN0
- E coli and klebsiellas are the most frequent
- Risk associated with antibiotic exposure
- More frequent in complete lesion, tetraplegia..
- Increasing in prevalence in the last 10 yrs

ORIGINAL ARTICLE

Prevalence and Factors Associated With Multidrug-Resistant Gram-Negative Organisms in Patients With Spinal Cord Injury

Sepsis is at high risk

- 318 Severe blood stream infection
- UTI in 34%, pressure sore in 25% and catheter line associated infection 11%
- 9% mortality at 30 days
- MDRO are not risk factors of mortality or severity of the initial sepsis

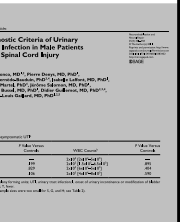
ORIGINAL ARTICLE

Blood stream infections due to multidrug-resistant organisms among spinal cord-injured patients, epidemiology over 16 years and associated risks: a comparative study

A Drissi[1], M Salhia[1], D Saadeh[1], F Bouchand[1], A Desarthe[1], AL Roux[2], B Davido[1], B Clair[1], P Denys[1], D Annane[3], C Perronne[1] and L Bernard[1,2]

Does urine culture help in case of fever ?

- Male SCI patients using intermittent catheterization
- 381 episodes of symtomatic UTI compared to 277 asymtomatic episoodes
- ROC and univariate analysis failed to discriminate based on WBC count and urine cfu between symptomatic or asymptomatic even in case of fever



Diagnostic Criteria of Urinary Tract Infection in Male Patients With Spinal Cord Injury

Does the patient is accurate to diagnose UTI

- Prospective cohort of 56 patients
- Subjects were able to predict their own UTI with 66.6% of accuracy and the negative predictive value was higher 82% rather than the positive predictive value 32%
- For fever high specificity 99% but very low sensitivity 6%
- Patient can help to eliminate but not to make the diagnostic

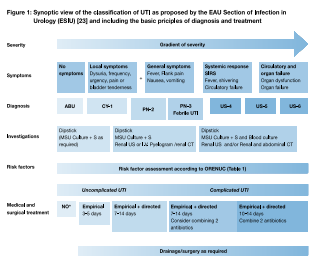
Clinical Utility, Accuracy, and Predictive Values of Urinary Tract Infection Signs and Symptoms in Individuals With Spinal Cord Injury or Dysfunction

J Spinal Cord Med. November 2009;32(5):568–573

Double blind situation

- Because
  - Signs are non specific
  - Urine culture frequently positive
- Very few interventional studies on the role CT scan, ultrasound or scintigraphy or procalcitonin or cytokines
  - Only one in 1996 with scintigraphy
- And very few on sepsis in SCI

Fabrizio et J Urol. 1996 Nov;156(5):1730-4



Type	Category of risk factor	Examples of risk factors
O	NO known/associated RF	- Healthy premenopausal women
R	Recurrent UTI RF, but no risk of severe outcome	- Sexual behaviour and contraceptive devices - Hormonal deficiency in post menopause - Secretory type of certain blood groups - Controlled diabetes mellitus
E	Extra-urogenital RF, with risk of more severe outcome	- Pregnancy - Male gender - Badly controlled diabetes mellitus - Relevant immunosuppression* - Connective tissue diseases* - Prematurity, new-born
N	Nephropathic disease, with risk of more severe outcome	- Relevant renal insufficiency* - Polycystic nephropathy
U	Urological RF, with risk of more severe outcome, which can be resolved during therapy	- Unilateral obstruction (i.e. stone, stricture) - Transient short-term urinary tract catheter - Asymptomatic Bacteriuria** - Controlled neurogenic bladder dysfunction - Urological surgery
C	Permanent urinary Catheter and non-resolvable urological RF, with risk of more severe outcome	- Long-term urinary tract catheter treatment - Non-resolvable urinary obstruction - Badly controlled neurogenic bladder

*RF = risk factor; * = not well defined; ** = usually in combination with other RF (i.e. pregnancy, urological intervention).*

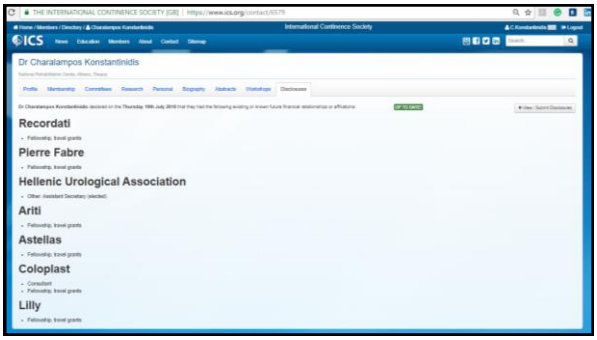
In case of fever

- Clinical exam (pressure sore, orchitis …)
- Biology and urine culture
- Abdominal CT scan or ultrasound depending on the level of the lesion and the completeness
- Clinical symptoms or features are non specific
- High risk of sepsis and complications

WORKSHOP 17
COMPLICATIONS OF NEUROGENIC BLADDER

UNABLITY TO CATHETERISE THROUGH NATIVE URETHRA : WHICH ALTERNATIVES?

Charalampos Konstantinidis, MD, FEBU, FECSM



Continent catheterizable channel (CCC) - Indications

Inability to catheterize through the urethra

- Limited access to the urethra
  - limited upper limb dexterity (high tetraplegia)
  - obesity (mainly in women)
  - destroyed (or injured) urethra
- Difficulty in transferring, undressing, or positioning
- Spinal deformity
- Refractory perineal ulcers

Bladder augmentation at the same time, depending on the bladder function, usually is needed

Special considerations

- The degree of upper-limb disability in tetraplegic patients should be evaluated thoroughly
- Specific rehabilitation procedures may be needed in order to improve upper limb dexterity for
  - Undressing and stoma expose
  - Gripping and catheterizing
  - Handling the urine bag
  - Dressing
- A sham stoma can be used for the proper evaluation of the best stoma location and the patient's abilities

Operating techniques

- Appendix (Mitrofanoff procedure)
- Retubularized short intestinal segment (Yang-Monti technique)
  - If the length of a single Yang-Monti tube is not enough, a double Yang-Monti tube or a Casale procedure ("spiral Monti") can be used.
- A Similar method using the efferent limb of a Kock pouch or Indiana pouch
- The cutaneous stoma is often located at the umbilicus or in the right lower abdomen

Additional procedures

- Bladder Augmentation
  - refractory detrusor overactivity
  - low bladder compliance / capacity
  - development or progression of upper urinary tract (UUT) deterioration
  - persistent severe urinary incontinence due to detrusor overactivity (under maximum conservative treatment or minimally invasive treatment such as botulinum neurotoxin type A intra-detrusor injection therapy - BoNTA).

Additional procedures

- Bladder Neck Closure
  - incontinence due to urethral incompetence
- Anti-incontinence surgery

  preservation of the urethra for safety reasons and access to the bladder in case of cystolithotripsy and/or difficulty in catheterization via the stoma
  - bladder neck sling (autologous or heterologous)
  - bladder neck reconstruction
  - implantation of an Artificial Urinary Sphincter (AUS)

Additional procedures

- Continent urinary reservoir
  - Lower Urinary Tract not suitable for reconstruction due to functional or anatomical reasons
  - necessity for Bladder Neck Closure
  - need for ureteral re-implantation

Bennett JK, Gray M, Green BG, Foote JE. Continent diversion and bladder augmentation in spinal cord-injured patients. Semin Urol. 1992;10(2:121–132

Plancke HR, Delaere KP, Pons C. Indiana pouch in female patients with spinal cord injury. Spinal Cord. 1999;37(3):208–210

Contraindications

- Bad compliance to medical care
- Inflammatory Bowel Disease
- Inability to perform self-intermittent catheterization and unreliable (or unstable) caregivers' environment
- Renal insufficiency (relevant contraindication for urinary tract reconstruction, due to intestinal use)
  - Serum creatinine > 2.0 mg/dL and creatinine clearance < 50 mL/min

Chen JL, Kuo HC. Long-term outcomes of augmentation enterocystoplasty with an ileal segment in patients with spinal cord injury. J Formos Med Assoc. 2009;108(6):475–480

Zommick JN, Simoneau AR, Skinner DG, Ginsberg DA. Continent lower urinary tract reconstruction in the cervical spinal cord injured population. J Urol. 2003;169(6):2184–2187

Complications

- Need for re-operation: 39%
- Tube stenosis: 4-32%
- Complications related to concomitant procedures (augmentation cystoplasty, pouch) included neovesicocutaneous fistulae: 3.4%
- Bladder stones: 20-25%
- Bladder perforations: 40%

Phe, V., et al. Continent catheterizable tubes/stomas in adult neuro-urological patients: A systematic review. Neurourol Urodyn, 2017. https://www.ncbi.nlm.nih.gov/pubmed/28139848

Complications

- Related to bladder augmentation
  - the addition of a CCC does not increase complications that are associated with the augmented cystoplasty, such as stone formation or UTIs
- Related to CCC
  - Incontinence: ~ 12% of patients
  - Stenosis: up to 9%
  - and stoma revision is needed to 9-22%

Complication rate and need for re-operation remains high, even at "experts' hands" at a specialized center

Efficacy & QoL issues

- Continence rate: 60 - 100%
- Stoma continence rate: 91 - 100%
- Gain independence: 80% of patients
- Increased social activities: 53% of patients
- Overall satisfaction: 60 - 100% of patients

Chulamorkodt NN, Estrada CR, Chaviano AH. Continent urinary diversion: 10-year experience of Shriners Hospitals for Children in Chicago. J Spinal Cord Med. 2004;27(Suppl 1):S84–S87

Van Savage JG, Chancellor MB, Slaughenhoupt B. Transverse retubularized ileovesicostomy continent urinary diversion to the umbilicus. Tech Urol. 2000;6(1):29–33

Zommick JN, Simoneau AR, Skinner DG, Ginsberg DA. Continent lower urinary tract reconstruction in the cervical spinal cord injured population. J Urol. 2003;169(6):2184–2187

Hakenberg OW, Ebermayer J, Manseck A, Wirth MP. Application of the Mitrofanoff principle for intermittent self-catheterization in quadriplegic patients. Urology. 2001;58(1):38–42

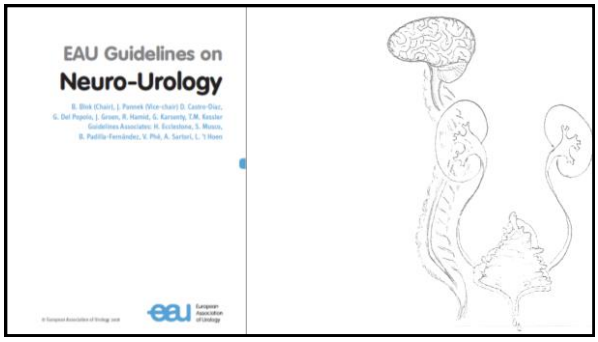
Non-continent Urinary Diversion

- In case that bladder augmentation and use of IC are not feasible, a non-continent urinary diversion (ileal conduit, ileo-vesicostomy) is an option.
- Concomitant cystectomy is debated

  Lawrence A, Hu B, Lee O, Stone A. Pyocystis after urinary diversion for incontinence–is a concomitant cystectomy necessary? Urology. 2013;82(5):1161–1165.
- Vesicostomy and cutaneous ureterostomy in SCI patients is not recommended.
- QoL is similar in patients with ileal conduit urinary diversion and continent diversion

Incontinent diversion - indications

- Compromised renal function (serum creatinine >150–200 µmol/L)
- Hepatic dysfunction
- Compromised intestinal function
- Deficient intrinsic sphincter
- Inability or unwillingness to perform CIC
- Impaired cognitive ability
- Lack of a reliable caregiver
- Patient preference
- Failure of continent diversion
- Requirement for BNC
- Intractable lower urinary tract obstruction
- Urethro-cutaneous fistula

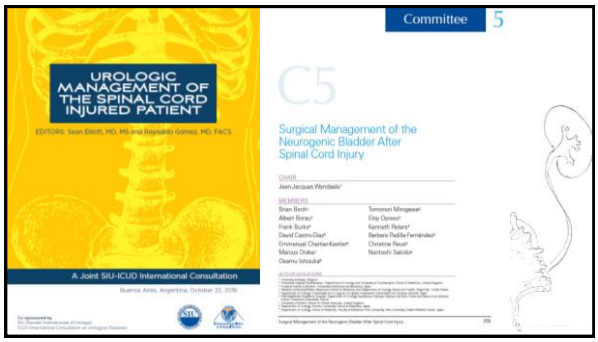


3.4.3.5 Urinary diversion

When no other therapy is successful, urinary diversion must be considered for the protection of the UUT and for the patient's QoL [131].

Continent diversion: This should be the first choice for urinary diversion. Patients with limited dexterity may prefer a stoma instead of using the urethra for catheterisation. For cosmetic reasons, the umbilicus is often used for the stoma site [318-323]. A systematic review of the literature concluded that continent catheterisable tubes/stomas are an effective treatment option in neuro-urological patients unable to perform intermittent self-catheterisation through the urethra [324]. However, the complication rates were significant with 85/213 post-operative events requiring re-operation [324]. Tube stenosis occurred in 4-32% of the cases. Complications related to concomitant procedures (augmentation cystoplasty, pouch) included neovesicocutaneous fistulae (3.4%), bladder stones (20-25%), and bladder perforations (40%). In addition, data comparing HRQoL before and after surgery were not reported [324].

Incontinent diversion: If catheterisation is impossible, incontinent diversion with a urine-collecting device is indicated. Ultimately, it could be considered in patients who are wheelchair bound or bed-ridden with intractable and untreatable incontinence, in patients with LUT destruction, when the UUT is severely compromised, and in patients who refuse other therapy [131]. An ileal segment is used for the deviation in most cases [131, 325-328]. Patients gain better functional status and QoL after surgery [329].



5.12.6 **Conclusions**

Continent catheterizable channel:

- The construction of a CCC should be considered if the patient is unable to perform IC via the native urethra but would be able to perform IC through an abdominal stoma. **[LOE 4]**
- The catheterizable channel provides independence in toileting and improvements in QOL. **[LOE 3]**
- Catheterizable channels have a high rate of re-operation for stenosis or incontinence. **[LOE 3]**
- Compliance with IC prevents stomal stenosis and helps lower the incidence of complications. **[LOE 4]**

Continent urinary reservoir:

- The construction of a CUR may be considered if the patient desires a continent reconstruction but the lower urinary tract cannot be used. **[LOE 3]**

Recommendations

- Surgeons should offer augmentation enterocystoplasty to SCI patients who have NDO or reduced bladder compliance refractory to medical therapy. **[GOR B]**
- Surgeons should offer CCC to SCI patients who would benefit from IC but are unable or unwilling to perform IC through the native urethra. **[GOR B]**
- Surgeons should offer CUR to SCI patients who desire a continent urinary diversion but have lower urinary tract pathology that prevents orthotopic reconstruction with bladder augmentation and CCC. **[GOR B]**
- Clinicians should confirm that the patient or reliable caregivers can perform IC before offering the patient a continent diversion, including augmentation cystoplasty. **[GOR B]**
- Surgeons must recommend long-term follow-up after continent diversion, due to the high risk for complications. **[GOR A]**
- Enterocystoplasty should be performed rather than auto-augmentation or SIS, except in research settings. **[GOR B]**

5.6 Non-continent Urinary Diversion

5.6.1 Introduction

The mainstay of management of the NBD is CIC, combined with medical management of the hyper-reflexic bladder.[120-125] Where conservative treatment fails to control detrusor leak point pressure (DLPP), bladder compliance, and detrusor overactivity, more invasive surgical options can be considered.

In general, continent methods of urinary reconstruction are preferred to incontinent techniques where there is no method of outlet control, necessitating the need for an external appliance to maintain dryness.

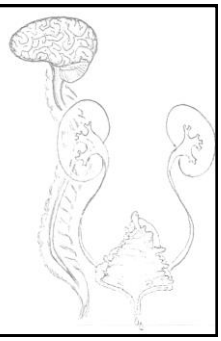
Conclusion

- Quality of life is similar with ileal conduit urinary diversion and continent diversion. **[LOE 3]**

Recommendations

- Surgeons should offer non-continent urinary diversion to SCI patients when other more conservative methods of bladder management have failed or are not an option. **[GOR B]**
- Surgeons may leave the bladder *in situ* during ileal conduit urinary diversion if there is unobstructed urethral drainage and no cancer, and if the patient prefers to leave the bladder *in situ* for reasons such as preserving sexual function. **[GOR C]**
- Surgeons may perform a supratrigonal simple cystectomy to minimize the morbidity of cystectomy at the time of urinary diversion. **[GOR C]**
- Surgeons should avoid ileal conduit in children due to the risk for upper tract deterioration over time. **[GOR B]**
- Surgeons may use ileo-vesicostomy in SCI patients when other forms of urinary diversion are not feasible. **[GOR C]**
- Surgeons should avoid vesicostomy and cutaneous ureterostomy in SCI patients. **[GOR B]**

Thank you for your attention



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Aging and spinal cord injury

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W17ComplicationsNeurogenicbladder28.8.18

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The changing

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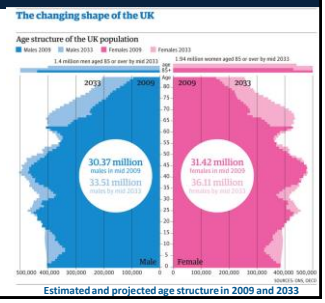
- Population projected to become older-

Median age 39.7 yrs (2010) ⟶ 42.2 years (2035)

- Oldest age groups will increase the fastest



Estimated and projected age structure in 2009 and 2033

SCI patients are living longer!

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General

- Better diets
- Ability to treat communicable diseases
- Evidence base management of non-communicable diseases

Management of SCI

- Evidence base management of SCI
- Better long-term care/ Surveillance

Number of medical co-morbidities increase with age

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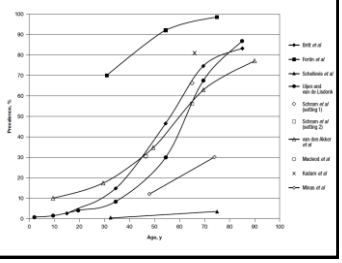
- Medical complexity (>1 chronic medical conditions) increases with age
- Those with long-term disability appear to "age" rapidly
- Those with SCI or SCD appear to be at greatest risk



Medical diseases increase with aging

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Sedentary behavior-

- Increase in BMI
- Increased incidence of central adiposity and insulin resistance, components of the metabolic syndrome.
- Increased risk of diabetes
- Independent risk factor for mortality

Wullems et al. 2016, Garshick et al. 2005

In those with longer duration SCI/ older SCI patients-

- Greater rates of CVD, diabetes, bone loss, fractures, and respiratory complications
- Diabetes, obstructive sleep apnea, peripheral oedema- associated with polyuria and nocturnal polyuria
- Diabetes- greater risk for UTIs
- Constipation- voiding and storage symptoms

Functional decline with aging

- Reduction of vibration sense and proprioception
- Reduced muscle mass/strength
- Slower reaction time
- Impaired fine coordination and agility
- Decreased deep tendon reflexes
- Increased postural instability
  Olafsdottir et al. 2007, Shaffer et al. 2007
- SCI of more than 20 years duration
  12% reported some sensory loss,
  20% reported increasing motor deficits
  Lammertse et al. 1993, Hitzig et al. 2008
- Implications- poorer mobility (functional incontinence), poorer dexterity (performing ISC)

Changes in the LUT with aging

- Reduced detrusor contractility
- Benign prostatic enlargement resulting in outlet obstruction

Significantly lower risk of developing prostate cancer compared with subjects without SCI (Lee et al. 2014)

- Pelvic floor changes with aging /menopause and stress incontinence

LUT changes

- Patients with SCI using reflex emptying and an external collecting device-

High pressures in the first decade, drop in maximum detrusor pressures subsequent 4 decades of surveillance. (Cardenas et al. 1995)

- Follow-up urodynamics in SCI (n= 246; mean duration of injury 17 yrs) mean 6 years apart
  - Increased bladder capacity
  - Improved compliance
  - Reduced detrusor sphincter dyssynergia
  - Due to aging or natural history of disease or treatment effect?
  - (Schoeps et al. 2015)

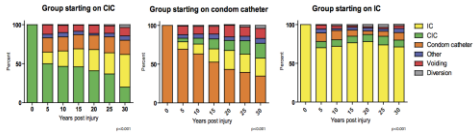
Upper Urinary Tract changes over time

- Long term follow up study suggests renal plasma flow diminished by 4.5 mL per year (Kuhlemeier et al. 1985)
- Obstruction
- Stone disease
- Reflux

Are these changes in the LUT and UUT

- Due to ageing?
- Due to chronic longstanding LUT dysfunction?

Changes in bladder management with aging



Bladder management longitudinally at discharge from rehabilitation

National Spinal Cord Injury Database from 1972 for 30 years n=24,762

Cameron et al. 2010

Barriers to intermittent catheterization

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- Neurological deterioration - strength and coordination, dexterity, truncal stability
- Motivation and cognitive ability for new learning, planning, and organization,
- Vision
- Development of prostatic enlargement
- Loss in the length of the penis
- Postmenopausal changes- finding the urethra
- Obesity- exacerbates all the above
- Preference for IDC- practical and pragmatic reasons

Conclusions

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Over time/ with aging

- Increasing medical co-morbidities
- Changes in neurological status
- Changes in the urological status

- Management of LUT dysfunction will need to be reviewed regularly