EAU Guidelines on

Neuro-Urology

B. Blok (Chair), D. Castro-Diaz,
G. Del Popolo, J. Groen, R. Hamid, G. Karsenty,
T.M. Kessler, S. Musco, B. Padilla-Fernández,
J. Pannek (Vice-chair)
Guidelines Associates: H. Ecclestone, D. Frings, A. Sartori
Patient representatives: P. de Keijzer, A. van der Vorm
Guidelines Office: N. Schouten

European
Association
of Urology

TABLE OF CONTENTS PAGE

1. INTRODUCTION 4
1.1 Aim and objectives 4
1.2 Panel composition 4
1.3 Available publications 4
1.4 Publication history 4
1.5 Background 4

2. METHODS 4
2.1 Introduction 4
2.2 Review 5

3. THE GUIDELINE 5
3.1 Epidemiology, aetiology and pathophysiology 5
3.1.1 Introduction 5
3.2 Classification systems 7
3.2.1 Introduction 7
3.3 Diagnostic evaluation 7
3.3.1 Introduction 7
3.3.2 Classification systems 7
3.3.3 Timing of diagnosis and treatment 8
3.3.4 Patient history 8
3.3.4.1 Bladder diaries 9
3.3.5 Patient quality of life questionnaires 9
3.3.5.1 Available Questionnaires 10
3.3.6 Physical examination and additional tests 11
3.3.6.1 Autonomic dysreflexia 11
3.3.6.2 Summary of evidence and recommendations for history taking and physical examination 12
3.3.7 Urodynamics 13
3.3.7.1 Introduction 13
3.3.7.2 Urodynamic tests 13
3.3.7.3 Specialist uro-neurophysiological tests 14
3.3.7.4 Summary of evidence and recommendations for urodynamics and uro-neurophysiology 14
3.3.8 Renal function 14
3.4 Disease management 15
3.4.1 Introduction 15
3.4.2 Non-invasive conservative treatment 15
3.4.2.1 Assisted bladder emptying - Credé manoeuvre, Valsalva manoeuvre, triggered reflex voiding 15
3.4.2.2 Neuro-urological rehabilitation 15
3.4.2.2.1 Bladder rehabilitation including electrical stimulation 15
3.4.2.3 Drug treatment 16
3.4.2.3.1 Drugs for storage symptoms 16
3.4.2.3.2 Drugs for voiding symptoms 17
3.4.2.4 Summary of evidence and recommendations for drug treatments 17
3.4.2.5 Minimally invasive treatment 18
3.4.2.5.1 Catheterisation 18
3.4.2.5.2 Summary of evidence and recommendations for catheterisation 18
3.4.2.5.3 Intravesical drug treatment 18
3.4.2.5.4 Summary of evidence and recommendations for intravesical drug treatment 19
3.4.2.5.5 Botulinum toxin injections in the bladder 19
3.4.2.5.6 Bladder neck and urethral procedures 19
3.4.2.5.7 Summary of evidence and recommendations for botulinum toxin A injections and bladder neck procedures 19

3.4.3 Surgical treatment 20
3.4.3.1 Bladder neck and urethral procedures 20
3.4.3.2 Denervation, deafferentation, sacral neuromodulation 21
3.4.3.3 Bladder covering by striated muscle 22
3.4.3.4 Bladder augmentation 22
3.4.3.5 Urinary diversion 22
3.4.3.6 Summary of evidence and recommendations for surgical treatment 23
3.5 Urinary tract infection in neuro-urological patients 23
3.5.1 Epidemiology, aetiology and pathophysiology 23
3.5.2 Diagnostic evaluation 23
3.5.3 Disease management 24
3.5.3.1 Recurrent UTI 24
3.5.3.2 Prevention 24
3.5.4 Summary of evidence and recommendations for the treatment of UTI 24
3.6 Sexual function and fertility 25
3.6.1 Erectile dysfunction 25
3.6.1.1 Phosphodiesterase type 5 inhibitors (PDE5Is) 25
3.6.1.2 Drug therapy other than PDE5Is 25
3.6.1.3 Mechanical devices 25
3.6.1.4 Intracavernous injections and intraurethral application 25
3.6.1.5 Sacral neuromodulation 26
3.6.1.6 Penile prostheses 26
3.6.1.7 Summary of evidence and recommendations for erectile dysfunction 26
3.6.2 Male fertility 26
3.6.2.1 Sperm quality and motility 27
3.6.2.2 Summary of evidence and recommendations for male fertility 27
3.6.3 Female sexuality 27
3.6.4 Female fertility 28
3.6.4.1 Summary of evidence and recommendation for female sexuality and fertility 28
3.7 Follow-up 28
3.7.1 Introduction 28
3.7.2 Summary of evidence and recommendations for follow-up 29
3.8 Conclusions 29

4. REFERENCES 29

5. CONFLICT OF INTEREST 56

6. CITATION INFORMATION 56

1. INTRODUCTION

1.1 Aim and objectives

The European Association of Urology (EAU) Neuro-Urology Guidelines aim to provide information for clinical practitioners on the incidence, definitions, diagnosis, therapy, and follow-up of neuro-urological disorders. These Guidelines reflect the current opinion of experts in this specific pathology and represent a state-of-the-art reference for all clinicians, as of the publication date.

The terminology used and the diagnostic procedures advised throughout these Guidelines follow the recommendations for investigations of the lower urinary tract (LUT) as published by the International Continence Society (ICS) [1-3]. Readers are advised to consult other EAU Guidelines that may address different aspects of the topics discussed in this document.

It must be emphasised that clinical guidelines present the best evidence available to the experts but following guideline recommendations will not necessarily result in the best outcome. Guidelines can never replace clinical expertise when making treatment decisions for individual patients, but rather help to focus decisions - also taking personal values and preferences/individual circumstances of patients into account. Guidelines are not mandates and do not purport to be a legal standard of care.

1.2 Panel composition

The EAU Neuro-Urology Guidelines Panel consists of an international multidisciplinary group of neuro-urological experts. All experts involved in the production of this document have submitted potential conflict of interest statements which can be viewed on the EAU website: http://www.uroweb.org/guideline/neuro-urology/.

1.3 Available publications

A quick reference document, the Pocket Guidelines, is available in print and as an app for iOS and Android devices. These are abridged versions which may require consultation with the full text version. A guideline summary has also been published in European Urology [4]. All are available through the EAU website: http://www.uroweb.org/guideline/neurourology/.

1.4 Publication history and summary of changes

*1.4.1 **Publication history***

The EAU Guidelines on Neuro-Urology were first published in 2003. Standard procedure for EAU Guidelines includes an annual assessment of newly published literature in the field to guide future updates. This 2024 Neuro-Urology Guidelines present an update of the 2022 publication.

*1.4.2 **Summary of changes***

All chapters of the 2024 Neuro-Urology Guidelines have been updated, based on the 2023 version of the Guidelines. References have been added throughout the document resulting in various text updates and changes in evidence summaries and recommendations including but not limited to:

- Updates throughout Table 1 and the inclusion of data for Myasthenia gravis.
- A new recommendation for blood pressure and heartrate monitoring in section 3.3.7.4
- A new paragraph on other drugs used as medical therapy for neuro-urological symptoms in section 3.4.2.3 as well as a new summary of evidence (SOE) and recommendation for mirabegron in section 3.4.2.4
- Multiple text updates in section 3.4.3. on the various surgical intervention options for SUI in neuro-urological patients.
- A new SOE and recommendation for sacral neuromodulation in section 3.4.3.6
- A new recommendation against the use of dipstick urine analysis to screen for UTI in neuro-urological patients in section 3.5.4.

1.5 Background

The function of the LUT is mainly storage and voiding of urine, which is regulated by the nervous system that co-ordinates the activity of the urinary bladder and bladder outlet. The part of the nervous system that regulates LUT function is disseminated from the peripheral nerves in the pelvis to highly specialised cortical areas. Any disturbance of the nervous system involved, can result in neuro-urological symptoms. The extent and location of the disturbance will determine the type of LUT dysfunction, which can be symptomatic or asymptomatic. Neuro-urological symptoms can cause a variety of long-term complications; the most significant being deterioration of renal function. Since symptoms and long-term complications do not correlate [5], it is important to identify patients with neuro-urological symptoms, and establish if they have a low or high risk of subsequent

complications. The risk of developing upper urinary tract (UUT) damage and renal failure is much lower in patients with slowly progressive non-traumatic neurological disorders than in those with spinal cord injury or spina bifida [6]. In summary, treatment and intensity of follow-up examinations are based on the type of neuro-urological disorder and the underlying cause.

2. METHODS

2.1 Introduction

For the 2024 Neuro-Urology Guidelines, new and relevant evidence has been identified, collated, and appraised through a structured assessment of the literature. A broad and comprehensive literature search, covering all sections of the Neuro-Urology Guidelines was performed. Databases searched included Medline, EMBASE, and the Cochrane Libraries, covering a time frame between the 1st of May 2021 and 1st May 2023. A total of 1,896 unique records were identified, retrieved, and screened for relevance. A detailed search strategy is available online: http://uroweb.org/guideline/neuro-urology/?type=appendices-publications.

Recommendation within the Guidelines are developed by the panels to prioritise clinically important care decisions. The strength of each recommendation is determined by the balance between desirable and undesirable consequences of alternative management strategies, the quality of the evidence (including certainty of estimates), and the nature and variability of patient values and preferences. This decision process, which can be reviewed in the strength rating forms which accompany each guideline statement, addresses a number of key elements:

1. the overall quality of the evidence which exists for the recommendation [7];
2. the magnitude of the effect (individual or combined effects);
3. the certainty of the results (precision, consistency, heterogeneity and other statistical or study related factors);
4. the balance between desirable and undesirable outcomes;
5. the impact and certainty of patient values and preferences on the intervention.

Strong recommendations typically indicate a high degree of evidence quality and / or a favourable balance of benefit to harm and patient preference. Weak recommendations typically indicate availability of lower quality evidence, and/or equivocal balance between benefit and harm, and uncertainty or variability of patient preference [8].

Additional methodology information and a list of associations endorsing the EAU Guidelines can be found in the online: https://uroweb.org/eau-guidelines/methodology-policies.

2.2 Review

Publications ensuing from panel-lead systematic reviews (SR) have all been peer-reviewed. The 2024 Neuro-Urology Guidelines were subject to peer review prior to publication.

3. THE GUIDELINE

3.1 Epidemiology, aetiology and pathophysiology

3.1.1 Introduction

Neuro-urological symptoms may be caused by a variety of diseases and events affecting the nervous system controlling the LUT. The resulting neuro-urological symptoms depend predominantly on the location and the extent of the neurological lesion. There are no exact figures on the overall prevalence of neuro-urological disorders in the general population, but data are available on the prevalence of the underlying conditions and the relative risk of these for the development of neuro-urological symptoms. It is important to note that the majority of the data shows a very wide range of prevalence/incidence. This reflects the variability in the cohort (e.g., early or late-stage disease) and the frequently small sample sizes, resulting in a low level of evidence in most published data (summarised in Table 1).

Table 1: Epidemiology of Neuro-Urological Disorders

Suprapontine and pontine lesions and diseases		
Neurological Disease	**Frequency in General Population**	**Type and Frequency of Neuro-Urological Symptoms**
Cerebrovascular accident (Strokes)	450 cases/100,000/yr (Europe) [9], 10% of cardiovascular mortality.	Nocturia - overactive bladder (OAB) - urgency urinary incontinence (UUI) – neurogenic detrusor overactivity (NDO), other patterns less frequent [10]. 57-83% of neuro-urological symptoms at one month post-stroke, 71-80% spontaneous recovery at six months [11]. Persistence of urinary incontinence (UI) correlates with poor prognosis [12].
Dementias: Alzheimer's disease (80%), Vascular (10%), Other (10%).	6.4% of adults > 65 yrs [13].	OAB - UUI – NDO, 25% of incontinence in Alzheimer's disease, > 25% in other dementias: Lewy body, NPH, Binswanger, Nasu-Hakola, Pick Disease [14]. Incontinence three times more frequent in geriatric patients with dementia than without [15].
Parkinsonian syndrome (PS) Idiopathic Parkinson's disease (IPD): 75-80% of PS.	Second most prevalent neurodegenerative disease after Alzheimer's disease. Rising prevalence of IPD with age [16].	LUTS affect 50% at onset, with urgency and nocturia being the most common. Patients with LUTS at presentation have worse disease progression in Parkinson's disease [17]. LUTS prevalence data depend on gender, age, and Hoehn and Yahr stage [18].
Non-IPD: Parkinson's-plus (18%): - Multiple system atrophy (MSA), - Progressive supranuclear palsy, - Corticobasal degeneration, - Dementia with Lewy bodies. Secondary Parkinson's (2%)	MSA is the most frequent non-IPD PS.	Infections account for a major cause of mortality in MSA [19]. Impaired detrusor contractility with post-void residual (PVR) > 150 mL seems to be the urodynamic finding distinguishing MSA from IPD [20-22].
Brain tumours	26.8/100,000/yr in adults (> 19 yrs), (17.9 benign, 8.9 malignant) [23].	Incontinence occurs mainly in frontal location (part of frontal syndrome or isolated in frontal location) [24].
Cerebral palsy	Cerebral palsy: 3.1-3.6/1,000 in children aged 8 yrs [25].	32-46% of patients with cerebral palsy suffer from UI, with 85% of patients having abnormal urodynamic studies (NDO most common 59%). Upper tract deterioration is rare (2.5%) [26, 27].
Traumatic brain injury	235/100,000/yr [28].	44% storage dysfunction, 38% voiding dysfunction, 60% urodynamic abnormalities [29].
Normal pressure hydrocephalus	0.5% of the population > 60, up to 2.9% of those > 65 [30].	Classic triad of gait and cognitive disturbance along with neurogenic lower urinary tract dysfunction (NLUTD). The latter is mainly related to NDO and affects 76-83% of patients [30].

Lesions and diseases between caudal brainstem and sacral spinal cord		
Spinal cord injury (SCI)	Prevalence of traumatic SCI in developed countries ranges from 280 to 906/million [31].	NDO and detrusor sphincter dyssynergia (DSD) (up to 95%) and detrusor underactivity (DU) (up to 83%) depending on the level of the lesion [32].
Spina bifida (SB)	Spina bifida 3-4/10,000 Lumbar and lumbosacral form are the most common (60%) [33].	Bladder function is impaired in up to 96% of SB patients [34]. Over 50% of patients are incontinent [35]. Patients with open and closed defects can have equally severe NLUTD [36].
Hereditary spastic paraplegia (HSP)	Prevalence 1.3-9/100,000 [37].	LUTS in about 75%, mainly urgency and voiding dysfunction NDO in 81% (of whom 76% with DSD) [37]
Lesions and diseases of the peripheral nervous system		
Lumbar spine Degenerative disease Disk prolapse Lumbar canal stenosis	Male (5%) and female (3%) > 35 yr. have had a lumbosciatic episode related to disc prolapse. Incidence: approx. 5/100,000/yr More common in females > 45 yr.	26% difficulty to void and acontractile detrusor [38]. Detrusor underactivity (up to 83%) [32]. Tarlov cysts: early sensation of filling (70%), NDO (33%), and stress urinary incontinence (SUI) (33%) [39].
Iatrogenic pelvic nerve lesions	Rectal cancer. Cervical cancer (multimodal therapy, radiotherapy and surgery). Endometriosis surgery.	After abdomino-perineal resection: 50% urinary retention. After total mesorectal excision: 10-30% voiding dysfunction [40].
Peripheral neuropathy Diabetes Other causes of peripheral neuropathy causing neuro-urological symptoms: - Alcohol abuse; - Lumbosacral zone and genital herpes; - Guillain Barre syndrome; - Porphyria; - and Sarcoidosis.	Worldwide, prevalence of pharmacologically treated diabetes 8.3% [41].	OAB +/- UUI [42]. Hypersensitivity and DU at later phase [42].
Myasthenia gravis	Prevalence 20/100,000 [43]	Increased daytime frequency, nocturia, incontinence [43]
Disseminated central diseases		
Multiple sclerosis (MS)	Prevalence: 83/100,000 in Europe [44].	10% of MS patients present with voiding dysfunction at disease onset, 75% of patients will develop it after 10 yrs of MS [45]. NDO: 65% [45], 43% [46]. DSD: 35% [45, 46]. DU: 25% [45].

3.2 Classification systems

3.2.1 Introduction

Relevant definitions can be found in the general ICS standardisation reports [2, 3, 47, 48]. Supplementary online Tables S1 and S2 list the definitions from these references, partly adapted, and other definitions considered useful for clinical practice: https://uroweb.org/guideline/neuro-urology/?type=appendices-publications. A classification system that also includes UUT dysfunction in neuro-urological patients has also been described [48].

3.3 Diagnostic evaluation

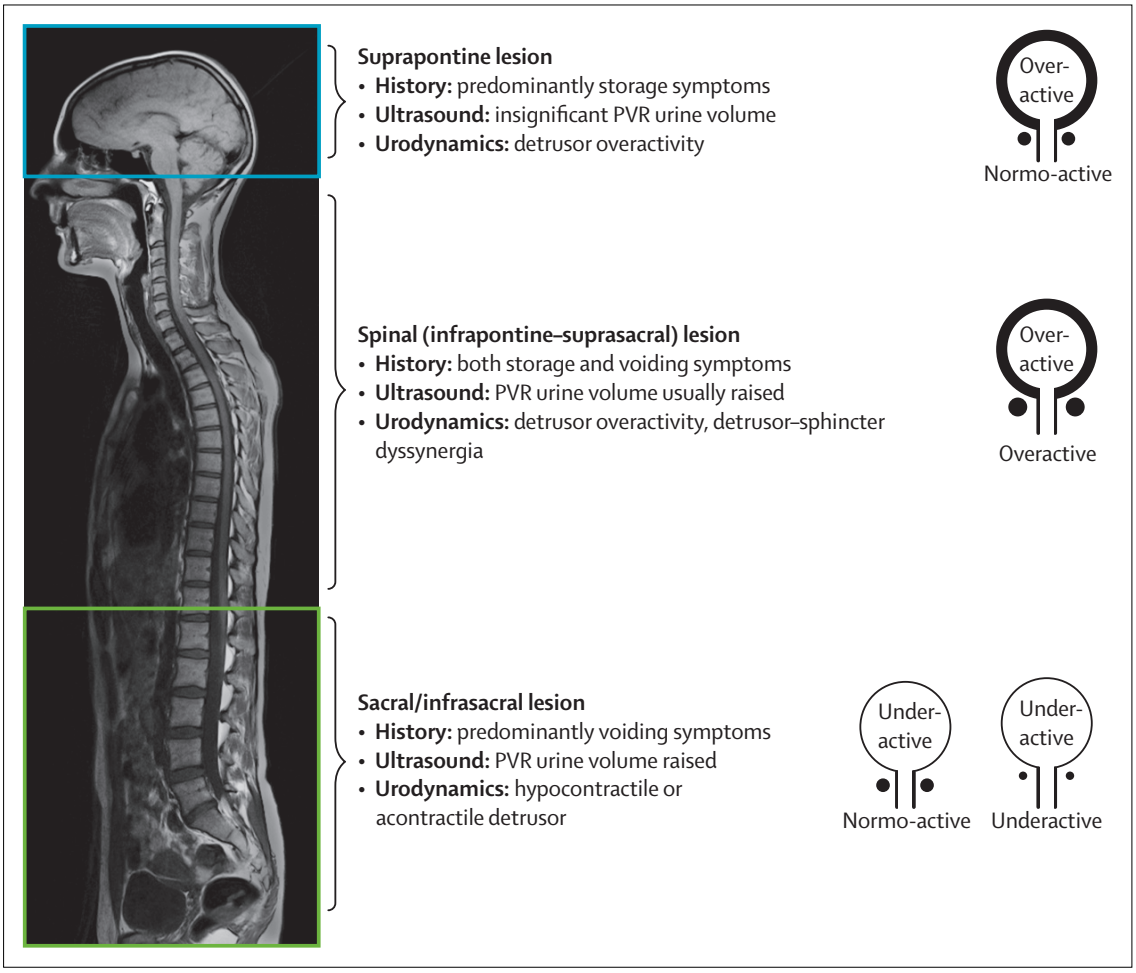
3.3.1 Introduction

The normal physiological function of the LUT depends on an intricate interplay between the sensory and motor nervous systems. When diagnosing neuro-urological symptoms, the aim is to describe the type of dysfunction involved. A thorough medical history, physical examination and bladder diary are mandatory before any additional diagnostic investigations can be planned. Results of the initial evaluation are used to decide the patient's long-term treatment and follow-up.

3.3.2 Classification systems

The pattern of LUT dysfunction following neurological disease is determined by the site and nature of the lesion. A very simple classification system for use in daily clinical practice to decide on the appropriate therapeutic approach is provided in Figure 1 [6].

Figure 1: Patterns of lower urinary tract dysfunction following neurological disease



The pattern of LUT dysfunction following neurological disease is determined by the site and nature of the lesion. Panel (A) denotes the region above the pons, panel (B) the region between the pons and the sacral cord and panel (C) the sacral cord and infrasacral region. Figures on the right show the expected dysfunctional states of the detrusor-sphincter system. Figure adapted from Panicker et al., [6] with permission from Elsevier.
PVR = post-void residual.

3.3.3 Timing of diagnosis and treatment

Early diagnosis and treatment are essential in both congenital and acquired neuro-urological disorders. This helps to prevent irreversible changes within the LUT, even in the presence of normal reflexes [49]. Furthermore, urological symptoms can be the presenting feature of neurological pathology [50, 51]. Early intervention can prevent irreversible deterioration of the LUT and UUT [51]. Long term follow-up (life-long) is mandatory to assess risk of UUT damage and renal failure [52, 53].

3.3.4 Patient history

History taking should include past and present symptoms and disorders (Table 4). It is the cornerstone of evaluation, as the answers will aid selection of diagnostic investigations and treatment options.

- In non-traumatic neuro-urological patients with an insidious onset, a detailed history may find that the condition started in childhood or adolescence [54].
- Urinary history consists of symptoms associated with both urine storage and voiding.
- Bowel history is important because patients with neuro-urological symptoms may also have related neurogenic bowel dysfunction [55].
- Sexual function may be impaired because of the neuro-urological condition [56].
- Special attention should be paid to possible warning signs and symptoms (e.g., pain, infection, haematuria, and fever) requiring further investigation.
- Patients with SCI usually find it difficult to report urinary tract infection (UTI)-related symptoms accurately [57, 58].
- The presence of urinary, bowel and sexual symptoms without neurological symptoms could be suggestive of an underlying neurological disease or condition.
- The severity of lesion after acute SCI does not predict the presence or absence of unfavourable urodynamic parameters [49].

Table 4: History taking in patients with suspected neuro-urological disorder

Past history
Childhood through to adolescence and into adulthood
Hereditary or familial risk factors
Specific female: menarche (age); this may suggest a metabolic disorder
Obstetric history
History of diabetes
Diseases, e.g., multiple sclerosis, parkinsonism, encephalitis, syphilis
Accidents and operations, especially those involving the spine and central nervous system
Present history
Present medication
Lifestyle (smoking, alcohol and drugs); may influence urinary, sexual and bowel function
Quality of life
Specific urinary history
Onset of urological history
Relief after voiding; to detect the extent of a neurological lesion in the absence of obstructive uropathy
Bladder sensation (painful, abnormal, absent or increased)
Initiation of micturition (normal, precipitate, reflex, strain, Credé)
Interruption of micturition (normal, paradoxical, passive)
Enuresis
Mode and type of voiding (catheterisation)
Frequency, voided volume, stress/urgency/mixed urinary incontinence, urgency episodes

Sexual history
Genital or sexual dysfunction symptoms
Sensation in genital area (absent, increased, abnormal, pain)
Specific male: libido, erection, (lack of) orgasm, ejaculation
Specific female: libido, dyspareunia, (lack of) orgasm
Bowel history
Type of bowel program
Frequency and faecal incontinence
Desire to defecate
Defecation pattern
Rectal sensation
Initiation of defecation (digital stimulation, enema, suppositories)
Neurological history
Acquired or congenital neurological condition
Mental status and comprehension
Neurological symptoms (somatic and sensory), with onset, evolution, and any treatment
Spasticity or autonomic dysreflexia (AD) (especially in lesions at or above level Th 6)
Mobility and hand function

3.3.4.1 Bladder diaries

Bladder diaries are considered a valuable diagnostic tool for the initial assessment of neurogenic LUT dysfunction. They provide data on the number of voids (spontaneous or intermittent catheter), voided volume, stress/urgency/mixed urinary incontinence episodes and contribute to the interpretation of urodynamic testing. Preferably, bladder diaries should be completed for three consecutive days [59].

3.3.5 ***Patient quality of life questionnaires***

Quality of life (QoL) is an essential aspect of the overall management of neuro-urological patients, for example when evaluating treatment related changes on a patient's QoL [60]. The type of bladder management has been shown to affect health-related QoL (HRQoL) mainly in patients with SCI [61, 62] and MS [63], as does the presence or absence of urinary, sexual and faecal incontinence [64]. Other research has also highlighted the importance of urological treatment and its impact on the urodynamic functionality of the neuro-urological patient in determining patient QoL [65].

In recent years a proliferation in the number of questionnaires to evaluate symptoms and QoL has been seen. Condition-specific questionnaires can be used to assess symptom severity and the impact of symptoms on QoL. A patient's overall QoL can be assessed using generic questionnaires. It is important that the questionnaire of choice has been validated in the neuro-urological population, and that it is available in the language that it is to be used in.

3.3.5.1 Available Questionnaires

Three condition-specific questionnaires for urinary or bowel dysfunction and QoL have been developed specifically for adult neuro-urological patients [63]. In MS and SCI patients the Qualiveen, also available in a short version, is validated and translated into various languages [66, 67]. Although several objective and subjective tools have been used to assess the influence of neurogenic lower urinary tract dysfunctions (N-LUTD) on QoL in SCI, the Quality life index-SCI and Qualiveen are the only validated condition-specific outcomes that have shown consistent sensitivity [68]. The Neurogenic Bladder Symptom Score (NBSS) and its short version has been validated in neurological patients to measure urinary symptoms and their consequences [69-71]. The QoL scoring tool related to Bowel Management (QoL-BM) [72] can be used to assess bowel dysfunction in MS and SCI patients. A new tool has recently been developed to understand the reasons for poor compliance in long-term management of neurogenic patients. [73, 74]. A variety of patient-reported outcome measures (PROMs) are available to evaluate sexual function in neuro-urological patients. However, only the Multiple Sclerosis Intimacy and Sexuality Questionnaire-15 (MSISQ-15) and -19 is supported by evidence [75-77].

In addition, several validated questionnaires that evaluate QoL and assess urinary symptoms as a subscale or question in neuro-urological patients have been identified [78] (Table 5). The condition-specific Incontinence-Quality of Life (I-QoL) questionnaire which was initially developed for the non-neurological population has now also been validated for neuro-urological patients [79].

A patient's overall QoL can be assessed by generic HRQoL questionnaires, the most commonly used being the I-QOL, King's Health Questionnaire (KHQ), or the Short Form 36-item and 12-item Health Survey Questionnaires (SF-36, SF-12) [80]. In addition, the quality-adjusted life year (QALY), quantifies outcomes, by weighing years of life spent in a specified health state, adjusted by a factor representing the value placed by society or patients on their specific health state [81].

No evidence was found for which validated questionnaires are the most appropriate for use, since no quality criteria for validated questionnaires have been assessed [80].

Table 5: Patient questionnaires

Questionnaire	Underlying neurological disorder	Bladder	Bowel	Sexual function
FAMS [82]	MS	X		X
FILMS [83]	MS	X	X	
HAQUAMS [84]	MS	X	X	X
I-QOL [79]	MS, SCI	X		X
LUTS-TCA [73]	MS, SCI, Parkinson	X		
MDS [85]	MS	X	X	
MSISQ-15 / MSISQ-19 [75, 76]	MS, SCI	X	X	X
MSQLI [86]	MS	X	X	X
MSQoL-54 [87]	MS	X	X	X
MSWDQ [88]	MS	X	X	
NBSS [69, 71]	MS, SCI, SB, Cerebral Palsy	X		
NBSS-SF [70]	MS, SCI, SB	X		
QoL-BM [72]	SCI		X	
Qualiveen/SF-Qualiveen [67, 89]	MS, SCI	X		X
RAYS [90]	MS	X		X
RHSCIR [91]	SCI	X	X	X
USQNB [74]	SCI	X	X	

*3.3.6 **Physical examination and additional tests***

In addition to a detailed patient history, attention should be paid to possible physical and intellectual disabilities with respect to the planned investigations [92, 93]. Neuro-urological status should be described as completely as possible (Figure 2) [6]. Patients with a high spinal cord lesion or supraspinal neurological lesions may suffer from a significant drop in blood pressure when moved into a sitting or standing position. All sensations and reflexes in the urogenital area must be tested [6]. Furthermore, detailed testing of the anal sphincter and pelvic floor functions must be performed (Figure 2) [6, 94]. It is essential to have this clinical information to reliably interpret later diagnostic investigations (Table 6).

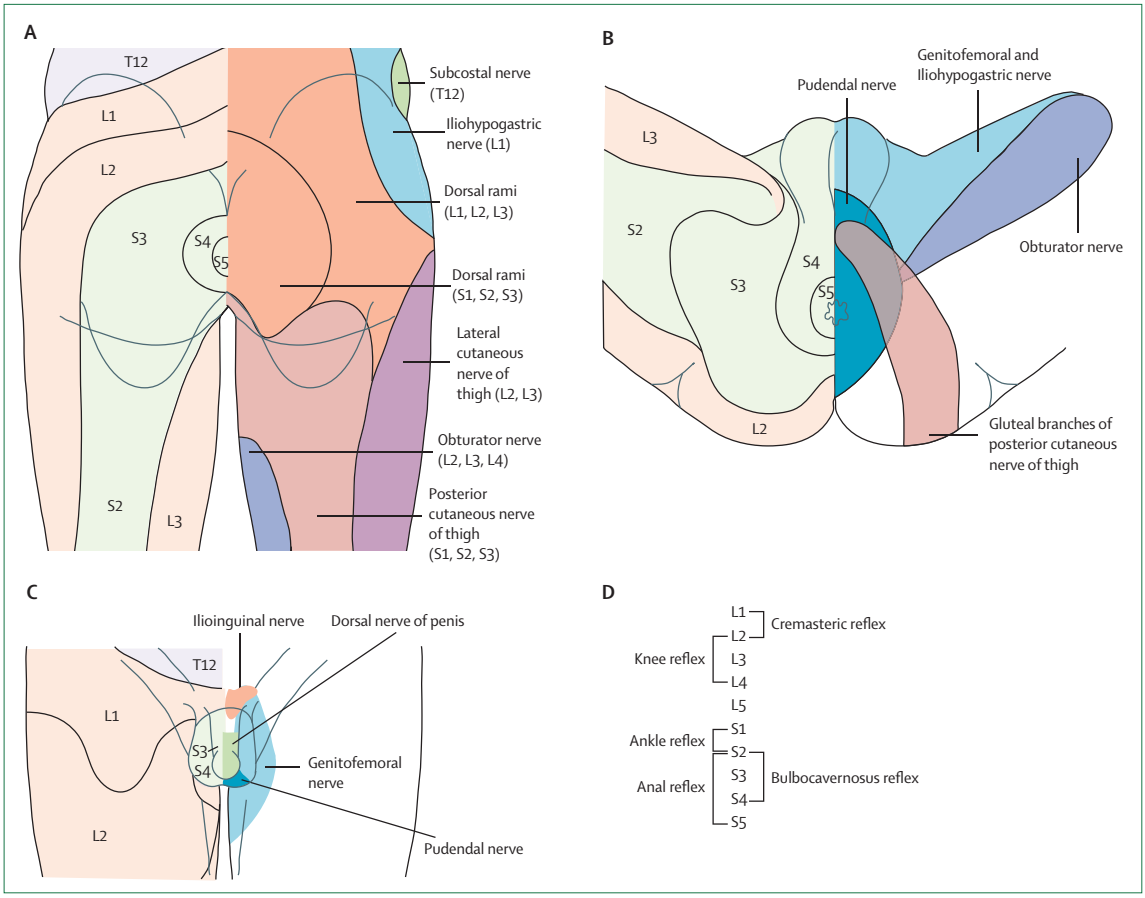
Additionally, urinalysis, blood chemistry, ultrasonography, post-void residual when indicated, incontinence quantification and were indicated free uroflowmetry, should be performed as part of the routine assessment of neuro-urological patients [6, 95].

3.3.6.1 Autonomic dysreflexia

Autonomic dysreflexia (AD) is a sudden and exaggerated autonomic response to various stimuli generally manifests in patients with SCI or spinal dysfunction at or above level Th 6. It is defined by an increase in systolic blood pressure > 20 mmHg from baseline and it is usually accompanied by a severe headache, blurred vision, feeling of anxiety, heart rate changes, as well as above the lesion, perspiration, piloerection, warm skin and flushing and below the lesion, pallor, cold skin, and sweating in the lower part of the body [96, 97]. Autonomic dysreflexia can have life-threatening consequences if not managed adequately. The stimulus can be distended

bladder or bowel (e.g., iatrogenic stimuli during cystoscopy or urodynamics) [98], but it can also be secondary to any noxious stimulus (e.g., infected toenail or pressure sore) or after sexual stimulation.

Figure 2: Lumbosacral dermatomes, cutaneous nerves, and reflexes



The physical examination includes testing sensations and reflexes mediated through the lower spinal cord. Abnormal findings would suggest a lesion affecting the lumbosacral segments; mapping out distinct areas of sensory impairment helps to further localise the site of the lesion. Distribution of dermatomes (areas of skin mainly supplied by a single spinal nerve) and cutaneous nerves over the perianal region and back of the upper thigh (A), the perineum [99] (B), male external genitalia [100] (C) and root values of lower spinal cord reflexes (D). Figure adapted from Panicker et al., [6] with parts A-C adapted from Standring [101], both with permission from Elsevier.

Table 6: Neuro-urological items to be specified

Sensation S2-S5 (both sides)
Presence (increased/normal/reduced/absent)
Type (light touch/pin prick)
Affected dermatomes
Reflexes (increased/normal/reduced/absent)
Bulbocavernous reflex
Perianal/anal reflex
Knee and ankle reflexes
Plantar responses (Babinski)
Anal sphincter tone
Presence (increased/normal/reduced/absent)
Voluntary contractions of anal sphincter and pelvic muscles (increased/normal/reduced/absent)

General urogenital assessment
Prostate palpation
Skin lesions
Size and presence of penis
Descensus (prolapse) of pelvic organs

3.3.6.2 Summary of evidence and recommendations for history taking and physical examination

Summary of evidence	LE
Early diagnosis and treatment are essential in both congenital and acquired neuro-urological disorders to prevent irreversible changes within the LUT.	4
An extensive general history is the basis of evaluation focusing on past and present symptoms including urinary, sexual, bowel and neurological function.	4
Assessment of present and expected future QoL is an essential aspect of the overall management of neuro-urological patients and is important to evaluate the effect of any therapy.	2a
Quality of life assessment should be completed with validated QoL questionnaires for neuro-urological patients.	1a
Bladder diaries provide data on the number of voids, voided volume, urinary incontinence, and urgency episodes.	3

Recommendations	Strength rating
Take an extensive general history, concentrating on past and present symptoms.	Strong
Take a specific history for each of the four mentioned functions - urinary, bowel, sexual and neurological.	Strong
Pay special attention to the possible existence of alarm symptoms/signs (e.g. pain, infection, haematuria, fever) that warrant further specific diagnosis.	Strong
Assess quality of life when evaluating and treating neuro-urological patients.	Strong
Use available validated tools for urinary and bowel symptoms in neuro-urological patients.	Strong
Use MSISQ-15 or MSISQ-19 to evaluate sexual function in multiple sclerosis patients.	Strong
Acknowledge individual patient disabilities when planning further investigations.	Strong
Describe the neurological status as completely as possible, sensations and reflexes in the urogenital area must all be tested.	Strong
Test the anal sphincter and pelvic floor functions.	Strong
Perform urinalysis, blood chemistry, bladder diary, post-void residual, incontinence quantification and urinary tract imaging as initial and routinary evaluation.	Strong

MSISQ 15/19 = Multiple Sclerosis Intimacy and Sexuality Questionnaire 15/19 question version.

*3.3.7 **Urodynamics***

3.3.7.1 Introduction

Urodynamic investigation is the only method that can objectively assess the function and dysfunction of the LUT. In neuro-urological patients, invasive urodynamic investigation is even more challenging than in general patients. Any technical source of artefacts must be critically considered. It is essential to maintain the quality of the urodynamic recording and its interpretation [1]. Same session repeat urodynamic investigations are crucial in clinical decision making, since repeat measurements may yield completely different results [102].

In patients at risk of AD, blood pressure (BP) and heartrate monitoring during the urodynamic study and other invasive procedures is mandatory [97, 103]. The rectal ampulla should be empty of stool before the start of the investigation. All urodynamic findings must be reported in detail and performed, according to the ICS technical recommendations and standards [1, 104].

In patients with SCI, first urodynamic investigation should take place within 3 months after SCI to facilitate early diagnosis of unfavourable urodynamic parameters and timely treatment [105] but there is need for further research regarding the urodynamic follow-up schedule during the first year after SCI [106].

3.3.7.2 Urodynamic tests

Free uroflowmetry and assessment of residual urine: It is recommended prior to planning any invasive urodynamics that patients are able to void in the usual position. For reliable information, it should be repeated at least two to three times [1]. Possible pathological findings include a low flow rate, low voided volume, intermittent flow, hesitancy and PVR.

Filling cystometry: This test is the only method for quantifying the patient's filling function. The status of LUT function must be documented during the filling phase. However, this technique has limited use as a solitary procedure. It is much more effective combined with bladder pressure measurement during micturition and is even more effective in video-urodynamics.

The bladder should be empty at the start of filling. A physiological filling rate should be used with body-warm saline. Possible pathological findings include neurogenic detrusor overactivity (NDO), low bladder compliance, abnormal bladder sensations, low cystometric capacity and urinary incontinence.

Detrusor leak point pressure [107]: Appears to have no use as a diagnostic tool. Some positive findings have been reported [52, 108, 109], but sensitivity is too low to estimate the risk to the UUT or for secondary bladder damage [110, 111].

Pressure flow study (or voiding cystometry): Reflects the coordination between detrusor and urethra or pelvic floor during the voiding phase. It is even more effective if combined with filling cystometry and video-urodynamics. Possible pathological findings include detrusor underactivity, acontractility, bladder outlet obstruction (BOO), DSD, a high urethral resistance, and residual urine.

Most types of obstruction caused by neuro-urological disorders are due to DSD [112, 113], non-relaxing urethra, and/or non-relaxing bladder neck [114, 115]. Pressure-flow analysis mainly assesses the amount of mechanical obstruction caused by the urethra's inherent mechanical and anatomical properties.

Electromyography (EMG): Reflects the activity of the external urethral sphincter, the peri-urethral striated musculature, the anal sphincter, and the striated pelvic floor muscles. Correct interpretation may be difficult due to artefacts introduced by other equipment. In the urodynamic setting, an EMG is useful as a gross indication of the patient's ability to control the pelvic floor. Possible pathological findings include inadequate recruitment upon specific stimuli (e.g. bladder filling, involuntary detrusor contractions, onset of voiding, coughing, Valsalva manoeuvre) suggesting a diagnosis of DSD [116].

Urethral pressure measurement: Has a very limited role in neuro-urological disorders. There is no consensus on parameters indicating pathological findings [117].

Video-urodynamics: Is the combination of filling cystometry and pressure flow studies with imaging. It is the optimum procedure for urodynamic investigation in neuro-urological disorders [5]. Possible pathological findings include all those described in the filling cystometry and the pressure flow study sections, and any morphological pathology of the LUT and reflux to the UUT [118].

Ambulatory urodynamics: This is the functional investigation of the urinary tract, which predominantly uses the natural filling of the urinary tract to reproduce the patient's normal activity. Although this type of study might be considered when conventional urodynamics does not reproduce the patient's symptoms, its role in the neuro-urological patient still needs to be determined [119, 120].

Triggered tests during urodynamics: Lower urinary tract function can be provoked by coughing, triggered voiding, or anal stretch. Fast-filling cystometry with cooled saline (the 'ice water test') was initially described to discriminate between upper and lower motor neuron lesions [121, 122]. Patients with upper motor neuron lesions develop a detrusor contraction if the detrusor is intact, while patients with lower motor neuron lesions do not. However, the test does not seem to be fully discriminative since also non neurological and lower motor SCI have shown positive test [123, 124].

Previously, a positive bethanechol test [125] (detrusor contraction > 25 cm H2O) was thought to indicate detrusor denervation hypersensitivity and the muscular integrity of an acontractile detrusor. However, in practice, the test has given equivocal results. A variation of this method was reported using intravesical electromotive administration of the bethanechol [126], but there was no published follow-up. Currently, there is no indication for this test.

3.3.7.3 Specialist uro-neurophysiological tests

The following tests are advised as part of the neurological work-up [127]:

- electromyography (in a neurophysiological setting) of pelvic floor muscles, urethral sphincter and/or anal sphincter;
- nerve conduction studies of pudendal nerve;
- reflex latency measurements of bulbocavernosus and anal reflex arcs;
- evoked responses from clitoris or glans penis;
- sensory testing on bladder and urethra.

Other elective tests, for specific conditions, may become obvious during the work-up and urodynamic investigations.

3.3.7.4 Summary of evidence and recommendations for urodynamics and uro-neurophysiological tests

Summary of evidence	**LE**
Urodynamic investigation is the only method that can objectively assess the (dys-)function of the LUT.	2a
Video-urodynamics is the optimum procedure for urodynamic investigation in neuro-urological disorders.	4
Specific uro-neurophysiological tests are elective procedures and should only be carried out in specialised settings.	4

Recommendations	**Strength rating**
Perform a urodynamic investigation to detect and specify lower urinary tract (dys-)function, use same session repeat measurement as it is crucial in clinical decision making.	Strong
Non-invasive testing is mandatory before invasive urodynamics is planned.	Strong
Use video-urodynamics for invasive urodynamics in neuro-urological patients. If this is not available, then perform a filling cystometry continuing into a pressure flow study.	Strong
Use a physiological filling rate and body-warm saline.	Strong
Perform blood pressure and heartrate monitoring during urodynamic investigation and other invasive procedures in patients at risk for autonomic dysreflexia.	Strong

3.3.8 ***Renal function***

In many patients with neuro-urological disorders, the UUT is at risk, particularly in patients who develop high detrusor pressure during the filling phase. Although effective treatment can reduce this risk, there is still a relatively high incidence of renal morbidity [128, 129]. Patients with SCI or SB have a higher risk of developing renal failure compared with patients with slowly progressive non-traumatic neurological disorders, such as MS and Parkinson's disease (PD) [130].

Caregivers must be informed of this risk and instructed to watch carefully for any signs or symptoms of a possible deterioration in the patient's renal function. In patients with poor muscle mass cystatin C based glomerular filtration rate (GFR) seems to be more accurate in detecting chronic kidney disease than serum creatinine estimated GFR [131]. There are no high-level evidence publications available which show the optimal management to preserve renal function in these patients [132].

3.4 Disease management

3.4.1 ***Introduction***

The primary aims for treatment of neuro-urological symptoms, and their priorities, are [129, 130]:

- protection of the UUT;
- achievement (or maintenance) of urinary continence;
- restoration of LUT function;
- improvement of the patient's QoL.

Further considerations are the patient's disability, cognition, social support, caregiver support, cost-effectiveness, technical complexity and possible complications [134].

Historically, renal failure was the main mortality factor in SCI patients who survived the trauma [135, 136]. Keeping the detrusor pressure during both the filling and voiding phases within safe limits significantly reduces the mortality from urological causes in these patients [137-139] and has consequently become the top priority in the treatment of patients with neuro-urological symptoms [133, 134].

In patients with high detrusor pressure during the filling phase (NDO, low bladder compliance), treatment is aimed primarily at conversion of an overactive, high-pressure bladder into a low-pressure reservoir despite the resulting residual urine [133]. Reduction of the detrusor pressure contributes to urinary continence, and consequently to social rehabilitation and QoL. It is also critical for preventing UTIs [140, 141]. However, complete continence cannot always be obtained.

*3.4.2 **Non-invasive conservative treatment***

3.4.2.1 Assisted bladder emptying - Credé manoeuvre, Valsalva manoeuvre, triggered reflex voiding

Incomplete bladder emptying is a serious risk factor for UTI, high intravesical pressure and incontinence. Methods to improve the voiding process should therefore be practiced.

Bladder expression: The downwards movement of the lower abdomen by suprapubic compression (Credé) or by abdominal straining (Valsalva) leads to an increase in intravesical pressure, and generally also causes a reflex sphincter contraction [142, 143]. The latter may increase bladder outlet resistance and lead to inefficient emptying. The high pressures created during these procedures are hazardous for the urinary tract [144, 145]. Therefore, their use should be discouraged unless urodynamics show that the intravesical pressure remains within safe limits [134].

Long-term complications are unavoidable for both methods of bladder emptying [143]. The already weak pelvic floor function may be further impaired, thus introducing or exacerbating already existing SUI [145].

Triggered reflex voiding: Stimulation of the sacral or lumbar dermatomes in patients with a upper motor neuron lesion can elicit a reflex detrusor contraction [145]. The risk of high pressure voiding is present and interventions to decrease outlet resistance may be necessary [146]. Triggering can induce AD, especially in patients with high level SCI (at or above Th 6) [147]. All assisted bladder emptying techniques require low outlet resistance. Even then, high detrusor pressures may still be present. Hence, patients need dedicated education and close urodynamic and urological surveillance [145, 148, 149].

Note: In the literature, including some of the references cited here, the concept "reflex voiding" is sometimes used to cover all three assisted voiding techniques described in this section.

External appliances: Social continence may be achieved by collecting urine during incontinence, for instance using pads. Condom catheters with urine collection devices are a practical method for men [134]. The penile clamp is absolutely contraindicated in case of NDO or low bladder compliance due to the risk of developing high intravesical pressure and pressure sores/necrosis in cases of altered/absent sensations.

3.4.2.2 Neuro-urological rehabilitation

3.4.2.2.1 Bladder rehabilitation including electrical stimulation

The term bladder rehabilitation summarises treatment options that aim to re-establish bladder function in patients with neuro-urological symptoms. Strong contraction of the urethral sphincter and/or pelvic floor, as well as anal dilatation, manipulation of the genital region, and physical activity inhibit micturition in a reflex manner [134, 150]. The first mechanism is affected by activation of efferent nerve fibres, and the latter ones are produced by activation of afferent fibres [110]. Electrical stimulation of the pudendal nerve afferents, strongly inhibits the micturition reflex and detrusor contraction [151]. This stimulation might then support the restoration of the balance between excitatory and inhibitory inputs at the spinal or supraspinal level [134, 152]. Evidence for bladder rehabilitation using electrical stimulation in neurological patients is mainly based on small non-comparative studies with a high risk of bias.

Behavioural therapy and bladder training: In patients with PD, behavioural therapy and bladder training may be considered based on randomised controlled trials (RCTs) with very limited number of patients [153, 154].

Pelvic floor muscle training (PFMT): In patients with MS and stroke, PFMT may have positive effects on LUTS, daytime urinary frequency and urinary incontinence but the evidence is still limited [155, 156].

Peripheral temporary electrostimulation: Tibial nerve stimulation and transcutaneous electrical nerve stimulation (TENS) might be effective and safe for treating neurogenic LUT dysfunction, but more reliable evidence from well-designed RCTs is required to reach definitive conclusions [152, 157, 158]. In post-stroke patients TENS has been shown to effectively improve urodynamic and bladder diary findings as well as QoL [159-161]. In an RCT, transcutaneous tibial nerve home stimulation has proven to significantly improve bladder diary parameters in patients with MS as well as in women with PD [162, 163]. In acute SCI, TENS is able to achieve bladder neuromodulation via modulation of the autonomous nervous system functions [164]. Greater volumes until full sensation, less detrusor-sphincter dyssynergia and an increased bladder capacity can be found when compared to sham-treated patients [165].

A SR on dorsal genital nerve stimulation showed higher relative and absolute bladder capacities and inhibition of detrusor hyperactivity in SCI people, although these therapeutic effects may be dependent on the current, amplitude and longer periods of stimulation [166].

Interferential medium frequency current electrical stimulation for SCI patients with American spinal cord injury association impairment scale (AIS) levels B, C and D demonstrated a significant decrease in PVR and volume of urine leakage between catheterisation [167]. Neuromuscular electrical stimulation applied in the sacral area has also improved the performance in symptoms scores in highly selected patients with UI after stroke [160]; however, new RCTs with more patients and longer follow-up are required.

Peripheral temporary electrostimulation combined with pelvic floor muscle training and biofeedback: In MS patients, combining active neuromuscular electrical stimulation with Pelvic Floor Muscle Training (PFMT) and EMG biofeedback can achieve a substantial reduction of neuro-urological symptoms [168, 169]. This treatment combination seems to be more effective than either therapy alone [170, 171]. However, the combination of intravaginal electrostimulation and PFMT was not superior to PFMT alone in reducing UI in women with incomplete SCI [172].

Intravesical electrostimulation: Intravesical electrostimulation can increase bladder capacity and improve bladder filling sensation in patients with incomplete SCI or myelomeningocele (MMC) [173]. In patients with neurogenic detrusor underactivity, intravesical electrostimulation may also improve voiding and reduce residual volume [174, 175].

Repetitive transcranial magnetic stimulation: Although improvement of neuro-urological symptoms has been described in PD, SCI and MS patients, this technique is still under investigation [176]. The role of cortical as well as sacral magnetic stimulation in MS patients with underactive bladder needs to be better defined [177].

Summary: To date, bladder rehabilitation techniques are mainly based on electrical or magnetic stimulation; however, there is a lack of well-designed studies.

3.4.2.3 Drug treatment

A single, optimal, medical therapy for neuro-urological symptoms is not always available. Commonly, a combination of different therapies (e.g. intermittent catheterisation and antimuscarinic drugs) is advised to prevent urinary tract damage and improve long-term outcomes, particularly in patients with a suprasacral SCI or MS [145, 178-180]. Drug treatments are categorised depending on their mechanism of action and focus on storage or voiding symptoms.

3.4.2.3.1 Drugs for storage symptoms

Antimuscarinic drugs: are the first-line choice for treating NDO, increasing bladder capacity and reducing episodes of UI secondary to NDO by the inhibition of parasympathetic pathways [134, 181-187]. Antimuscarinic drugs have been used for many years to treat patients with NDO [185, 186, 188], and the responses of individual patients to antimuscarinic treatment are variable. Despite a meta-analysis confirming the clinical and urodynamic efficacy of antimuscarinic therapy compared to placebo in adult NDO, a more recent integrative review has indicated that the information provided is still too limited for clinicians to be able to match trial data to the needs of individual patients with SCI, mainly due to the lack of use of standardised clinical evaluation tools such as the American Spinal Injury Association bladder diary and validated symptoms score [186, 189].

Higher doses or a combination of antimuscarinic agents may be an option to maximise outcomes in neurological patients [182, 183, 190-193]. However, these drugs have a high incidence of adverse events, which may lead to early discontinuation of therapy. Despite this, NDO patients have generally shown better treatment adherence compared to idiopathic DO patients [194].

Choice of antimuscarinic agent: Oxybutynin [134, 182, 183, 185, 186, 195], trospium [186, 192, 196], tolterodine [197] and propiverine [186, 198] are established, effective and well-tolerated treatments even in long-term use [185, 186, 199, 200]. Darifenacin [201, 202] and solifenacin [203] have been evaluated in NDO secondary to SCI and MS [186, 201-203] with results similar to other antimuscarinic drugs. A pilot study using solifenacin in NDO due to PD showed an improvement in UI [204]. Fesoterodine, an active metabolite of tolterodine, has also been introduced; improving urodynamic variables in SCI, MS and PD patients [205, 206]. Fesoterodine for SCI patients can diminish the magnitude and frequency of AD episodes [207]. Favourable results with the new drug imidafenacin have been reported in suprapontine as well as SCI patients [208, 209].

Side effects: Controlled-release antimuscarinics have some minor side effects, e.g. dry mouth [210]. It has been suggested that different ways of administration may help to reduce side effects [211]. Imidafenacine has been safely used in neurological patients with no worsening of cognitive function [208]. Nevertheless, the potential risk of developing dementia should be taken into account [212]; consider switching to beta-3 agonists or other therapies if cognition is affected [213].

Beta-3-adrenergic receptor agonists
Despite the increasing use of mirabegron in neuro urological patients, its role in these patients is still unclear [214, 215]. In MS and SCI patients, with very short follow-up, mirabegron has not demonstrated any significant effect on detrusor pressure or cystometric capacity [69, 216, 217], despite the reported improvement in LUT symptoms and quality of life similar to antimuscarinics [215]. Cardiovascular safety in NDO population has been suggested in a placebo-controlled RCT [218]. A significant subjective improvement in NDO symptoms has also been reported using lower dosages of mirabegron in patients affected by CNS lesions without any negative effects on voiding function [219]. A standard dosage of 50 mg has been found effective with no worsening of cognitive function in patients with PD [220].

Vibegron treatments significantly improved maximum cystometric capacity, bladder compliance, and NDO in a retrospective cohort study [221], but more studies are needed to do a recommendation.

Other drugs
A SR found that desmopressin may be effective for treating nocturnal polyuria in MS patients; however, adverse events were common, with the included studies being heterogeneous and of low quality [222].

Combination therapy with mirabegron and desmopressin in MS patients has shown promising results; however, clinical experience is still very limited in neuro-urological populations [223, 224].

In preliminary studies, improvements in daily incontinence rates, nocturia, daytime and 24-hour voids, as well as the low risk of adverse events, suggest that cannabinoids may be effective and safe in MS patients [225, 226]. A concomitant improvement in NDO symptoms has been reported in male MS patients using daily tadalafil to treat neurogenic erectile dysfunction (ED) [227].

3.4.2.3.2 Drugs for voiding symptoms
Detrusor underactivity: Cholinergic drugs, such as bethanechol and distigmine, have been considered to enhance detrusor contractility and promote bladder emptying, but are not frequently used in clinical practice [228]. Only preclinical studies have documented the potential benefits of cannabinoid agonists for improving detrusor contractility when administered intravesically [229, 230].

Decreasing bladder outlet resistance: α-blockers (e.g. tamsulosin, naftopidil and silodosin) seem to be effective for decreasing bladder outlet resistance, PVR and AD [231-235].

Increasing bladder outlet resistance: Several drugs have shown efficacy in selected cases of mild SUI, but there are no high-level evidence studies in neurological patients [134].

3.4.2.4 Summary of evidence and recommendations for drug treatments

Summary of evidence	**LE**
Long-term efficacy and safety of antimuscarinic therapy for NDO is well documented.	1a
Mirabegron has shown similar symptom related clinical effects compared to antimuscarinics.	1b
Mirabegron does not improve urodynamic parameters in NDO patients.	1a
Maximise outcomes for NDO by considering combination therapy	3

Recommendations	Strength rating
Use antimuscarinic therapy as the first-line medical treatment for neurogenic detrusor overactivity.	Strong
Do not use mirabegron with the intention of reducing urodynamically proven neurogenic detrusor overactivity.	Strong
Prescribe α-blockers to decrease bladder outlet resistance.	Strong
Do not prescribe parasympathomimetics for underactive detrusor.	Strong

3.4.2.5 Minimally invasive treatment

3.4.2.5.1 Catheterisation

Intermittent self- or third-party catheterisation [236, 237] is the preferred management for neuro-urological patients who cannot effectively empty their bladders [134]. An adequate hand function is an independent risk factor for cessation of intermittent catheterisation (IC) [238].

It has not yet been established whether or not the incidence of UTI, other complications and user satisfaction are affected by either sterile, aseptic or clean IC, coated or uncoated catheters or by any other catheter type [239].

Sterile IC cannot be considered a routine procedure [134, 240] and careful counselling should be employed before commencing IC. In those with MS, commencing IC increases UTI rate over one year by seven fold, without improvement in QoL or symptom score [241]. In addition, in those with SCI, dissatisfaction (and discontinuation) is associated with increased UTI frequency, as well as being of the female sex [242]. It is worth considering patient satisfaction and subsequent compliance when instigating and continuing IC. Shared decision making is imperative, as although IC has better medical outcomes than indwelling catheterisation, in the SCI population it is associated with worse reported QoL compared to indwelling catheters, especially if recurrent (> 4 per year) UTIs complicate management [61, 243]. The use of hydrophilic catheters is associated with a lower rate of UTI [244]. An observational study found that of the 56.9% of patients who used IC 42.1% of patients discontinued IC within 12 months with inconvenience (36%), leakage (20%) and increased infections (19%) listed as the main reasons for the discontinuation [243].

To minimise the risk of UTI in neuro-urological patients, it is important that patient should be adequately taught to self-catheterise [134, 245-249]. The average frequency of catheterisations per day is four to six times [250] and the catheter size most often used is between 12-16 Fr. In aseptic IC, an optimum frequency of five times showed a reduction of UTI [250]. Ideally, bladder volume at catheterisation should, as a rule, not exceed 400-500 mL.

Indwelling transurethral catheterisation and, to a lesser extent, suprapubic cystostomy are associated with a range of complications as well as an enhanced risk for UTI [134, 251-258]; therefore, both procedures should be avoided, when possible. Silicone catheters are preferred as they are less susceptible to encrustation and because of the high incidence of latex allergy in the neuro-urological patient population [259].

Bladder cancer might be an increased risk in the general population with an indwelling catheter including neuro-urological patients, and clinicians should promptly investigate patients with the standard red flags for bladder cancer [258, 260].

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 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

3.4.2.5.3 Intravesical drug treatment

To reduce NDO, antimuscarinics can also be administered intravesically [261]. The efficacy and tolerability of intravesical administration of oxybutynin hydrochloride for treatment of NDO has been demonstrated in a recent randomised controlled study [211]. This approach may reduce adverse effects due to the fact that the antimuscarinic drug is metabolised differently [262] and a greater amount is sequestered in the bladder, even more than with electromotive administration [263].

The vanilloids, capsaicin and resiniferatoxin, desensitise the C-fibres for a period of a few months [264, 265]. Clinical studies have shown that resiniferatoxin has limited clinical efficacy compared to botulinum toxin A injections in the detrusor [264].

Although preliminary data suggest that intravesical vanilloids might be effective for treating neurological LUT dysfunction, their safety profile appears to be unfavourable [222]. Currently, there is no indication for the use of these substances, which are not licensed for intravesical treatment.

3.4.2.5.4 Summary of evidence and recommendations for intravesical drug treatment

Summary of evidence	**LE**
A significant reduction in adverse events was observed for intravesical administration of oxybutynin compared to oral administration.	1a

Recommendation	**Strength rating**
Offer intravesical oxybutynin to neurogenic detrusor overactivity patients with poor tolerance to the oral route.	Strong

3.4.2.5.5 Botulinum toxin injections in the bladder

Botulinum toxin A causes a long-lasting but reversible chemical denervation that lasts for about nine months [266, 267]. The toxin injections are mapped over the detrusor in a dosage that depends on the preparation used. Botulinum toxin A has been proven effective in patients with neuro-urological disorders due to MS, SCI and PD in multiple RCTs and meta-analyses [268-271]. In mid- to long-term follow-up, 50%-70% of the patients continue botulinum toxin treatment [272-274]. Urodynamic studies might be necessary after treatment in order to monitor the effect of the injections on bladder pressure [275]. Repeated injections seem to be possible without loss of efficacy, even after initial low response rates, based on years of follow-up [266, 276-279]. The clinical efficacy of botulinum toxin A injection in patients with low morbidity after failure of augmentation enterocystoplasty has been demonstrated [280, 281]. The effectiveness of the different toxin variations seems to be comparable [282, 283]. A switch between different toxin variations may improve responsiveness [284]. The most frequent side effects are UTIs, urinary retention and haematuria [285]. Intermittent catheterisation may become necessary, this is especially relevant in MS patients as they do not often perform IC prior to intravesical botulinum toxin injections. However, a lower dose of botulinum toxin A (100 U) may reduce the rate of IC in MS patients [286]. Rare complications include generalised muscle weakness and AD [285]. Including the trigone has been suggested to be more effective than trigone-sparing injection [287]. Current research focuses on different delivery approaches to injection such as liposome encapsulated botulinum toxin to decrease side effects [288]. Neuro-urological patients with an indwelling catheter and concomitant bladder pain and/or catheter bypass leakage could benefit from intravesical botulinum injections [289].

3.4.2.5.6 Bladder neck and urethral procedures

Reduction of the bladder outlet resistance: This may be necessary to protect the UUT. This can be achieved by chemical denervation of the sphincter or by surgical interventions (bladder neck or sphincter incision or urethral stent – Section 3.4.3.1). However, high rates of long-term complications are still noted after the procedures. Patients should be fully aware about the high risk of urinary incontinence which can be the main reason of dissatisfaction although its management with external devices [290] (Section 3.4.2.1).

- *Botulinum toxin A:* This can be used to treat DSD effectively by injecting the sphincter at a dose that depends on the preparation used. An improvement of patient reported outcomes has been described in DSD patients with cervical, incomplete SCI, detrusor overactivity and partial hand function [291]. Detrusor sphincter dyssynergia is abolished only for a few months, necessitating repeat injections. The benefit of this treatment has been reported to be limited with mild AEs [292]. However, a recent SR concluded that, because of limited evidence, future RCTs assessing the effectiveness of botulinum toxin A injections also need to address the uncertainty about the optimal dose and mode of injection [293]. In addition, this therapy is not licensed.

- *Increasing bladder outlet resistance:* This can improve the continence condition. However, despite early positive results with urethral bulking agents, a relative early loss of continence is reported in patients with neuro-urological disorders [134, 294, 295].

- *Urethral inserts:* Urethral plugs or valves for the management of (female) stress incontinence have not been applied in neuro-urological patients. The experience with active pumping urethral prosthesis for treatment of the underactive or acontractile detrusor were disappointing [296].

3.4.2.5.7 Summary of evidence and recommendations for botulinum toxin A injections

Summary of evidence	**LE**
Botulinum toxin A has been proven effective in patients with neuro-urological disorders due to MS or SCI in multiple RCTs and meta-analyses.	1a

Recommendations	**Strength rating**
Use botulinum toxin injection in the detrusor to reduce neurogenic detrusor overactivity in multiple sclerosis or spinal cord injury patients if antimuscarinic therapy is ineffective.	Strong

*3.4.3 **Surgical treatment***

There is considerable heterogeneity in outcome parameters and definitions of cure used to report on outcomes of surgical interventions for SUI in neuro-urological patients [297]. The heterogeneity of outcome reporting makes it difficult to interpret and compare different studies and therapies. A consistent comparison of the outcomes of therapy can only be made after standardisation of outcome parameters and definitions of cure or success; therefore, it would seem prudent to develop a core outcome set (COS) for use in UI research in neuro-urological patients [297]. Until such a COS is developed it would seem feasible to use both a subjective and objective outcome parameter and the combination of both to define cure [297]. Due to the importance of QoL for neuro-urological patients a disease-specific QoL questionnaire or a validated bother questionnaire validated for neuro-urological patients should be used as the subjective outcome parameter [297].

3.4.3.1 Bladder neck and urethral procedures to improve neurogenic stress urinary incontinence

Procedures to treat neurogenic stress urinary incontinence (N-SUI) are suitable only when the risk for upper urinary tract deterioration and detrusor pressures can be controlled. A simultaneous therapy of bladder management may be necessary [298].

- *Urethral sling:* Various materials have been used for this procedure with enduring positive results. The procedure is established in women with the ability to self-catheterise [298-303]. There is growing evidence that female synthetic mid-urethral slings (MUS) can be used effectively with acceptable medium to long-term results and minimal morbidity in neuro-urological patients [300, 301]. Autologous pubovaginal sling has been considered the procedure of choice for treating female N-SUI and it should be preferred when concomitant bladder augmentation is also indicated [300]. Compared to transobturator, the retropubic route has been suggested to be more effective in women with N-SUI [301]. However, either for both synthetic MUS as well as autologous sling additional bladder management may become necessary due to the risk of "*de novo*" LUTS [300-302]. Complications include the need to perform IC especially after retropubic approach, mesh erosion or extrusion requiring partial or total removal, and retropubic haematoma and the 5-year failure rate is relevant [300, 301]. In men, both autologous and synthetic slings have been investigated less frequently compared to women and mainly in patients already on IC regimen before surgery [300]. The cure rate ranged from 29% to 71% at a follow-up of 12 to 36 months. Complications included haematoma, tape infection or erosion into urethra and difficulty to perform IC [300].

- *Artificial urinary sphincter (AUS):* This device was introduced by Light and Scott for male patients with N-SUI [304]. It has stood the test of time and acceptable long-term outcomes can be obtained [305]. Implantation of AUS is the most often performed procedure for N-SUI especially in men with a high success/improvement rate [300]. However, the complication and re-operation rates are higher than in non-neurogenic SUI (up to 60%), so it is advisable that patients are conscientiously informed about the success rates as well as the possible need for re-intervention [306, 307]. In a case series with 25 years follow-up only 7.1% of patients were revision free at twenty years [308]. Re-interventions are commonly due to mechanical failure, urethral atrophy or erosion and infection. There is growing interest in the use of this device with development of laparoscopic and robot-assisted approaches via an anterior or a posterior access to the bladder neck [309, 310]. Nonetheless, careful patient selection and appropriate preoperative investigation are crucial [310]. Although from a single institution series, long-term surgical results are now available and support the potentially prominent role of AUS placement in female patients with N-SUI [300, 311-313]. Long-term surgical and patient-reported outcomes are needed to determine the role of AUS placement in female patients with N-SUI [311].

- *Adjustable continence device – (inflatable balloons):* The efficacy of this device has been reported mainly in post-prostatectomy incontinence (non-neurogenic male lower urinary tract symptoms EAU guidelines – Section 5.6.5.3.2). A similar cure and improvement rate has been reported in neurological patients when compared to non-neurological patients [314, 315]. However, it is associated with a low safety profile due to the high complication and limited device survival rate [316].

- *Bladder neck and urethra reconstruction:* The classical Young-Dees-Leadbetter procedure [317] for bladder neck reconstruction in children with bladder exstrophy, and Kropp urethra lengthening [318] improved by Salle [319], are established methods to restore continence provided that IC is practiced and/or bladder augmentation is performed [134, 320].

Endoscopic techniques for treating anatomic bladder outlet obstruction [321]:

- *Transurethral resection of the prostate* is indicated in male patients with refractory LUT symptoms due to benign prostatic obstruction. Special consideration should be given to pre-operative abnormal sphincter function and the type of neurological disease, which can lead to persistent or "*de novo*" LUTS [322, 323].

- *Urethrotomy* is indicated in patients with urethral strictures. Cold knife or neodymium:YAG contact laser urethrotomy at the twelve o'clock position can be performed [324, 325].

- *Urethroplasty* should be performed on an individual basis depending on the urethral lesion (erosion, stricture, diverticula, fistula), length and location. However urethral surgery in neurological patients has a high failure rate and in recurrent strictures, urinary diversion should be considered [326].

- *Sphincterotomy* has been shown to be an efficient technique for the resolution of AD, hydronephrosis and recurrent UTI, and for decreasing detrusor pressure, PVR and vesicoureteral reflux. It is irreversible and should be limited to men who are able to wear a condom catheter. By staged incision, bladder outlet resistance can be reduced without completely losing the closure function of the urethra [133, 134, 327]. The incision with less complications, is the twelve o'clock sphincterotomy with cold knife [328] or neodymium:YAG laser [329]. Sphincterotomy needs to be repeated at regular intervals in many patients [330], but it is efficient and does not cause severe adverse effects [133, 331]. Secondary narrowing of the bladder neck may occur, for which combined bladder neck incision might be considered [332].

- *Bladder neck incision:* This may be indicated for anatomical or functional bladder neck obstruction [290, 293, 321, 323].

- *Stents:* Implantation of urethral stents results in continence being dependent on adequate closure of the bladder neck [134]. The results are comparable with sphincterotomy and the stenting procedure has a shorter duration of surgery and hospital stay [333, 334]. However, the costs [133], possible complications and re-interventions [335, 336] are limiting factors in their use [337-340].

3.4.3.2 Denervation, deafferentation, sacral neuromodulation

Sacral anterior root stimulation (SARS) is aimed at producing detrusor contraction. The technique was developed by Brindley [341] and is only applicable to complete lesions above the implant location, as its stimulation amplitude is over the pain threshold. The urethral sphincter efferents are also stimulated, but because the striated muscle relaxes faster than the smooth muscle of the detrusor, so-called "post-stimulus voiding" occurs. This approach has been successful in highly selected patients [342-345]. Although it has been shown that detrusor pressure during SARS decreases over time, the changes do not seem to be clinically relevant during the first decade after surgery [346]. By changing the stimulation parameters, this method can also induce defecation or erection. A recent study reported that Charcot spinal arthropathy should be considered as a potential long-term complication of SARS, leading to spinal instability and to SARS dysfunction [347].

Sacral rhizotomy, also known as sacral deafferentation, has achieved some success in reducing NDO [348-350], but nowadays, it is used mostly as an adjuvant to SARS [342, 351-354]. Alternatives to rhizotomy are sought in this treatment combination [355-357].

There is growing evidence, including one RCT [358], on the use of sacral neuromodulation for treating neuro-urological symptoms, but due to the paucity of disease specific studies it remains unclear which neurological patients are most suitable [359-361]. MS patients with NDO have been often reported as good responders to several types of neuromodulations [361-363]. The neuromodulation effect on urodynamic parameters is still unclear [364]. With the development of MRI-compatible pulse generators and leads, the avoidance of this procedure in patients needing this imaging technique for their follow-up is no longer required.

Other neuromodulation techniques like the deep brain stimulation in PD patients may have beneficial effects in the LUT but these depend on the site of stimulation and although prospective, specifically designed studies are needed in neuro-urological patients [365, 366].

3.4.3.3 Bladder covering by striated muscle

When the bladder is covered by striated muscle, that can be stimulated electrically, or ideally that can be contracted voluntarily, voiding function can be restored to an acontractile bladder. The rectus abdominis [367] and latissimus dorsi [368] have been used successfully in neuro-urological patients [369, 370].

3.4.3.4 Bladder augmentation

The aim of auto-augmentation (detrusor myectomy) is to reduce NDO or improve bladder compliance. The advantages are low surgical burden, low rate of long-term adverse effects, positive effect on patient QoL, and it does not preclude further interventions [133, 298, 371-374].

Replacing or expanding the bladder by intestine ensures a low-pressure reservoir improving bladder compliance and abolishing or at least reducing NDO [375, 376]. Improved QoL and stable renal function has been reported during long-term follow-up in SCI and SB patients [377-379]. It is not clear whether augmented cystoplasty should be combined with simultaneous ureter reimplantation when high grade VUR is present [379, 380]. Patients performing IC with augmented cystoplasty had better urinary function and satisfaction with their urinary symptoms compared to patients performing IC with or without botulinum toxin treatment [381]. Long-term complications includes bladder perforation (1.9%), mucus production (12.5%), metabolic abnormalities (3.35%), bowel dysfunction (15%), and stone formation (10%) [377].

The procedure should be used with caution in neuro-urological patients but may become necessary if all less-invasive treatment methods have failed. Special attention should be paid to patients with pre-operative renal scars since metabolic acidosis can develop [382]. Supratrigonal cystectomy [376, 383], is indicated in patients with a severely thick and fibrotic bladder wall. Intermittent catheterisation may become necessary after this procedure. The long-term scientific evidence shows that bladder augmentation is a highly successful procedure that stabilises renal function and prevents anatomical deterioration; however, lifelong follow-up is essential in this patient group given the significant morbidity associated with this procedure [377, 384, 385].

3.4.3.5 Urinary diversion

When no other therapy is successful, urinary diversion must be considered for the protection of the UUT [298].

Continent diversion: This should be the first choice for urinary diversion. Patients with limited dexterity or anatomical barriers (e.g., urethral strictures, women with poor mobility and/or obesity) may prefer a stoma instead of using the urethra for catheterisation. For cosmetic reasons, the umbilicus is often used for the stoma site [386-392]. A SR 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 [393]. The positive impact on QoL comprised sexual life improvement, better body image, high satisfaction rates in urologic management, independence, time saved on catheterisation, and better capacity to perform daily activity and work [394]. However, the complication rates were significant with 85/213 post-

operative events requiring re-operation [393]. 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 (up to 40% in one case series) [393].

Incontinent diversion: If catheterisation is impossible, incontinent diversion with a urine-collecting device is indicated. Ultimately, it could be considered in selected patients with intractable and untreatable incontinence, in patients with LUT destruction, when the UUT is severely compromised, and in patients who refuse other therapy [134]. An ileal segment is used for the diversion in most cases [134, 395-398]. Patients gain better functional status and QoL after surgery [399]. Moreover, to achieve a high satisfaction rate, it is necessary to involve relatives and caregivers with stoma management. Concomitant cystectomy to avoid pyocystitis may be advisable [400]. All procedures can be done open, laparoscopically as well as robotically [401-403]. However, prospective comparative studies are lacking [402, 404].

Undiversion: Long-standing diversions may be successfully undiverted or an incontinent diversion changed to a continent one with the emergence of new and better techniques for control of detrusor pressure and incontinence [134]. The patient must be carefully counselled and must comply meticulously with the instructions [134]. Successful undiversion can then be performed [405].

In a prospective observational study (n=1,479), QoL was investigated in neuro-urological patients using four different bladder management options. It is the first study to focus on PROMS and noted that surgery was associated with fewer bladder management difficulties and a better QoL [61].

3.4.3.6 Summary of evidence and recommendations for surgical treatment

Summary of evidence	**LE**
Bladder augmentation is an effective option to decrease detrusor pressure and increase bladder capacity, when all less-invasive treatment methods have failed.	3
Urethral sling placement is an established procedure, with acceptable mid- to long-term results, in women with the ability to self-catheterise.	3
Artificial urinary sphincter insertion is the most frequently offered option to treat neurogenic SUI with acceptable long-term outcomes, in males. The complication and re-operation rates are higher in neuro-urological patients; therefore, patients must be adequately informed regarding the success rates as well as the complications that may occur following the procedure.	3
Sacral neuromodulation is an effective and safe option in the treatment of selective neurogenic LUT dysfunction.	1b

Recommendations	**Strength rating**
Offer bladder augmentation in low bladder compliance and/or refractory neurogenic detrusor overactivity.	Strong
Place an autologous urethral sling as first-line treatment in female patients with neurogenic stress urinary incontinence (SUI) who are able to self-catheterise.	Strong
Place a synthetic urethral sling, as an alternative to autologous urethral slings, in selected female patients with neurogenic SUI who are able to self-catheterise.	Weak
Insert an artificial urinary sphincter in selected female patients with neurogenic SUI; however, patients should be referred to experienced centres for the procedure.	Weak
Insert an artificial urinary sphincter in male patients with neurogenic SUI.	Strong
Consider sacral neuromodulation in selected neuro-urological patients.	Strong

3.5 Urinary tract infection in neuro-urological patients

3.5.1 Epidemiology, aetiology and pathophysiology

Urinary tract infection is the onset of signs and/or symptoms accompanied by laboratory findings of a UTI (bacteriuria, leukocyturia and positive urine culture) [387]. There are no evidence-based cut-off values for the quantification of these findings [406]. The published consensus is that a significant bacteriuria in persons performing IC is present with > 102 cfu/mL, > 104 cfu/mL in clean-void specimens and any detectable concentration in suprapubic aspirates. Regarding leukocyturia, ten or more leukocytes in centrifuged urine samples per microscopic field (400x) are regarded as significant [387].

The pathogenesis of UTI in neuro-urological patients is multifactorial. Male gender seems to be a risk factor for febrile and recurrent UTIs [407, 408]. Several etiological factors have been described: altered intrinsic defence mechanisms, impaired washout and catheterisation [409-412]. Poor glycemic control has also been established as a risk factor for UTI in women with type 1 diabetes [413]. However, the exact working mechanisms remain unknown. The presence of asymptomatic bacteriuria in SCI patients is higher than in the general population and varies depending on bladder management. Prevalence of bacteriuria in those performing clean IC varies from 23%-89% [414]. Sphincterotomy and condom catheter drainage has a 57% prevalence [415]. Asymptomatic bacteria should not be routinely screened for in this population [416] but a nomogram can be a helpful tool for early prediction of UTIs [417].

Individuals with neuro-urological symptoms, especially those with SCI, may have other signs and symptoms in addition to or instead of traditional signs and symptoms of a UTI in able-bodied individuals [418]. Other problems, such as AD, may develop or worsen due to a UTI [244]. The most common signs and symptoms suspicious of a UTI in those with neuro-urological disorders are fever, new onset or increase in incontinence, including leaking around an indwelling catheter, increased spasticity, malaise, lethargy or sense of unease, cloudy urine with increased urine odour, discomfort or pain over the kidney or bladder, dysuria, or AD [244, 419]. New incontinence is the most specific symptom, whereas cloudy and foul-smelling urine has the highest positive predictive value for UTI diagnosis [420].

*3.5.2 **Diagnostic evaluation***

Urine culture and urinalysis are the optimum tests for the diagnosis of UTI in neuro-urological patients. A dipstick test is more useful to exclude rather than to prove UTI [421, 422] and is not recommended. As bacterial strains and resistance patterns in persons with neuro-urological disorders may differ from those of able-bodied patients, microbiologic testing is mandatory [423].ro-urological disorders may differ from those of able-bodied patients, microbiologic testing is mandatory [400].

*3.5.3 **Disease management***

Bacteriuria in patients with neuro-urological disorders should not be treated. Treatment of asymptomatic bacteriuria results in significantly more resistant bacterial strains without improving the outcome [424]. Urinary tract infections in persons with neuro-urological disorders are by definition a complicated UTI; therefore, single-dose treatment is not advised. There is no consensus in the literature about the duration of treatment as it depends on the severity of the UTI and the involvement of the kidneys and the prostate. Generally, a five to seven day course of antibiotic treatment is advised, which can be extended up to fourteen days according to the extent of the infection [424]. The choice of antibiotic therapy should be based on the results of the microbiologic testing. If immediate treatment is mandatory (e.g., fever, septicaemia, intolerable clinical symptoms, extensive AD), the choice of treatment should be based on local and individual resistance profiles, as well as on results from previous urine cultures [425]. In patients with afebrile UTI, an initial non-antibiotic treatment may be justified [426, 427].

3.5.3.1 Recurrent UTI

Recurrent UTI in patients with neuro-urological disorders may indicate suboptimal management of the underlying functional problem, e.g., high bladder pressure during storage and voiding, incomplete voiding or bladder stones. The improvement of bladder function, by treating NDO by botulinum toxin A injection in the detrusor [428], and the removal of bladder stones or other direct supporting factors, especially indwelling catheters, as early as possible, are mandatory [423].

3.5.3.2 Prevention

If the improvement of bladder function and removal of foreign bodies/stones is not successful, additional UTI prevention strategies should be utilised. In a meta-analysis the use of hydrophilic catheters was associated with a lower rate of UTI [244].

Various medical approaches have been tested for UTI prophylaxis in patients with neuro-urological disorders. The benefit of cranberry juice or probiotics for the prevention of UTI could not be demonstrated in RCTs [429, 430]. Methenamine hippurate is not effective in individuals with neuro-urological symptoms [431]. There is no sufficient evidence to support the use of L-methionine for urine acidification to prevent recurrent UTIs [432]. There is only weak evidence that oral immunotherapy reduces bacteriuria in patients with SCI [433] and that recurrent UTIs are reduced [434]. Low-dose, long-term, antibiotic prophylaxis can reduce UTI frequency, but increases bacterial resistance and is therefore not recommended [435].

Weekly cycling of antibiotic prophylaxis provided long-term positive results, but the results of this trial need to be confirmed in further studies [436]. Another possible future option, the inoculation of apathogenic Escherichia coli strains into the bladder, has provided positive results in initial studies, but because of the paucity of data [437], cannot be recommended as a treatment option. There is initial evidence that homeopathic treatment can decrease UTI frequency [438].

The use of daily intravesical iodine washouts shows promising results for reduction of symptomatic UTIs and hospitalisation without increase in multi drug resistance in patients with NLUTD who perform IC [439] Other intravesical agents have also been trialed for the reduction of UTIs, both antimicrobial and non. Intravesical gentamicin has been shown to reduce UTIs and oral antibiotic use, without increasing antimicrobial resistance [435, 440]. Intravesical hyaluronic acid was also reported in this metanalysis to reduce mean number of UTIs [441].

In summary, based on the criteria of evidence-based medicine, there is currently no preventive measure for recurrent UTI in patients with neuro-urological disorders that can be recommended without limitations. Therefore, individualised concepts should be taken into consideration, including immunostimulation, phytotherapy and complementary medicine [442]. Prevention of UTIs in patients with neuro-urological disorders is important to pursue, but since there are no data favouring one approach over another, prophylaxis is essentially a trial-and-error approach.

*3.5.4 **Summary of evidence and recommendations for the treatment of UTI***

Summary of evidence	**LE**
Treatment of asymptomatic bacteriuria results in significantly more resistant bacterial strains without improving patient outcome.	1a
Low-dose, long-term, antibiotic prophylaxis can reduce UTI frequency, but increases bacterial resistance.	2a
Recurrent UTIs in patients with neuro-urological disorders may indicate suboptimal management of the underlying functional problem. Improvement of bladder function as early as possible is mandatory.	3
There is currently no preventive measure for recurrent UTI in patients with neuro-urological disorders that can be recommended without limitations.	3

Recommendations	**Strength rating**
Do not use dipstick urine analysis to screen for urinary tract infection (UTI) in neuro-urological patients.	Strong
Do not screen for or treat asymptomatic bacteriuria in patients with neuro-urological disorders.	Strong
Avoid the use of long-term antibiotics for recurrent UTIs.	Strong
In patients with recurrent UTIs, optimise treatment of neuro-urological symptoms and remove foreign bodies (e.g., stones, indwelling catheters) from the urinary tract.	Strong
Individualise UTI prophylaxis in patients with neuro-urological disorders as there is no optimal prophylactic measure available.	Strong

3.6 Sexual function and fertility

This section specifically focuses on sexual dysfunction and infertility in patients with a neurological disease [443, 444]. Non-neurogenic, male sexual dysfunction and infertility are covered in separate EAU Guidelines [445, 446]. In neuro-urological patients sexual problems can be identified at three levels: primary (direct neurological damage), secondary (general physical disabilities) and tertiary (psychosocial and emotional issues) sexual dysfunction [447]. Adopting a systematic approach, such as the PLISSIT model (Permission, Limited Information, Specific Suggestions and Intensive Therapy) [448], provides a framework for counselling and treatment involving a stepwise approach to the management of neurogenic sexual dysfunction. Sexual dysfunction is associated with neurogenic LUT dysfunction in patients with MS [449] and SB [450]. Although various PROMs are available to evaluate sexual function, the evidence for good PROMs is limited and studies with high methodological quality are needed [77].

3.6.1 ***Erectile dysfunction***

3.6.1.1 Phosphodiesterase type 5 inhibitors (PDE5Is)

Phosphodiesterase type 5 inhibitors (PDE5Is) are recommended as first-line treatment in neurogenic ED [443, 444]. In SCI patients, tadalafil, vardenafil and sildenafil have all improved retrograde ejaculation and improved erectile function and satisfaction on IIEF-15. Tadalafil 10 mg was shown to be more effective than sildenafil 50 mg. All currently available PDE5Is appear to be effective and safe, although there are no high-level evidence studies in neuro-urological patients investigating the efficacy and side effects across different PDE5Is, dosages and formulations [451].

For MS patients two studies reported significant improvement in ED when using sildenafil and tadalafil [444, 452] however, another study showed no improvement in ED with sildenafil [453]. One study found a significant improvement in ED in SB patients when using sildenafil [454].

In PD normal erectile function was described in over half of the patients using sildenafil 100 mg and a significant improvement in IIEF-15 score was found compared to placebo. While most neuro-urological patients require long-term therapy for ED some have a low compliance rate or stop therapy because of side effects [455, 456], most commonly headache and flushing [444]. In addition, PDE5Is may induce relevant hypotension in patients with tetraplegia/high-level paraplegia and multiple system atrophy [455, 456]. As a prerequisite for successful PDE5I-therapy, some residual nerve function is required to induce erection. Since many patients with SCI use on-demand nitrates for the treatment of AD, they must be counselled that PDE5Is are contraindicated when using nitrate medication.

3.6.1.2 Drug therapy other than PDE5Is

Fampridine to treat neurogenic spasticity has been shown to be beneficial in improving ED in two domains of the IIEF-15 in SCI and MS patients, however, with a significant discontinuation rate due to severe adverse events [457]. Sublingual apomorfine was shown to have poor results on ED in SCI patients and side-effects in half of the patients [458]. In PD, pergolide mesylate showed a significant improvement in IIEF-15 scores up to twelve months follow-up [459].

3.6.1.3 Mechanical devices

Mechanical devices (vacuum tumescence devices and penile rings) may be effective but are less popular [460-464].

3.6.1.4 Intracavernous injections and intraurethral application

Patients not responding to oral drugs may be offered intracavernous injections (alprostadil, papaverine and phentolamine) that have been shown to be effective in a number of neurological conditions, including SCI, MS, and diabetes mellitus [465-471], but their use requires careful dose titration and some precautions. Complications of intracavernous drugs include pain, priapism and corpora cavernosa fibrosis.

Intracavernous vasoactive drug injection is the first-line therapeutic option in patients taking nitrate medications, as well as those with concerns about drug interactions with PDE5Is, or in whom PDE5Is are ineffective. The impact of intracavernous injections on ejaculation and orgasmic function, their early use for increasing the recovery rate of a spontaneous erection, and their effectiveness and tolerability in the long-term are unclear [455]. Intra-urethral alprostadil application is an alternative, but less effective, route of administration [467, 472].

3.6.1.5 Sacral neuromodulation

Sacral neuromodulation for LUT dysfunction may improve sexual function; however, high level evidence studies are lacking.

3.6.1.6 Penile prostheses

Penile prostheses may be considered for treatment of neurogenic ED when all conservative treatments have failed. At a mean follow-up of seven years, 83.7% of patients with SCI were able to have sexual intercourse [444]. Serious complications, including infection and prosthesis perforation, may occur in about 10% of patients, depending on implant type [473-475].

3.6.1.7 Summary of evidence and recommendations for erectile dysfunction

Summary of evidence	LE
The long-term efficacy and safety of oral PDE5Is for the treatment of ED is well documented.	1b
Intracavernous vasoactive drug injections have been shown to be effective in a number of neurological conditions, including SCI and MS; however, their use requires careful dose titration and precautions.	3
Mechanical devices (vacuum tumescence devices and penile rings) may be effective but are less popular.	3
Reserve penile prostheses for selected patients, those in which all conservative treatments have failed, with neurogenic ED.	4

Recommendations	Strength rating
Prescribe oral phosphodiesterase type 5 inhibitors as first-line medical treatment in neurogenic erectile dysfunction (ED).	Strong
Give intracavernous injections of vasoactive drugs (alone or in combination) as second-line medical treatment in neurogenic ED.	Strong
Offer mechanical devices such as vacuum devices and rings to patients with neurogenic ED.	Strong

*3.6.2 **Male fertility***

Male fertility can be compromised in the neurological patient by ED, ejaculation disorder, impaired sperm quality or various combinations of these three disorders. Among the major conditions contributing to neurogenic infertility are pelvic and retroperitoneal surgery, diabetes mellitus, SB, MS and SCI [476]. Erectile dysfunction is managed as described previously. Retrograde ejaculation may be reversed by sympathomimetic agents contracting the bladder neck, including imipramine, ephedrine, pseudoephedrine, and phenylpropanolamine [476]. The use of a balloon catheter to obstruct the bladder neck may be effective in obtaining antegrade ejaculation [477]. If antegrade ejaculation is not achieved, the harvest of semen from the urine may be considered [478].

Prostatic massage is safe and easy to use for obtaining semen in men with lesions above Th 10 [479]. In several patients, vibrostimulation or transrectal electroejaculation are needed for sperm retrieval [476, 480, 481]. Semen retrieval is more likely with vibrostimulation in men with lesions above Th 10 [482-484]. In men with SCI, especially at or above Th 6, AD might occur during sexual activity and ejaculation [485, 486]; patients at risk and fertility clinics must be informed and aware of this potentially life-threatening condition. In SCI patients the use of oral midodrine can improve sperm retrieval at vibrostimulation [487].

In men with MS, use of disease modifying drugs during the conception phase, has not been associated with altered pregnancy outcomes [488]. Surgical procedures, such as, microsurgical epididymal sperm aspiration or testicular sperm extraction, may be used if vibrostimulation and electroejaculation are not successful [489, 490]. Pregnancy rates in patients with SCI are lower than in the general population, but since the introduction of intracytoplasmic sperm injection, men with SCI now have a good chance of becoming biological fathers [491-493].

3.6.2.1 Sperm quality and motility

The following has been reported on sperm quality and motility:

- bladder management with clean IC may improve semen quality compared to indwelling catheterisation, reflex voiding or bladder expression [494];
- in SCI patients sperm quality decreases at the early post-traumatic phase demonstrating lower spermatozoid vitality (necrospermia), reduced motility (asthenospermia) and leucospermia [489];
- long-term valproate treatment for epilepsy negatively influences sperm count and motility [495];
- vibrostimulation produces samples with better sperm motility than electrostimulation [496, 497];
- electro-ejaculation with interrupted current produces better sperm motility than continuous current [498];
- freezing of sperm is unlikely to improve fertility rates in men with SCI [499].

3.6.2.2 Summary of evidence and recommendations for male fertility

Summary of evidence	LE
Vibrostimulation and transrectal electroejaculation have been shown to be effective for sperm retrieval in neuro-urological patients.	1b
Surgical procedures, such as, microsurgical epididymal sperm aspiration or testicular sperm extraction, may be used if vibrostimulation and electroejaculation are not successful.	3
In men with SCI at or above Th 6, AD might occur during sexual activity and ejaculation.	3

Recommendations	Strength rating
Perform vibrostimulation and transrectal electroejaculation for sperm retrieval in men with spinal cord injury.	Strong
Perform microsurgical epididymal sperm aspiration, testicular sperm extraction and intracytoplasmic sperm injection after failed vibrostimulation and/or transrectal electroejaculation in men with spinal cord injury.	Strong
Counsel men with spinal cord injury at or above Th 6 and fertility clinics about the potentially life-threatening condition of autonomic dysreflexia.	Strong

3.6.3 Female sexuality

The most relevant publications on neurogenic female sexual dysfunction are in women with SCI and MS, while there is only limited evidence for women with stroke and SB. After SCI, about 65-80% of women continue to be sexually active, but to a much lesser extent than before the injury, and about 25% report a decreased satisfaction with their sexual life [500-502]. Although sexual dysfunction is very common in women with MS, it is still often overlooked by medical professionals [503, 504]. A vast majority of female SB patients showed sexual dysfunction [505] and considered information about sexuality from their physicians insufficient [506]. Women with SCI reported dissatisfaction with the quality and quantity of sexuality-related rehabilitation services and were less likely to receive sexual information than men [507-509]. Similarly, majority of female stroke patients are not sexually satisfied [510].

The greatest physical barrier to sexual activity is UI. A correlation has been found between the urodynamic outcomes of low bladder capacity, compliance and high maximum detrusor pressure and sexual dysfunction in MS patients. Problems with positioning and spasticity affect mainly tetraplegic patients. Peer support may help to optimise the sexual adjustment of women with SCI in achieving a more positive self-image, self-esteem and feelings of being attractive to themselves and others [500, 511-513].

The use of specific drugs for sexual dysfunction is indicated to treat inadequate lubrication. Data on sildenafil for treating female sexual dysfunction are poor and controversial [444]. Although good evidence exists that psychological interventions are effective in the treatment of female hypoactive sexual desire disorder and female orgasmic disorder [514], there is a lack of high-level evidence studies in the neurological population.

Neurophysiological studies have shown that women with the ability to perceive Th 11-L2 pin-prick sensations may have psychogenic genital vasocongestion. Reflex lubrication and orgasm are more prevalent in women with SCI who have preserved the sacral reflex arc (S2-S5), even when it has not been shown in an individual woman that a specific level and degree of lesion is the cause of a particular sexual dysfunction. In SCI women with a complete lesion of the sacral reflex, arousal and orgasm may be evoked through stimulation of other erogenous zones above the level of lesions [507, 515, 516].

Sacral neuromodulation for LUT dysfunction may improve sexual function but high-evidence studies are lacking [444].

3.6.4 Female fertility

There are few studies on female fertility in neurological patients. More than a third (38%) of women with epilepsy had infertility and the relevant predictors were exposure to multiple (three or more) antiepileptic drugs, older age and lower education [517].

Although it seems that the reproductive capacity of women with SCI is only temporarily affected by SCI with cessation of menstruation for approximately six months after SCI [518], there are no high-level evidence studies. About 70% of sexually active women use some form of contraception after injury, but fewer women use the birth control pill compared to before their injury [519].

Women with SCI are more likely to suffer complications during pregnancy, labour and delivery compared to able-bodied women. Complications of labour and delivery include bladder problems, spasticity, pressure sores, anaemia, and AD [520-524]. Obstetric outcomes include higher rates of Caesarean sections and an increased incidence of low birth-weight babies [519, 522-524].

Epidural anaesthesia is chosen and effective for most patients with AD during labour and delivery [525, 526].

There is very little published data on women's experience of the menopause following SCI [527]. Women with MS who plan a pregnancy should evaluate their current drug treatment with their treating physician [528-530]. Clinical management should be individualised to optimise both the mother's reproductive outcomes and MS course [528, 529, 531].

3.6.4.1 Summary of evidence and recommendation for female sexuality and fertility

Summary of evidence	**LE**
Data on specific drugs for treating female sexual dysfunction are poor and controversial.	4
There are limited numbers of studies on female fertility in neurological patients, clinical management should be individualised to optimise both the mother's reproductive outcomes and medical condition.	4

Recommendations	**Strength rating**
Do not offer medical therapy for the treatment of neurogenic sexual dysfunction in women.	Strong
Take a multidisciplinary approach, tailored to individual patient's needs and preferences, in the management of fertility, pregnancy and delivery in women with neurological diseases.	Strong

3.7 Follow-up

*3.7.1 **Introduction***

Neuro-urological disorders are often unstable, and the symptoms may vary considerably, even within a relatively short period. Regular follow-up is therefore necessary to assess the UUT [132].

Depending on the type of the underlying neurological pathology and the current stability of the neuro-urological symptoms, the interval between initial investigations and control diagnostics may vary and, in many cases, should not exceed one to two years. high-risk neuro-urological this interval should be much shorter. The UUT should be checked by ultrasonography at regular intervals in high-risk patients; about once every six months [6, 532]. In these patients, physical examination and urine laboratory should take place every year [6, 532]. In MS patients higher scores on the Expanded Disability Status Scale (EDSS) are associated with risk factors for UUT deterioration [533]. A urodynamic investigation should be performed as a diagnostic baseline, and repeated during follow-up, more frequently in high-risk patients [6, 532]. The bladder diary can aid in detecting MS patients that require urodynamic investigations [534]. In addition, bladder wall thickness can be measured on ultrasonography as an additional risk assessment for upper tract damage [535], although a 'safe' cut-off threshold for this has not been agreed [536]. The utility of DMSA (dimercaptosuccinic acid) for follow-up of neuro-urological patients has not been fully evaluated [537]. Any significant clinical change warrants further, specialised, investigation [6, 532]. However, there is a lack of high level evidence studies on this topic and every recommendation must be viewed critically in each individual neuro-urological patient [132].

The increased prevalence of muscle invasive bladder cancer in neuro-urological patients also warrants long-term follow-up [260]. The exact frequency of cystoscopy with or without cytology remains unknown, but presence of risk factors similar to the general population should trigger further investigation [538].

Adolescent patients with neurological pathology are at risk of being lost to follow-up during the transition to adulthood. It is important that a standardised approach during this transition is adopted to improve follow-up and specific treatment during adult life [539].

3.7.2 Summary of evidence and recommendations for follow-up

Summary of evidence	LE
Neuro-urological disorders are often unstable, and the symptoms may vary considerably; therefore, regular follow-up is necessary.	4

Recommendations	Strength rating
Assess the upper urinary tract at regular intervals in high-risk patients.	Strong
Any significant clinical changes should instigate further, specialised, investigation.	Strong
Perform urodynamic investigation as a mandatory baseline diagnostic intervention in high-risk patients at regular intervals.	Strong

3.8 Conclusions

Neuro-urological disorders have a multifaceted pathology. They require an extensive and specific diagnosis before one can embark on an individualised therapy, which takes into account the medical and physical condition of the patient and the patient's expectations about their future. The urologist can select from a wealth of therapeutic options, each with its own pros and cons. Notwithstanding the success of any therapy embarked upon, close surveillance is necessary for the patient's entire life.

These Guidelines offer you expert advice on how to define the patient's neuro-urological symptoms as precisely as possible and how to select, together with the patient, the appropriate therapy. This last choice, as always, is governed by the golden rule: as effective as needed, as non-invasive as possible.

4. REFERENCES

1. Schafer, W., *et al.* Good urodynamic practices: uroflowmetry, filling cystometry, and pressure-flow studies. Neurourol Urodyn, 2002. 21: 261. https://pubmed.ncbi.nlm.nih.gov/11948720
2. Abrams, P., *et al.* Reviewing the ICS 2002 terminology report: the ongoing debate. Neurourol Urodyn, 2009. 28: 287. https://pubmed.ncbi.nlm.nih.gov/19350662
3. Abrams, P., *et al.* The standardisation of terminology of lower urinary tract function: report from the Standardisation Sub-committee of the International Continence Society. Neurourol Urodyn, 2002. 21: 167. https://pubmed.ncbi.nlm.nih.gov/11857671
4. Groen, J., *et al.* Summary of European Association of Urology (EAU) Guidelines on Neuro-Urology. Eur Urol, 2016. 69: 324. https://pubmed.ncbi.nlm.nih.gov/26304502
5. Nosseir, M., *et al.* Clinical usefulness of urodynamic assessment for maintenance of bladder function in patients with spinal cord injury. Neurourol Urodyn, 2007. 26: 228. https://pubmed.ncbi.nlm.nih.gov/16998859
6. Panicker, J.N., *et al.* Lower urinary tract dysfunction in the neurological patient: clinical assessment and management. Lancet Neurol, 2015. 14: 720. https://pubmed.ncbi.nlm.nih.gov/26067125
7. Phillips, B. Oxford Centre for Evidence-based Medicine Levels of Evidence. Updated by Jeremy Howick March 2009. 1998. https://www.cebm.net/2009/06/oxford-centre-evidence-based-medicine-levels-evidence-march-2009/
8. Guyatt, G.H., *et al.* Going from evidence to recommendations. BMJ, 2008. 336: 1049. https://pubmed.ncbi.nlm.nih.gov/18467413
9. Townsend, N., *et al.* Cardiovascular disease in Europe--epidemiological update 2015. Eur Heart J, 2015. 36: 2696. https://pubmed.ncbi.nlm.nih.gov/26306399

10. Tibaek, S., *et al.* Prevalence of lower urinary tract symptoms (LUTS) in stroke patients: a cross-sectional, clinical survey. Neurourol Urodyn, 2008. 27: 763.
https://pubmed.ncbi.nlm.nih.gov/18551565
11. Marinkovic, S.P., *et al.* Voiding and sexual dysfunction after cerebrovascular accidents. J Urol, 2001. 165: 359.
https://pubmed.ncbi.nlm.nih.gov/11176374
12. Rotar, M., *et al.* Stroke patients who regain urinary continence in the first week after acute first-ever stroke have better prognosis than patients with persistent lower urinary tract dysfunction. Neurourol Urodyn, 2011. 30: 1315.
https://pubmed.ncbi.nlm.nih.gov/21488096
13. Lobo, A., *et al.* Prevalence of dementia and major subtypes in Europe: A collaborative study of population-based cohorts. Neurologic Diseases in the Elderly Research Group. Neurology, 2000. 54: S4.
https://pubmed.ncbi.nlm.nih.gov/10854354
14. Na, H.R., *et al.* Urinary incontinence in Alzheimer's disease is associated with Clinical Dementia Rating-Sum of Boxes and Barthel Activities of Daily Living. Asia Pac Psychiatry, 2015. 7: 113.
https://pubmed.ncbi.nlm.nih.gov/23857871
15. Grant, R.L., *et al.* First diagnosis and management of incontinence in older people with and without dementia in primary care: a cohort study using The Health Improvement Network primary care database. PLoS Med, 2013. 10: e1001505.
https://pubmed.ncbi.nlm.nih.gov/24015113
16. Pringsheim, T., *et al.* The prevalence of Parkinson's disease: a systematic review and meta-analysis. Mov Disord, 2014. 29: 1583.
https://pubmed.ncbi.nlm.nih.gov/24976103
17. Picillo, M., *et al.* The PRIAMO study: urinary dysfunction as a marker of disease progression in early Parkinson's disease. European Journal of Neurology, 2017. 24: 788.
https://pubmed.ncbi.nlm.nih.gov/28425642
18. Li, F.F., *et al.* Prevalence of lower urinary tract symptoms, urinary incontinence and retention in Parkinson's disease: A systematic review and meta-analysis. Front Aging Neurosci, 2022. 14: 977572.
https://pubmed.ncbi.nlm.nih.gov/36172485
19. Papatsoris, A.G., *et al.* Urinary and erectile dysfunction in multiple system atrophy (MSA). Neurourol Urodyn, 2008. 27: 22.
https://pubmed.ncbi.nlm.nih.gov/17563111
20. Kim, M., *et al.* Impaired detrusor contractility is the pathognomonic urodynamic finding of multiple system atrophy compared to idiopathic Parkinson's disease. Parkinsonism Relat Disord, 2015. 21: 205.
https://pubmed.ncbi.nlm.nih.gov/25534084
21. Sakakibara, R., *et al.* A guideline for the management of bladder dysfunction in Parkinson's disease and other gait disorders. Neurourol Urodyn, 2016. 35: 551.
https://pubmed.ncbi.nlm.nih.gov/25810035
22. Yamamoto, T., *et al.* Postvoid residual predicts the diagnosis of multiple system atrophy in Parkinsonian syndrome. J Neurol Sci, 2017. 381: 230.
https://pubmed.ncbi.nlm.nih.gov/28991688
23. Dolecek, T.A., *et al.* CBTRUS statistical report: primary brain and central nervous system tumors diagnosed in the United States in 2005-2009. Neuro Oncol, 2012. 14 Suppl 5: v1.
https://pubmed.ncbi.nlm.nih.gov/23095881
24. Maurice-Williams, R.S. Micturition symptoms in frontal tumours. J Neurol Neurosurg Psychiatry, 1974. 37: 431.
https://pubmed.ncbi.nlm.nih.gov/4365244
25. Christensen, D., *et al.* Prevalence of cerebral palsy, co-occurring autism spectrum disorders, and motor functioning - Autism and Developmental Disabilities Monitoring Network, USA, 2008. Dev Med Child Neurol, 2014. 56: 59.
https://pubmed.ncbi.nlm.nih.gov/24117446
26. Samijn, B., *et al.* Lower urinary tract symptoms and urodynamic findings in children and adults with cerebral palsy: A systematic review. Neurourol Urodyn, 2017. 36: 541.
https://pubmed.ncbi.nlm.nih.gov/26894322
27. Ryan, J.M., *et al.* Prevalence and incidence of chronic conditions among adults with cerebral palsy: A systematic review and meta-analysis. Dev Med Child Neurol, 2023. 65: 1174.
https://pubmed.ncbi.nlm.nih.gov/36807150

28. Tagliaferri, F., *et al.* A systematic review of brain injury epidemiology in Europe. Acta Neurochir (Wien), 2006. 148: 255.
https://pubmed.ncbi.nlm.nih.gov/16311842
29. Kulakli, F., *et al.* Relationship between urinary dysfunction and clinical factors in patients with traumatic brain injury. Brain Inj, 2014. 28: 323.
https://pubmed.ncbi.nlm.nih.gov/24377376
30. Aruga, S., *et al.* Effect of cerebrospinal fluid shunt surgery on lower urinary tract dysfunction in idiopathic normal pressure hydrocephalus. Neurourol Urodyn, 2018. 37: 1053.
https://pubmed.ncbi.nlm.nih.gov/28892272
31. Singh, A., *et al.* Global prevalence and incidence of traumatic spinal cord injury. Clin Epidemiol, 2014. 6: 309.
https://pubmed.ncbi.nlm.nih.gov/25278785
32. Weld, K.J., *et al.* Association of level of injury and bladder behavior in patients with post-traumatic spinal cord injury. Urology, 2000. 55: 490.
https://pubmed.ncbi.nlm.nih.gov/10736489
33. Kondo, A., *et al.* Neural tube defects: prevalence, etiology and prevention. Int J Urol, 2009. 16: 49.
https://pubmed.ncbi.nlm.nih.gov/19120526
34. Sawin, K.J., *et al.* The National Spina Bifida Patient Registry: profile of a large cohort of participants from the first 10 clinics. J Pediatr, 2015. 166: 444.
https://pubmed.ncbi.nlm.nih.gov/25444012
35. Wiener, J.S., *et al.* Bladder Management and Continence Outcomes in Adults with Spina Bifida: Results from the National Spina Bifida Patient Registry, 2009 to 2015. J Urol, 2018. 200: 187.
https://pubmed.ncbi.nlm.nih.gov/29588216
36. Peyronnet, B., *et al.* Comparison of neurogenic lower urinary tract dysfunctions in open versus closed spinal dysraphism: A prospective cross-sectional study of 318 patients. Neurourol Urodyn, 2018. 37: 2818.
https://pubmed.ncbi.nlm.nih.gov/30070396
37. Joussain, C., *et al.* Urological dysfunction in patients with hereditary spastic paraplegia. Neurourology and Urodynamics, 2019. 38: 1081.
https://pubmed.ncbi.nlm.nih.gov/30848841
38. Bartolin, Z., *et al.* Relationship between clinical data and urodynamic findings in patients with lumbar intervertebral disk protrusion. Urol Res, 2002. 30: 219.
https://pubmed.ncbi.nlm.nih.gov/12202938
39. Baker, M., *et al.* Urogenital symptoms in women with Tarlov cysts. J Obstet Gynaecol Res, 2018. 44: 1817.
https://pubmed.ncbi.nlm.nih.gov/29974579
40. Lange, M.M., *et al.* Urinary and sexual dysfunction after rectal cancer treatment. Nat Rev Urol, 2011. 8: 51.
https://pubmed.ncbi.nlm.nih.gov/21135876
41. Federation, I.D., IDF Diabetes Atlas, 6th edn. 2013, International Diabetes Federation: Brussels, Belgium.
42. Yuan, Z., *et al.* Diabetic cystopathy: A review. J Diabetes, 2015. 7: 442.
https://pubmed.ncbi.nlm.nih.gov/25619174
43. Tateno, F., *et al.* Lower Urinary Tract Symptoms in Myasthenia Gravis. Case Rep Neurol, 2021. 13: 490.
https://pubmed.ncbi.nlm.nih.gov/34413752
44. Pugliatti, M., *et al.* The epidemiology of multiple sclerosis in Europe. Eur J Neurol, 2006. 13: 700.
https://pubmed.ncbi.nlm.nih.gov/16834700
45. de Seze, M., *et al.* The neurogenic bladder in multiple sclerosis: review of the literature and proposal of management guidelines. Mult Scler, 2007. 13: 915.
https://pubmed.ncbi.nlm.nih.gov/17881401
46. Al Dandan, H.B., *et al.* Prevalence of Lower Urinary Tract Symptoms in People with Multiple Sclerosis: A Systematic Review and Meta-analysis. Int J MS Care, 2020. 22: 91.
https://pubmed.ncbi.nlm.nih.gov/32410904
47. Gajewski, J.B., *et al.* An International Continence Society (ICS) report on the terminology for adult neurogenic lower urinary tract dysfunction (ANLUTD). Neurourol Urodyn, 2018. 37: 1152.
https://pubmed.ncbi.nlm.nih.gov/29149505

48. Liao, L. A new comprehensive classification system for both lower and upper urinary tract dysfunction in patients with neurogenic bladder. Urol Int, 2015. 94: 244.
https://pubmed.ncbi.nlm.nih.gov/25115367
49. Garcia Fadrique, G., *et al.* Urodynamic Differences between Complete and Incomplete Spinal Cord Injuries with Neurogenic Detrusor Overactivity. Urol Int, 2020. 104: 273.
https://pubmed.ncbi.nlm.nih.gov/31461727
50. Ahlberg, J., *et al.* Neurological signs are common in patients with urodynamically verified "idiopathic" bladder overactivity. Neurourol Urodyn, 2002. 21: 65.
https://pubmed.ncbi.nlm.nih.gov/11835426
51. Borau, A., *et al.* A systematic review of the diagnosis and treatment of patients with neurogenic hyperactivity of the detrusor muscle. Actas Urol Esp (Engl Ed), 2018. 42: 5.
https://pubmed.ncbi.nlm.nih.gov/28413135
52. Musco, S., *et al.* Value of urodynamic findings in predicting upper urinary tract damage in neuro-urological patients: A systematic review. Neurourol Urodyn, 2018. 37: 1522.
https://pubmed.ncbi.nlm.nih.gov/29392753
53. Farrelly, E., *et al.* The Stockholm Spinal Cord Uro Study: 3. Urodynamic characteristics in a regional prevalence group of persons with spinal cord injury and indications for improved follow-up. Scand J Urol, 2021. 55: 412.
https://pubmed.ncbi.nlm.nih.gov/34279177
54. Bors, E., *et al.* History and physical examination in neurological urology. J Urol, 1960. 83: 759.
https://pubmed.ncbi.nlm.nih.gov/13802958
55. Cameron, A.P., *et al.* The Severity of Bowel Dysfunction in Patients with Neurogenic Bladder. J Urol, 2015. 194: 1336.
https://pubmed.ncbi.nlm.nih.gov/25956470
56. Vodusek, D.B. Lower urinary tract and sexual dysfunction in neurological patients. Eur Neurol, 2014. 72: 109.
https://pubmed.ncbi.nlm.nih.gov/24993182
57. Linsenmeyer, T.A., *et al.* Accuracy of individuals with spinal cord injury at predicting urinary tract infections based on their symptoms. J Spinal Cord Med, 2003. 26: 352.
https://pubmed.ncbi.nlm.nih.gov/14992336
58. Massa, L.M., *et al.* Validity, accuracy, and predictive value of urinary tract infection signs and symptoms in individuals with spinal cord injury on intermittent catheterization. J Spinal Cord Med, 2009. 32: 568.
https://pubmed.ncbi.nlm.nih.gov/20025153
59. Konstantinidis, C., *et al.* Optimal bladder diary duration for patients with suprapontine neurogenic lower urinary tract dysfunction. Int Braz J Urol, 2016. 42: 766.
https://pubmed.ncbi.nlm.nih.gov/27564288
60. Henze, T. Managing specific symptoms in people with multiple sclerosis. Int MS J, 2005. 12: 60.
https://pubmed.ncbi.nlm.nih.gov/16417816
61. Myers, J.B., *et al.* Patient Reported Bladder Related Symptoms and Quality of Life after Spinal Cord Injury with Different Bladder Management Strategies. J Urol, 2019. 202: 574.
https://pubmed.ncbi.nlm.nih.gov/30958741
62. Moghalu, O., *et al.* Psychosocial aspects of health-related quality of life and the association with patient-reported bladder symptoms and satisfaction after spinal cord injury. Spinal Cord, 2021. 59: 987.
https://pubmed.ncbi.nlm.nih.gov/33495582
63. Khalaf, K.M., *et al.* The impact of lower urinary tract symptoms on health-related quality of life among patients with multiple sclerosis. Neurourol Urodyn, 2016. 35: 48.
https://pubmed.ncbi.nlm.nih.gov/25327401
64. Szymanski, K.M., *et al.* All Incontinence is Not Created Equal: Impact of Urinary and Fecal Incontinence on Quality of Life in Adults with Spina Bifida. Journal of Urology, 2017. 197: 885.
https://pubmed.ncbi.nlm.nih.gov/28131501
65. Pannek, J., *et al.* Does optimizing bladder management equal optimizing quality of life? Correlation between health-related quality of life and urodynamic parameters in patients with spinal cord lesions. Urology, 2009. 74: 263.
https://pubmed.ncbi.nlm.nih.gov/19428089
66. Bonniaud, V., *et al.* Qualiveen, a urinary-disorder specific instrument: 0.5 corresponds to the minimal important difference. J Clin Epidemiol, 2008. 61: 505.
https://pubmed.ncbi.nlm.nih.gov/18394545

67. Bonniaud, V., *et al.* Development and validation of the short form of a urinary quality of life questionnaire: SF-Qualiveen. J Urol, 2008. 180: 2592.
https://pubmed.ncbi.nlm.nih.gov/18950816
68. Best, K.L., *et al.* Identifying and classifying quality of life tools for neurogenic bladder function after spinal cord injury: A systematic review. J Spinal Cord Med, 2017. 40: 505.
https://pubmed.ncbi.nlm.nih.gov/27734771
69. Welk, B., *et al.* A pilot randomized-controlled trial of the urodynamic efficacy of mirabegron for patients with neurogenic lower urinary tract dysfunction. Neurourol Urodyn, 2018. 37: 2810.
https://pubmed.ncbi.nlm.nih.gov/30168626
70. Welk, B., *et al.* The creation and validation of a short form of the Neurogenic Bladder Symptom Score. Neurourol Urodyn, 2020. 39: 1162.
https://pubmed.ncbi.nlm.nih.gov/32196732
71. Pariser, J.J., *et al.* Reliability and Validity of the Neurogenic Bladder Symptom Score in Adults with Cerebral Palsy. Urology, 2019. 128: 107.
https://pubmed.ncbi.nlm.nih.gov/30890419
72. Gulick, E.E. Bowel management related quality of life in people with multiple sclerosis: psychometric evaluation of the QoL-BM measure. Int J Nurs Stud, 2011. 48: 1066.
https://pubmed.ncbi.nlm.nih.gov/21377677
73. Turmel, N., *et al.* Lower urinary tract symptoms treatment constraints assessment (LUTS-TCA): a new tool for a global evaluation of neurogenic bladder treatments. World J Urol, 2019. 37: 1917.
https://pubmed.ncbi.nlm.nih.gov/30511213
74. Tractenberg, R.E., *et al.* Clinical Profiles and Symptom Burden Estimates to Support Decision-Making Using the Urinary Symptom Questionnaire for People with Neurogenic Bladder (USQNB) using Intermittent Catheters. PM R, 2021. 13: 229.
https://pubmed.ncbi.nlm.nih.gov/32860333
75. Foley, F.W., *et al.* The Multiple Sclerosis Intimacy and Sexuality Questionnaire -- re-validation and development of a 15-item version with a large US sample. Mult Scler, 2013. 19: 1197.
https://pubmed.ncbi.nlm.nih.gov/23369892
76. Sanders, A.S., *et al.* The Multiple Sclerosis Intimacy and Sexuality Questionnaire-19 (MSISQ-19). Sexuality and Disability, 2000. 18: 3.
77. 't Hoen, L.A., *et al.* A Quality Assessment of Patient-Reported Outcome Measures for Sexual Function in Neurologic Patients Using the Consensus-based Standards for the Selection of Health Measurement Instruments Checklist: A Systematic Review. Eur Urol Focus, 2017. 3: 444.
https://pubmed.ncbi.nlm.nih.gov/28753768
78. Tsang, B., *et al.* A systematic review and comparison of questionnaires in the management of spinal cord injury, multiple sclerosis and the neurogenic bladder. Neurourol Urodyn, 2016. 35: 354.
https://pubmed.ncbi.nlm.nih.gov/25620137
79. Schurch, B., *et al.* Reliability and validity of the Incontinence Quality of Life questionnaire in patients with neurogenic urinary incontinence. Arch Phys Med Rehabil, 2007. 88: 646.
https://pubmed.ncbi.nlm.nih.gov/17466735
80. Patel, D.P., *et al.* Patient reported outcomes measures in neurogenic bladder and bowel: A systematic review of the current literature. Neurourol Urodyn, 2016. 35: 8.
https://pubmed.ncbi.nlm.nih.gov/25327455
81. Hollingworth, W., *et al.* Exploring the impact of changes in neurogenic urinary incontinence frequency and condition-specific quality of life on preference-based outcomes. Qual Life Res, 2010. 19: 323.
https://pubmed.ncbi.nlm.nih.gov/20094804
82. Cella, D.F., *et al.* Validation of the functional assessment of multiple sclerosis quality of life instrument. Neurology, 1996. 47: 129.
https://pubmed.ncbi.nlm.nih.gov/8710066
83. Wesson, J.M., *et al.* The functional index for living with multiple sclerosis: development and validation of a new quality of life questionnaire. Mult Scler, 2009. 15: 1239.
https://pubmed.ncbi.nlm.nih.gov/19737850
84. Gold, S.M., *et al.* Disease specific quality of life instruments in multiple sclerosis: validation of the Hamburg Quality of Life Questionnaire in Multiple Sclerosis (HAQUAMS). Mult Scler, 2001. 7: 119.
https://pubmed.ncbi.nlm.nih.gov/11424632
85. Goodin, D.S. A questionnaire to assess neurological impairment in multiple sclerosis. Mult Scler, 1998. 4: 444.
https://pubmed.ncbi.nlm.nih.gov/9839306

86. Marrie, R.A., *et al.* Validity and reliability of the MSQLI in cognitively impaired patients with multiple sclerosis. Mult Scler, 2003. 9: 621.
https://pubmed.ncbi.nlm.nih.gov/14664477
87. Vickrey, B.G., *et al.* A health-related quality of life measure for multiple sclerosis. Qual Life Res, 1995. 4: 187.
https://pubmed.ncbi.nlm.nih.gov/7613530
88. Honan, C.A., *et al.* The multiple sclerosis work difficulties questionnaire (MSWDQ): development of a shortened scale. Disabil Rehabil, 2014. 36: 635.
https://pubmed.ncbi.nlm.nih.gov/23786346
89. Bonniaud, V., *et al.* Measuring quality of life in multiple sclerosis patients with urinary disorders using the Qualiveen questionnaire. Arch Phys Med Rehabil, 2004. 85: 1317.
https://pubmed.ncbi.nlm.nih.gov/15295759
90. Franceschini, M., *et al.* Follow-up in persons with traumatic spinal cord injury: questionnaire reliability. Eura Medicophys, 2006. 42: 211.
https://pubmed.ncbi.nlm.nih.gov/17039217
91. Noreau, L., *et al.* Development and assessment of a community follow-up questionnaire for the Rick Hansen spinal cord injury registry. Arch Phys Med Rehabil, 2013. 94: 1753.
https://pubmed.ncbi.nlm.nih.gov/23529142
92. Husmann, D.A. Mortality following augmentation cystoplasty: A transitional urologist's viewpoint. J Pediatr Urol, 2017. 13: 358.
https://pubmed.ncbi.nlm.nih.gov/28645552
93. Yang, C.C., *et al.* Bladder management in women with neurologic disabilities. Phys Med Rehabil Clin N Am, 2001. 12: 91.
https://pubmed.ncbi.nlm.nih.gov/11853041
94. Podnar, S., *et al.* Protocol for clinical neurophysiologic examination of the pelvic floor. Neurourol Urodyn, 2001. 20: 669.
https://pubmed.ncbi.nlm.nih.gov/11746548
95. Harrison, S., *et al.* Urinary incontinence in neurological disease: assessment and management. NICE Clinical Guideline 2012. [CG148].
https://www.nice.org.uk/guidance/cg148
96. Krassioukov, A., *et al.* International standards to document remaining autonomic function after spinal cord injury. J Spinal Cord Med, 2012. 35: 201.
https://pubmed.ncbi.nlm.nih.gov/22925746
97. Walter, M., *et al.* Prediction of autonomic dysreflexia during urodynamics: a prospective cohort study. BMC Med, 2018. 16: 53.
https://pubmed.ncbi.nlm.nih.gov/29650001
98. Liu, N., *et al.* Autonomic dysreflexia severity during urodynamics and cystoscopy in individuals with spinal cord injury. Spinal Cord, 2013. 51: 863.
https://pubmed.ncbi.nlm.nih.gov/24060768
99. Labat, J.J., *et al.* Diagnostic criteria for pudendal neuralgia by pudendal nerve entrapment (Nantes criteria). Neurourol Urodyn, 2008. 27: 306.
https://pubmed.ncbi.nlm.nih.gov/17828787
100. Brown, D., Atlas of regional anesthesia. 3rd. ed. 2006, Philadelphia
101. Standring, S., Gray's anatomy, . 40th ed. 2008.
102. Bellucci, C.H., *et al.* Neurogenic lower urinary tract dysfunction--do we need same session repeat urodynamic investigations? J Urol, 2012. 187: 1318.
https://pubmed.ncbi.nlm.nih.gov/22341264
103. Walter, M., *et al.* Autonomic dysreflexia and repeatability of cardiovascular changes during same session repeat urodynamic investigation in women with spinal cord injury. World J Urol, 2016. 34: 391.
https://pubmed.ncbi.nlm.nih.gov/26055644
104. Gammie, A., *et al.* International Continence Society guidelines on urodynamic equipment performance. Neurourol Urodyn, 2014. 33: 370.
https://pubmed.ncbi.nlm.nih.gov/24390971
105. Anderson, C.E., *et al.* Temporal development of unfavourable urodynamic parameters during the first year after spinal cord injury. BJU Int, 2023. 131: 503.
https://pubmed.ncbi.nlm.nih.gov/36221991

106. Kozomara, M., *et al.* Neurogenic Lower Urinary Tract Dysfunction in the First Year After Spinal Cord Injury: A Descriptive Study of Urodynamic Findings. J Urol, 2023. 209: 225. https://pubmed.ncbi.nlm.nih.gov/36263681
107. McGuire, E.J., *et al.* Leak-point pressures. Urol Clin North Am, 1996. 23: 253. https://pubmed.ncbi.nlm.nih.gov/8659025
108. Ozkan, B., *et al.* Which factors predict upper urinary tract deterioration in overactive neurogenic bladder dysfunction? Urology, 2005. 66: 99. https://pubmed.ncbi.nlm.nih.gov/15992868
109. Wang, Q.W., *et al.* Is it possible to use urodynamic variables to predict upper urinary tract dilatation in children with neurogenic bladder-sphincter dysfunction? BJU Int, 2006. 98: 1295. https://pubmed.ncbi.nlm.nih.gov/17034510
110. Linsenmeyer, T.A., *et al.* The impact of urodynamic parameters on the upper tracts of spinal cord injured men who void reflexly. J Spinal Cord Med, 1998. 21: 15. https://pubmed.ncbi.nlm.nih.gov/9541882
111. McGuire, E.J., *et al.* Prognostic value of urodynamic testing in myelodysplastic patients. J Urol, 1981. 126: 205. https://pubmed.ncbi.nlm.nih.gov/7196460
112. Krongrad, A., *et al.* Bladder neck dysynergia in spinal cord injury. Am J Phys Med Rehabil, 1996. 75: 204. https://pubmed.ncbi.nlm.nih.gov/8663928
113. Weld, K.J., *et al.* Clinical significance of detrusor sphincter dyssynergia type in patients with post-traumatic spinal cord injury. Urology, 2000. 56: 565. https://pubmed.ncbi.nlm.nih.gov/11018603
114. Rossier, A.B., *et al.* 5-microtransducer catheter in evaluation of neurogenic bladder function. Urology, 1986. 27: 371. https://pubmed.ncbi.nlm.nih.gov/3962062
115. Al-Ali, M., *et al.* A 10 year review of the endoscopic treatment of 125 spinal cord injured patients with vesical outlet obstruction: does bladder neck dyssynergia exist? Paraplegia, 1996. 34: 34. https://pubmed.ncbi.nlm.nih.gov/8848321
116. Bacsu, C.D., *et al.* Diagnosing detrusor sphincter dyssynergia in the neurological patient. BJU Int, 2012. 109 Suppl 3: 31. https://pubmed.ncbi.nlm.nih.gov/22458490
117. Lose, G., *et al.* Standardisation of urethral pressure measurement: report from the Standardisation Sub-Committee of the International Continence Society. Neurourol Urodyn, 2002. 21: 258. https://pubmed.ncbi.nlm.nih.gov/11948719
118. Marks, B.K., *et al.* Videourodynamics: indications and technique. Urol Clin North Am, 2014. 41: 383. https://pubmed.ncbi.nlm.nih.gov/25063594
119. Virseda, M., *et al.* Reliability of ambulatory urodynamics in patients with spinal cord injuries. Neurourol Urodyn, 2013. 32: 387. https://pubmed.ncbi.nlm.nih.gov/23002043
120. Virseda-Chamorro, M., *et al.* Comparison of ambulatory versus video urodynamics in patients with spinal cord injury. Spinal Cord, 2014. 52: 551. https://pubmed.ncbi.nlm.nih.gov/24663000
121. Geirsson, G., *et al.* The ice-water test--a simple and valuable supplement to routine cystometry. Br J Urol, 1993. 71: 681. https://pubmed.ncbi.nlm.nih.gov/8343894
122. Geirsson, G., *et al.* Pressure, volume and infusion speed criteria for the ice-water test. Br J Urol, 1994. 73: 498. https://pubmed.ncbi.nlm.nih.gov/8012770
123. Kozomara, M., *et al.* Is Detrusor Contraction during Rapid Bladder Filling Caused by Cold or Warm Water? A Randomized, Controlled, Double-Blind Trial. J Urol, 2018. 199: 223. https://pubmed.ncbi.nlm.nih.gov/28751267
124. Al-Hayek, S., *et al.* The 50-year history of the ice water test in urology. J Urol, 2010. 183: 1686. https://pubmed.ncbi.nlm.nih.gov/20299050
125. Lapides, J. Neurogenic bladder. Principles of treatment. Urol Clin North Am, 1974. 1: 81. https://pubmed.ncbi.nlm.nih.gov/4428540
126. Riedl, C.R., *et al.* Electromotive administration of intravesical bethanechol and the clinical impact on acontractile detrusor management: introduction of a new test. J Urol, 2000. 164: 2108. https://pubmed.ncbi.nlm.nih.gov/11061937

127. Podnar, S., *et al.* Lower urinary tract dysfunction in patients with peripheral nervous system lesions. Handb Clin Neurol, 2015. 130: 203.
https://pubmed.ncbi.nlm.nih.gov/26003246
128. Ouyang, L., *et al.* Characteristics and survival of patients with end stage renal disease and spina bifida in the United States renal data system. J Urol, 2015. 193: 558.
https://pubmed.ncbi.nlm.nih.gov/25167993
129. Lane, G.I., *et al.* Clinical outcomes of non-surgical management of detrusor leak point pressures above 40 cm water in adults with congenital neurogenic bladder. Neurourol Urodyn, 2018. 37: 1943.
https://pubmed.ncbi.nlm.nih.gov/29488655
130. Lawrenson, R., *et al.* Renal failure in patients with neurogenic lower urinary tract dysfunction. Neuroepidemiology, 2001. 20: 138.
https://pubmed.ncbi.nlm.nih.gov/11359083
131. Mingat, N., *et al.* Prospective study of methods of renal function evaluation in patients with neurogenic bladder dysfunction. Urology, 2013. 82: 1032.
https://pubmed.ncbi.nlm.nih.gov/24001705
132. Averbeck, M.A., *et al.* Follow-up of the neuro-urological patient: a systematic review. BJU Int, 2015. 115 Suppl 6: 39.
https://pubmed.ncbi.nlm.nih.gov/25891319
133. Stöhrer, M., *et al.* Diagnosis and treatment of bladder dysfunction in spinal cord injury patients. Eur Urol Update Series 1994. 3: 170.
134. Apostolidis, A., *et al.*, Neurologic Urinary and Faecal Incontinence, in Incontinence 6th Edition, P. Abrams, L. Cardozo, S. Khoury & A. Wein, Editors. 2017.
135. Chamberlain, J.D., *et al.* Mortality and longevity after a spinal cord injury: systematic review and meta-analysis. Neuroepidemiology, 2015. 44: 182.
https://pubmed.ncbi.nlm.nih.gov/25997873
136. Game, X., *et al.* Botulinum toxin A detrusor injections in patients with neurogenic detrusor overactivity significantly decrease the incidence of symptomatic urinary tract infections. Eur Urol, 2008. 53: 613.
https://pubmed.ncbi.nlm.nih.gov/17804150
137. Frankel, H.L., *et al.* Long-term survival in spinal cord injury: a fifty year investigation. Spinal Cord, 1998. 36: 266.
https://pubmed.ncbi.nlm.nih.gov/9589527
138. Jamil, F. Towards a catheter free status in neurogenic bladder dysfunction: a review of bladder management options in spinal cord injury (SCI). Spinal Cord, 2001. 39: 355.
https://pubmed.ncbi.nlm.nih.gov/11464308
139. Thietje, R., *et al.* Mortality in patients with traumatic spinal cord injury: descriptive analysis of 62 deceased subjects. J Spinal Cord Med, 2011. 34: 482.
https://pubmed.ncbi.nlm.nih.gov/22118255
140. Hackler, R.H. A 25-year prospective mortality study in the spinal cord injured patient: comparison with the long-term living paraplegic. J Urol, 1977. 117: 486.
https://pubmed.ncbi.nlm.nih.gov/850323
141. Rodrigues, P., *et al.* Involuntary detrusor contraction is a frequent finding in patients with recurrent urinary tract infections. Urol Int, 2014. 93: 67.
https://pubmed.ncbi.nlm.nih.gov/25011551
142. Bauer, S.B. Neurogenic bladder: etiology and assessment. Pediatr Nephrol, 2008. 23: 541.
https://pubmed.ncbi.nlm.nih.gov/18270749
143. Barbalias, G.A., *et al.* Critical evaluation of the Crede maneuver: a urodynamic study of 207 patients. J Urol, 1983. 130: 720.
https://pubmed.ncbi.nlm.nih.gov/6887405
144. Reinberg, Y., *et al.* Renal rupture after the Crede maneuver. J Pediatr, 1994. 124: 279.
https://pubmed.ncbi.nlm.nih.gov/8301439
145. Wyndaele, J.J., *et al.* Neurologic urinary incontinence. Neurourol Urodyn, 2010. 29: 159.
https://pubmed.ncbi.nlm.nih.gov/20025021
146. Menon, E.B., *et al.* Bladder training in patients with spinal cord injury. Urology, 1992. 40: 425.
https://pubmed.ncbi.nlm.nih.gov/1441039
147. Furusawa, K., *et al.* Incidence of symptomatic autonomic dysreflexia varies according to the bowel and bladder management techniques in patients with spinal cord injury. Spinal Cord, 2011. 49: 49.
https://pubmed.ncbi.nlm.nih.gov/20697419

148. Consortium for Spinal Cord, M. Outcomes following traumatic spinal cord injury: clinical practice guidelines for health-care professionals. J Spinal Cord Med, 2000. 23: 289.
https://pubmed.ncbi.nlm.nih.gov/17536300
149. El-Masri, W.S., *et al.* Long-term follow-up study of outcomes of bladder management in spinal cord injury patients under the care of the Midlands Centre for Spinal Injuries in Oswestry. Spinal Cord, 2012. 50: 14.
https://pubmed.ncbi.nlm.nih.gov/21808256
150. Fall, M., *et al.* Electrical stimulation. A physiologic approach to the treatment of urinary incontinence. Urol Clin North Am, 1991. 18: 393.
https://pubmed.ncbi.nlm.nih.gov/2017820
151. Sundin, T., *et al.* Detrusor inhibition induced from mechanical stimulation of the anal region and from electrical stimulation of pudendal nerve afferents. An experimental study in cats. Invest Urol, 1974. 11: 374.
https://pubmed.ncbi.nlm.nih.gov/4815623
152. Gross, T., *et al.* Transcutaneous Electrical Nerve Stimulation for Treating Neurogenic Lower Urinary Tract Dysfunction: A Systematic Review. Eur Urol, 2016. 69: 1102.
https://pubmed.ncbi.nlm.nih.gov/26831506
153. Vaughan, C.P., *et al.* Behavioral therapy for urinary symptoms in Parkinson's disease: A randomized clinical trial. Neurourol Urodyn, 2019. 38: 1737.
https://pubmed.ncbi.nlm.nih.gov/31187552
154. McDonald, C., *et al.* Bladder training for urinary tract symptoms in Parkinson disease: A randomized controlled trial. Neurology, 2020. 94: e1427.
https://pubmed.ncbi.nlm.nih.gov/32054791
155. Ozden, F., *et al.* The effect of pelvic floor muscle training on urinary incontinence in patients with stroke: a systematic review and meta-analysis. Ir J Med Sci, 2023. 192: 1481.
https://pubmed.ncbi.nlm.nih.gov/35776264
156. Kajbafvala, M., *et al.* Pelvic floor muscle training in multiple sclerosis patients with lower urinary tract dysfunction: A systematic review and meta-analysis. Mult Scler Relat Disord, 2022. 59: 103559.
https://pubmed.ncbi.nlm.nih.gov/35144089
157. Bapir, R., *et al.* Efficacy of overactive neurogenic bladder treatment: A systematic review of randomized controlled trials. Arch Ital Urol Androl, 2022. 94: 492.
https://pubmed.ncbi.nlm.nih.gov/36576454
158. Ali, M.U., *et al.* Effects of nonsurgical, minimally or noninvasive therapies for urinary incontinence due to neurogenic bladder: a systematic review and meta-analysis. Ther Adv Chronic Dis, 2022. 13: 20406223211063059.
https://pubmed.ncbi.nlm.nih.gov/35321402
159. Liu, Y., *et al.* Effects of Transcutaneous Electrical Nerve Stimulation at Two Frequencies on Urinary Incontinence in Poststroke Patients: A Randomized Controlled Trial. Am J Phys Med Rehabil, 2016. 95: 183.
https://pubmed.ncbi.nlm.nih.gov/26259053
160. Guo, G.Y., *et al.* Effectiveness of neuromuscular electrical stimulation therapy in patients with urinary incontinence after stroke: A randomized sham controlled trial. Medicine (Baltimore), 2018. 97: e13702.
https://pubmed.ncbi.nlm.nih.gov/30593142
161. Shen, S.X., *et al.* A retrospective study of neuromuscular electrical stimulation for treating women with post-stroke incontinence. Medicine (Baltimore), 2018. 97: e11264.
https://pubmed.ncbi.nlm.nih.gov/29952999
162. Marzouk, M.H., *et al.* Posterior tibial nerve stimulation as a neuromodulation therapy in treatment of neurogenic overactive bladder in multiple sclerosis: A prospective randomized controlled study. Mult Scler Relat Disord, 2022. 68: 104252.
https://pubmed.ncbi.nlm.nih.gov/36274285
163. Smith, M.D., *et al.* Neuromodulation for Storage Lower Urinary Tract Symptoms in Parkinson Disease: A Systematic Review. Neuromodulation, 2022. 25: 1076.
https://pubmed.ncbi.nlm.nih.gov/35300922
164. Stampas, A., *et al.* Bladder Neuromodulation in Acute Spinal Cord Injury via Transcutaneous Tibial Nerve Stimulation: Cystometrogram and Autonomic Nervous System Evidence From a Randomized Control Pilot Trial. Front Neurosci, 2019. 13: 119.
https://pubmed.ncbi.nlm.nih.gov/30837835

165. Stampas, A., *et al.* Safety, Feasibility, and Efficacy of Transcutaneous Tibial Nerve Stimulation in Acute Spinal Cord Injury Neurogenic Bladder: A Randomized Control Pilot Trial. Neuromodulation, 2019. 22: 716.
https://pubmed.ncbi.nlm.nih.gov/30284350
166. Parittotokkaporn, S., *et al.* Non-invasive neuromodulation for bowel, bladder and sexual restoration following spinal cord injury: A systematic review. Clin Neurol Neurosurg, 2020. 194: 105822.
https://pubmed.ncbi.nlm.nih.gov/32334284
167. Daia, C., *et al.* Interferential electrical stimulation for improved bladder management following spinal cord injury. Biomed Rep, 2019. 11: 115.
https://pubmed.ncbi.nlm.nih.gov/31423306
168. McClurg, D., *et al.* Neuromuscular electrical stimulation and the treatment of lower urinary tract dysfunction in multiple sclerosis--a double blind, placebo controlled, randomised clinical trial. Neurourol Urodyn, 2008. 27: 231.
https://pubmed.ncbi.nlm.nih.gov/17705160
169. Silva Ferreira, A.P., *et al.* A Controlled Clinical Trial on the Effects of Exercise on Lower Urinary Tract Symptoms in Women With Multiple Sclerosis. Am J Phys Med Rehabil, 2019. 98: 777.
https://pubmed.ncbi.nlm.nih.gov/30932917
170. McClurg, D., *et al.* Comparison of pelvic floor muscle training, electromyography biofeedback, and neuromuscular electrical stimulation for bladder dysfunction in people with multiple sclerosis: a randomized pilot study. Neurourol Urodyn, 2006. 25: 337.
https://pubmed.ncbi.nlm.nih.gov/16637070
171. Ferreira, A.P., *et al.* Impact of a Pelvic Floor Training Program Among Women with Multiple Sclerosis: A Controlled Clinical Trial. Am J Phys Med Rehabil, 2016. 95: 1.
https://pubmed.ncbi.nlm.nih.gov/25888662
172. Elmelund, M., *et al.* The effect of pelvic floor muscle training and intravaginal electrical stimulation on urinary incontinence in women with incomplete spinal cord injury: an investigator-blinded parallel randomized clinical trial. Int Urogynecol J, 2018. 29: 1597.
https://pubmed.ncbi.nlm.nih.gov/29574482
173. Hagerty, J.A., *et al.* Intravesical electrotherapy for neurogenic bladder dysfunction: a 22-year experience. J Urol, 2007. 178: 1680.
https://pubmed.ncbi.nlm.nih.gov/17707024
174. Primus, G., *et al.* Restoration of micturition in patients with acontractile and hypocontractile detrusor by transurethral electrical bladder stimulation. Neurourol Urodyn, 1996. 15: 489.
https://pubmed.ncbi.nlm.nih.gov/8857617
175. Lombardi, G., *et al.* Clinical efficacy of intravesical electrostimulation on incomplete spinal cord patients suffering from chronic neurogenic non-obstructive retention: a 15-year single centre retrospective study. Spinal Cord, 2013. 51: 232.
https://pubmed.ncbi.nlm.nih.gov/23147136
176. Nardone, R., *et al.* Transcranial magnetic stimulation and bladder function: A systematic review. Clin Neurophysiol, 2019. 130: 2032.
https://pubmed.ncbi.nlm.nih.gov/31541980
177. El-Habashy, H., *et al.* The effect of cortical versus sacral repetitive magnetic stimulation on lower urinary tract dysfunction in patients with multiple sclerosis. Acta Neurol Belg, 2020. 120: 141.
https://pubmed.ncbi.nlm.nih.gov/31828602
178. Thomas, L.H., *et al.* Treatment of urinary incontinence after stroke in adults. Cochrane Database Syst Rev, 2008. 2008: CD004462.
https://pubmed.ncbi.nlm.nih.gov/18254050
179. Yeo, L., *et al.* Urinary tract dysfunction in Parkinson's disease: a review. Int Urol Nephrol, 2012. 44: 415.
https://pubmed.ncbi.nlm.nih.gov/21553114
180. Phe, V., *et al.* Management of neurogenic bladder in patients with multiple sclerosis. Nat Rev Urol, 2016. 13: 275.
https://pubmed.ncbi.nlm.nih.gov/27030526
181. Andersson, K.E. Antimuscarinic mechanisms and the overactive detrusor: an update. Eur Urol, 2011. 59: 377.
https://pubmed.ncbi.nlm.nih.gov/21168951
182. Bennett, N., *et al.* Can higher doses of oxybutynin improve efficacy in neurogenic bladder? J Urol, 2004. 171: 749.
https://pubmed.ncbi.nlm.nih.gov/14713802

183. Horstmann, M., *et al.* Neurogenic bladder treatment by doubling the recommended antimuscarinic dosage. Neurourol Urodyn, 2006. 25: 441.
https://pubmed.ncbi.nlm.nih.gov/16847942
184. Kennelly, M.J., *et al.* Overactive bladder: pharmacologic treatments in the neurogenic population. Rev Urol, 2008. 10: 182.
https://pubmed.ncbi.nlm.nih.gov/18836537
185. Madersbacher, H., *et al.* Neurogenic detrusor overactivity in adults: a review on efficacy, tolerability and safety of oral antimuscarinics. Spinal Cord, 2013. 51: 432.
https://pubmed.ncbi.nlm.nih.gov/23743498
186. Madhuvrata, P., *et al.* Anticholinergic drugs for adult neurogenic detrusor overactivity: a systematic review and meta-analysis. Eur Urol, 2012. 62: 816.
https://pubmed.ncbi.nlm.nih.gov/22397851
187. Stohrer, M., *et al.* EAU guidelines on neurogenic lower urinary tract dysfunction. Eur Urol, 2009. 56: 81.
https://pubmed.ncbi.nlm.nih.gov/19403235
188. Mehnert, U., *et al.* The management of urinary incontinence in the male neurological patient. Curr Opin Urol, 2014. 24: 586.
https://pubmed.ncbi.nlm.nih.gov/25389549
189. Stothers, L., *et al.* An integrative review of standardized clinical evaluation tool utilization in anticholinergic drug trials for neurogenic lower urinary tract dysfunction. Spinal Cord, 2016. 54: 1114.
https://pubmed.ncbi.nlm.nih.gov/27241452
190. Amend, B., *et al.* Effective treatment of neurogenic detrusor dysfunction by combined high-dosed antimuscarinics without increased side-effects. Eur Urol, 2008. 53: 1021.
https://pubmed.ncbi.nlm.nih.gov/18243516
191. Cameron, A.P. Pharmacologic therapy for the neurogenic bladder. Urol Clin North Am, 2010. 37: 495.
https://pubmed.ncbi.nlm.nih.gov/20955901
192. Menarini, M., *et al.* Trospium chloride in patients with neurogenic detrusor overactivity: is dose titration of benefit to the patients? Int J Clin Pharmacol Ther, 2006. 44: 623.
https://pubmed.ncbi.nlm.nih.gov/17190372
193. Nardulli, R., *et al.* Combined antimuscarinics for treatment of neurogenic overactive bladder. Int J Immunopathol Pharmacol, 2012. 25: 35S.
https://pubmed.ncbi.nlm.nih.gov/22652160
194. Tijnagel, M.J., *et al.* Real life persistence rate with antimuscarinic treatment in patients with idiopathic or neurogenic overactive bladder: a prospective cohort study with solifenacin. BMC Urol, 2017. 17: 30.
https://pubmed.ncbi.nlm.nih.gov/28403849
195. Cameron, A.P., *et al.* Combination drug therapy improves compliance of the neurogenic bladder. J Urol, 2009. 182: 1062.
https://pubmed.ncbi.nlm.nih.gov/19616807
196. Isik, A.T., *et al.* Trospium and cognition in patients with late onset Alzheimer disease. J Nutr Health Aging, 2009. 13: 672.
https://pubmed.ncbi.nlm.nih.gov/19657549
197. Ethans, K.D., *et al.* Efficacy and safety of tolterodine in people with neurogenic detrusor overactivity. J Spinal Cord Med, 2004. 27: 214.
https://pubmed.ncbi.nlm.nih.gov/15478523
198. McKeage, K. Propiverine: a review of its use in the treatment of adults and children with overactive bladder associated with idiopathic or neurogenic detrusor overactivity, and in men with lower urinary tract symptoms. Clin Drug Investig, 2013. 33: 71.
https://pubmed.ncbi.nlm.nih.gov/23288694
199. Nicholas, R.S., *et al.* Anticholinergics for urinary symptoms in multiple sclerosis. Cochrane Database Syst Rev, 2009: CD004193.
https://pubmed.ncbi.nlm.nih.gov/19160231
200. van Rey, F., *et al.* Solifenacin in multiple sclerosis patients with overactive bladder: a prospective study. Adv Urol, 2011. 2011: 834753.
https://pubmed.ncbi.nlm.nih.gov/21687581
201. Bycroft, J., *et al.* The effect of darifenacin on neurogenic detrusor overactivity in patients with spinal cord injury. Neurourol Urodyn 2003. 22: A190.
https://www.ics.org/Abstracts/Publish/41/000190.pdf
202. Carl, S., *et al.* Up-01.88. Urology, 2006. 68: 250.
https://www.goldjournal.net/article/S0090-4295(06)01724-9/fulltext

203. Amarenco, G., *et al.* Solifenacin is effective and well tolerated in patients with neurogenic detrusor overactivity: Results from the double-blind, randomized, active- and placebo-controlled SONIC urodynamic study. Neurourol Urodyn, 2017. 36: 414.
https://pubmed.ncbi.nlm.nih.gov/26714009
204. Zesiewicz, T.A., *et al.* Randomized, controlled pilot trial of solifenacin succinate for overactive bladder in Parkinson's disease. Parkinsonism Relat Disord, 2015. 21: 514.
https://pubmed.ncbi.nlm.nih.gov/25814050
205. Yonguc, T., *et al.* Randomized, controlled trial of fesoterodine fumarate for overactive bladder in Parkinson's disease. World J Urol, 2020. 38: 2013.
https://pubmed.ncbi.nlm.nih.gov/31642953
206. Konstantinidis, C., *et al.* Efficacy of fesoterodine fumarate (8 mg) in neurogenic detrusor overactivity due to spinal cord lesion or multiple sclerosis: A prospective study. Neurourol Urodyn, 2021. 40: 2026.
https://pubmed.ncbi.nlm.nih.gov/34498773
207. Walter, M., *et al.* Fesoterodine Ameliorates Autonomic Dysreflexia While Improving Lower Urinary Tract Function and Urinary Incontinence-Related Quality of Life in Individuals With Spinal Cord Injury: A Prospective Phase IIa Study. J Neurotrauma, 2023. 40: 1020.
https://pubmed.ncbi.nlm.nih.gov/36178342
208. Sakakibara, R., *et al.* Imidafenacin on bladder and cognitive function in neurologic OAB patients. Clin Auton Res, 2013. 23: 189.
https://pubmed.ncbi.nlm.nih.gov/23820664
209. Sugiyama, H., *et al.* Effect of imidafenacin on the urodynamic parameters of patients with indwelling bladder catheters due to spinal cord injury. Spinal Cord, 2017. 55: 187.
https://pubmed.ncbi.nlm.nih.gov/27897185
210. Stohrer, M., *et al.* Efficacy and tolerability of propiverine hydrochloride extended-release compared with immediate-release in patients with neurogenic detrusor overactivity. Spinal Cord, 2013. 51: 419.
https://pubmed.ncbi.nlm.nih.gov/23338657
211. Schroder, A., *et al.* Efficacy, safety, and tolerability of intravesically administered 0.1% oxybutynin hydrochloride solution in adult patients with neurogenic bladder: A randomized, prospective, controlled multi-center trial. Neurourol Urodyn, 2016. 35: 582.
https://pubmed.ncbi.nlm.nih.gov/25754454
212. Dmochowski, R.R., *et al.* Increased risk of incident dementia following use of anticholinergic agents: A systematic literature review and meta-analysis. Neurourol Urodyn, 2021. 40: 28.
https://pubmed.ncbi.nlm.nih.gov/33098213
213. Trbovich, M., *et al.* The treatment of neurogenic lower urinary tract dysfunction in persons with spinal cord injury: An open label, pilot study of anticholinergic agent vs. mirabegron to evaluate cognitive impact and efficacy. Spinal Cord Ser Cases, 2021. 7: 50.
https://pubmed.ncbi.nlm.nih.gov/34112758
214. El Helou, E., *et al.* The use of mirabegron in neurogenic bladder: a systematic review. World J Urol, 2020. 38: 2435.
https://pubmed.ncbi.nlm.nih.gov/31802206
215. Glykas, I., *et al.* B3 agonists or anticholinergics in the treatment of the lower urinary tract dysfunction in patients with multiple sclerosis?-A randomized study. World J Urol, 2021. 39: 3049.
https://pubmed.ncbi.nlm.nih.gov/33386947
216. Krhut, J., *et al.* Efficacy and safety of mirabegron for the treatment of neurogenic detrusor overactivity-Prospective, randomized, double-blind, placebo-controlled study. Neurourol Urodyn, 2018. 37: 2226.
https://pubmed.ncbi.nlm.nih.gov/29603781
217. Akkoc, Y. Efficacy and safety of mirabegron for treatment of neurogenic detrusor overactivity in adults with spinal cord injury or multiple sclerosis: a systematic review. Spinal Cord, 2022. 60: 854.
https://pubmed.ncbi.nlm.nih.gov/36085413
218. Krhut, J., *et al.* Cardiovascular safety of mirabegron in individuals treated for spinal cord injury- or multiple sclerosis-induced neurogenic detrusor overactivity. Int Urol Nephrol, 2021. 53: 1089.
https://pubmed.ncbi.nlm.nih.gov/33417146
219. Chen, S.F., *et al.* Therapeutic efficacy of low-dose (25 mg) mirabegron therapy for patients with mild to moderate overactive bladder symptoms due to central nervous system diseases. LUTS: Lower Urinary Tract Symptoms, 2018. 11: O53.
https://pubmed.ncbi.nlm.nih.gov/29380517

220. Cho, S.Y., *et al.* Mirabegron for treatment of overactive bladder symptoms in patients with Parkinson's disease: A double-blind, randomized placebo-controlled trial (Parkinson's Disease Overactive bladder Mirabegron, PaDoMi Study). Neurourol Urodyn, 2021. 40: 286.
https://pubmed.ncbi.nlm.nih.gov/33389776
221. Matsuda, K., *et al.* Urodynamic effect of vibegron on neurogenic lower urinary tract dysfunction in individuals with spinal cord injury: A retrospective study. Spinal Cord, 2022. 60: 716.
https://pubmed.ncbi.nlm.nih.gov/35177800
222. Phe, V., *et al.* Desmopressin for treating nocturia in patients with multiple sclerosis: A systematic review: A report from the Neuro-Urology Promotion Committee of the International Continence Society (ICS). Neurourol Urodyn, 2019. 38: 563.
https://pubmed.ncbi.nlm.nih.gov/30653737
223. Zachariou, A., *et al.* Effective treatment of neurogenic detrusor overactivity in multiple sclerosis patients using desmopressin and mirabegron. The Canadian journal of urology, 2017. 24: 9107.
https://pubmed.ncbi.nlm.nih.gov/29260636
224. Moussa, M., *et al.* The safety and effectiveness of mirabegron in Parkinson's disease patients with overactive bladder: a randomized controlled trial. Scand J Urol, 2022. 56: 66.
https://pubmed.ncbi.nlm.nih.gov/34672847
225. Abo Youssef, N., *et al.* Cannabinoids for treating neurogenic lower urinary tract dysfunction in patients with multiple sclerosis: a systematic review and meta-analysis. BJU Int, 2017. 119: 515.
https://pubmed.ncbi.nlm.nih.gov/28058780
226. Torri Clerici, V., *et al.* Nabiximols oromucosal spray in patients with multiple sclerosis-related bladder dysfunction: A prospective study. Mult Scler Relat Disord, 2023. 74: 104711.
https://pubmed.ncbi.nlm.nih.gov/37062198
227. Francomano, D., *et al.* Effects of daily tadalafil on lower urinary tract symptoms in young men with multiple sclerosis and erectile dysfunction: a pilot study. J Endocrinol Invest, 2017. 40: 275.
https://pubmed.ncbi.nlm.nih.gov/27752863
228. Barendrecht, M.M., *et al.* Is the use of parasympathomimetics for treating an underactive urinary bladder evidence-based? BJU Int, 2007. 99: 749.
https://pubmed.ncbi.nlm.nih.gov/17233798
229. Apostolidis, A. Taming the cannabinoids: new potential in the pharmacologic control of lower urinary tract dysfunction. Eur Urol, 2012. 61: 107.
https://pubmed.ncbi.nlm.nih.gov/21996529
230. Gratzke, C., *et al.* Effects of cannabinor, a novel selective cannabinoid 2 receptor agonist, on bladder function in normal rats. Eur Urol, 2010. 57: 1093.
https://pubmed.ncbi.nlm.nih.gov/20207474
231. Abrams, P., *et al.* Tamsulosin: efficacy and safety in patients with neurogenic lower urinary tract dysfunction due to suprasacral spinal cord injury. J Urol, 2003. 170: 1242.
https://pubmed.ncbi.nlm.nih.gov/14501734
232. Gomes, C.M., *et al.* Neurological status predicts response to alpha-blockers in men with voiding dysfunction and Parkinson's disease. Clinics (Sao Paulo), 2014. 69: 817.
https://pubmed.ncbi.nlm.nih.gov/25627993
233. Moon, K.H., *et al.* A 12-Week, Open Label, Multi-Center Study to Evaluate the Clinical Efficacy and Safety of Silodosin on Voiding Dysfunction in Patients with Neurogenic Bladder. Low Urin Tract Symptoms, 2015. 7: 27.
https://pubmed.ncbi.nlm.nih.gov/26663648
234. Schneider, M.P., *et al.* Alpha-blockers for treating neurogenic lower urinary tract dysfunction in patients with multiple sclerosis: A systematic review and meta-analysis. A report from the Neuro-Urology Promotion Committee of the International Continence Society (ICS). Neurourol Urodyn, 2019. 38: 1482.
https://pubmed.ncbi.nlm.nih.gov/31099113
235. Sung, H.H., *et al.* Efficacy and Safety of Naftopidil in Patients With Neurogenic Lower Urinary Tract Dysfunction: An 8-Week, Active-Controlled, Stratified-Randomized, Double-Blind, Double-Dummy, Parallel Group, Noninferiority, Multicenter Design. Int Neurourol J, 2020. 24: 163.
https://pubmed.ncbi.nlm.nih.gov/32615679
236. Guttmann, L., *et al.* The value of intermittent catheterisation in the early management of traumatic paraplegia and tetraplegia. Paraplegia, 1966. 4: 63.
https://pubmed.ncbi.nlm.nih.gov/5969402
237. Lapides, J., *et al.* Clean, intermittent self-catheterization in the treatment of urinary tract disease. J Urol, 1972. 107: 458.
https://pubmed.ncbi.nlm.nih.gov/5010715

238. Elliott, C.S., *et al.* Validation of Upper Extremity Motor Function as a Key Predictor of Bladder Management After Spinal Cord Injury. Arch Phys Med Rehabil, 2019. 100: 1939. https://pubmed.ncbi.nlm.nih.gov/31348899
239. Jamison, J., *et al.* Catheter policies for management of long term voiding problems in adults with neurogenic bladder disorders. Cochrane Database Syst Rev, 2013. 11: CD004375. https://pubmed.ncbi.nlm.nih.gov/24249436
240. Prieto-Fingerhut, T., *et al.* A study comparing sterile and nonsterile urethral catheterization in patients with spinal cord injury. Rehabil Nurs, 1997. 22: 299. https://pubmed.ncbi.nlm.nih.gov/9416190
241. Corona, L.E., *et al.* Intermittent catheterization and urinary tract infection in multiple sclerosis patients. Can J Urol, 2020. 27: 10294. https://pubmed.ncbi.nlm.nih.gov/32861254
242. Crescenze, I.M., *et al.* Predictors of low urinary quality of life in spinal cord injury patients on clean intermittent catheterization. Neurourol Urodyn, 2019. 38: 1332. https://pubmed.ncbi.nlm.nih.gov/30912199
243. Patel, D.P., *et al.* Reasons for cessation of clean intermittent catheterization after spinal cord injury: Results from the Neurogenic Bladder Research Group spinal cord injury registry. Neurourol Urodyn, 2020. 39: 211. https://pubmed.ncbi.nlm.nih.gov/31578784
244. Goetz, L.L., *et al.* International Spinal Cord Injury Urinary Tract Infection Basic Data Set. Spinal Cord, 2013. 51: 700. https://pubmed.ncbi.nlm.nih.gov/23896666
245. Bakke, A., *et al.* Physical predictors of infection in patients treated with clean intermittent catheterization: a prospective 7-year study. Br J Urol, 1997. 79: 85. https://pubmed.ncbi.nlm.nih.gov/9043503
246. Günther, M., *et al.* Auswirkungen des aseptischen intermittierenden Katheterismus auf die männliche Harnröhre. Der Urologe B, 2001. 41: 359. https://link.springer.com/article/10.1007/s00131-002-0207-x
247. Kurze, I., *et al.* Intermittent Catheterisation and Prevention of Urinary Tract Infections in Patients with Neurogenic Lower Urinary Tract Dysfunction - Best PracticeAn Overview. [German]. Aktuelle Neurologie, 2015. 42: 515.
248. Waller, L., *et al.* Clean intermittent catheterization in spinal cord injury patients: long-term followup of a hydrophilic low friction technique. J Urol, 1995. 153: 345. https://pubmed.ncbi.nlm.nih.gov/7815579
249. Wyndaele, J.J. Complications of intermittent catheterization: their prevention and treatment. Spinal Cord, 2002. 40: 536. https://pubmed.ncbi.nlm.nih.gov/12235537
250. Woodbury, M.G., *et al.* Intermittent catheterization practices following spinal cord injury: a national survey. Can J Urol, 2008. 15: 4065. https://pubmed.ncbi.nlm.nih.gov/18570710
251. Bennett, C.J., *et al.* Comparison of bladder management complication outcomes in female spinal cord injury patients. J Urol, 1995. 153: 1458. https://pubmed.ncbi.nlm.nih.gov/7714965
252. Chao, R., *et al.* Fate of upper urinary tracts in patients with indwelling catheters after spinal cord injury. Urology, 1993. 42: 259. https://pubmed.ncbi.nlm.nih.gov/8379025
253. Larsen, L.D., *et al.* Retrospective analysis of urologic complications in male patients with spinal cord injury managed with and without indwelling urinary catheters. Urology, 1997. 50: 418. https://pubmed.ncbi.nlm.nih.gov/9301708
254. Mitsui, T., *et al.* Is suprapubic cystostomy an optimal urinary management in high quadriplegics?. A comparative study of suprapubic cystostomy and clean intermittent catheterization. Eur Urol, 2000. 38: 434. https://pubmed.ncbi.nlm.nih.gov/11025382
255. Weld, K.J., *et al.* Effect of bladder management on urological complications in spinal cord injured patients. J Urol, 2000. 163: 768. https://pubmed.ncbi.nlm.nih.gov/10687973
256. Weld, K.J., *et al.* Influences on renal function in chronic spinal cord injured patients. J Urol, 2000. 164: 1490. https://pubmed.ncbi.nlm.nih.gov/11025689

257. Lavelle, R.S., *et al.* Quality of life after suprapubic catheter placement in patients with neurogenic bladder conditions. Neurourol Urodyn, 2016. 35: 831.
https://pubmed.ncbi.nlm.nih.gov/26197729
258. Hird, A.E., *et al.* Association between chronic bladder catheterisation and bladder cancer incidence and mortality: a population-based retrospective cohort study in Ontario, Canada. BMJ Open, 2021. 11: e050728.
https://pubmed.ncbi.nlm.nih.gov/34475180
259. Hollingsworth, J.M., *et al.* Determining the noninfectious complications of indwelling urethral catheters: a systematic review and meta-analysis. Ann Intern Med, 2013. 159: 401.
https://pubmed.ncbi.nlm.nih.gov/24042368
260. Ismail, S., *et al.* Prevalence, management, and prognosis of bladder cancer in patients with neurogenic bladder: A systematic review. Neurourol Urodyn, 2018. 37: 1386.
https://pubmed.ncbi.nlm.nih.gov/29168217
261. Shen, S.H., *et al.* Intravesical oxybutynin therapy for patients with neurogenic detrusor overactivity: a systematic review and meta-analysis. Int Urol Nephrol, 2022. 54: 737.
https://pubmed.ncbi.nlm.nih.gov/35226282
262. Buyse, G., *et al.* Intravesical oxybutynin for neurogenic bladder dysfunction: less systemic side effects due to reduced first pass metabolism. J Urol, 1998. 160: 892.
https://pubmed.ncbi.nlm.nih.gov/9720583
263. Di Stasi, S.M., *et al.* Intravesical oxybutynin: mode of action assessed by passive diffusion and electromotive administration with pharmacokinetics of oxybutynin and N-desethyl oxybutynin. J Urol, 2001. 166: 2232.
https://pubmed.ncbi.nlm.nih.gov/11696741
264. Giannantoni, A., *et al.* Intravesical resiniferatoxin versus botulinum-A toxin injections for neurogenic detrusor overactivity: a prospective randomized study. J Urol, 2004. 172: 240.
https://pubmed.ncbi.nlm.nih.gov/15201783
265. Kim, J.H., *et al.* Intravesical resiniferatoxin for refractory detrusor hyperreflexia: a multicenter, blinded, randomized, placebo-controlled trial. J Spinal Cord Med, 2003. 26: 358.
https://pubmed.ncbi.nlm.nih.gov/14992337
266. Del Popolo, G., *et al.* Neurogenic detrusor overactivity treated with english botulinum toxin a: 8-year experience of one single centre. Eur Urol, 2008. 53: 1013.
https://pubmed.ncbi.nlm.nih.gov/17950989
267. Reitz, A., *et al.* European experience of 200 cases treated with botulinum-A toxin injections into the detrusor muscle for urinary incontinence due to neurogenic detrusor overactivity. Eur Urol, 2004. 45: 510.
https://pubmed.ncbi.nlm.nih.gov/15041117
268. Yuan, H., *et al.* Efficacy and Adverse Events Associated With Use of OnabotulinumtoxinA for Treatment of Neurogenic Detrusor Overactivity: A Meta-Analysis. International Neurourology Journal, 2017. 21: 53.
https://pubmed.ncbi.nlm.nih.gov/28361515
269. Cheng, T., *et al.* Efficacy and Safety of OnabotulinumtoxinA in Patients with Neurogenic Detrusor Overactivity: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. PLoS One, 2016. 11: e0159307.
https://pubmed.ncbi.nlm.nih.gov/27463810
270. Wagle Shukla, A., *et al.* Botulinum Toxin Therapy for Parkinson's Disease. Semin Neurol, 2017. 37: 193.
https://pubmed.ncbi.nlm.nih.gov/28511260
271. Wu, S.J., *et al.* Clinical outcomes of botulinum toxin A management for neurogenic detrusor overactivity: meta-analysis. Ren Fail, 2019. 41: 937.
https://pubmed.ncbi.nlm.nih.gov/31599184
272. Chen, S.F., *et al.* Satisfaction with Detrusor OnabotulinumtoxinA Injections and Conversion to Other Bladder Management in Patients with Chronic Spinal Cord Injury. Toxins (Basel), 2022. 14.
https://pubmed.ncbi.nlm.nih.gov/35051012
273. Baron, M., *et al.* Long-Term Discontinuation of Botulinum Toxin A Intradetrusor Injections for Neurogenic Detrusor Overactivity: A Multicenter Study. J Urol, 2019. 201: 769.
https://pubmed.ncbi.nlm.nih.gov/30359679
274. Leitner, L., *et al.* More Than 15 Years of Experience with Intradetrusor OnabotulinumtoxinA Injections for Treating Refractory Neurogenic Detrusor Overactivity: Lessons to Be Learned. Eur Urol, 2016. 70: 522.
https://pubmed.ncbi.nlm.nih.gov/27106070

275. Koschorke, M., *et al.* Intradetrusor onabotulinumtoxinA injections for refractory neurogenic detrusor overactivity incontinence: do we need urodynamic investigation for outcome assessment? BJU Int, 2017. 120: 848.
https://pubmed.ncbi.nlm.nih.gov/28771936
276. Ginsberg, D., *et al.* Phase 3 efficacy and tolerability study of onabotulinumtoxinA for urinary incontinence from neurogenic detrusor overactivity. J Urol, 2012. 187: 2131.
https://pubmed.ncbi.nlm.nih.gov/22503020
277. Grosse, J., *et al.* Success of repeat detrusor injections of botulinum a toxin in patients with severe neurogenic detrusor overactivity and incontinence. Eur Urol, 2005. 47: 653.
https://pubmed.ncbi.nlm.nih.gov/15826758
278. Rovner, E., *et al.* Long-Term Efficacy and Safety of OnabotulinumtoxinA in Patients with Neurogenic Detrusor Overactivity Who Completed 4 Years of Treatment. J Urol, 2016. 196: 801.
https://pubmed.ncbi.nlm.nih.gov/27091236
279. Ni, J., *et al.* Is repeat Botulinum Toxin A injection valuable for neurogenic detrusor overactivity-A systematic review and meta-analysis. Neurourol Urodyn, 2018. 37: 542.
https://pubmed.ncbi.nlm.nih.gov/28745818
280. Michel, F., *et al.* Botulinum Toxin Type A Injection After Failure of Augmentation Enterocystoplasty Performed for Neurogenic Detrusor Overactivity: Preliminary Results of a Salvage Strategy. The ENTEROTOX Study. Urology, 2019. 129: 43.
https://pubmed.ncbi.nlm.nih.gov/30926380
281. Toia, B., *et al.* The efficacy of onabotulinumtoxinA in patients with previous failed augmentation cystoplasty: Cohort series and literature review. Neurourol Urodyn, 2020. 39: 1831.
https://pubmed.ncbi.nlm.nih.gov/32572987
282. Giannantoni, A., *et al.* IncobotulinumtoxinA versus onabotulinumtoxinA intradetrusor injections in patients with neurogenic detrusor overactivity incontinence: a double-blind, randomized, non-inferiority trial. Minerva Urol Nephrol, 2022. 74: 625.
https://pubmed.ncbi.nlm.nih.gov/33769020
283. Cruz, F., *et al.* Efficacy of abobotulinumtoxinA versus onabotulinumtoxinA for the treatment of refractory neurogenic detrusor overactivity: a systematic review and indirect treatment comparison. J Med Econ, 2023. 26: 200.
https://pubmed.ncbi.nlm.nih.gov/36647624
284. Bottet, F., *et al.* Switch to Abobotulinum toxin A may be useful in the treatment of neurogenic detrusor overactivity when intradetrusor injections of Onabotulinum toxin A failed. Neurourol Urodyn, 2018. 37: 291.
https://pubmed.ncbi.nlm.nih.gov/28431196
285. Leu, R., *et al.* Complications of Botox and their Management. Current Urology Reports, 2018. 19: 90.
https://pubmed.ncbi.nlm.nih.gov/30194497
286. Tullman, M., *et al.* Low-dose onabotulinumtoxinA improves urinary symptoms in noncatheterizing patients with MS. Neurology, 2018. 91: e657.
https://pubmed.ncbi.nlm.nih.gov/30030330
287. Cui, Y., *et al.* Trigonal-Sparing vs. Trigonal-Involved OnabotulinumtoxinA Injection for the Treatment of Overactive Bladder: A Systematic Review and Meta-Analysis. Front Neurol, 2021. 12: 651635.
https://pubmed.ncbi.nlm.nih.gov/34690904
288. Tyagi, P., *et al.* Past, Present and Future of Chemodenervation with Botulinum Toxin in the Treatment of Overactive Bladder. J Urol, 2017. 197: 982.
https://pubmed.ncbi.nlm.nih.gov/27871929
289. Young, M.J., *et al.* Another Therapeutic Role for Intravesical Botulinum Toxin: Patients with Long-stay Catheters and Refractory Bladder Pain and Catheter Bypass Leakage. Eur Urol Focus, 2020. 6: 339.
https://pubmed.ncbi.nlm.nih.gov/30392867
290. Wu, S.Y., *et al.* Satisfaction with Surgical Procedures and Bladder Management of Chronic Spinal Cord Injured Patients with Voiding Dysfunction Who Desire Spontaneous Voiding. J Pers Med, 2022. 12.
https://pubmed.ncbi.nlm.nih.gov/36294890
291. Lee, C.L., *et al.* Real-World Data Regarding Satisfaction to Botulinum Toxin A Injection into the Urethral Sphincter and Further Bladder Management for Voiding Dysfunction among Patients with Spinal Cord Injury and Voiding Dysfunction. Toxins (Basel), 2022. 14.
https://pubmed.ncbi.nlm.nih.gov/35051007
292. Popat, S., *et al.* Sphincteric Injection of Botulinum Toxin for Urinary Retention due to Neurogenic Bladder. Current Bladder Dysfunction Reports, 2022. 17: 179.
https://link.springer.com/article/10.1007/s11884-022-00657-4

293. Utomo, E., *et al.* Surgical management of functional bladder outlet obstruction in adults with neurogenic bladder dysfunction. Cochrane Database Syst Rev, 2014. 5: CD004927. https://pubmed.ncbi.nlm.nih.gov/24859260
294. Bennett, J.K., *et al.* Collagen injections for intrinsic sphincter deficiency in the neuropathic urethra. Paraplegia, 1995. 33: 697. https://pubmed.ncbi.nlm.nih.gov/8927407
295. Block, C.A., *et al.* Long-term efficacy of periurethral collagen injection for the treatment of urinary incontinence secondary to myelomeningocele. J Urol, 2003. 169: 327. https://pubmed.ncbi.nlm.nih.gov/12478183
296. Schurch, B., *et al.* Intraurethral sphincter prosthesis to treat hyporeflexic bladders in women: does it work? BJU Int, 1999. 84: 789. https://pubmed.ncbi.nlm.nih.gov/10532973
297. Reuvers, S.H.M., *et al.* Heterogeneity in reporting on urinary outcome and cure after surgical interventions for stress urinary incontinence in adult neuro-urological patients: A systematic review. Neurourol Urodyn, 2018. 37: 554. https://pubmed.ncbi.nlm.nih.gov/28792081
298. Cardozo, L., *et al.*, Incontinence 7th Edition ICI-ICS. Vol. 7th 2023, Bristol, UK.
299. Barthold, J.S., *et al.* Results of the rectus fascial sling and wrap procedures for the treatment of neurogenic sphincteric incontinence. J Urol, 1999. 161: 272. https://pubmed.ncbi.nlm.nih.gov/10037423
300. Musco, S., *et al.* Efficacy and Safety of Surgical Treatments for Neurogenic Stress Urinary Incontinence in Adults: A Systematic Review. Eur Urol Focus, 2022. 8: 1090. https://pubmed.ncbi.nlm.nih.gov/34509413
301. Sarrazin, C., *et al.* Synthetic Mid-urethral Sling for the Treatment of Urinary Incontinence in Women With Neurogenic Lower Urinary Tract Dysfunction: A Multicentric Retrospective Study. J Urol, 2023. 209: 1176. https://pubmed.ncbi.nlm.nih.gov/36812396
302. Pannek, J., *et al.* Management of stress urinary incontinence in female patients with spinal cord injury by autologous fascial sling: time for a revival? Spinal Cord Ser Cases, 2022. 8: 57. https://pubmed.ncbi.nlm.nih.gov/35610208
303. Deytrikh, A., *et al.* Autologous fascial slings for stress urinary incontinence in patients with neuropathic bladder. Spinal Cord Ser Cases, 2022. 8: 25. https://pubmed.ncbi.nlm.nih.gov/35210403
304. Light, J.K., *et al.* Use of the artificial urinary sphincter in spinal cord injury patients. J Urol, 1983. 130: 1127. https://pubmed.ncbi.nlm.nih.gov/6644893
305. Farag, F., *et al.* Surgical treatment of neurogenic stress urinary incontinence: A systematic review of quality assessment and surgical outcomes. Neurourol Urodyn, 2016. 35: 21. https://pubmed.ncbi.nlm.nih.gov/25327633
306. Kim, S.P., *et al.* Long-term durability and functional outcomes among patients with artificial urinary sphincters: a 10-year retrospective review from the University of Michigan. J Urol, 2008. 179: 1912. https://pubmed.ncbi.nlm.nih.gov/18353376
307. Wang, R., *et al.* Long-term outcomes after primary failures of artificial urinary sphincter implantation. Urology, 2012. 79: 922. https://pubmed.ncbi.nlm.nih.gov/22305763
308. Guillot-Tantay, C., *et al.* [Male neurogenic stress urinary incontinence treated by artificial urinary sphincter AMS 800 (Boston Scientific, Boston, USA): Very long-term results (>25 years)]. Prog Urol, 2018. 28: 39. https://pubmed.ncbi.nlm.nih.gov/29102375
309. Phe, V., *et al.* Stress urinary incontinence in female neurological patients: long-term functional outcomes after artificial urinary sphincter (AMS 800(TM)) implantation. Neurourol Urodyn, 2017. 36: 764. https://pubmed.ncbi.nlm.nih.gov/27080729
310. Chartier-Kastler, E., *et al.* Outcomes of robot-assisted urinary sphincter implantation for male neurogenic urinary incontinence. BJU Int, 2022. 129: 243. https://pubmed.ncbi.nlm.nih.gov/34174147
311. Scott, K.A., *et al.* Use of Artificial Urinary Sphincter and Slings to Manage Neurogenic Bladder Following Spinal Cord Injury-Is It Safe? Current Bladder Dysfunction Reports 2017. 12: 311. https://doi.org/10.1007/s11884-017-0449-9

312. Tricard, T., *et al.* Outcomes of artificial urinary sphincter in female with neurological stress urinary incontinence: a long-term follow-up. World J Urol, 2021. 39: 157.
https://pubmed.ncbi.nlm.nih.gov/32052128
313. Gasmi, A., *et al.* Long-term outcomes of artificial urinary sphincter in female patients with spina bifida. Neurourol Urodyn, 2021. 40: 412.
https://pubmed.ncbi.nlm.nih.gov/33197064
314. Ruggiero, M., *et al.* Single center experience and long-term outcomes of implantable devices ACT and Pro-ACT (Uromedica, Irvin, CA, USA) - Adjustable continence Therapy for treatment of stress urinary incontinence. Prog Urol, 2023. 33: 96.
https://pubmed.ncbi.nlm.nih.gov/36572628
315. Demeestere, A., *et al.* Adjustable continence therapy (ACT(R)) balloons to treat neurogenic and non-neurogenic female urinary incontinence. Neurourol Urodyn, 2022. 41: 313.
https://pubmed.ncbi.nlm.nih.gov/34633672
316. Ronzi, Y., *et al.* Neurogenic stress urinary incontinence: is there a place for Adjustable Continence Therapy (ACT and ProACT, Uromedica, Plymouth, MN, USA)? A retrospective multicenter study. Spinal Cord, 2019. 57: 388.
https://pubmed.ncbi.nlm.nih.gov/30626977
317. Donnahoo, K.K., *et al.* The Young-Dees-Leadbetter bladder neck repair for neurogenic incontinence. J Urol, 1999. 161: 1946.
https://pubmed.ncbi.nlm.nih.gov/10332478
318. Kropp, K.A., *et al.* Urethral lengthening and reimplantation for neurogenic incontinence in children. J Urol, 1986. 135: 533.
https://pubmed.ncbi.nlm.nih.gov/3944902
319. Salle, J.L., *et al.* Urethral lengthening with anterior bladder wall flap (Pippi Salle procedure): modifications and extended indications of the technique. J Urol, 1997. 158: 585.
https://pubmed.ncbi.nlm.nih.gov/9224369
320. Rawashdeh, Y.F., *et al.* International Children's Continence Society's recommendations for therapeutic intervention in congenital neuropathic bladder and bowel dysfunction in children. Neurourol Urodyn, 2012. 31: 615.
https://pubmed.ncbi.nlm.nih.gov/22532368
321. Noordhoff, T.C., *et al.* Surgical Management of Anatomic Bladder Outlet Obstruction in Males with Neurogenic Bladder Dysfunction: A Systematic Review. Eur Urol Focus, 2019. 5: 875.
https://pubmed.ncbi.nlm.nih.gov/29551557
322. Roth, B., *et al.* Benign prostatic obstruction and parkinson's disease--should transurethral resection of the prostate be avoided? J Urol, 2009. 181: 2209.
https://pubmed.ncbi.nlm.nih.gov/19296974
323. Chang, T.L., *et al.* Surgical outcome of male patients with chronic central nervous system disorders and voiding dysfunction due to bladder outlet obstruction. Int Urol Nephrol, 2022. 54: 2511.
https://pubmed.ncbi.nlm.nih.gov/35821368
324. Cornejo-Davila, V., *et al.* Incidence of Urethral Stricture in Patients With Spinal Cord Injury Treated With Clean Intermittent Self-Catheterization. Urology, 2017. 99: 260.
https://pubmed.ncbi.nlm.nih.gov/27566143
325. Perkash, I. Ablation of urethral strictures using contact chisel crystal firing neodymium:YAG laser. J Urol, 1997. 157: 809.
https://pubmed.ncbi.nlm.nih.gov/9072572
326. Gonzalez-Espinosa, C., *et al.* Diagnosis and treatment of urethral stricture in men with neurogenic lower urinary tract dysfunction: A systematic review. Neurourol Urodyn, 2022. 41: 1248.
https://pubmed.ncbi.nlm.nih.gov/35686544
327. Schurch, B., *et al.* Botulinum toxin type a is a safe and effective treatment for neurogenic urinary incontinence: results of a single treatment, randomized, placebo controlled 6-month study. J Urol, 2005. 174: 196.
https://pubmed.ncbi.nlm.nih.gov/15947626
328. Madersbacher, H., *et al.* Twelve o'clock sphincterotomy: technique, indications, results. (Abbreviated report). Urol Int, 1975. 30: 75.
https://pubmed.ncbi.nlm.nih.gov/1118951
329. Perkash, I. Laser sphincterotomy and ablation of the prostate using a sapphire chisel contact tip firing neodymium:YAG laser. J Urol, 1994. 152: 2020.
https://pubmed.ncbi.nlm.nih.gov/7966667

330. Noll, F., *et al.* Transurethral sphincterotomy in quadriplegic patients: long-term-follow-up. Neurourol Urodyn, 1995. 14: 351.
https://pubmed.ncbi.nlm.nih.gov/7581471
331. Chancellor, M.B., *et al.* Prospective comparison of external sphincter balloon dilatation and prosthesis placement with external sphincterotomy in spinal cord injured men. Arch Phys Med Rehabil, 1994. 75: 297.
https://pubmed.ncbi.nlm.nih.gov/8129583
332. Derry, F., *et al.* Audit of bladder neck resection in spinal cord injured patients. Spinal Cord, 1998. 36: 345.
https://pubmed.ncbi.nlm.nih.gov/9601115
333. Chancellor, M.B., *et al.* Long-term followup of the North American multicenter UroLume trial for the treatment of external detrusor-sphincter dyssynergia. J Urol, 1999. 161: 1545.
https://pubmed.ncbi.nlm.nih.gov/10210393
334. Seoane-Rodriguez, S., *et al.* Long-term follow-up study of intraurethral stents in spinal cord injured patients with detrusor-sphincter dyssynergia. Spinal Cord, 2007. 45: 621.
https://pubmed.ncbi.nlm.nih.gov/17211463
335. Gajewski, J.B., *et al.* Removal of UroLume endoprosthesis: experience of the North American Study Group for detrusor-sphincter dyssynergia application. J Urol, 2000. 163: 773.
https://pubmed.ncbi.nlm.nih.gov/10687974
336. Wilson, T.S., *et al.* UroLume stents: lessons learned. J Urol, 2002. 167: 2477.
https://pubmed.ncbi.nlm.nih.gov/11992061
337. Abdul-Rahman, A., *et al.* A 20-year follow-up of the mesh wallstent in the treatment of detrusor external sphincter dyssynergia in patients with spinal cord injury. BJU Int, 2010. 106: 1510.
https://pubmed.ncbi.nlm.nih.gov/20500511
338. Pannek, J., *et al.* Clinical usefulness of the memokath stent as a second-line procedure after sphincterotomy failure. J Endourol, 2011. 25: 335.
https://pubmed.ncbi.nlm.nih.gov/20977372
339. Polguer, T., *et al.* [Treatment of detrusor-striated sphincter dyssynergia with permanent nitinol urethral stent: results after a minimum follow-up of 2 years]. Prog Urol, 2012. 22: 1058.
https://pubmed.ncbi.nlm.nih.gov/23182120
340. van der Merwe, A., *et al.* Outcome of dual flange metallic urethral stents in the treatment of neuropathic bladder dysfunction after spinal cord injury. J Endourol, 2012. 26: 1210.
https://pubmed.ncbi.nlm.nih.gov/22519741
341. Brindley, G.S. An implant to empty the bladder or close the urethra. J Neurol Neurosurg Psychiatry, 1977. 40: 358.
https://pubmed.ncbi.nlm.nih.gov/406364
342. Krasmik, D., *et al.* Urodynamic results, clinical efficacy, and complication rates of sacral intradural deafferentation and sacral anterior root stimulation in patients with neurogenic lower urinary tract dysfunction resulting from complete spinal cord injury. Neurourol Urodyn, 2014. 33: 1202.
https://pubmed.ncbi.nlm.nih.gov/24038405
343. Benard, A., *et al.* Comparative cost-effectiveness analysis of sacral anterior root stimulation for rehabilitation of bladder dysfunction in spinal cord injured patients. Neurosurgery, 2013. 73: 600.
https://pubmed.ncbi.nlm.nih.gov/23787880
344. Martens, F.M., *et al.* Quality of life in complete spinal cord injury patients with a Brindley bladder stimulator compared to a matched control group. Neurourol Urodyn, 2011. 30: 551.
https://pubmed.ncbi.nlm.nih.gov/21328472
345. Guiho, T., *et al.* Sacral Anterior Root Stimulation and Visceral Function Outcomes in Spinal Cord Injury-A Systematic Review of the Literature Over Four Decades. World Neurosurg, 2022. 157: 218.
https://pubmed.ncbi.nlm.nih.gov/34547528
346. Krebs, J., *et al.* Long-term course of sacral anterior root stimulation in spinal cord injured individuals: The fate of the detrusor. Neurourol Urodyn, 2017. 36: 1596.
https://pubmed.ncbi.nlm.nih.gov/27778371
347. Krebs, J., *et al.* Charcot arthropathy of the spine in spinal cord injured individuals with sacral deafferentation and anterior root stimulator implantation. Neurourol Urodyn, 2016. 35: 241.
https://pubmed.ncbi.nlm.nih.gov/25524388
348. Nagib, A., *et al.* Successful control of selective anterior sacral rhizotomy for treatment of spastic bladder and ureteric reflux in paraplegics. Med Serv J Can, 1966. 22: 576.
https://pubmed.ncbi.nlm.nih.gov/5966992

349. Schneidau, T., *et al.* Selective sacral rhizotomy for the management of neurogenic bladders in spina bifida patients: long-term followup. J Urol, 1995. 154: 766.
https://pubmed.ncbi.nlm.nih.gov/7609174
350. Young, B., *et al.* Percutaneous sacral rhizotomy for neurogenic detrusor hyperreflexia. J Neurosurg, 1980. 53: 85.
https://pubmed.ncbi.nlm.nih.gov/7411212
351. Koldewijn, E.L., *et al.* Bladder compliance after posterior sacral root rhizotomies and anterior sacral root stimulation. J Urol, 1994. 151: 955.
https://pubmed.ncbi.nlm.nih.gov/8126835
352. Singh, G., *et al.* Intravesical oxybutynin in patients with posterior rhizotomies and sacral anterior root stimulators. Neurourol Urodyn, 1995. 14: 65.
https://pubmed.ncbi.nlm.nih.gov/7742851
353. Van Kerrebroeck, P.E., *et al.* Results of the treatment of neurogenic bladder dysfunction in spinal cord injury by sacral posterior root rhizotomy and anterior sacral root stimulation. J Urol, 1996. 155: 1378.
https://pubmed.ncbi.nlm.nih.gov/8632580
354. Kutzenberger, J. Surgical therapy of neurogenic detrusor overactivity (hyperreflexia) in paraplegic patients by sacral deafferentation and implant driven micturition by sacral anterior root stimulation: methods, indications, results, complications, and future prospects. Acta Neurochir Suppl, 2007. 97: 333.
https://pubmed.ncbi.nlm.nih.gov/17691394
355. Bhadra, N., *et al.* Selective suppression of sphincter activation during sacral anterior nerve root stimulation. Neurourol Urodyn, 2002. 21: 55.
https://pubmed.ncbi.nlm.nih.gov/11835425
356. Kirkham, A.P., *et al.* Neuromodulation through sacral nerve roots 2 to 4 with a Finetech-Brindley sacral posterior and anterior root stimulator. Spinal Cord, 2002. 40: 272.
https://pubmed.ncbi.nlm.nih.gov/12037708
357. Schumacher, S., *et al.* Extradural cold block for selective neurostimulation of the bladder: development of a new technique. J Urol, 1999. 161: 950.
https://pubmed.ncbi.nlm.nih.gov/10022732
358. Liechti, M.D., *et al.* Sacral Neuromodulation for Neurogenic Lower Urinary Tract Dysfunction. NEJM Evidence, 2022. 1: EVIDoa2200071.
https://evidence.nejm.org/doi/full/10.1056/EVIDoa2200071
359. Greenberg, D.R., *et al.* Sacral Nerve Stimulation in Parkinson's Disease Patients With Overactive Bladder Symptoms. Urology, 2020. 144: 99.
https://pubmed.ncbi.nlm.nih.gov/32681915
360. Kessler, T.M., *et al.* Sacral neuromodulation for neurogenic lower urinary tract dysfunction: systematic review and meta-analysis. Eur Urol, 2010. 58: 865.
https://pubmed.ncbi.nlm.nih.gov/20934242
361. van Ophoven, A., *et al.* Systematic Literature Review and Meta-Analysis of Sacral Neuromodulation (SNM) in Patients with Neurogenic Lower Urinary Tract Dysfunction (nLUTD): Over 20 Years' Experience and Future Directions. Adv Ther, 2021. 38: 1987.
https://pubmed.ncbi.nlm.nih.gov/33713279
362. Guitynavard, F., *et al.* Percutaneous posterior tibial nerve stimulation (PTNS) for lower urinary tract symptoms (LUTSs) treatment in patients with multiple sclerosis (MS): A systematic review and meta-analysis. Mult Scler Relat Disord, 2022. 58: 103392.
https://pubmed.ncbi.nlm.nih.gov/35216773
363. Pericolini, M., *et al.* Cortical, Spinal, Sacral, and Peripheral Neuromodulations as Therapeutic Approaches for the Treatment of Lower Urinary Tract Symptoms in Multiple Sclerosis Patients: A Review. Neuromodulation, 2022. 25: 1065.
https://pubmed.ncbi.nlm.nih.gov/34496454
364. Pattanshetti, S., *et al.* Transcutaneous Electrical Nerve Stimulation in Management of Neurogenic bladder Secondary to Spina Bifida. J Indian Assoc Pediatr Surg, 2022. 27: 570.
https://pubmed.ncbi.nlm.nih.gov/36530811
365. Jorg, E., *et al.* Deep brain stimulation effects on lower urinary tract function: Systematic review and meta-analysis. Parkinsonism Relat Disord, 2020. 79: 65.
https://pubmed.ncbi.nlm.nih.gov/32889502
366. Sartori, A.M., *et al.* Effects of Deep Brain Stimulation on Lower Urinary Tract Function in Neurological Patients. Eur Urol Focus, 2022. 8: 1775.
https://pubmed.ncbi.nlm.nih.gov/35662503

367. Zhang, Y.H., *et al.* Enveloping the bladder with displacement of flap of the rectus abdominis muscle for the treatment of neurogenic bladder. J Urol, 1990. 144: 1194.
https://pubmed.ncbi.nlm.nih.gov/2146404
368. Stenzl, A., *et al.* Restoration of voluntary emptying of the bladder by transplantation of innervated free skeletal muscle. Lancet, 1998. 351: 1483.
https://pubmed.ncbi.nlm.nih.gov/9605805
369. Gakis, G., *et al.* Functional detrusor myoplasty for bladder acontractility: long-term results. J Urol, 2011. 185: 593.
https://pubmed.ncbi.nlm.nih.gov/21168866
370. Ninkovic, M., *et al.* The latissimus dorsi detrusor myoplasty for functional treatment of bladder acontractility. Clin Plast Surg, 2012. 39: 507.
https://pubmed.ncbi.nlm.nih.gov/23036300
371. Duel, B.P., *et al.* Alternative techniques for augmentation cystoplasty. J Urol, 1998. 159: 998.
https://pubmed.ncbi.nlm.nih.gov/9474216
372. Snow, B.W., *et al.* Bladder autoaugmentation. Urol Clin North Am, 1996. 23: 323.
https://pubmed.ncbi.nlm.nih.gov/8659030
373. Stohrer, M., *et al.* Bladder auto-augmentation--an alternative for enterocystoplasty: preliminary results. Neurourol Urodyn, 1995. 14: 11.
https://pubmed.ncbi.nlm.nih.gov/7742844
374. Stohrer, M., *et al.* Bladder autoaugmentation in adult patients with neurogenic voiding dysfunction. Spinal Cord, 1997. 35: 456.
https://pubmed.ncbi.nlm.nih.gov/9232751
375. Vainrib, M., *et al.* Differences in urodynamic study variables in adult patients with neurogenic bladder and myelomeningocele before and after augmentation enterocystoplasty. Neurourol Urodyn, 2013. 32: 250.
https://pubmed.ncbi.nlm.nih.gov/22965686
376. Krebs, J., *et al.* Functional outcome of supratrigonal cystectomy and augmentation ileocystoplasty in adult patients with refractory neurogenic lower urinary tract dysfunction. Neurourol Urodyn, 2016. 35: 260.
https://pubmed.ncbi.nlm.nih.gov/25524480
377. 't Hoen, L., *et al.* Long-term effectiveness and complication rates of bladder augmentation in patients with neurogenic bladder dysfunction: A systematic review. Neurourol Urodyn, 2017. 36: 1685.
https://pubmed.ncbi.nlm.nih.gov/28169459
378. Trojan, K.C., *et al.* Improvement of bladder function after bladder augmentation surgery: a report of 26 years of clinical experience. Pediatr Surg Int, 2022. 38: 941.
https://pubmed.ncbi.nlm.nih.gov/35348841
379. Romero-Maroto, J., *et al.* Long-term effectiveness and safety of bladder augmentation in spina bifida patients. Neurourol Urodyn, 2021. 40: 1576.
https://pubmed.ncbi.nlm.nih.gov/34082472
380. Wang, Z., *et al.* Effectiveness and Complications of Augmentation Cystoplasty with or without Nonrefluxing Ureteral Reimplantation in Patients with Bladder Dysfunction: A Single Center 11-Year Experience. Journal of Urology, 2018. 199: 200.
https://pubmed.ncbi.nlm.nih.gov/28743527
381. Myers, J.B., *et al.* The effects of augmentation cystoplasty and botulinum toxin injection on patient-reported bladder function and quality of life among individuals with spinal cord injury performing clean intermittent catheterization. Neurourol Urodyn, 2019. 38: 285.
https://pubmed.ncbi.nlm.nih.gov/30375055
382. Mitsui, T., *et al.* Preoperative renal scar as a risk factor of postoperative metabolic acidosis following ileocystoplasty in patients with neurogenic bladder. Spinal Cord, 2014. 52: 292.
https://pubmed.ncbi.nlm.nih.gov/24469144
383. Balanca, A., *et al.* Long-term clinical and urodynamic effectiveness of augmentation ileocystoplasty with supra-trigonal cystectomy in individuals with spinal cord injury. World J Urol, 2022. 40: 2121.
https://pubmed.ncbi.nlm.nih.gov/35680652
384. Perrouin-Verbe, M.A., *et al.* Long-term functional outcomes of augmentation cystoplasty in adult spina bifida patients: A single-center experience in a multidisciplinary team. Neurourol Urodyn, 2019. 38: 330.
https://pubmed.ncbi.nlm.nih.gov/30350892
385. Frainey, B.T., *et al.* Complications of Pediatric Bladder Reconstruction in the Adult Patient. Current Bladder Dysfunction Reports, 2020. 15: 173.
https://doi.org/10.1007/s11884-020-00584-2

386. Moreno, J.G., *et al.* Improved quality of life and sexuality with continent urinary diversion in quadriplegic women with umbilical stoma. Arch Phys Med Rehabil, 1995. 76: 758.
https://pubmed.ncbi.nlm.nih.gov/7632132
387. Peterson, A.C., *et al.* Urinary diversion in patients with spinal cord injury in the United States. Urology, 2012. 80: 1247.
https://pubmed.ncbi.nlm.nih.gov/23206770
388. Sylora, J.A., *et al.* Intermittent self-catheterization by quadriplegic patients via a catheterizable Mitrofanoff channel. J Urol, 1997. 157: 48.
https://pubmed.ncbi.nlm.nih.gov/8976213
389. Van Savage, J.G., *et al.* Transverse retubularized sigmoidovesicostomy continent urinary diversion to the umbilicus. J Urol, 2001. 166: 644.
https://pubmed.ncbi.nlm.nih.gov/11458110
390. Vanni, A.J., *et al.* Ileovesicostomy for the neurogenic bladder patient: outcome and cost comparison of open and robotic assisted techniques. Urology, 2011. 77: 1375.
https://pubmed.ncbi.nlm.nih.gov/21146864
391. Wiener, J.S., *et al.* Bladder augmentation versus urinary diversion in patients with spina bifida in the United States. J Urol, 2011. 186: 161.
https://pubmed.ncbi.nlm.nih.gov/21575969
392. Cheng, P.J., *et al.* Contemporary multicenter outcomes of continent cutaneous ileocecocystoplasty in the adult population over a 10-year period: A Neurogenic Bladder Research Group study. Neurourol Urodyn, 2020. 39: 1771.
https://pubmed.ncbi.nlm.nih.gov/32506711
393. Phe, V., *et al.* Continent catheterizable tubes/stomas in adult neuro-urological patients: A systematic review. Neurourol Urodyn, 2017. 36: 1711.
https://pubmed.ncbi.nlm.nih.gov/28139848
394. Gharbi, M., *et al.* Quality of life in neurogenic patients based on different bladder management methods: A review. Prog Urol, 2022. 32: 784.
https://pubmed.ncbi.nlm.nih.gov/35941011
395. Atan, A., *et al.* Advantages and risks of ileovesicostomy for the management of neuropathic bladder. Urology, 1999. 54: 636.
https://pubmed.ncbi.nlm.nih.gov/10510920
396. Cass, A.S., *et al.* A 22-Year Followup of Ileal Conduits in Children with a Neurogenic Bladder. Journal of Urology, 1984. 132: 529.
https://pubmed.ncbi.nlm.nih.gov/6471190
397. Hald, T., *et al.* Vesicostomy--an alternative urine diversion operation. Long term results. Scand J Urol Nephrol, 1978. 12: 227.
https://pubmed.ncbi.nlm.nih.gov/725543
398. Schwartz, S.L., *et al.* Incontinent ileo-vesicostomy urinary diversion in the treatment of lower urinary tract dysfunction. J Urol, 1994. 152: 99.
https://pubmed.ncbi.nlm.nih.gov/8201699
399. Sakhri, R., *et al.* [Laparoscopic cystectomy and ileal conduit urinary diversion for neurogenic bladders and related conditions. Morbidity and better quality of life]. Prog Urol, 2015. 25: 342.
https://pubmed.ncbi.nlm.nih.gov/25726693
400. Akakpo, W., *et al.* Outcomes of ileal conduit urinary diversion in patients with multiple sclerosis. Neurourol Urodyn, 2020. 39: 771.
https://pubmed.ncbi.nlm.nih.gov/31951678
401. Mazouin, C., *et al.* Robot-Assisted Cystectomy and Ileal Conduit for Neurogenic Bladder: Comparison of Extracorporeal vs Intracorporeal Urinary Diversion. J Endourol, 2021. 35: 1350.
https://pubmed.ncbi.nlm.nih.gov/33499755
402. Haudebert, C., *et al.* Cystectomy and ileal conduit for neurogenic bladder: Comparison of the open, laparoscopic and robotic approaches. Neurourol Urodyn, 2022. 41: 601.
https://pubmed.ncbi.nlm.nih.gov/34962653
403. Chkir, S., *et al.* Non-continent Urinary Diversion (Ileal Conduit) as Salvage Therapy in Patients With Refractory Lower Urinary Tract Dysfunctions due to Multiple Sclerosis: Results of a National Cohort From the French Association of Urology (AFU) Neurourology Committee and the French-speaking Neurourology Study Group (GENULF). Urology, 2022. 168: 216.
https://pubmed.ncbi.nlm.nih.gov/35768028
404. Beirnaert, J., *et al.* Robotic versus open cystectomy with ileal conduit for the management of neurogenic bladder: a comparative study. World J Urol, 2022. 40: 2963.
https://pubmed.ncbi.nlm.nih.gov/36280600

405. Herschorn, S., *et al.* Urinary undiversion in adults with myelodysplasia: long-term followup. J Urol, 1994. 152: 329.
https://pubmed.ncbi.nlm.nih.gov/8015064
406. Sartori, A.M., *et al.* Definitions of Urinary Tract Infection Used in Interventional Studies Involving Neurourological Patients-A Systematic Review. Eur Urol Focus, 2022. 8: 1386.
https://pubmed.ncbi.nlm.nih.gov/34404618
407. Mukai, S., *et al.* Retrospective study for risk factors for febrile UTI in spinal cord injury patients with routine concomitant intermittent catheterization in outpatient settings. Spinal Cord, 2016. 54: 69.
https://pubmed.ncbi.nlm.nih.gov/26458969
408. Everett, R.G., *et al.* Factors associated with recurrent urinary tract infections in spinal cord injured patients who use intermittent catheterization. Can J Urol, 2021. 28: 10920.
https://pubmed.ncbi.nlm.nih.gov/34895397
409. Vasudeva, P., *et al.* Factors implicated in pathogenesis of urinary tract infections in neurogenic bladders: some revered, few forgotten, others ignored. Neurourol Urodyn, 2014. 33: 95.
https://pubmed.ncbi.nlm.nih.gov/23460489
410. Ruijuan, Z., *et al.* Effects of Catheter Tracking Management on Urinary Tract Function and Infection Rates in Patients With Spinal Cord Injury. Altern Ther Health Med, 2023. 29: 104.
https://pubmed.ncbi.nlm.nih.gov/36634314
411. Welk, B., *et al.* Differences in the incidence of urinary tract infections between neurogenic and non-neurogenic bladder dysfunction individuals performing intermittent catheterization. Neurourol Urodyn, 2022. 41: 1002.
https://pubmed.ncbi.nlm.nih.gov/35332597
412. Zhou, L., *et al.* Early warning model construction and validation for urinary tract infection in patients with neurogenic lower urinary tract dysfunction (NLUTD): a retrospective study. PeerJ, 2022. 10: e13388.
https://pubmed.ncbi.nlm.nih.gov/35539015
413. Lenherr, S.M., *et al.* Glycemic Control and Urinary Tract Infections in Women with Type 1 Diabetes: Results from the DCCT/EDIC. J Urol, 2016. 196: 1129.
https://pubmed.ncbi.nlm.nih.gov/27131462
414. Bakke, A., *et al.* Bacteriuria in patients treated with clean intermittent catheterization. Scand J Infect Dis, 1991. 23: 577.
https://pubmed.ncbi.nlm.nih.gov/1767253
415. Waites, K.B., *et al.* Epidemiology and risk factors for urinary tract infection following spinal cord injury. Arch Phys Med Rehabil, 1993. 74: 691.
https://pubmed.ncbi.nlm.nih.gov/8328888
416. Nicolle, L.E., *et al.* Infectious Diseases Society of America guidelines for the diagnosis and treatment of asymptomatic bacteriuria in adults. Clin Infect Dis, 2005. 40: 643.
https://pubmed.ncbi.nlm.nih.gov/15714408
417. Wang, W., *et al.* A risk prediction model of urinary tract infections for patients with neurogenic bladder. Int J Neurosci, 2021. 131: 31.
https://pubmed.ncbi.nlm.nih.gov/32075472
418. Wirth, M., *et al.* Retrospective Cohort Study of Patient-Reported Urinary Tract Infection Signs and Symptoms Among Individuals With Neurogenic Bladder. Am J Phys Med Rehabil, 2023. 102: 663.
https://pubmed.ncbi.nlm.nih.gov/36927768
419. Pannek, J. Treatment of urinary tract infection in persons with spinal cord injury: guidelines, evidence, and clinical practice. A questionnaire-based survey and review of the literature. J Spinal Cord Med, 2011. 34: 11.
https://pubmed.ncbi.nlm.nih.gov/21528621
420. Alavinia, S.M., *et al.* Enhancing quality practice for prevention and diagnosis of urinary tract infection during inpatient spinal cord rehabilitation. J Spinal Cord Med, 2017. 40: 803.
https://pubmed.ncbi.nlm.nih.gov/28872426
421. Deville, W.L., *et al.* The urine dipstick test useful to rule out infections. A meta-analysis of the accuracy. BMC Urol, 2004. 4: 4.
https://pubmed.ncbi.nlm.nih.gov/15175113
422. Hoffman, J.M., *et al.* Nitrite and leukocyte dipstick testing for urinary tract infection in individuals with spinal cord injury. J Spinal Cord Med, 2004. 27: 128.
https://pubmed.ncbi.nlm.nih.gov/15162883
423. Biering-Sorensen, F., *et al.* Urinary tract infections in patients with spinal cord lesions: treatment and prevention. Drugs, 2001. 61: 1275.
https://pubmed.ncbi.nlm.nih.gov/11511022

424. Everaert, K., *et al.* Urinary tract infections in spinal cord injury: prevention and treatment guidelines. Acta Clin Belg, 2009. 64: 335.
https://pubmed.ncbi.nlm.nih.gov/19810421
425. Clark, R., *et al.* The ability of prior urinary cultures results to predict future culture results in neurogenic bladder patients. Neurourol Urodyn, 2018. 37: 2645.
https://pubmed.ncbi.nlm.nih.gov/29799144
426. Pannek, J., *et al.* Treatment of Complicated Urinary Tract Infections in Individuals with Chronic Neurogenic Lower Urinary Tract Dysfunction: Are Antibiotics Mandatory? Urol Int, 2018. 100: 434.
https://pubmed.ncbi.nlm.nih.gov/29649808
427. Del Popolo, G., *et al.* Recurrent bacterial symptomatic cystitis: A pilot study on a new natural option for treatment. Arch Ital Urol Androl, 2018. 90: 101.
https://pubmed.ncbi.nlm.nih.gov/29974728
428. Jia, C., *et al.* Detrusor botulinum toxin A injection significantly decreased urinary tract infection in patients with traumatic spinal cord injury. Spinal Cord, 2013. 51: 487.
https://pubmed.ncbi.nlm.nih.gov/23357928
429. Gallien, P., *et al.* Cranberry versus placebo in the prevention of urinary infections in multiple sclerosis: a multicenter, randomized, placebo-controlled, double-blind trial. Mult Scler, 2014. 20: 1252.
https://pubmed.ncbi.nlm.nih.gov/24402038
430. Toh, S.L., *et al.* Probiotics [LGG-BB12 or RC14-GR1] versus placebo as prophylaxis for urinary tract infection in persons with spinal cord injury [ProSCIUTTU]: a randomised controlled trial. Spinal Cord, 2019. 57: 550.
https://pubmed.ncbi.nlm.nih.gov/30814670
431. Lee, B.S., *et al.* Methenamine hippurate for preventing urinary tract infections. Cochrane Database Syst Rev, 2012. 10: CD003265.
https://pubmed.ncbi.nlm.nih.gov/23076896
432. Günther, M., *et al.* Harnwegsinfektprophylaxe. Urinansäuerung mittels L-Methionin bei neurogener Blasenfunktionsstörung. Urologe B, 2002. 42: 218.
https://link.springer.com/article/10.1007/s00131-002-0207-x
433. Hachen, H.J. Oral immunotherapy in paraplegic patients with chronic urinary tract infections: a double-blind, placebo-controlled trial. J Urol, 1990. 143: 759.
https://pubmed.ncbi.nlm.nih.gov/2179584
434. Krebs, J., *et al.* Effects of oral immunomodulation therapy on urinary tract infections in individuals with chronic spinal cord injury-A retrospective cohort study. Neurourol Urodyn, 2019. 38: 346.
https://pubmed.ncbi.nlm.nih.gov/30350886
435. Welk, B., *et al.* Efficacy of antibiotic prophylaxis among intermittent catheter users with different neurologic diseases: A secondary analysis of the AnTIC Trial. Continence, 2022. 1: 100004.
https://doi.org/10.1016/j.cont.2022.100004
436. Poirier, C., *et al.* Prevention of urinary tract infections by antibiotic cycling in spinal cord injury patients and low emergence of multidrug resistant bacteria. Med Mal Infect, 2016. 46: 294.
https://pubmed.ncbi.nlm.nih.gov/27321478
437. Darouiche, R.O., *et al.* Multicenter randomized controlled trial of bacterial interference for prevention of urinary tract infection in patients with neurogenic bladder. Urology, 2011. 78: 341.
https://pubmed.ncbi.nlm.nih.gov/21683991
438. Pannek, J., *et al.* Usefulness of classical homeopathy for the prophylaxis of recurrent urinary tract infections in individuals with chronic neurogenic lower urinary tract dysfunction. J Spinal Cord Med, 2019. 42: 453.
https://pubmed.ncbi.nlm.nih.gov/29485355
439. Moussa, M., *et al.* Bladder irrigation with povidone-iodine prevent recurrent urinary tract infections in neurogenic bladder patients on clean intermittent catheterization. Neurourol Urodyn, 2021. 40: 672.
https://pubmed.ncbi.nlm.nih.gov/33476092
440. Cox, L., *et al.* Gentamicin bladder instillations decrease symptomatic urinary tract infections in neurogenic bladder patients on intermittent catheterization. Can Urol Assoc J, 2017. 11: E350.
https://pubmed.ncbi.nlm.nih.gov/29382457
441. Ziadeh, T., *et al.* Bladder instillation for urinary tract infection prevention in neurogenic bladder patients practicing clean intermittent catheterization: A systematic review. Urologia, 2022. 89: 261.
https://pubmed.ncbi.nlm.nih.gov/34612750
442. Pannek, J., *et al.* Usefulness of classical homoeopathy for the prevention of urinary tract infections in patients with neurogenic bladder dysfunction: A case series. . Indian J Res Homoeopathy, 2014. 8: 31.
https://www.ijrh.org/journal/vol8/iss1/6/

443. Rees, P.M., *et al.* Sexual function in men and women with neurological disorders. Lancet, 2007. 369: 512.
https://pubmed.ncbi.nlm.nih.gov/17292771
444. Lombardi, G., *et al.* Management of sexual dysfunction due to central nervous system disorders: a systematic review. BJU Int, 2015. 115 Suppl 6: 47.
https://pubmed.ncbi.nlm.nih.gov/25599613
445. Salonia, A., *et al.*, EAU Guidelines on sexual and reproductive health, in EAU Guidelines. Edn. presented at the EAU Annual Congress Milan. March 2023.
446. Hentzen, C., *et al.* Approach and management to patients with neurological disorders reporting sexual dysfunction. Lancet Neurol, 2022. 21: 551.
https://pubmed.ncbi.nlm.nih.gov/35405093
447. Foley, F.W., Sexuality, in Multiple Sclerosis: A Guide for Families K. RC., Editor. 2006, Demos Medical Publishing: New York, USA.
448. Annon, J.S., PLISSIT Therapy in Handbook of Innovative Psychotherapies. , R. Corsini, Editor. 1981, Wiley & Sons: New York.
449. Fragala, E., *et al.* Relationship between urodynamic findings and sexual function in multiple sclerosis patients with lower urinary tract dysfunction. Eur J Neurol, 2015. 22: 485.
https://pubmed.ncbi.nlm.nih.gov/25410608
450. Game, X., *et al.* Sexual function of young women with myelomeningocele. J Pediatr Urol, 2014. 10: 418.
https://pubmed.ncbi.nlm.nih.gov/23992838
451. Chen, L., *et al.* Phosphodiesterase 5 inhibitors for the treatment of erectile dysfunction: a trade-off network meta-analysis. Eur Urol, 2015. 68: 674.
https://pubmed.ncbi.nlm.nih.gov/25817916
452. Fowler, C.J., *et al.* A double blind, randomised study of sildenafil citrate for erectile dysfunction in men with multiple sclerosis. J Neurol Neurosurg Psychiatry, 2005. 76: 700.
https://pubmed.ncbi.nlm.nih.gov/15834030
453. Safarinejad, M.R. Expression of Concern: Evaluation of the Safety and Efficacy of Sildenafil Citrate for Erectile Dysfunction in Men With Multiple Sclerosis: A Double-Blind, Placebo Controlled, Randomized Study. J Urol, 2023: 101097JU0000000000003114.
https://pubmed.ncbi.nlm.nih.gov/36626341
454. Streur, C.S., *et al.* Sexual Function of Men and Women With Spina Bifida: A Scoping Literature Review. Sex Med Rev, 2021. 9: 244.
https://pubmed.ncbi.nlm.nih.gov/33608247
455. Lombardi, G., *et al.* Ten years of phosphodiesterase type 5 inhibitors in spinal cord injured patients. J Sex Med, 2009. 6: 1248.
https://pubmed.ncbi.nlm.nih.gov/19210710
456. Lombardi, G., *et al.* Treating erectile dysfunction and central neurological diseases with oral phosphodiesterase type 5 inhibitors. Review of the literature. J Sex Med, 2012. 9: 970.
https://pubmed.ncbi.nlm.nih.gov/22304626
457. Cardenas, D.D., *et al.* Two phase 3, multicenter, randomized, placebo-controlled clinical trials of fampridine-SR for treatment of spasticity in chronic spinal cord injury. Spinal Cord, 2014. 52: 70.
https://pubmed.ncbi.nlm.nih.gov/24216616
458. Strebel, R.T., *et al.* Apomorphine sublingual as primary or secondary treatment for erectile dysfunction in patients with spinal cord injury. BJU Int, 2004. 93: 100.
https://pubmed.ncbi.nlm.nih.gov/14678378
459. Pohanka, M., *et al.* The long-lasting improvement of sexual dysfunction in patients with advanced, fluctuating Parkinson's disease induced by pergolide: evidence from the results of an open, prospective, one-year trial. Parkinsonism Relat Disord, 2005. 11: 509.
https://pubmed.ncbi.nlm.nih.gov/15994112
460. Chancellor, M.B., *et al.* Prospective comparison of topical minoxidil to vacuum constriction device and intracorporeal papaverine injection in treatment of erectile dysfunction due to spinal cord injury. Urology, 1994. 43: 365.
https://pubmed.ncbi.nlm.nih.gov/8134992
461. Cookson, M.S., *et al.* Long-term results with vacuum constriction device. J Urol, 1993. 149: 290.
https://pubmed.ncbi.nlm.nih.gov/8426404
462. Denil, J., *et al.* Vacuum erection device in spinal cord injured men: patient and partner satisfaction. Arch Phys Med Rehabil, 1996. 77: 750.
https://pubmed.ncbi.nlm.nih.gov/8702367
463. Levine, L.A. External devices for treatment of erectile dysfunction. Endocrine, 2004. 23: 157.

https://pubmed.ncbi.nlm.nih.gov/15146095
464. Levine, L.A., *et al.* Vacuum constriction and external erection devices in erectile dysfunction. Urol Clin North Am, 2001. 28: 335.
https://pubmed.ncbi.nlm.nih.gov/11402585
465. Bella, A.J., *et al.* Intracavernous pharmacotherapy for erectile dysfunction. Endocrine, 2004. 23: 149.
https://pubmed.ncbi.nlm.nih.gov/15146094
466. Bodner, D.R., *et al.* The application of intracavernous injection of vasoactive medications for erection in men with spinal cord injury. J Urol, 1987. 138: 310.
https://pubmed.ncbi.nlm.nih.gov/3599245
467. Deforge, D., *et al.* Male erectile dysfunction following spinal cord injury: a systematic review. Spinal Cord, 2006. 44: 465.
https://pubmed.ncbi.nlm.nih.gov/16317419
468. Dinsmore, W.W., *et al.* Treating men with predominantly nonpsychogenic erectile dysfunction with intracavernosal vasoactive intestinal polypeptide and phentolamine mesylate in a novel auto-injector system: a multicentre double-blind placebo-controlled study. BJU Int, 1999. 83: 274.
https://pubmed.ncbi.nlm.nih.gov/10233493
469. Hirsch, I.H., *et al.* Use of intracavernous injection of prostaglandin E1 for neuropathic erectile dysfunction. Paraplegia, 1994. 32: 661.
https://pubmed.ncbi.nlm.nih.gov/7831071
470. Kapoor, V.K., *et al.* Intracavernous papaverine for impotence in spinal cord injured patients. Paraplegia, 1993. 31: 675.
https://pubmed.ncbi.nlm.nih.gov/8259331
471. Vidal, J., *et al.* Intracavernous pharmacotherapy for management of erectile dysfunction in multiple sclerosis patients. Rev Neurol, 1995. 23: 269.
https://pubmed.ncbi.nlm.nih.gov/7497173
472. Bodner, D.R., *et al.* Intraurethral alprostadil for treatment of erectile dysfunction in patients with spinal cord injury. Urology, 1999. 53: 199.
https://pubmed.ncbi.nlm.nih.gov/9886612
473. Gross, A.J., *et al.* Penile prostheses in paraplegic men. Br J Urol, 1996. 78: 262.
https://pubmed.ncbi.nlm.nih.gov/8813925
474. Kimoto, Y., *et al.* Penile prostheses for the management of the neuropathic bladder and sexual dysfunction in spinal cord injury patients: long term follow up. Paraplegia, 1994. 32: 336.
https://pubmed.ncbi.nlm.nih.gov/8058351
475. Zermann, D.H., *et al.* Penile prosthetic surgery in neurologically impaired patients: long-term followup. J Urol, 2006. 175: 1041.
https://pubmed.ncbi.nlm.nih.gov/16469612
476. Fode, M., *et al.* Male sexual dysfunction and infertility associated with neurological disorders. Asian J Androl, 2012. 14: 61.
https://pubmed.ncbi.nlm.nih.gov/22138899
477. Lim, T.C., *et al.* A simple technique to prevent retrograde ejaculation during assisted ejaculation. Paraplegia, 1994. 32: 142.
https://pubmed.ncbi.nlm.nih.gov/8008416
478. Philippon, M., *et al.* Successful pregnancies and healthy live births using frozen-thawed sperm retrieved by a new modified Hotchkiss procedure in males with retrograde ejaculation: first case series. Basic Clin Androl, 2015. 25: 5.
https://pubmed.ncbi.nlm.nih.gov/26034605
479. Arafa, M.M., *et al.* Prostatic massage: a simple method of semen retrieval in men with spinal cord injury. Int J Androl, 2007. 30: 170.
https://pubmed.ncbi.nlm.nih.gov/17298549
480. Kolettis, P.N., *et al.* Fertility outcomes after electroejaculation in men with spinal cord injury. Fertil Steril, 2002. 78: 429.
https://pubmed.ncbi.nlm.nih.gov/12137889
481. Chehensse, C., *et al.* The spinal control of ejaculation revisited: a systematic review and meta-analysis of anejaculation in spinal cord injured patients. Hum Reprod Update, 2013. 19: 507.
https://pubmed.ncbi.nlm.nih.gov/23820516
482. Beretta, G., *et al.* Reproductive aspects in spinal cord injured males. Paraplegia, 1989. 27: 113.
https://pubmed.ncbi.nlm.nih.gov/2717193

483. Brackett, N.L., *et al.* Application of 2 vibrators salvages ejaculatory failures to 1 vibrator during penile vibratory stimulation in men with spinal cord injuries. J Urol, 2007. 177: 660.
https://pubmed.ncbi.nlm.nih.gov/17222653
484. Sonksen, J., *et al.* Ejaculation induced by penile vibratory stimulation in men with spinal cord injuries. The importance of the vibratory amplitude. Paraplegia, 1994. 32: 651.
https://pubmed.ncbi.nlm.nih.gov/7831070
485. Claydon, V.E., *et al.* Cardiovascular responses to vibrostimulation for sperm retrieval in men with spinal cord injury. J Spinal Cord Med, 2006. 29: 207.
https://pubmed.ncbi.nlm.nih.gov/16859224
486. Ekland, M.B., *et al.* Incidence of autonomic dysreflexia and silent autonomic dysreflexia in men with spinal cord injury undergoing sperm retrieval: implications for clinical practice. J Spinal Cord Med, 2008. 31: 33.
https://pubmed.ncbi.nlm.nih.gov/18533409
487. Soler, J.M., *et al.* Midodrine improves ejaculation in spinal cord injured men. J Urol, 2007. 178: 2082.
https://pubmed.ncbi.nlm.nih.gov/17869290
488. Pecori, C., *et al.* Paternal therapy with disease modifying drugs in multiple sclerosis and pregnancy outcomes: a prospective observational multicentric study. BMC Neurol, 2014. 14: 114.
https://pubmed.ncbi.nlm.nih.gov/24884599
489. Brackett, N.L., *et al.* Treatment of infertility in men with spinal cord injury. Nat Rev Urol, 2010. 7: 162.
https://pubmed.ncbi.nlm.nih.gov/20157304
490. Raviv, G., *et al.* Testicular sperm retrieval and intra cytoplasmic sperm injection provide favorable outcome in spinal cord injury patients, failing conservative reproductive treatment. Spinal Cord, 2013. 51: 642.
https://pubmed.ncbi.nlm.nih.gov/23689394
491. Schatte, E.C., *et al.* Treatment of infertility due to anejaculation in the male with electroejaculation and intracytoplasmic sperm injection. J Urol, 2000. 163: 1717.
https://pubmed.ncbi.nlm.nih.gov/10799167
492. Shieh, J.Y., *et al.* A protocol of electroejaculation and systematic assisted reproductive technology achieved high efficiency and efficacy for pregnancy for anejaculatory men with spinal cord injury. Arch Phys Med Rehabil, 2003. 84: 535.
https://pubmed.ncbi.nlm.nih.gov/12690592
493. Taylor, Z., *et al.* Contribution of the assisted reproductive technologies to fertility in males suffering spinal cord injury. Aust N Z J Obstet Gynaecol, 1999. 39: 84.
https://pubmed.ncbi.nlm.nih.gov/10099757
494. Rutkowski, S.B., *et al.* The influence of bladder management on fertility in spinal cord injured males. Spinal Cord, 1995. 33: 263.
https://pubmed.ncbi.nlm.nih.gov/7630651
495. Hamed, S.A., *et al.* Seminal fluid analysis and testicular volume in adults with epilepsy receiving valproate. J Clin Neurosci, 2015. 22: 508.
https://pubmed.ncbi.nlm.nih.gov/25636832
496. Ohl, D.A., *et al.* Electroejaculation versus vibratory stimulation in spinal cord injured men: sperm quality and patient preference. J Urol, 1997. 157: 2147.
https://pubmed.ncbi.nlm.nih.gov/9146603
497. Brackett, N.L., *et al.* Semen quality of spinal cord injured men is better when obtained by vibratory stimulation versus electroejaculation. J Urol, 1997. 157: 151.
https://pubmed.ncbi.nlm.nih.gov/8976239
498. Brackett, N.L., *et al.* Semen retrieval in men with spinal cord injury is improved by interrupting current delivery during electroejaculation. J Urol, 2002. 167: 201.
https://pubmed.ncbi.nlm.nih.gov/11743305
499. DeForge, D., *et al.* Fertility following spinal cord injury: a systematic review. Spinal Cord, 2005. 43: 693.
https://pubmed.ncbi.nlm.nih.gov/15951744
500. Ferreiro-Velasco, M.E., *et al.* Sexual issues in a sample of women with spinal cord injury. Spinal Cord, 2005. 43: 51.
https://pubmed.ncbi.nlm.nih.gov/15303115
501. Kreuter, M., *et al.* Sexuality and sexual life in women with spinal cord injury: a controlled study. J Rehabil Med, 2008. 40: 61.
https://pubmed.ncbi.nlm.nih.gov/18176739

502. Kreuter, M., *et al.* Sexual adjustment and quality of relationship in spinal paraplegia: a controlled study. Arch Phys Med Rehabil, 1996. 77: 541.
https://pubmed.ncbi.nlm.nih.gov/8831469
503. Kessler, T.M., *et al.* Sexual dysfunction in multiple sclerosis. Expert Rev Neurother, 2009. 9: 341.
https://pubmed.ncbi.nlm.nih.gov/19271943
504. Lew-Starowicz, M., *et al.* Prevalence of Sexual Dysfunctions Among Women with Multiple Sclerosis. Sex Disabil, 2013. 31: 141.
https://pubmed.ncbi.nlm.nih.gov/23704801
505. Motta, G.L., *et al.* Sexuality of Female Spina Bifida Patients: Predictors of a Satisfactory Sexual Function. Rev Bras Ginecol Obstet, 2021. 43: 467.
https://pubmed.ncbi.nlm.nih.gov/34318472
506. Motta, G.L., *et al.* The impact of neurogenic bladder bowel dysfunction in the sexuality of female spina bifida patients. J Pediatr Urol, 2021. 17: 288 e1.
https://pubmed.ncbi.nlm.nih.gov/33546979
507. Alexander, M., *et al.* Spinal cord injuries and orgasm: a review. J Sex Marital Ther, 2008. 34: 308.
https://pubmed.ncbi.nlm.nih.gov/18576233
508. McAlonan, S. Improving sexual rehabilitation services: the patient's perspective. Am J Occup Ther, 1996. 50: 826.
https://pubmed.ncbi.nlm.nih.gov/8947375
509. Schopp, L.H., *et al.* Impact of comprehensive gynecologic services on health maintenance behaviours among women with spinal cord injury. Disabil Rehabil, 2002. 24: 899.
https://pubmed.ncbi.nlm.nih.gov/12519485
510. Vikan, J.K., *et al.* Sexual Satisfaction and Associated Biopsychosocial Factors in Stroke Patients Admitted to Specialized Cognitive Rehabilitation. Sex Med, 2021. 9: 100424.
https://pubmed.ncbi.nlm.nih.gov/34474266
511. Reitz, A., *et al.* Impact of spinal cord injury on sexual health and quality of life. Int J Impot Res, 2004. 16: 167.
https://pubmed.ncbi.nlm.nih.gov/14973522
512. Harrison, J., *et al.* Factors associated with sexual functioning in women following spinal cord injury. Paraplegia, 1995. 33: 687.
https://pubmed.ncbi.nlm.nih.gov/8927405
513. Westgren, N., *et al.* Sexuality in women with traumatic spinal cord injury. Acta Obstet Gynecol Scand, 1997. 76: 977.
https://pubmed.ncbi.nlm.nih.gov/9435740
514. Fruhauf, S., *et al.* Efficacy of psychological interventions for sexual dysfunction: a systematic review and meta-analysis. Arch Sex Behav, 2013. 42: 915.
https://pubmed.ncbi.nlm.nih.gov/23559141
515. Sipski, M.L., *et al.* Physiologic parameters associated with sexual arousal in women with incomplete spinal cord injuries. Arch Phys Med Rehabil, 1997. 78: 305.
https://pubmed.ncbi.nlm.nih.gov/9084355
516. Sipski, M.L., *et al.* Sexual arousal and orgasm in women: effects of spinal cord injury. Ann Neurol, 2001. 49: 35.
https://pubmed.ncbi.nlm.nih.gov/11198294
517. Sukumaran, S.C., *et al.* Polytherapy increases the risk of infertility in women with epilepsy. Neurology, 2010. 75: 1351.
https://pubmed.ncbi.nlm.nih.gov/20938026
518. Axel, S.J. Spinal cord injured women's concerns: menstruation and pregnancy. Rehabil Nurs, 1982. 7: 10.
https://pubmed.ncbi.nlm.nih.gov/6921826
519. Jackson, A.B., *et al.* A multicenter study of women's self-reported reproductive health after spinal cord injury. Arch Phys Med Rehabil, 1999. 80: 1420.
https://pubmed.ncbi.nlm.nih.gov/10569436
520. Baker, E.R., *et al.* Pregnancy in spinal cord injured women. Arch Phys Med Rehabil, 1996. 77: 501.
https://pubmed.ncbi.nlm.nih.gov/8629929
521. Baker, E.R., *et al.* Risks associated with pregnancy in spinal cord-injured women. Obstet Gynecol, 1992. 80: 425.
https://pubmed.ncbi.nlm.nih.gov/1495699

522. Bertschy, S., *et al.* Delivering care under uncertainty: Swiss providers' experiences in caring for women with spinal cord injury during pregnancy and childbirth - an expert interview study. BMC Pregnancy Childbirth, 2016. 16: 181.
https://pubmed.ncbi.nlm.nih.gov/27443838
523. Le Liepvre, H., *et al.* Pregnancy in spinal cord-injured women, a cohort study of 37 pregnancies in 25 women. Spinal Cord, 2017. 55: 167.
https://pubmed.ncbi.nlm.nih.gov/27670808
524. Skowronski, E., *et al.* Obstetric management following traumatic tetraplegia: case series and literature review. Aust N Z J Obstet Gynaecol, 2008. 48: 485.
https://pubmed.ncbi.nlm.nih.gov/19032665
525. Cross, L.L., *et al.* Pregnancy, labor and delivery post spinal cord injury. Paraplegia, 1992. 30: 890.
https://pubmed.ncbi.nlm.nih.gov/1287543
526. Hughes, S.J., *et al.* Management of the pregnant woman with spinal cord injuries. Br J Obstet Gynaecol, 1991. 98: 513.
https://pubmed.ncbi.nlm.nih.gov/1873238
527. Dannels, A., *et al.* The perimenopause experience for women with spinal cord injuries. SCI Nurs, 2004. 21: 9.
https://pubmed.ncbi.nlm.nih.gov/15176344
528. Amato, M.P., *et al.* Management of pregnancy-related issues in multiple sclerosis patients: the need for an interdisciplinary approach. Neurol Sci, 2017. 38: 1849.
https://pubmed.ncbi.nlm.nih.gov/28770366
529. Delaney, K.E., *et al.* Multiple sclerosis and sexual dysfunction: A need for further education and interdisciplinary care. NeuroRehabilitation, 2017. 41: 317.
https://pubmed.ncbi.nlm.nih.gov/29036844
530. Kanagaraj, P., *et al.* Multiple sclerosis and pregnancy. The Obstetrician & Gynaecologist, 2019. 21: 177.
https://obgyn.onlinelibrary.wiley.com/journal/17444667
531. Bove, R., *et al.* Management of multiple sclerosis during pregnancy and the reproductive years: a systematic review. Obstet Gynecol, 2014. 124: 1157.
https://pubmed.ncbi.nlm.nih.gov/25415167
532. Abrams, P., *et al.* A proposed guideline for the urological management of patients with spinal cord injury. BJU Int, 2008. 101: 989.
https://pubmed.ncbi.nlm.nih.gov/18279449
533. Ineichen, B.V., *et al.* High EDSS can predict risk for upper urinary tract damage in patients with multiple sclerosis. Mult Scler, 2018. 24: 529.
https://pubmed.ncbi.nlm.nih.gov/28367674
534. Beck, J., *et al.* Clinical Predictors of Neurogenic Lower Urinary Tract Dysfunction in Persons with Multiple Sclerosis. Diagnostics (Basel), 2022. 12.
https://pubmed.ncbi.nlm.nih.gov/35054358
535. Pannek, J., *et al.* Clinical usefulness of ultrasound assessment of detrusor wall thickness in patients with neurogenic lower urinary tract dysfunction due to spinal cord injury: urodynamics made easy? World J Urol, 2013. 31: 659.
https://pubmed.ncbi.nlm.nih.gov/23073657
536. Silva, J.A., *et al.* Association between the bladder wall thickness and urodynamic findings in patients with spinal cord injury. World J Urol, 2015. 33: 131.
https://pubmed.ncbi.nlm.nih.gov/24573904
537. Veenboer, P.W., *et al.* Diagnostic accuracy of Tc-99m DMSA scintigraphy and renal ultrasonography for detecting renal scarring and relative function in patients with spinal dysraphism. Neurourol Urodyn, 2015. 34: 513.
https://pubmed.ncbi.nlm.nih.gov/24706504
538. Przydacz, M., *et al.* Recommendations for urological follow-up of patients with neurogenic bladder secondary to spinal cord injury. Int Urol Nephrol, 2018. 50: 1005.
https://pubmed.ncbi.nlm.nih.gov/29569211
539. Lewis, J., *et al.* A framework for transitioning patients from pediatric to adult health settings for patients with neurogenic bladder. Neurourol Urodyn, 2017. 36: 973.
https://pubmed.ncbi.nlm.nih.gov/27276694

5. CONFLICT OF INTEREST

All members of the Neuro-urology working group have provided disclosure statements of all relationships that they have that might be perceived as a potential source of a conflict of interest. This information is publically accessible through the European Association of Urology website: http://uroweb.org/guideline. This guidelines document was developed with the financial support of the European Association of Urology. No external sources of funding and support have been involved. The EAU is a non-profit organisation and funding is limited to administrative and travel and meeting expenses. No honoraria or other reimbursements have been provided.

6. CITATION INFORMATION

The format in which to cite the EAU Guidelines will vary depending on the style guide of the journal in which the citation appears. Accordingly, the number of authors or whether, for instance, to include the publisher, location, or an ISBN number may vary.

The compilation of the complete Guidelines should be referenced as:
EAU Guidelines. Edn. presented at the EAU Annual Congress Paris 2024. ISBN 978-94-92671-23-3.

If a publisher and/or location is required, include:
EAU Guidelines Office, Arnhem, The Netherlands. http://uroweb.org/guidelines/compilations-of-all-guidelines/

References to individual guidelines should be structured in the following way:
Contributors' names. Title of resource. Publication type. ISBN. Publisher and publisher location, year.