



**This consensus guidelines have been developed
by SCI rehabilitators and urologists from the 12 SCI
Units / Hospitals that exist in Spain**







Handbook on clinical management of neurogenic vesicourethral dysfunction in spinal cord injury

Sponsored by





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Authors

ARLANDIS GUZMÁN, S.
University Hospital La Fe (Valencia)

BARRERA CHACÓN, J.M.
University Hospital Virgen del Rocío (Sevilla)

BENITO PENALVA, J.
Guttmann Institute (Barcelona)

BONILLO GARCIA, M.A.
University Hospital La Fe (Valencia)

BORAU DURÁN, A.
Guttmann Institute (Barcelona)

ESCLARÍN DE RUZ, A.
National Paraplegics Hospital (Toledo)

ESPINOSA QUIRÓS, J.R.
University Hospital Puerta del Mar (Cádiz)

ESTEBAN FUERTES, M.
National Paraplegics Hospital (Toledo)

FUENTES ELLAURI, M.A.
University Hospital Virgen de las Nieves (Granada)

GONZÁLEZ VIEJO, M.A.
University Hospital Vall d'Hebrón (Barcelona)



JAUREGUI ABRISQUETA, M.L.
Cruces University Hospital (Bilbao)

LEDESMA ROMANO, L.
University Hospital Miguel Servet (Zaragoza)

LÓPEZ LLANO, M.L.
Central University Hospital of Asturias (Oviedo)

MÉNDEZ SUÁREZ, J.L.
Insular University Hospital of Gran Canaria (Las Palmas)

SALVADOR DE LA BARRERA, S.
University Hospital Complex A Coruña (La Coruña)

SÁNCHEZ RODRÍGUEZ-LOSADA, J.
University Hospital Complex A Coruña (La Coruña)

Collaborators

CÍVICOS SÁNCHEZ, N.
Cruces University Hospital (Bilbao)

ALEMÁN SÁNCHEZ, C.
Insular University Hospital of Gran Canaria (Las Palmas)

SÁNCHEZ RAMOS, A.
National Paraplegics Hospital (Toledo)

VILLARREAL SALCEDO, I.
University Hospital Miguel Servet (Zaragoza)



Spinal cord injury has far reaching and devastating consequences for the patient and his or her family. There are few conditions that we deal with, where an active young life is, at a stroke, altered suddenly, dramatically and irreversibly. Modern resuscitative techniques, along with active orthopedic care are allowing these patients to survive their initial injuries in ever increasing numbers. The challenge for these patients is then to deal with the associated medical and social issues related to their disability.

Urologists have, over the past 25 years, made great strides in improving the care of the spinal cord patient. Urodynamics has helped us understand the nature of the vesicourethral dysfunction, intermittent catheterization has revolutionized bladder care along with antimuscarinic medications and lately botulinum toxin injections. The role of continuous urinary drainage, bladder reconstruction and urinary diversion have been rationalized. Treatment focuses on preservation of renal function, establishing continence, and allowing appropriate bladder voiding with an overall emphasis on improving the patients quality of life.

The comprehensive care of these patients requires the input of multiple specialties in addition to urologists. These include rehabilitation specialists, neurologists, neurosurgeons, orthopedic surgeons, physical therapists, psychologists, occupational therapists and nurses.



Despite these advances in care, those of us dealing with spinal cord patients on a regular basis, will often encounter significant problems related to poor understanding of the most appropriate treatment. The consequences of lack of or poorly judged treatment can severely alter the patients health and quality of life.

This simple and thoughtful publication is an excellent tool to avoid these problems. The Spanish Society of Paraplegia and the Spanish Association of Urology, in collaboration with Coloplast, should be commended for producing a text that comprehensively and succinctly outlines these management principles. The aim of improving and disseminating information, to all health care professionals, involved in spinal cord injury management, is very well served.

Professor Anthony Stone, MB. ChB
Vice Chair, Department of Urology
University of California, Davis, California, USA

Chair, Neurourology Promotion Committee
International Continence Society



1 Introduction





Objective, research lines and societies

The effects of a spinal cord injury (SCI) are devastating for patients, their families and friends. These patients undergo significant functional changes, which include a difficult physiological, psychological, family and social/work adaptation that can last a lifetime. Our duty as physicians is to help those with spinal cord injuries in this journey, from a human, scientific and professional perspective. The appropriate management of these patients depends on reducing their suffering as much as possible and improving their quality of life.

The urologic consequences of a spinal cord injury can be dramatic. Therefore, it is important to understand the neurogenic bladder, therapeutic options and follow-up.

Spinal cord injury units offer an ideal environment for comprehensive treatment because there is close contact between the rehabilitation specialist, urologist, neurologist, neurosurgeon, orthopaedic surgeon, psychologist, physiotherapist and specialised nurses. However, this ideal situation is not found in many hospital centres that have to face the difficult management of patients with spinal cord injuries without the collaboration of highly experienced clinical professionals.

It seems logical that the most appropriate way to improve the quality of care of patients with spinal cord injuries is to increase the information provided to the health professionals



involved at any point in the treatment and follow-up of these patients. While recognising that the management of these patients is generally of high quality, we must stress the importance of common guidelines to follow in centres with less experience treating patients with spinal cord injuries.

From the Spanish Society of Paraplegia and the Spanish Urological Association, in collaboration with Coloplast, an initiative has emerged to create a handbook that establishes common guidelines for managing the neurogenic bladder in patients with spinal cord injuries.

The scientific evidence obtained from the literature is of limited quality; therefore, it is difficult to establish strict standards based on high levels of recommendation. It is for this reason that the content of this guide was created out of the opinions of an expert group of clinicians, rehabilitators and urologists, who came together for the express purpose of preparing this guide. Over the course of several joint sessions in which its content was discussed, a consensus opinion was reached. There are many issues still that need clarification, issues that only the evolution and progressive understanding of medical science will manage to elucidate in the coming years.

We would like to thank Coloplast for their original training proposal for the FIC workgroup (Coloplast Incontinence Forum) and the logistical support provided for the preparation of this guide. We would especially like to thank Verónica Vivas and Juan José Cardeña for their perseverance and determination, without which we would not have been able to complete our study.

The authors



2 Terminology

Arlandis Guzmán, S.; Espinosa Quirós, J.R.;
Esteban Fuertes, M.







Common and supported nomenclature

Acontractile detrusor	Absence of contraction.
Aseptic intermittent catheterisation	Genital disinfection and use of catheters, gloves and other sterile instruments.
ASIA	American Spinal Injury Association.
Bladder	Painful, palpable or percussible bladder when the patient is incapable of urinating.
Bladder capacity	Volume of liquid introduced into the bladder that causes a strong desire to urinate.
Bladder sensations	The various sensations that the patient ex- periences during filling.
Bulbocavernosus reflex	Contraction of the anus, when pressing the glans in males or when pressing the cli- toris in females, by contraction of the bul- bocavernosus muscle.



Clean intermittent catheterisation	Use of common techniques of lavage and single-use or reusable washed catheters.
Clitoral anal reflex	Contraction of the anus when pressing the clitoris by contraction of the bulbocavernosus muscle.
Complete injury	Spinal cord injury with no motor activity and complete lack of sensitivity in the lowest sacral segments (S4-S5).
Compliance	Relationship between the change in bladder volume and detrusor pressure or the adaptation of the bladder wall to filling. Bladder pressure response to the increase in filling volume.
Cough reflex	Contraction of the anus when coughing.
Cystomanometry	Method by which the bladder pressure/volume ratio during filling is measured.
Dyssynergia	Detrusor contraction occurring simultaneously with an involuntary contraction of the urethral and/or periurethral striated muscles or lack of coordination between the detrusor and the sphincter due to a neurological disorder.
Dysuria	Anomalous urination. Discomfort or pain during urination.
Flowmetry	Measure of the volume of urine expelled through the urethra per unit of time.



IDC	Indwelling catheter
Incomplete injury	Presence of incomplete sensory and/or motor activity distal to the injury, including the lowest sacral segments (S4-S5).
Intermittent catheterisation	Voiding of the bladder using a probe that is withdrawn after the procedure, most of the time at regular intervals, or drainage of the bladder or urinary reservoir with the subsequent withdrawal of the catheter.
IVC	Intermittent Vesical Catheterisation.
KHQ	King's Health Questionnaire on quality of life.
Leakage pressure	Determines the competency of the sphincter system when faced with urine leakage during abdominal straining increases or during involuntary detrusor activity.
Leak point pressure	The lowest detrusor pressure that causes urine to escape in the absence of contractions and with no abdominal straining.
Neurogenic bladder	Neurogenic dysfunction of the lower urinary tract secondary to a confirmed innervation pathology.
Neurological level	Last segment with normal sensory and motor function.



Normal activity in the detrusor	Bladder filling is produced by minimal pressure changes.
Overactive detrusor	Involuntary contractions of the detrusor during the filling phase.
Paraplegia	Paralysis of the lower extremities, torso and pelvic organs, depending on the level of the spinal cord injury.
Permanent catheterisation	When the catheter is left in the bladder, urinary reservoir or ileal conduit for a period greater than the interval between two urinations.
Pollakiuria	Increase in the frequency of urination.
Post void residual	Volume of urine remaining in the bladder after urination.
PBC	Permanent Bladder Catheterisation.
QOL	Quality of Life.
SARS	Sacral anterior root stimulator.
SF-12	Quality of life questionnaire Satisfaction with Life Scale (SF-12).
SF-36	Quality of life questionnaire Outcomes Study SF-36™ Health Survey (SF-36).
Sphincterotomy	Performing cuts in the urethral sphincter by endoscopy.



Spinal cord shock Functional interruption of the sensitivity, motility and sphincter control with no organic spinal cord injury.

Spinal shock Immediate effect of an SCI, characterised by the cessation of all spinal cord functions below the level of the injury, including the loss of movement and sensitivity, areflexia and autonomic nervous system involvement with flaccid paralysis of the bladder and intestine and involvement of all body systems below this level. Lasting from hours to several weeks.



Superficial anal reflex Contraction of the anal sphincter when rubbing the edges of the anus.



Tenesmus Overwhelming need to urinate. Feeling of not having completely evacuated the bowels/bladder.

Tetraplegia Paralysis in the four extremities, torso and pelvic organs.

Urinary incontinence The involuntary loss of urine, which creates hygiene and social problems.

Urinary retention Inability of the patient to urinate.

Urodynamic study Functional tests of the lower urinary tract using artificial filling of the bladder.





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UTI Urinary tract infection.

Voiding diary Registry of the times of urination and the
urinary volumes.





Neurogenic bladder drugs

Antimuscarinic agents

Trospium chloride

- **Action:** A compound of quaternary ammonium with an antimuscarinic effect with no selectivity for the cholinergic receptor subtype. Approximately 10% of the administered dose is absorbed and is eliminated primarily through the urine (60%). It barely crosses the blood-brain barrier; therefore, few side effects in the central nervous system (CNS) are expected.
- **Indication:** Symptomatic treatment of urgent urinary incontinence and/or an increase in urinary frequency and urgency. It has shown its usefulness in the hyperactivity of neurogenic and idiopathic detrusors.
- **Side effects:** dry mouth, dry eyes, gastrointestinal disorders such as constipation, blurred vision, sleepiness, palpitations, skin reactions (including dry skin, rash and photosensitivity), headaches, diarrhoea, angio-oedema, arrhythmias and tachycardia. A stimulation of the central nervous system may occur with agitation, disorientation, hallucinations and convulsions; children have a greater risk of suffering from these effects. Antimuscarinic agents



may reduce sweating, thereby producing feelings of heat and fainting in hot environments or in patients with fever. In addition, *tropium* may cause flatulence, chest pain, dyspnoea and asthenia.

- **Contraindications:** narrow-angle glaucoma, myasthenia gravis, and significant obstruction of the urinary tract, severe ulcerative colitis, toxic megacolon, gastrointestinal obstruction and intestinal atony. Digestive haemorrhage.
- **Precautions:** elderly (especially those that are debilitated), and subjects with vegetative neuropathy. Furthermore, they should be applied with caution in cases of hiatal hernia with reflux esophagitis or in cases of hepatic or renal failure. May worsen hyperthyroidism, coronary disease, congestive heart failure, hypertension, benign prostate hypertrophy, arrhythmia and tachycardia.

Active ingredient	Brand name®	Dosage
<i>Tropium Chloride</i>	URAPLEX	20 mg/12h*

*Must be administered during fasting because its administration with food decreases its absorption.

Oxybutynin hydrochloride

- **Action:** A tertiary amine that is a competitive antagonist of acetylcholine at the postganglionic muscarinic receptor level. It has a greater affinity for the M1 and M3 receptors. It has antimuscarinic properties but also acts as a direct muscle relaxant and local anaesthetic.
- **Indication:** Symptomatic treatment of urgent urinary incontinence and/or the increase in urinary frequency and urgency. Night time enuresis associated with hyperactivity. Overactivity of neurogenic and idiopathic detrusors.



- **Side effects:** dry mouth, dry eyes, gastrointestinal disorders such as constipation, blurred vision, sleepiness, palpitations, skin reactions (including dry skin, rash and photosensitivity), headaches, diarrhoea, angio-oedema, arrhythmias and tachycardia. A stimulation of the central nervous system may occur with agitation, disorientation, hallucinations and convulsions; children have a greater risk of suffering from these effects. May reduce sweating, thereby producing feelings of heat and fainting in hot environments or in patients with fever. Oxybutynin may also cause anorexia.
- **Contraindications:** narrow-angle glaucoma, myasthenia gravis, significant obstruction of the urinary tract, severe ulcerative colitis, toxic megacolon, gastrointestinal obstruction and intestinal atony. Digestive haemorrhage.
- **Precautions:** elderly (especially those that are debilitated), in subjects with vegetative neuropathy. Furthermore, they should be applied with caution in cases of hiatal hernia with reflux esophagitis or in cases of hepatic or renal failure. May worsen hyperthyroidism, coronary disease, congestive heart failure, hypertension, benign prostate hypertrophy, arrhythmia and tachycardia. Porphyrria.

Active ingredient	Brand name®	Dosage
<i>Oxybutynin hydrochloride</i>	DITROPAN	2.5-5 mg/8-12 h* children: 2.5-3 mg/12 h**

* Increase if necessary up to 5 mg/6 h.

** Increase if necessary up to 5 mg/12 h.



Tolterodine tartrate

- **Action:** A tertiary amine that is a competitive antagonist of muscarinic receptors that shows a greater selectivity in vivo for the urinary bladder than for salivary glands. It shows no selectivity for any subtype of muscarinic receptor. It passes through the blood brain barrier with difficulty due to its low lipophilicity, which explains the low incidence of effects on the CNS.
- **Indication:** Treatment of the hyperactivity of neurogenic and idiopathic detrusors. Treatment of hyperactive bladder syndrome.
- **Side effects:** Bronchitis, sinusitis, dizziness, sleepiness, paraesthesia, cephalgia, dry eyes, abnormal vision (including abnormal compliance), vertigo, palpitations, dry mouth, dyspepsia, constipation, abdominal pain, flatulence, diarrhoea, vomiting, dry skin, dysuria, urinary retention, fatigue, chest pain, peripheral edema, weight gain.
- **Contraindications:** Narrow-angle glaucoma, myasthenia gravis, significant obstruction of the urinary tract, severe ulcerative colitis, toxic megacolon, gastrointestinal obstruction and intestinal atony. Digestive haemorrhage.
- **Precautions:** Elderly (especially those that are debilitated), in subjects with vegetative neuropathy. Furthermore, they should be applied with caution in cases of hiatal hernia with reflux esophagitis or in cases of hepatic or renal failure. May worsen hyperthyroidism, coronary disease, congestive heart failure, hypertension, benign prostate hypertrophy, arrhythmia and tachycardia. Porphyrria.



Active ingredient	Brand name®	Dosage
<i>Tolterodine tartrate</i>	UROtrol NEO DETRUSITOL NEO	4 mg/24 h or 2 mg/12 h

Solifenacin succinate

- **Action:** Tertiary amine that acts as a competitive inhibitor of subtype M3 muscarinic receptors.
- **Indication:** Documented efficacy in hyperactive detrusor and hyperactive bladder.
- **Side effects:** blurred vision, dry mouth, constipation, nausea, dyspepsia, abdominal pain.
- **Contraindications:** hypersensitivity, haemodialysis, severe HF-RF, urinary retention, severe gastrointestinal disorders (including toxic megacolon), myasthenia gravis and narrow-angle glaucoma.
- **Precautions:** Severe RF (do not exceed 5 mg/day), moderate HF (do not exceed 5 mg/day), clinically significant obstruction of the lower urinary tract with urinary retention risk, gastrointestinal obstruction disorders, neurogenic detrusor hyperactivity (lack of safety and efficacy), autonomic neuropathy, hiatal hernia / gastro-oesophageal reflux and/or are in treatment with bisphosphonates that may cause or worsen the esophagitis. Reduced risk of gastrointestinal motility. Concomitant use of a potent CYP3A4 inhibitor (ke-toconazole). Not recommended for children.

Active ingredient	Brand name®	Dosage
<i>Solifenacin succinate</i>	VESICARE	5 mg/24 h*

* Increase if necessary up to 10 mg/24 h.



Fesoterodine

- **Action:** Is metabolised by esterases non specific to 5-hydroxymethyl tolterodine, which is the active metabolite that competitively inhibits the muscarinic receptors. Approximately 15% is eliminated in the urine without being metabolised.
- **Indication:** Symptomatic treatment of urgent urinary incontinence and/or an increase in urinary frequency and urgency.
- **Side effects:** Dizziness, cephalaea, dry eyes, dry throat, dry mouth, abdominal pain, diarrhoea, dyspepsia, constipation, nausea, dysuria, insomnia.
- **Contraindications:** Hypersensitivity, urinary retention, gastric retention, uncontrolled angle-closure glaucoma, myasthenia gravis, severe HF, severe ulcerative colitis, toxic megacolon.
- **Precautions:** Significant obstruction of the lower urinary tract with risk of urinary retention; gastrointestinal obstructive disorders (pyloric stenosis); gastro-oesophageal reflux and/or patients who concurrently take drugs (oral bisphosphonates) that may cause or worsen esophagitis; reduction of gastrointestinal motility; autonomic neuropathy; controlled angle-closure glaucoma; patients at risk of prolonged QT, relevant cardiac disease (myocardial ischemia, arrhythmia, CHF). Not recommended for children and adolescents under 18 years of age.

Active ingredient	Brand name®	Dosage
<i>Fesoterodine</i>	TOVIAZ	4 mg/24 h*

* Increase if necessary up to 8 mg/24 h.



Stress urinary incontinence

Duloxetine

- **Action:** Uptake inhibitor of serotonin and noradrenaline. Increases the activity of neurons in Onuf's nucleus (pudendal), increasing the tone of the external urethral sphincter.
- **Indication:** Major depressive disorder; diabetic neuropathy; in Spain, its use has not been marketed for stress urinary incontinence.
- **Side effects:** nausea, constipation, dry mouth, sleepiness, decreased appetite, increased sweating, blurred vision, insomnia, fatigue, sexual dysfunction.
- **Contraindications:** hypersensitivity, HF, severe RF, uncontrolled HBP, in conjunction with MAOIs.

Active ingredient	Brand name®	Dosage
Duloxetine	CYMBALTA XERISTAR	40 mg/12 h*

* In Spain, Duloxetine is sold in 30 and 60-mg capsules.

α - blockers

Phenoxybenzamine

- **Action:** nonselective alpha antagonist (α_1 and α_2 postsynaptic receptors). Used initially in the symptomatic treatment of pheochromocytoma and of hypertensive crises caused by sympathomimetic amines.



- **Side effects:** Up to 30% of patients may experience orthostatic hypotension, tachycardia, nasal congestion, diarrhoea, nausea and vomiting.
- **Contraindications:** Hypotension, syncope, muscle weakness, muscle laxity, nasal congestion, retrograde ejaculation, hypersensitivity. Should be used with care in young patients due to the mutagenic effect shown in animals.

Active ingredient	Brand name®	Dosage
<i>Phenoxybenzamine</i>	DIBENYLIN®*	10 mg/d+

*Available in Spain as a foreign medication.

+May be increased according to the response and tolerance. Dosage between 5 and 60 mg/day.

Alfuzosin

- **Action:** Selective antagonist of postsynaptic α_1 adrenergic receptors.
- **Side effects:** dizziness, cephalgia, tachycardia, hypotension, intraoperative floppy iris syndrome (warn if undergoing eye surgery for cataracts), nausea, abdominal pain, priapism.
- **Contraindications:** hypersensitivity, history of orthostatic hypotension, combination with other α_1 -blockers, severe HF, RF (creatinine clearance <30 ml/min), bowel obstruction (due to the castor oil it contains as an excipient).

Active ingredient	Brand name®	Dosage
<i>Alfuzosin</i>	UNIBENESTAN®*	1 tablet/d

*Modified release Alfuzosin.



Doxazosin

- **Action:** Selective antagonist of postsynaptic α_1 adrenergic receptors.
- **Side effects:** dizziness, headaches, drowsiness, vertigo, palpitations, tachycardia, hypotension, postural hypotension, cough, dyspnoea, rhinitis, abdominal pain, dyspepsia, dry mouth, nausea, pruritus, myalgia, peripheral edema, intraoperative floppy iris syndrome, retrograde ejaculation, priapism.
- **Contraindications:** hypersensitivity, hypotension, bowel obstruction.

Active ingredient	Brand name®	Dosage
<i>Doxazosin</i>	CARDURAN NEO PROGANDOL NEO	4 mg or 8 mg/24 h

Silodosin

- **Action:** Selective antagonist of postsynaptic α_1 adrenergic receptors.
- **Indication:** Symptoms of the lower urinary tract secondary to HBP.
- **Side effects:** Anejaculation, retrograde ejaculation, intraoperative floppy iris syndrome, orthostatic hypotension.
- **Contraindications:** Hypersensitivity, severe RF-HF. Not recommended for concomitant use with potent CYP3A4 inhibitors such as *Ketoconazole* and *Ritonavir*.



Active ingredient	Brand name®	Dosage
<i>Silodosin</i>	SILODYX 4/ 8 mg	8 mg/24 h

*In cases of RF, use 4 mg/24 h.

Tamsulosin

- **Action:** Selective antagonist of postsynaptic α_1 adrenergic receptors.
- **Indication:** Symptoms of the lower urinary tract.
- **Side effects:** dizziness, cephalgia, syncope, palpitations, postural hypotension, rhinitis, constipation, diarrhoea, nausea, vomiting, exanthema, pruritus, priapism, retrograde ejaculation, intraoperative floppy iris syndrome.
- **Contraindications:** hypersensitivity, orthostatic hypotension, severe HF.

Active ingredient	Brand name®	Dosage
<i>Tamsulosin</i>	OMNIC OCAS UROLOSIN OCAS	1 tablet/24 h

Terazosin

- **Action:** Selective antagonist of postsynaptic α_1 adrenergic receptors.
- **Indication:** Symptoms of the lower urinary tract secondary to HBP.
- **Side effects:** asthenia, cephalgia, palpitations, postural hypotension, syncope, tachycardia, nausea, peripheral



enema, weight gain, dizziness, vertigo, decreased libido, sleepiness, dyspnoea, rhinitis, intraoperative floppy iris syndrome, retrograde ejaculation.

- **Contraindications:** hypersensitivity, history of syncope.

Active ingredient	Brand name®	Dosage
<i>Terazosin</i>	DEFLOX	2 mg/d 3-4 days, subsequently 5 mg/24 h*

*Maximum dosage 10 mg/day.

Muscle relaxants

Diazepam

- **Action:** benzodiazepine with anxiolytic, muscle relaxant, anticonvulsant and sedative properties. Acts by reducing the nerve conduction in CNS neurons, enhancing or facilitating the GABA action. It is the benzodiazepine with the greatest muscle relaxant effect.
- **Indication:** anxiety, muscle spasms.
- **Side effects:** sedation, sleepiness, vertigo, hypotension, gastrointestinal disorders, changes in libido.
- **Contraindications:** myasthenia gravis, glaucoma, respiratory failure, respiratory depression, hepatic and renal failure.

Active ingredient	Brand name®	Dosage
<i>Diazepam</i>	VALIUM	5 mg/8 h*

*Depending on tolerance, the dosage may be increased up to 10 mg/8 h.



Tetrazepam

- **Action:** Benzodiazepine used as a centrally acting muscle relaxant. Tetrazepam has an associated sedative effect.
- **Side effects:** Those of any benzodiazepine (see diazepam).
- **Contraindications:** Those of benzodiazepines.

Active ingredient	Brand name®	Dosage
<i>Tetrazepam</i>	MYOLASTAN	25-50 mg/d*

*50 mg tablets; depending on tolerance, the dosage may be increased up to 150 mg/d (50 mg/8 h.)

Baclofen

- **Action:** GABA-ergic agent that depresses the monosynaptic and polysynaptic excitation of motor neurons and interneurons in the spinal cord (and also in the CNS). Slightly lipophilic and therefore crosses the blood-brain barrier with difficulty. Intrathecal administration increases its efficacy.
- **Indication:** muscle spasticity of various causes.
- **Side effects:** sedation, sleepiness, vertigo, muscle weakness, insomnia, rash. Abrupt cessation of treatment may cause hallucinations, anxiety and tachycardia.
- **Contraindications:** hypersensitivity, epilepsy, pregnancy.

Active ingredient	Brand name®	Dosage
<i>Baclofen</i>	LIORESAL	5 mg/8 h*

*Tablets of 10 and 25 mg; the dosage should be increased progressively depending on tolerance, up to a maximum of 30-80 mg/d. Some patients may require higher doses, but patients should always be monitored for the onset of side effects.



3 Spinal cord injury

Esclarín de Ruz, A.; Fuentes Ellauri, M.A.

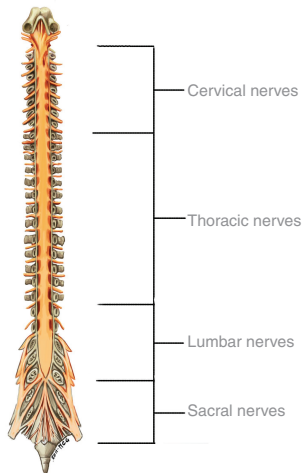




Introduction

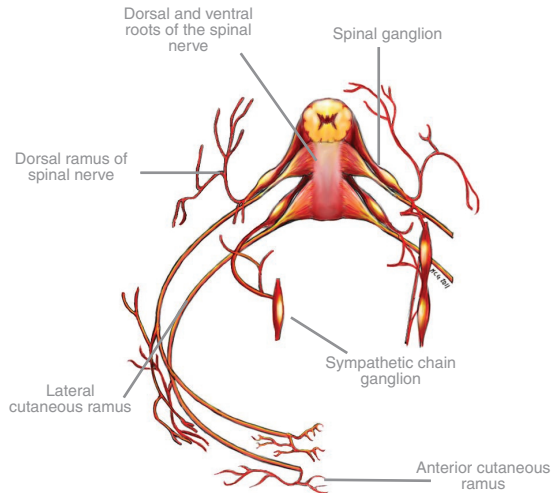
Brief anatomical review of the spinal cord

The spinal cord is responsible for the sensory transmission to cerebral structures and for the regulation of motor and autonomic function. The spinal cord is cylindrical and flattened





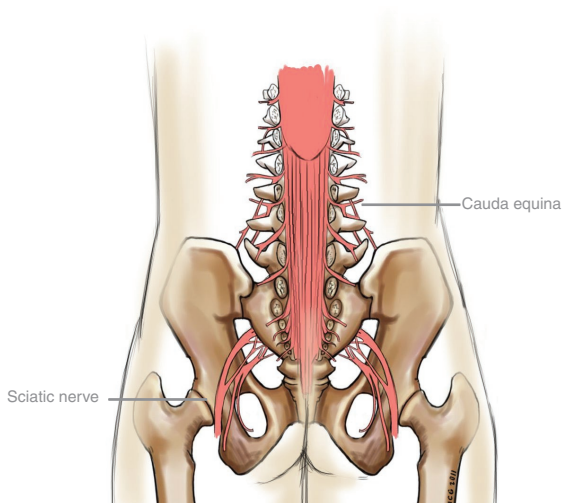
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in the anteroposterior direction. Its calibre is not uniform. It is white and has a soft consistency. It starts at the bulbomedullary junction and extends between the first and second lumbar vertebra. Its lower end is cone-shaped and is known as the conus medullaris

The myelomere is a spinal segment from which a pair of spinal nerves emerges. The spinal cord consists of 31 myelomeres: 8 cervical, 12 thoracic, 5 lumbar, 5 sacral and 1 coccygeal.

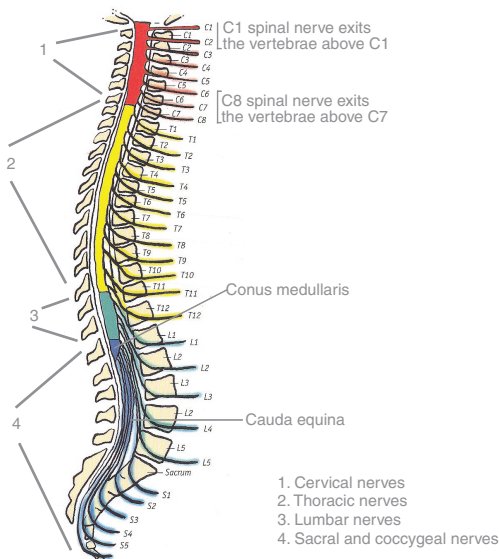
These are protected by the spinal canal and a system of three layers of tissue called the spinal meninges.



The spinal cord does not occupy the entire spine but rather ends at the L2 vertebra; therefore, the lumbar and sacral nerves must descend to their respective foramina forming the cauda equine.

Definition and epidemiology

A spinal cord injury is defined as any spinal impairment that causes a disorder in movement, sensitivity and in the autonomic nervous system.



The incidence of spinal cord injury is 12-20 cases per million population and year in Spain.^{1,2} The prevalence is 350-380 new cases per million population, thus estimating a current total of 16,000 subjects with spinal cord injury. In countries such as the USA, Japan and Canada, the incidence is greater, with figures of 40/10⁶ hab. year.³

It occurs more frequently in the fourth decade of life with a peak at 38 years. It has a predominantly traumatic aetiology, although we are witnessing an increase in injuries of medical



aetiology due mainly to the increased life expectancy of the population.

Spinal anatomic level

As stated above, there is a discrepancy between the sizes of the spinal column and the spinal cord, which ends at the 1st-2nd lumbar vertebra. The lumbar and sacral roots form the cauda equine in their paths before exiting through the corresponding foramen.

To locate a specific spinal segment through the spinal column, it is essential to know that up to the 6th cervical vertebra, the spinal segment corresponds to the vertebra plus one (the roots corresponding to the C7 segment will exit through the C6 intervertebral foramen).

Up to the 6th dorsal vertebra, the spinal segment corresponds to the vertebra plus 2. Up to the 8th dorsal vertebra, the spinal segment is calculated by adding 3.

Up to the 10th dorsal vertebra, the spinal segment corresponds to the vertebra plus 4. The rest of the spinal and sacral segments are grouped from D11 to L1-L2 forming the epiconus and the conus medullaris.



Types of spinal cord injury

Injury level

Tetraplegia: Caused when there is an injury in the cervical segments of the spinal cord, which causes a disorder in the upper extremities, dorsal region, lower extremities and pelvic organs. If the injury occurs above C4, the innervation of the diaphragm will be affected; the subject will not be able to breathe spontaneously, making tetraplegics dependent on mechanical ventilation.

Paraplegia: Corresponds to spinal impairment of the dorsal, lumbar and sacral regions of the spinal cord; depending on the level of injury, the dorsal region, lower extremities and pelvic organs will be affected.⁴

Injury extent

Complete injury: Occurs when all the spinal connections are interrupted below the injury, with the subsequent loss of movement, sensitivity and autonomic innervation.

Incomplete injury: There is persistent total or partial motor, sensory and autonomic innervation.



ASIA nomenclature and classification

The American Spinal Injury Association (ASIA) establishes the worldwide guidelines for the examination and diagnosis of spinal cord injury, with the objective of unifying the nomenclature of all professionals dedicated to this pathology.⁶⁻⁷

The neurological assessment of patients with spinal cord injuries based on the ASIA classification⁶ is based on a systematic examination of motor and sensory functions.

Motor examination should always be performed supine decubitus. The examination explores 10 key muscles, 5 in the upper limbs and 5 in the lower limbs, scoring the patient's muscle balance between 0 and 5. A muscle is considered "normal" with a score of 3 if those immediately above are at 5. The examiner should also determine whether there is voluntary anal contraction. Following the latest updates on muscle assessment according to ASIA,⁷ an additional score is considered⁵ in which the muscle contraction is performed against a normal resistance, absent the interference of inhibitors for this contraction.

The sensitivity examination assesses the posterior cord pathways using a surface touch with cotton and assesses the lateral spinothalamic pathways through the sharp and blunt edge of a pinprick. The score ranges from 0-2 in the key points of 28 dermatomes of both sides of the body and using the sensitivity of the face as normal. The absence of sensitivity



is scored as 0, altered sensitivity as 1 and normal sensitivity as 2, taking into account that a hypersensitivity situation is scored as 1 and not being able to discriminate the pinprick as such is considered analgesia and therefore scored as 0.

The injury level constitutes the segment with normal sensory and motor function located above the most affected rostral segment. A similar injury may have different levels of motor and sensory function and may also differ in both halves of the body.

The ASIA Impairment scale (AIS) establishes 5 categories depending on the severity of the injury

GRADE A= Complete: No sensory or motor function is preserved in the sacral segments S4-S5.

GRADE B= Sensory Incomplete: Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-S5 (light touch, pin prick at S4-S5: or deep anal pressure (DAP), AND no motor function is preserved more than three levels below the motor level on either side of the body.

GRADE C= Motor Incomplete: Motor function is preserved below the neurological level**, and more than half of key muscle functions below the single neurological level of injury (NLI) have a muscle grade less than 3 (Grades 0-2).

GRADE D= Motor Incomplete: Motor function is preserved below the neurological level**, and at least half (half or more) of key muscle functions below the NLI have a muscle grade > 3.



GRADE E= Normal: If sensation and motor function as tested with the ISNCSCI are graded as normal in all segments, and the patient had prior deficits, then the AIS grade is E. Someone without an initial SCI does not receive an AIS grade.

**For an individual to receive a grade of C or D, i.e. motor incomplete status, they must have either (1) voluntary anal sphincter contraction or (2) sacral sensory sparing with sparing of motor function more than three levels below the motor level for that side of the body. The Standards at this time allows even non-key muscle function more than 3 levels below the motor level to be used in determining motor incomplete status (AIS B versus C).

NOTE: When assessing the extent of motor sparing below the level for distinguishing between AIS B and C, the motor level on each side is used; whereas to differentiate between AIS C and D (based on proportion of key muscle functions with strength grade 3 or greater) the single neurological level is used.

Spinal Cord Syndromes⁸

Central cord syndrome (Schneider syndrome): The most common occurs in the cervical levels and is characterised by greater weakness in the upper limbs than in the lower limbs and at least partial sacral preservation. Occurs most often in elderly subjects due to degenerative changes in the cervical spine. The mechanism is often a hyperextension of the neck. It usually has a good prognosis, although it worsens with age.

Brown-Séquard syndrome: This is a spinal hemisection that is below the level of the injury: motor loss on the same side, loss of proprioception of the same side and loss of thermoalgesic

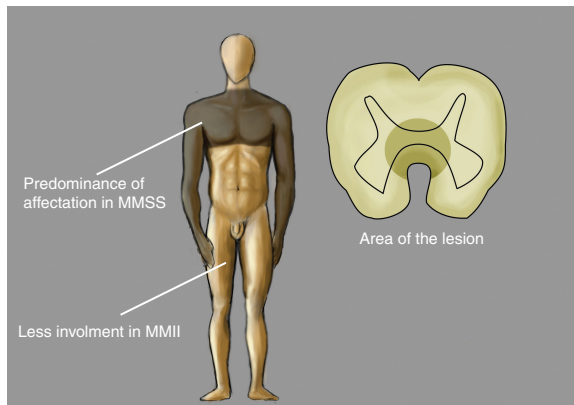


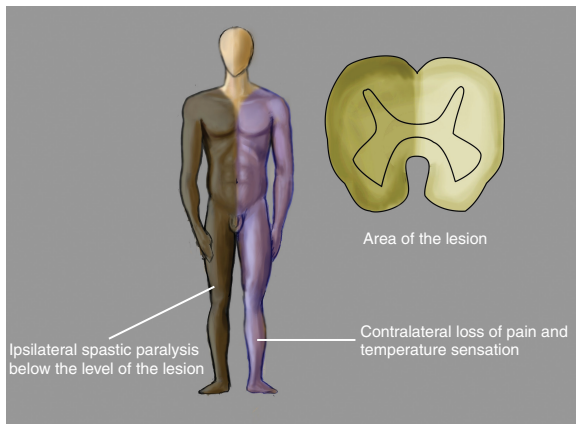
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sensitivity of the opposite side. It is rarely found in its pure form. The prognosis for functional recovery depends on the various forms of presentation and is generally good.

Anterior cord syndrome: This injury affects the anterior two thirds of the spinal cord without involving the posterior columns. It presents with a greater or lesser loss of motor function and thermoalgesic sensitivity, with preservation of sensitivity of the posterior cords.

Injury of the conus medullaris and cauda equina: The conus medullaris is found at the level of the lower face of L1 and includes the spinal cord levels S2-S4. The segment immediately above is the epiconus consisting of levels L4-S1. The cauda equina consists of the nerve roots of the last segments of the spinal cord. Epiconus injuries are those of upper motor





neurons as are the upper level injuries. Cone injuries specifically affect sphincter, bladder and sexual functions. Horse's tail injuries are those of lower motor neurons. In clinical practice, it is difficult to find these injuries independently because the injuries normally overlap.

In the last pages of this chapter, we present the neurological classification of spinal cord injuries according to the American Spinal Injury Association (ASIA).

Evolution of spinal cord injuries

Spinal shock corresponds to a functional interruption in sensitivity, motility and sphincter control with no injury in the medulla. The patient recovers *ad integrum* within hours.



When a spinal cord injury occurs, the spinal shock phase starts immediately and lasts from a few hours up to several weeks and results in the cessation of all spinal functions below the level of the injury. Therefore, in addition to the change in motor and sensory function caused by the interruption of descending and ascending fibres, we find areflexia and an impairment of the autonomic nervous system with bladder paralysis, vasomotor alterations, hypothermia, hypotension and bradycardia. Depending on the level of injury, the change in autonomic function leads to clinical situations of lesser or greater risk such as neurogenic shock. Overcoming this phase represents the initiation of spinal reflex function below the injury. The examination of sacral and osteotendinous reflexes and muscle tone therefore allows us to determine whether we are in the spinal shock phase or whether it has already been overcome to the extent that reflexes are present.

The level, extent and evolutionary phase of the injury allows us to determine its functional impact regarding the motor, sensory and other organic functions: respiratory, digestive, bladder, sexual and circulatory.⁵

Prognosis

In complete injuries (ASIA A), 80% stay as grade A, 10% progress to ASIA B and another 10% progress to ASIA C. If the level of the injury is taken into account, we can see for tetraplegic patients the transition to B or D becomes twice that in the rest of the lesion levels.

In incomplete injuries (ASIA B,C), there is more variability in the studies; between 15%-40% of those in B progress to C, and 60-80% of ASIA C injuries become D injuries.



References

- ALCOBENDAS M., Conceptos generales sobre el síndrome de lesión medular. Esclarín A. (ed.) Lesión Medular enfoque multidisciplinario. 3-10. 2010. Madrid, Editorial Médica Panamericana. Ref Type: Generic.
- American spinal injury association [página web. Atlanta: ASIA;c1996-08. [Available at: www.asia-spinalinjury.org/publications/2006_Classif_worksheet.pdf]. 2006. Ref Type: Generic.
- DITUNNO, J.F.; YOUNG, W.; DONOVAN, W.H., American Spinal Injury Association/International Medical Society of Paraplegia (ASIA/IMSOP). The international Standards Bloklet for Neurological and Functional Classification of Spinal Cord Injury. Paraplegia 32, 70-80. 1994. Ref Type: Generic
- GARCÍA-RENESES, J.; HERRUZO-CABRERA, R.; MARTÍNEZ-MORENO, M., Epidemiological study of spinal cord injury in Spain 1984-1985. Paraplegia. 1991; 28: 180-90.
- KIRSHBLUM, S.; DONOVAN, W.H., Neurologic Assessment and clasifcation of Traumatic Spinal Cord Injury. Kirshblum S, Campagnolo DI, Delisa JA (eds.) Spinal Cord Medicine. 82-85. 2002. Philadelphia, Lippincott Williams and Wilkins. Ref Type: Generic.
- MAZAIRA, J.; LABANDA, F.; ROMERO, J.; GARCÍA, M.E.; GAMBARRUTA, C.; SÁNCHEZ A. et al., Epidemiología de la lesión medular y otros aspectos. Rehabilitación, Madrid. 1998; 32: 365-72.
- National Spinal Cord Injury Statistical Center. Junio 2006, NSCISC Birmingham, Alabama [Consultado 4 mayo de 2010]. Available at: www.uab.edu/NSCISC.
- SAPRU, H.N., Spinal Cord: Physiology and Pathophysiology. [Spinal Cord Medicine. Kirshblum S, Campagnolo DI, Delisa JA], 5-26. 2002. Philadelphia, Lippincott-Williams and Wilkins. Ref Type: Generic.

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Muscle Function Grading

- 0 = total paralysis
1 = palpable or visible contraction
2 = active movement, full range of motion (ROM) with gravity eliminated
3 = active movement, full ROM against gravity
4 = active movement, full ROM against gravity and moderate resistance in a muscle specific position.
5 = (normal) active movement, full ROM against gravity and full resistance in a muscle specific position expected from an otherwise unimpaired person.
5+ = (normal) active movement, full ROM against gravity and sufficient resistance to be considered normal if identified inhibiting factors (i.e. pain, disuse) were not present.
NT = not testable (i.e. due to immobilization, severe pain such that the patient cannot be graded, or amputation of limb, or contracture of >50% of the range of motion).

ASIA Impairment (AIS) Scale

- ☐ **A = Complete.** No sensory or motor function is preserved in the sacral segments S4-S5.
 - ☐ **B = Sensory Incomplete.** Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-S5 (light touch, pin prick) and no S5; or deep anal pressure (DAP), AND no motor function is preserved more than three levels below the motor level on either side of the body.
 - ☐ **C = Motor Incomplete.** Motor function is preserved below the neurological level** and more than half of key muscle functions below the single neurological level of injury (NLI) have a muscle grade less than 3 (Grades 0-2).
 - ☐ **D = Motor Incomplete.** Motor function is preserved below the neurological level** and at least half (half or more) of key muscle functions below the NLI have a muscle grade > 3.
 - ☐ **E = Normal.** If sensation and motor function as tested with the ISNCSCI are graded as normal in all segments, and the patient had no other deficits, then AIS is E. Someone without an initial SCI does not receive an AIS grade.
- ** For an individual to receive a grade of C or D, i.e. motor incomplete status, they must have either (1) voluntary anal sphincter contraction or (2) sacral sensory sparing with sparing of anal reflex and/or rectal tone. The Standards at this time allows even non-key muscle function more than 3 levels below the motor level to be used in determining motor incomplete status (AIS B versus C).
- NOTE: When assessing the extent of motor sparing below AIS C and D, the AIS C and D are used to differentiate between AIS C and D (based on proportion of key muscle functions with strength grade 3 or greater) the **single neurological level** is used.

Steps in Classification

The following order is recommended in determining the classification of individuals with SCI.

1. Determine sensory levels for right and left sides.
2. Determine motor levels for right and left sides.
Note: In regions where there is no myotome to test, the motor level is presumed to be the same as the sensory level, if testable motor function above that level is also normal.
3. Determine the single neurological level.
This is the lowest segment where motor and sensory function is normal on both sides, and is the most cephalad of the sensory and motor levels determined in steps 1 and 2.
4. Determine whether the injury is Complete or Incomplete (i.e. absence or presence of sacral sparing)
If voluntary anal contraction = No AND all S4-5 sensory scores = 0 AND deep anal pressure = No, then injury is COMPLETE. Otherwise, injury is incomplete.
5. Determine ASIA Impairment Scale (AIS) Grade.

Is Injury Complete? If YES, AIS=A and can record ZPP (lowest dermatome or myotome on each side with some preservation)
NO

Is injury motor incomplete? If NO, AIS=B
YES

Of voluntary anal contraction
Contracted more than three levels below the motor level on a given side, if the patient has sensory incomplete classification

Are at least half of the key muscles below the single neurological level graded 3 or better?

NO → AIS=C
YES → AIS=D

If sensation and motor function is normal in all segments, AIS=E

Note: AIS E is used in follow-up testing when an individual with a documented SCI has recovered normal function. If at Initial testing no deficits are found, the individual is neurologically intact; the ASIA Impairment Scale does not apply.





4 | Neuorological diagnosis

López Llano, M. L.; Méndez Suárez, J. L.;
Sánchez Rodríguez-Losada, J.





A patient's medical history includes 2 initial phases: anamnesis and physical examination, which we will now discuss in depth.

Questioning should focus on understanding the patient's general and urological history, analysing the sensory and motor behaviour of the bladder, based on the guidelines of the International Continence Society (ICS) and the International Spinal Cord Injury (ISCOS) lower urinary tract function data set: Basic Data Set (1,2).



Anamnesis

Family history

General personal history

Ability to collaborate
Toxic habits
Family situation
Pregnancies, births and menstrual cycle
Work and financial situation
Drug and latex allergies

General treatment

Anticoagulant treatment
Antihypertensive treatment
Other treatments

Previous diseases General

SPINAL CORD INJURY
Other neurological diseases
High Blood Pressure
Diabetes
Neoplasias
Psychiatric disease
Surgical interventions
Others

Previous diseases Urologic

Urine infections - Fever
Prostatic pathology
Lithiasis
Haematuria



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Previous intestinal rhythm

Post spinal cord injury intestinal rhythm

Use of laxatives

Previous voiding pattern

Voiding pattern after spinal cord injury

Sensation of bladder voiding ☐ yes ☐ no ☐ don't know

Normal voiding:

Voiding reflex:

Voluntary: suprapubic tapping / anal stimulation

Involuntary

Involuntary bladder contraction:

Internal: abdominal muscle contraction / Valsalva

External: Crede manoeuvre

Intermittent catheterisation:

Self-catheterisation

Catheterisation performed by caregiver

Permanent catheterisation:

Transurethral

Suprapubic

Sacral anterior root stimulation SARS

Incontinent bladder: ostomy

Other methods

Average daily voluntary urinations in the last week

Presence of involuntary urination (incontinence)



Presence of autonomic dysreflexia

Incontinence devices

- Urisheath / catheter
- Absorbent diaper
- Ostomy bag
- Others

Medication related to the urinary tract in the past year

Antibiotics, anticholinergic, alpha-adrenergic blockers, antidepressants

Specific surgical interventions on the urinary tract and date of interventions

- Insertion of suprapubic catheter
- Lithiasis
- Bladder expansion
- Sphincterotomy
- Intravesical administration of Botulinum Toxin
- Artificial sphincter - SARS
- Vesicostomy - ureterostomy
- Others

Changes regarding the past year

Note. The various phases of bladder filling produce characteristic symptoms in the general population. However, in patients with neurological pathology, these symptoms may not manifest due to the patients' sensitivity disorders. In these cases, the patients may report other poorly defined complaints such as discomfort, suprapubic weight, voiding effort, terminal dribbling, etc.



Examination

The **basic neurological** examination is started by using the ASIA scale (American Spinal Injury Association) to determine the level of paralysis and sensitivity, along with **abdominal palpation, review of the genitals and urethra and a rectal and vaginal examination**.

The examination proceeds with an assessment of the **lum-bosacral nerve system** analysing **the sensitivity in the perineum, anal sphincter tone and reflexes related to the S2-4 segments**:

1. **Superficial anal reflex.** The S4-S5 segments are studied and explored by touching the edges of the anus and/or inserting a finger to see if the anal sphincter contracts.
2. **Bulbocavernosus or clitoral-anal reflex.** The S2-S3-S4 segments are studied and explored by pressing the glans or clitoris and observing whether there is a contraction of the bulbo and ischio cavernous muscles.
3. **Cough reflex.** A finger is inserted in the anus and the patient is asked to cough. If the anus contracts at the same time that the patient coughs then this indicates that the T6-T12 segment is intact.
4. **Abdominal muscle reflex and Beevor's sign.** This is a deep reflex that is examined bilaterally, tapping the lower costal margin and observing whether this causes a contraction of the abdominal wall. When the lower abdominal muscles are paralysed, the navel is observed to rise due to the patient's inability to prevent the action of its antagonist



muscle. Study the dorsal reflex centres from D6 to D12. The importance of this reflex lies in detecting active abdominal muscles that will help bladder voiding by abdominal straining.

5. It is advisable to also know the **post void residual**, measured using a portable ultrasound or bladder catheterisation immediately after urination to quantify the residual urine.

References

- ABRAMS P, CARDOZO L, FALL M, GRIFFITHS D, ROSIER P, ULMSTEN U, VAN KERREBROECK P, VICTOR A, WEIN A. The standardisation of terminology of lower urinary tract function: report from the Standardisation Sub-committee of the International Continence Society. Standardisation Sub-committee of the International Continence Society. *Neurourol Urodyn* 2002; 21(2):167-78.
- BIERING- SORESENSEN F, CRAGGS M, KENNELLY M, SCHICK E, WYNDAELE JJ. SPINAL (coord.) International urinary tract Imaging Basic spinal cord injury data set. 2009 May;47(5): 379-83.



Appendix

International Spinal Cord Injury Data Sets

LOWER URINARY TRACT FUNCTION BASIC DATA SET - FORM

Date of data collection: YYYYMMDD

Urinary tract impairment unrelated to spinal cord lesion:

☐ No ☐ Yes, specify _____ ☐ Unknown

Awareness of the need to empty the bladder:

☐ No ☐ Yes ☐ Not applicable ☐ Not known

Bladder voiding:	Main	Supplementary
Normal voiding	<input type="checkbox"/>	<input type="checkbox"/>
Bladder reflex triggering		
Voluntary (tapping, scratching, anal stretch, etc.)	<input type="checkbox"/>	<input type="checkbox"/>
Involuntary	<input type="checkbox"/>	<input type="checkbox"/>
Bladder expression		
Straining (abdominal straining, Valsalva's manoeuvre)	<input type="checkbox"/>	<input type="checkbox"/>
External compression (Credé manoeuvre)	<input type="checkbox"/>	<input type="checkbox"/>
Intermittent catheterization		
Self-catheterization	<input type="checkbox"/>	<input type="checkbox"/>
Catheterisation by attendant	<input type="checkbox"/>	<input type="checkbox"/>
Indwelling catheter		
Transurethral	<input type="checkbox"/>	<input type="checkbox"/>
Suprapubic	<input type="checkbox"/>	<input type="checkbox"/>
Sacral anterior root stimulation	<input type="checkbox"/>	<input type="checkbox"/>
Non-continent urinary diversion/ostomy	<input type="checkbox"/>	
Other method, specify _____	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Unknown		





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- ☐ Yes, sphincterotomy/urethral stent, date last performed
YYYYMMDD
- ☐ Yes, botulinum toxin injection, date last performed
YYYYMMDD
- ☐ Yes, artificial sphincter, date last performed, YYYYMMDD
- ☐ Yes, ileovesicostomy, date last performed YYYYMMDD
- ☐ Yes, ileoureterostomy, date last performed YYYYMMDD
- ☐ Yes, continent catheterizable valves, date last performed
YYYYMMDD
- ☐ Yes, sacral anterior root stimulator, date performed
YYYYMMDD
- ☐ Yes, other, specify _____, date
performed YYYYMMDD
- ☐ Unknown

Any change in urinary symptoms within the last year:

- ☐ No ☐ Yes ☐ Not applicable ☐ Unknown



Additional examinations

Patients with SCIs have neurogenic bladders that primarily affect the lower urinary tract. Any change in the lower urinary tract may have a direct impact on the upper urinary tract. Therefore, monitoring of the entire urinary system should be ensured from the start and be performed periodically. There are various additional tests that will provide information on the renal morphology and its function.

Analytical study

- **Blood count, biochemistry and coagulation.**
- **Creatinine:** The blood creatinine level is a parameter that is not very sensitive to changes in renal function. First, the level is related to muscle mass, which in these patients is reduced. Second, a 50% loss of renal function is necessary to increase the levels of creatinine in blood.
- **Creatinine clearance** is also not very sensitive because it does not take muscle atrophy into account. In contrast, **24-hour creatinine clearance** is a sensitive test of renal function.
- A number of studies report that **cystatin C in blood** is an effective marker of renal function; however, it is an expensive test that has not been sufficiently proven.
- **Urine analysis.** When urinary tract infection is suspected, **urine culture** and **sediment** test should be requested.



Imaging techniques

- **Ultrasound:** In recent years, ultrasounds of the abdomen and urinary apparatus have been used as a screening test. Ultrasounds are useful for providing information on morphology and detecting ureterolithiasis and dilation of the urinary tract. It has the advantage of being non-invasive, it can be performed regardless of the level of injury to the kidney and it is usually available in any radiology department. Its major disadvantage is that it is dependent on the evaluator and does not provide information on renal function.
- Before the widespread use of renal ultrasound, **intravenous urography (IVU)** was commonly performed to visualise the kidneys and ureters. IVU is useful for diagnosing an obstruction or dilation, primarily in the upper urinary tract, but it has a number of drawbacks: it requires the patient to be stable, it requires intestinal preparation the night before the test; it may cause an allergic reaction and it requires a prolonged exposure to radiation. Currently, IVU (which provides more accurate information than ultrasound) is useful when suspecting a renal or ureteral tumour, possible lithiasis or when the ultrasound is questionable.
- **Serial voiding cystourethrography (SVCU):** Performed to visualise the morphology of the lower urinary tract, determine whether there is vesicoureteral reflux (VUR), and identify possible urethral obstructions (in the bladder neck, prostate or sphincter). In cases of lack of voluntary control of urination and in patients with preserved sacral centre, it is possible to cause urination to perform a **SVCU** using ice-cooled contrast medium.
- **Computed tomography urography (CTU):** Currently, multislice CT provides high-resolution spatial and tempo-



ral images, which in addition to the high-quality three-dimensional reconstructions have made CTU the technique of choice for assessing the urinary tract, virtually replacing IVU.

- In the event of allergy to the contrast, the need for more anatomical information, etc., we should consider using **renal magnetic resonance imaging**.

Isotopic study

The various techniques of nuclear medicine subject the patient to less radiation than conventional radiology. Although they are not available in all hospitals and are more expensive, these techniques are often indicated in children and adults who require greater monitoring due to risk factors for injury to the upper urinary tract.

- **Direct isotopic cystography** diagnoses the presence and degree of VUR.
- **Isotopic renogram with diethylenetriamine pentaacetic acid labelled with technetium 99 (Tc-99m DTPA)** is useful for determining renal function and the degree of renal obstruction.



Urodynamic studies

The majority of patients with neurological injuries have functional disorders in urination, either in the filling or voiding phase.

Urodynamic studies are the only tests that provide an objective identification of the actual functional situation of the lower urinary apparatus.

Urodynamic studies can be classified within a series of diagnostic techniques that range from the simplicity of flowmetry to the complexity of videourodynamics with EMG.

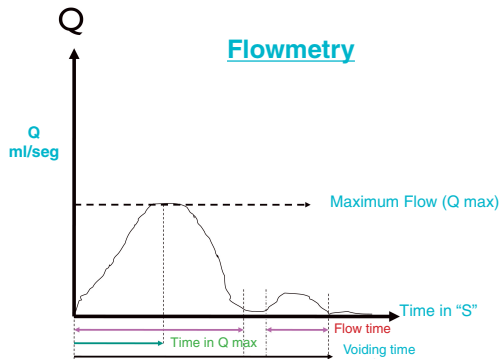
Flowmetry

Flowmetry is performed in an apparatus known as a flowmeter that, by various procedures, measures the voiding volume in units of time measured in ml per second. It is important to perform the tests in a private setting and in the usual position, seated or standing. The patient should present a voiding volume greater than 150 cc and less than 600, and the post void residual volume should always be measured, either through ultrasound or catheter. Before making a decision, a minimum of two flowmetry readings need to be taken.

The data used in flowmetry are the maximum flow (Q_{max}), the voiding volume, the voiding time, the residue and the shape of the curve.



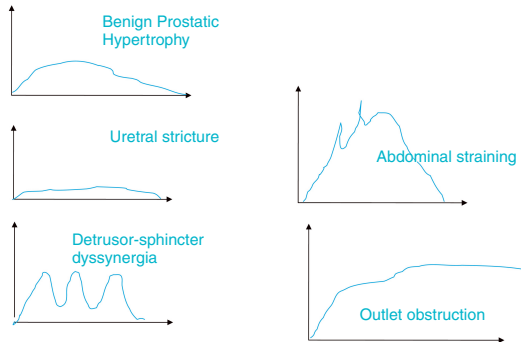
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Flowmetry indicates the difficulty in bladder voiding but is not capable of discriminating whether it is due to a contractile disorder of the detrusor or an obstructive problem of the neck, external sphincter or urethra.

Traditionally, a Qmax below 10 ml/s is indicative of obstruction, a Qmax between 10 and 15 is ambiguous and a Qmax above 15 is normal.

Similarly, the shape of the curve may indicate a possible disorder. A curve in the shape of a Gauss bell is considered normal, a flat and elongated curve indicates an outlet obstruction, a curve with spikes throughout it is indicative of the use of the abdominal straining, and an intermittent curve may be related to a detrusor-sphincter dyssynergia.



Flowmetry is an excellent test due to its safety and its ability to determine the onset of functional disorders in urination and to monitor the efficacy of established treatments. For a significant percentage of patients with spinal cord injuries, this test has little value, given their inability to voluntarily urinate.

Occasionally, flowmetry can be performed with perineal electromyography, thereby detecting uncoordinated urination or detrusor-sphincter dyssynergia. To study the various phases of the voiding cycle (filling and voiding), various types of measurement are used with their corresponding graphical representations. Therefore, in a conventional study of neurogenic patients, we will have a graph of the changes in bladder pressure, changes in abdominal straining, a detrusor curve (which is the abdominal straining minus the bladder pressure)



and the flow curve, a graph of the electrical activity (EMG) of the pelvic floor and an infused volume curve, as well as infused volume and voiding volume indicators.

When performing videourodynamics, we add to all of the above a real-time radiological image of the bladder filling and voiding, which is performed with contrast.

Filling cystomanometry

Filling cystomanometry is performed by inserting a 6-10 Ch gauge 2-channel vesical catheter into the bladder. One of the channels serves to measure the intrabladder pressure throughout the study, with the filling performed through the second channel with saline solution at room temperature using a pump that creates a flow of 20-50-100 ml/minute, depending on whether the patients are neurogenic or a filling that stimulates the detrusor is desired, for example, when detecting involuntary contractions. In children, the flow varies depending on age and the theoretical calculation of the capacity.

Similarly, an intrarectal balloon probe is inserted, which measures the intra-abdominal pressure throughout the study.

The pressure changes are transmitted to transducers, typically membrane-based and external, which transform the pressure gradients into electric current that the machine transforms into pressure curves.

Therefore, we will have an intrabladder pressure curve and an abdominal straining curve.



According to Laplace's law and given that the abdominal cavity is a closed space, all increases in pressure in any part of the abdomen are transmitted in equal magnitude to all points of the abdomen. Therefore, for example, the increased pressure due to coughing is transmitted equally to the bladder. Therefore, in order to determine whether an increase in pressure in the bladder comes from a contraction of the detrusor, the machine automatically subtracts the abdominal straining from the bladder pressure, thereby obtaining a curve known as the detrusor pressure. This shows us that any change in pressure in this curve depends exclusively on the activity of the detrusor.

In summary, we will have three curves, the so-called bladder pressure, the abdominal straining and the detrusor pressure.

Before the start of the study, the ICS guidelines need to be followed. These guidelines include the study quality criteria, patient positioning, placement of transducers on the pubis, resetting with the help of three-way stopcocks, and the confirmation with coughing of a proper transmission of pressures during the study.

During the filling phase, we will obtain various data on the bladder from the study:

The compliance, which is the ability of the bladder to adapt to fillings without increasing the detrusor pressure, is measured in ml/cm H₂O, i.e., the quantity in cc of the filling needed to increase the pressure by 1 cm H₂O. Normal is considered above 30-40 ml/cm H₂O. Below this is considered reduced compliance and is considered a risk condition for the upper urinary apparatus.



The cystomanometric capacity is given by the amount of fluid introduced into the bladder needed to induce a strong desire to urinate. This tends to match the so-called maximum cystometric capacity but may change in the presence of pain, or by sensory or motor disorders, a typical condition in patients with spinal cord injuries. A capacity of 500 cc is considered normal.

Bladder sensations refer to the various sensations that the patient feels over the course of the filling. We can define them as the initial sensation of filling, the initial desire to urinate, the strong desire to urinate, the maximum cystomanometric capacity, the sensation of urgent voiding, and painful sensations. When these last sensations are present without an increase in detrusor pressure, we have a sensory disorder of the detrusor.

Detrusor activity. In normal situations, the detrusor pressure will vary at maximum capacity by a maximum of approximately 10 cm/H₂O. Any change in pressure will cause a change in the compliance or involuntary activity of the detrusor; for neurogenic patients, this is a neurogenic hyperactivity.

Leak pressure. Determines the competency of the sphincter system when faced with urine leakage during abdominal straining increases or during involuntary detrusor activity. Normally there is an absence of leakage in stress conditions (pressure increases). Two leak point pressures are distinguished: the **abdominal leak point pressure** that determines the abdominal straining caused by the Valsava manoeuvre or coughing, in which leaks are present, and which tells us the degree of urethral competence; and the **detrusor leak point pressure** where the leak occurs in the absence of



an increase in abdominal straining or independently of involuntary contractions. A detrusor leak point pressure under low compliance is related to an at-risk bladder for the upper urinary apparatus. As an absolute value, an at-risk bladder is considered that which has a detrusor leak point pressure $>40 \text{ cm/H}_2\text{O}$.

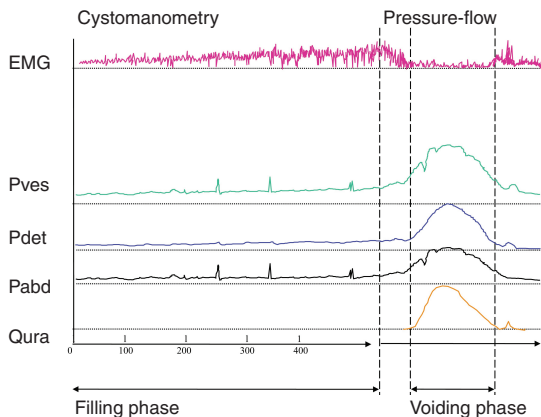
EMG. In cases where an electromyography of the pelvic floor is performed, we see that the electrical activity increases depending on whether the bladder is filling, a condition known as “guardian reflex”.

Pressure-flow study

Once the filling phase is complete, we move on to the measurement of the voiding phase, known as the **pressure-flow study**, which should be performed whenever possible in the most appropriate position and the position used most frequently by the patient. In this phase, we continue measuring the bladder pressure, the abdominal straining and the detrusor pressure, and at greater pressures the flow curve appears. Similarly, we maintain the electromyography.

The voiding phase starts when the patient has a strong desire to urinate and is given the order to urinate. In neurological patients, the phase starts when they reach their maximum cystomanometric capacity and usually occurs involuntarily.

Under normal conditions, we should initially find a sphincter relaxation and a relaxation of the pelvic floor followed immediately by an increase in detrusor pressure (isovolumetric



contraction) with no changes in bladder volume, until the bladder neck opens with the resulting output of urine and decrease in bladder volume, which by the end of urination should be complete. Once urination has finished, the bladder neck closes and the detrusor relaxes.

Graphically, the electromyograph will consequently show decreased activity as an indication of the relaxation of the pelvic floor and external sphincter (synergy). During the contraction of the detrusor, there will be an increase in bladder pressure, with a virtually identical increase in detrusor pressure. There will be no changes in abdominal straining, and a flow curve will appear.



When using videourodynamics, we can observe the opening of the bladder neck and the relaxation of the external sphincter.

The parameters to consider in the voiding phase are the following:

- Prevoiding pressure
- Maximum voiding pressure (normal value between 25 and 50 cm/H₂O)
- Maximum flow pressure
- Closure pressure (at the end of the flow)
- Opening time (from the start of the detrusor contraction to the start of the flow)
- Maximum flow (15-35 ml/s)

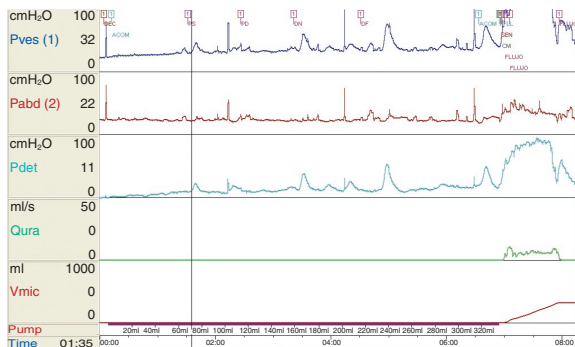
In neurological patients and depending on the extent of the injury, we may find various types of filling and voiding.

Thus, during the filling phase, we may see a reduced compliance or a greatly increased compliance with considerable bladder capacity.

The patient may present detrusor hyperactivity at different filling levels (**neurogenic detrusor overactivity**) that, on occasions, causes urine leakage.

During the voiding phase, we may find an **acontractile detrusor** or reduced contractility.

We may find an increase in electrical activity of the perineum/sphincter related to a **dyssynergia (DES)**, resulting in situa-



tions where the patient is unable to urinate, or the urination is laboured or incomplete.

We may find it necessary to use an abdominal straining to achieve urination.

Occasionally, we may also find a wave of contraction of the detrusor, after the completion of urination. This situation is highly questionable, but there are authors who relate it to detrusor overactivity.

During the urodynamic study, the urethral function is also assessed in terms of whether it is competent or not, either because of the presence of leaks in the filling phase (incompetence) or the inability or deficient flow in the emptying phase (bladder neck obstruction, detrusor-sphincter dyssynergia).



Videourodynamics, considered the gold standard in urodynamic studies, in addition to the above, shows us the presence or absence of reflux in the filling phase (passive), the presence of reflux in the voiding phase (active), the morphology of the bladder, the opening of the bladder neck and the relaxation of the external sphincter.

Once we have all these data, we can have a clear idea of the functional situation of the lower urinary apparatus and take the most appropriate measures for correcting or preventing problems of incontinence, voiding, and especially the deterioration of the upper urinary apparatus.

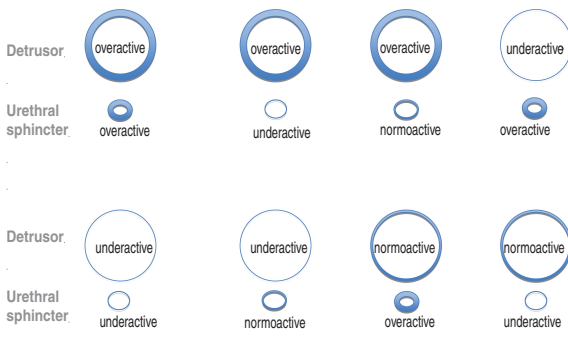




Table 1
Madersbacher classification system of neurogenic lower urinary tract dysfunction (NLUTD)

Dysfunction type	Organ behaviour	
	Bladder	Periurethral sphincter
Spinal	Overactive	Overactive
Lumbosacral I	Overactive	Underactive
Suprapontine	Overactive	Normoactive
Lumbosacral II	Underactive	Overactive
Subsacral	Underactive	Underactive
Lumbosacral III	Underactive	Normoactive
Only sphincter I	Normoactive	Overactive
Only sphincter II	Normoactive	Underactive
Absence of injury*	Normoactive	Normoactive

* Not included in the Madersbacher classification

There are several classifications based on neurological injury, in the anatomical location of the injury or on the functional situation of the lower urinary apparatus depending on the urodynamic results. The Madersbacher classification presented above is a simple classification based on the functional situation of the bladder and the sphincter system, with a clear implication as to the type of treatment to be followed.

Urethral profile

This is performed using a probe that records the pressure throughout the urethra when tractioned at a constant speed from the interior of the bladder to the penile urethra. The



measurement of the pressure can be performed using the calculation of the resistance to the constant output of fluid or using electronic devices that measure the pressure directly throughout the entire path that the probe covers. We thus obtain graphs that show us the situation of the bladder neck, external sphincter, length of the prostatic urethra, etc.

The urethral profile is a study that has currently lost much of its prominence for its lack of reproducibility, and the data that it provides does not clearly improve those we already have from the filling cystomanometry and the flow-pressure study. Especially in spinal cord injuries, its usefulness is very limited.

References

- CHAPPLE, C. R.; MACDIARMID, S. A.; PATEL, A. (eds.), *Urodynamics. Made easy*. Third Edition. Churchill Livingstone. Elsevier. 2009.
- GRUPO ESPAÑOL DE URODINÁMICA y de SINUG. Consenso sobre terminología y conceptos de la función del tracto urinario inferior. *Actas Urol Esp*. 2005; 29(11): 16-30.
- MONTOTO MARQUES, A.; FERREIRO VELASCO, M. E.; RODRIGUEZ SOTILLO, A.; SALVADOR DE LA BARRERA, S. (eds.), *Lesión medular y vejiga neurógena. Valoración y rehabilitación*. Ars Medica. 2005.
- SCHAFER, W.; ABRMS, P.; LIAO, L.; MATTIASSEN, A.; PESCE, F.; SPANGBERG, A.; STERLING, A. M.; ZINNER, N. R.; VAN KERREBROECK, P., International Continence Society. Good urodynamic practices: uroflowmetry, filling cystometry, and pressure-flow studies. *Neurourol Urodyn* 2002; 21(3): 261-74.



WYNDAELE, J.J.; CASTRO, D.; MADERSBACHER, H.; CHARTIER-KASTLER, E.; IGAWA, Y.; KOVINDHA, A.; RADZISZEWSKI, .P; STONE, A.; WIESEL, P., Neurogenic urinary and fecal incontinence. In: Abrams P, Cardozo L, Khoury S, Wein A. (eds.) Incontinence. Plymouth: Healt Publications, 2008: 793-960.





5 | Lower urinary tract

Esteban Fuertes, M.





Innervation of the lower urinary tract

The lower urinary tract is innervated by three types of nerve fibres in the body:

- Sympathetic
- Parasympathetic
- Voluntary or somatic

This innervation presents a number of spinal centres (where the synaptic connection is established with the corresponding neuron) and a number of nerve pathways, both medullary and peripheral. In turn, each type of innervation acts on a specific target organ.

Sympathetic innervation

The nerve centre where the sympathetic neurons that innervate the lower urinary tract are found is located between segments D10 to L2.

This centre receives efferent fibres from the mesencephalic micturition centre and receives afferent fibres from the free sensory endings.

Sympathetic efferent motor fibres innervate the bladder, stimulating two types of adrenergic neuroreceptors: alpha-adrenergic and beta-adrenergic. Alpha-adrenergic receptors



are mainly distributed through the bladder neck and the urethral smooth muscle, while the beta-adrenergic receptors are distributed mainly through the bladder neck.

Parasympathetic innervation

The sacral micturition centre, where the parasympathetic neurons that innervate the lower urinary tract are located, is found in sacral segments S2 to S4.

This centre, in similar fashion to the sympathetic spinal centre, receives efferent fibres from the Pontine micturition centre and receives afferent fibres from the bladder mechanoreceptors.

The parasympathetic system issues efferent motor fibres that innervate the bladder body, stimulating the muscarinic receptors.

Somatic innervation

The spinal centre where the somatic neurons that intervene in the function of the lower urinary tract are located is found at the same level as that of the parasympathetic innervation (S2 to S4) but in a different location within those segments. The parasympathetic neurons are located in the intermediolateral horns, while the somatic motor innervation is located in the anterior horns (known as Onuf's nucleus), and the somatic sensory innervation is located in the posterior horns.

The somatic centre receives efferent fibres from the upper motor centres (through the pyramidal and extrapyramidal



pathways) and from the mesencephalic micturition centre and receives afferent sensory fibres of the perineal nerve endings through the pudendal nerve.

This centre, in turn, issues motor fibres that are also conducted by the pudendal nerve that innervates the periurethral striated sphincter and the pelvic floor muscles.

Supraspinal centres

The Pontine micturition centre is in charge of ensuring that the actions of these three types of innervation are synergistic.

The motor cortex sends efferent stimuli to this centre to initiate or inhibit urination.



Physiology of the lower urinary tract

The lower urinary tract has a double function:

- Store the urine that continuously arrives from the kidneys.
- Periodically eliminate it to the exterior.
Therefore, its functional cycle can be divided into two phases:
- Filling phase.
- Voiding phase.

These phases are characterised by the following properties:

- Filling phase:
 - A progressive increase in bladder volume without a corresponding increase in pressure. The bladder has a high compliance.
 - There is no urine leakage. Urinary continence is maintained.
- Voiding phase
 - The accumulated urine is eliminated within a short period of time. The urine flow is adequate.
 - All of the accumulated urine is eliminated. There is no post void residual.

From a functional standpoint, the lower urinary tract can be considered to be formed by three organs:

- The bladder.
- The urethra.
- The pelvic floor muscles.



Each of these organs must behave in a specific manner for the correct functioning of the lower urinary tract.

Bladder

During the filling phase, the bladder or detrusor muscle is relaxed, facilitating the storage of urine at low pressure.

During the voiding phase, the detrusor contracts, initiating the expulsion of the accumulated urine and the voiding of post void residual.

The bladder is innervated at the level of the parasympathetic centre by muscarinic receptors and at the level of sympathetic by beta-adrenergic receptors. Therefore, in order to the bladder function appropriately, it is essential that the parasympathetic stimuli be inhibited during the filling phase (to avoid detrusor contraction) and the sympathetic activated (so that the baseline tone of the detrusor is relaxed). In contrast, during the voiding phase, the parasympathetic impulses need to be activated (so that the detrusor contracts).

Urethra

During the filling phase, the urethra is contracted to avoid urine leakage as the bladder fills.

During the voiding phase, the urethral muscles must be relaxed to allow the passage of urine through them.



The urethra is innervated by the sympathetic centre. Therefore, in order to properly fulfil its function, the sympathetic centre must be activated to facilitate the contraction of the urethral smooth muscles and increase the pressure of the urethra, and during the voiding phase it must be inhibited to allow its relaxation and thereby reduce urethral resistance to the passage of urine.

Pelvic floor muscles

Although the pelvic floor muscles are not part of the urinary tract from an anatomical standpoint, they play an important role from a functional standpoint.

During the filling phase, these muscles help maintain urinary continence, especially with abrupt increases in abdominal straining, contracting and facilitating the increase in urethral pressure.

During the voiding phase, these muscles must relax to facilitate the passage of urine.

The pelvic floor muscles are innervated by the pudendal nerve and, in contrast to the muscles innervated by the autonomic nervous system, are of voluntary contraction, although the patient may not be conscious of their contraction, causing functional disorders if these muscles do not contract during the filling phase or do not relax during the voiding phase.



Classification of neurogenic dysfunction of the lower urinary tract

There are two types of criteria for classifying neurogenic dysfunctions of the lower urinary tract: anatomical and functional. Each has its own limitations and therefore there is no perfect classification.

The European Association of Urology recommends following the functional classification proposed by Madersbacher. This author classifies lower urinary tract dysfunctions according to the functional impact that the neurogenic dysfunction causes both in the bladder and in the periurethral sphincter.

Three states may exist in each of these organs: normal activity (normoactive), reduced activity (underactive) and increased activity (overactive). The combination of both types of factors results in a total of $3^2=9$ possible types of neurogenic dysfunctions (Table 1).



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Dysfunction type	Organ behaviour	
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Only sphincter I	Normoactive	Overactive
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Absence of injury*	Normoactive	Normoactive

* Not included in the Madersbacher classification

An overactive bladder corresponds to a demonstration of involuntary detrusor contractions during the filling phase.

An underactive bladder corresponds to a absence of bladder contraction during the voiding phase.

An overactive sphincter corresponds to a lack of relaxation of the periurethral sphincter during the voiding phase.

An underactive sphincter corresponds to a lack of contraction of the periurethral sphincter during the filling phase.

This classification does not take into account the behaviour of the urethra.



References

- BURGDÖRFER, H.; HEIDLER, H.; MADERSBACHER, H.; KUTZENBERGER, J.; PLAMTAG, H.; PANNEK, J.; STÖHER, M., Manual Neuro-Urology and Spinal Cord Lesion. Guidelines for urological care of spinal cord injury patients, 2007.
- NOSSEIR, M.; NIKEL, A.; PANNEK, J., Clinical Usefulness of Urodynamic Assessment for Maintenance of Bladder Function in Patients with Spinal Cord Injury. *Neurol Urodyn*: 2007; 26: 228-223
- STOHRER, M.; CASTRO-DIAZ, D.; CHARTIER-KASTLER, E.; DEL POPOLO, G.; KRAMER, G.; PANNEK, J.; RADZISZEWSKI, P.; WYNDAELE, J.J., Guidelines on neurogenic lower urinary tract dysfunction. Arnhem, The Netherlands: European Association of Urology (EAU); 2008.
- STUART, B.; BAUER, S.B., Neurogenic bladder: etiology and assessment *Pediatr Nephrol*. 2008; 23(4): 541-551
- VIRSEDA, M.; SALINAS, J.; ADOT, J. M.; MARTÍN GARCÍA, C., Guías Urodinámicas V. Urodinámica en neurourología. *Urod A* 2001; 14: 59-79.





6 | Urological management in the acute phase

Barrera Chacón, J. M.; Jauregui Abrisqueta, M. L.







The immediate effects of a complete SCI include the loss of movement and sensitivity below the level of the injury, flaccid paralysis of the bladder and intestine, with urinary retention and gastrointestinal dilatation, and impairment of all body systems below the level of the injury. In some cases, generally in injuries above the T6 neurological level, so-called neurogenic shock may occur with hypotension and bradycardia. The collection of these symptoms is known as spinal shock, which is accompanied by the absence of reflex activity below the level of the injury.

The duration of the spinal shock varies significantly from days to weeks. In most cases, the reflex activity appears progressively between 6 and 8 weeks with a definite pattern.

Neurogenic bladder during the acute phase

During the spinal shock phase, there is often acontractility of the detrusor with urinary retention due to loss of its functions and overflow incontinence. Detrusor activity starts as spinal automatism begins to appear.



Management of neurogenic bladder in the emergency department

Management of the neurogenic bladder should be initiated the moment the spinal cord injury occurs. For patients who have suffered traumatic spinal cord injury, the approach to the management of the neurogenic bladder should begin by the emergency service at the site of injury. Alternatively, management should begin upon arrival at the hospital emergency room.

Bladder management in these initial moments will be identical for all patients, regardless of the injury level or severity of the spinal cord injury.

- **Anamnesis:** The patient's history will be recorded without excluding those of urological importance (recurrent infections, malformations, renal lithiasis, prostate problems, etc.)
- **Examination:** Neurological examination using the ASIA scale. Cough reflex, bulbocavernosus reflex and superficial anal reflex.
- **Additional tests:** In addition to those directed at the diagnosis of the spinal trauma and associated injuries, other tests will be performed aimed at the diagnosis of possible associated urological trauma (renal, vesical or urethral), which may suggest a different management approach than usual:
 - Macroscopic examination of urine: Presence/absence of haematuria.



- Elemental urine analysis.
- Blood count, biochemistry and coagulation study.
- Total Body CT: encompassed within the polytrauma protocol or, alternatively, renal and urinary tract ultrasound.

Objectives in this phase

1. Ensure bladder voiding.
2. Monitor the water balance.
 - Control the parenteral fluid supply.
 - Monitoring of diuresis.
3. Observe the presence of haematuria → suspicion of urinary tract and/or kidney injury.

Measures to follow in this phase

- Indwelling urinary catheter (IDC):
 - Catheterisation under aseptic conditions.
 - Silicone catheter.
 - ✓ Males: 14 or 16 Ch gauge. In the event of difficulty with catheterisation, a Tiemann catheter will be used.
 - ✓ Females: 14 or 16 Ch gauge.
 - Attachment of the catheter loosely to the abdomen in males and to the internal face of the thigh in females (avoids ulcerations in decubitus at the penoscrotal level in males and at the clitoris in females).
 - Continuous drainage with the IDC open to a bag.
 - Closed circuit system.



- Daily care of the catheter.
- Change of catheter every 21 days, if it is not possible to start intermittent catheterisation due to the patient's clinical condition.

If urethral trauma is suspected (blood in meatus, hematoma in the scrotum and/or upward displacement of the prostate) then we should not attempt to catheterise the patient. It should be considered an emergency, regardless of whether the patient has a spinal cord injury, and should be assessed and treated as such by the urologist.



Management of neurogenic bladder in the hospital ward

Once the clinical stability of the patient permits it and the supply of fluids can be adjusted, the indwelling urinary catheter is withdrawn, and the **intermittent catheterisation (IC)** can be started. This is the technique of bladder voiding recommended for this stage.

Intermittent catheterisation can generally be started between 7 and 10 days after the spinal cord injury, except in high cervical and dorsal injuries (levels above T6) where, in order to achieve clinical stability, longer periods of time are needed; or in cases of patients with associated injuries (thoracic trauma, abdominal trauma, etc.) or injuries secondary to surgical treatment.

Objectives in this phase:

1. Ensure bladder voiding.
2. Prevent bladder overdistension.
3. Prevent urinary infections.
4. Prevent the formation of stones.
5. Preserve renal function.

Measures to follow in this phase

- Intermittent catheterisation (IC):
 - Adjust fluid intake to 1500 cc/day.



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- Aseptic technique.
- Frequency: IC every 6 hours.
- Maximum volume of urine extracted in each catheterisation under 400 cc.
- If the volumes of urine extracted are above 400 cc, transition to IC every 4 hours and review intake.
- Use of low friction catheters.
- Males: 12 or 14 Ch gauge.
- Females: 12 or 14 Ch gauge.

Contraindications

- Bladder or urethral injury (haematuria or urethral bleeding).
- Urethral stricture.

References

- CHANG, H.Y.; HAVTON, L.A., Re-established micturition reflexes show differential activation patterns after lumbosacral ventral root avulsion injury and repair in rats. *Exp Neurol*. 2008 Aug; 212(2): 291-7. Epub 2008 Apr 8.
- GREGORY SAMSON, M.D.; DIANA, D.; CARDENAS, M.D., Neurogenic Bladder in Spinal Cord Injury. *Physical Medicine and Rehabilitation Clinics of North America*. Volume 18, Issue 2, May 2007, Pages 255-274.
- 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 ± 361.



- JIMENEZ MURILLO, L. y cols., Medicina de urgencias y emergencias. Guía diagnóstica y protocolos de actuación. 3ª edición. Elsevier. 2007.
- MENON, E.B., Tan ES. Urinary tract infection in acute spinal cord injury. Singapore Med J. 1992 Aug;33(4):359-61.
- SAMSON, G.; CARDENAS, D.D., Neurogenic bladder in spinal cord injury. Phys Med Rehabil Clin N Am. 2007 May;18(2): 255-74, vi.
- STÖHRER, M.; CASTRO-DIAZ, D.; CHARTIER-KASTLER, E.; KRAMER, G.; MATTIASSEN, A.; WYNDAELE, J.J., Guidelines on neurogenic lower urinary tract dysfunction. European Association of Urology. February 2003.
- STUART B. BAUER. Neurogenic bladder: etiology and assessment. *Pediatr Nephrol* (2008) 23: 541–551.
- THÜROFF, J. (chairman); ABRAMS, P.; ANDERSSON, K.E.; ARTIBANI, W.; CHARTIER-KASTLER, E.; HAMPEL, C., Ph. van Kerrebroeck. Guidelines on Urinary Incontinence. European Association of Urology 2006.
- WHEELER, J.S. JR; WALTER, J.W., Acute urologic management of the patient with spinal cord injury. Initial hospitalization. *Urol Clin North Am.* 1993 Aug; 20(3): 403-11.





7 | Chronic stage treatment

Arlandis Guzmán, S.; Salvador de la Barrera, S.;
Bonillo García, M.A.







The anatomoclinical classification of spinal cord injuries (SCI) is only indicative for predicting vesicourethral behaviour. Urodynamic study in neurogenic bladder patients secondary to SCI is recommended to be performed since it categorises the behaviour of the bladder and sphincters of each patient, in order to establish the most appropriate treatment.

The **overall objectives of treatment** can be summarised as follows:

- Preserve or improve the function of the upper urinary tract.
- Eliminate or control urinary infections.
- Ensure appropriate bladder filling under low pressure.
- Ensure appropriate bladder voiding under low pressure.
- Adequate voiding control.
- Avoid the use of indwelling catheters or stomas.

We should always attempt as **first** option the simplest therapeutic (which has to be reversible, if possible) that achieves the aforementioned objectives. When these objectives are not achieved, or undesirable side effects occur, we should move to the next more aggressive therapeutic step.

It is also important to take into account the following **influencing factors**:

- Prognosis of underlying disease.
- Limiting factors (e.g., hand dexterity).
- Mental status.



- Motivation.
- Desire to remain catheter- or appliance-free.
- Rejection of surgery.
- Sexual activity.
- Educational level.
- Psychosocial and family environment.
- Economic level.
- Age.

Cervicodorsal spinal cord injury

Cervical and thoracic level SCI will cause an upper motor neuron lesion syndrome by affecting the supranuclear and infrapontine pathways. The most common pattern of vesicourethral behaviour is detrusor-sphincter dyssynergia (DSD).

The symptoms and their evolution may vary depending on whether the lesion is complete or incomplete, however, the initial management should always be the same: to avoid upper urinary tract (UUT) damage. Therefore, bladder voiding at low pressure has to be ensured from the beginning using urinary diversions measures, as intermittent bladder catheterisation as the initial choice. The long-term treatment and its follow-up will depend on the degree of the injury, overall functionality, manual dexterity of the patient, gender and personal and caregiver motivation.

Incomplete cervicodorsal spinal cord injury

Cervical SCI who preserve partial activity of the muscle groups below the injury and the sensation or contraction in



the sacral segments (ASIA C,D), bladder behaviour can be characterised by the presence of signs of impairment in the descending pathways (suprasacral control), which behaves as detrusor overactivity or as sphincter overactivity. Hence, initial measures of bladder function rehabilitation, as with complete SCI, are focused to ensure proper bladder voiding and avoid high bladder pressures that may damage the UUT. Therefore, starting with IC program as well as perform an early urodynamic assessment are essential and should be repeated in a shorter interval than for complete SCI patients since spontaneous recovery is not rare.

Lumbosacral spinal cord injury

Lumbosacral SCI cause a lower motor neuron lesion syndrome since it affects the spinal micturition centres or the infranuclear pathways (chapter 5). The most common pattern of vesicourethral behaviour is neurogenic acontractility of the detrusor.

The treatment has to be taken according to the urodynamic findings (behaviour of the detrusor and sphincter). We can therefore find, following the Madersbacher classification:

- Acontractile detrusor and underactive sphincter.
- Underactive detrusor and overactive-normoactive sphincter.
- Normoactive detrusor and underactive sphincter.
- Overactive detrusor and underactive sphincter.



Measures to improve bladder capacity

1. Reduction in detrusor contractility and bladder pressure

1.1. Anticholinergic drugs: oxybutynin, trospium chloride, tolterodine, solifenacin, fesoterodine.

Their aim is to reduce filling pressure and detrusor overactivity and improve continence. They are very often associated with IC. Common side effects are dry mouth and constipation and they are contraindicated in severe asthma, narrow-angle glaucoma, severe esophagitis, pyloric stenosis, ulcerative colitis, myasthenia gravis and breastfeeding. Their use during pregnancy is not recommended and should be used with caution in the elderly (due to the effect that some of these drugs may cause by crossing of the blood-brain barrier and causing cognitive impairment).

1.2. Botulinum toxin detrusor injection. Injections at numerous points in the detrusor are administered to provoke temporary (average duration of 9 months) chemical denervation, which reduces overactivity and improves compliance and bladder capacity. The ideal candidates are patients with DSD who present reflex urinary incontinence with residue that requires IC.



- 1.3. Sacral neuromodulation.
- 1.4. SARS (posterior rhizotomy).
- 1.5. Augmentation cystoplasty.

2. Increased urethral resistance

- 2.1. **Duloxetine:** uptake inhibitor of serotonin and noradrenaline that increases the activity of motor neurons in Onuf's nucleus (pudendal). Not very useful for complete injuries. Sparse clinical efficacy.
- 2.2. **Periurethral space-occupying agents** (low efficacy).
- 2.3. **Suburethral slings: simple or adjustable** (Remeex® type).
- 2.4. **Artificial urinary sphincter.**
- 2.5. **Pelvic floor rehabilitation techniques:** kinesitherapy (Kegel exercises), electrostimulation and biofeedback: these techniques are only for incomplete SCI with residual pudendal activity.



Measures to improve bladder voiding

1. Increase in detrusor contractility and bladder pressure

- 1.1. **Crede and Valsalva manoeuvres:** These are indicated to increase bladder pressure and are considered as a risk factor for the excretory system. They should only be used in cases of low or no urethral resistance. Their long-term use may also cause pelvic floor deterioration, with the onset of pelvic prolapse, haemorrhoids, etc.
- 1.2. **Provoked micturition reflex** (Triggering of the bladder reflex –tapping or triggering–) This procedure consists of stimulation of the contraction of the detrusor by percussion or pressure on the suprapubic region, anal stimulation or stimulation of the internal face of the thigh. It may be performed on patients with mild DSD, with good bladder compliance whose bladders empty at pressures below the levels of risk (in non-obstructive parameters). This manoeuvre should not be done without a previous urodynamic study and never in at-risk bladders... Regular visits should be performed because it is often necessary to add drugs to reduce the outlet resistance of the bladder neck or to perform interventions on the sphincter. External collector should be added in males since most patients do not achieve complete continence.



1.3. SARS.

2. Decreased urethral resistance

- 2.1. **Alpha-adrenergic blockers: phenoxybenzamine, alfuzosin, terazosin, doxazosin and tamsulosin.** The aim is to reduce the bladder neck resistance and ease the voiding reflex. They are also used in cases of neurogenic overactivity in patients who use IC. The most common side effect is hypotension. Hence, it should be used with caution in SCI with orthostatic hypotension and a night-time administration at the beginning of treatment is recommended. In SCI with preserved erection and ejaculation, blockers may cause retrograde ejaculation and erectile dysfunction. They should be discontinued before cataract surgery (floppy iris syndrome).
- 2.2. **Striated muscle fibre relaxants:** baclofen and benzodiazepines: Their efficacy is very limited in clinical practice, given the small effect on the external sphincter and the maximum effective dose tolerated by the patient.
- 2.3. **Botulinum toxin injection into the external sphincter.** This causes a denervation of the striated sphincter, which decreases the urethral resistance, improving outflow. It causes a temporary “sphincterotomy-like” effect (3-4 months). It is therefore indicated for improving bladder voiding (spontaneous or stimulated) in males with the ability to maintain a penile collector.



2.4. Endourethral prostheses (stent type). These are placed by endourethral endoscopy and are an alternative to sphincterotomy. They have fewer perioperative complications and can be removed. However, the results vary, and relocation or telescoping using a new stent may be required if the results of the outflow are unsatisfactory, and complications may arise in the long term (infections, displacements, calcification), which may require their removal.

2.5. Sphincterotomy. Cuts are made on the sphincter by urethral endoscopy trying to reduce the flow resistance without reaching total incontinence and respecting the innervation from the pudendal nerve, responsible for the reflex erection. An external collection system is also necessary and may require reoperation depending on the result of the urodynamic parameters or due to recurrence of sphincter overactivity. Furthermore, retrograde ejaculation is common in those patients who retain this ability.

Special cases: For cases of dependent male quadriplegics and paraplegics on whom CI cannot be performed and whose social environment provides few possibilities for care, the physician may attempt to achieve an excretory system without catheter, with a previously performed urodynamic study and a complete assessment of the excretory apparatus. Physicians should attempt to elicit a micturition reflex using alpha-blocker drugs, botulinum toxin in the sphincter or surgery on the sphincter. Regular specialised monitoring is required, and the monitoring should be based on urodynamic examination and additional tests of upper excretory system control. We should anticipate and facilitate the placement of urine collection de-



vices, their care and resolution of complications associated with their use. In the event of the onset of complications, we recommend the options of indwelling urinary catheterisation, suprapubic catheterisation or deafferentation combined with SARS.

3. Urinary diversions measures

3.1. Intermittent catheterisation (IC). This is the gold standard for the management of this type of patient. Its objective is to promote continence by ensuring complete bladder voiding, with fewer complications in the UUT. Patients with neurological levels below C7 may achieve self-catheterisation, and in cases of those with levels C6 and C7, they can perform it with adjustments and preparation. In the event of the inability to self-catheterise, which is common in upper levels and in females with cervical spinal cord injuries, catheterisation by the caregivers will be proposed.

3.2. Indwelling urinary catheter (IDC): This is used when the objectives have not been achieved with the previous measures, or when the patient or the caregivers are not willing to perform IC, or when the external collection systems are not properly adapted. In females who are unable to self-catheterise and/or are elderly, the IDC is often indicated to avoid aggressive interventions. The use of silicone 14-16 Ch gauge Foley catheters is recommended. In the event of a risk of complications in the UUT or high detrusor pressures, anticholinergic agents should be added. In cases of long-standing IDC



(years), the possibility of using suprapubic catheters should be assessed. The patient should accept the risks of a long-term indwelling urinary catheter by signing and informed consent form: urinary infections, vesical lithiasis, urethral lesions (fistulae, periurethral abscesses, urethral erosion in females), contracted bladder, squamous metaplasia with risk of carcinomatous degeneration, bladder neck lesions due to accidental traction, etc.

3.3. Suprapubic catheter. This is indicated for those patients who are candidates for permanent use of an IDC in order to manage a neurogenic bladder. It is performed in order to treat or prevent the complications of chronic urethral catheterisation. In addition to the surgical complications, urine leakage may occur through the stoma and urethra, which will require closure of the bladder neck. The long-term results are similar to the IDC, and the quality of life of tetraplegic patients improves in many cases.

3.4. Urinary-related surgery.

Table 1 summarises the therapeutic measures taken depending on the predominant dysfunction of voiding or filling.



Table 1
Summary of therapeutic measures in the treatment
of neurogenic bladder due to SCI

IMPROVE FILLING-CONTINENCE	IMPROVE VOIDING
Reduction in detrusor contractility and bladder pressure <ul style="list-style-type: none"> • Anticholinergic agents • Botulinum Toxin in the detrusor • Sacral Neuromodulation • SARS (posterior rhizotomy) • Augmentation cystoplasty 	Increase in detrusor contractility and bladder pressure <ul style="list-style-type: none"> • Crede and Valsalva • Provoked micturition reflex • SARS (anterior root stimulation)
	Decreased urethral resistance <ul style="list-style-type: none"> • Alpha-blocker drugs • Striated fibre relaxants • Botulinum Toxin in the sphincter • Urethral stent • Sphincterotomy
Increased urethral resistance <ul style="list-style-type: none"> • Duloxetine • Injection of periurethral agents • Suburethral slings • Artificial urinary sphincter • Pelvic floor rehabilitation 	Urinary diversions measures <ul style="list-style-type: none"> • Intermittent catheterisation • Suprapubic cystostomy • Indwelling urinary catheter • Urinary-related



References

- ABRAMS et al., A proposed guideline for the urological management of patients with spinal cord injury. *BJU Int* 2008; 101: 989-994
- BURGDÖRFER, H. et al., *Manual of Neuro-Urology and Spinal Cord Lesion*. Far-Pharma GmbH, Cologne, 2007.
- BURNS, A.S.; RIVAS, D.A.; DITUNNO, J.F., The management of neurogenic bladder and sexual dysfunction after spinal cord injury. *Spine* 2001; 26: S129-36.
- FERREIRO, M.E.; Balsa B., Tratamiento de la vejiga neurógena en la lesión medular. Seguimiento a largo plazo. En: *Lesión Medular y Vejiga Neurógena*. Montoto A., ed. Ars Médica, Barcelona 2005: 149-174
- MARTÍNEZ AGULLÓ, E.; RUÍZ, J.L.; ARLANDIS, S.; GÓMEZ, L., *Disfunción vesical en el enfermo neurológico*. Prous Science, Barcelona, 2003.
- STÖHRER, M.; BLOK, B.; CASTRO, D.; CHARTIER-KASTLER, E.; DEL POPOLO, G.; KRAMER, G.; PANNEK, J.; RADZISZEWSKI, P.; WYNADAELE, J.J., Guidelines on neurogenic lower urinary tract dysfunction. *European Association of Urology* 2010.
- STÖHRER, M.; BLOK, B.; CASTRO-DIAZ, D.; CHARTIER-KASTLER, E.; DEL POPOLO, G.; KRAMER, G.; PANNEK, J.; RADZISZEWSKI P.; WYNDAELE. J.J., *EAU Guidelines on neurogenic lower urinary tract dysfunction*. *Eur Urol* 2009; 56: 81-8.
- WEIN, A.J., Neuromuscular dysfunction of the lower urinary tract and its management. En: Walsh PC, Retik AB, Vaughan ED, Wein AJ. Editores. *Campbell's Urology*. 8ª edición. Filadelfia. Saunders, 2002, p. Vol I.(capítulo 26).
- SA. Conservative treatment of the neuropathic bladder in spinal cord injured patients. *Spinal Cord* 2001; 39: 294-300.



8 Invasive treatments and surgery

Benito Penalva, J.; Borau Durán, A.





Indicated as second-line therapy after conservative treatment of the neurogenic bladder (manoeuvres, drugs, external neuromodulation, etc.) or as the first option in those processes with direct surgical indication (complications or reconstructive surgery).

Directed at the treatment of the following disorders:

- **Filling phase disorder:** Characterised by a reduced functional capacity of the bladder and therefore, by reduced autonomy. This correlates with an increase in the number of low-volume urinations, to which may be added manifestations of irritability in the form of urgency or precipitancy.
- **Voiding phase disorder:** Characterised by the difficulty or effectiveness of urination, with urine production being delayed or blocked. Urination attempts may even end in failure. In decompensated phases, post void residual or high pressures may be generated, causing frequent complications such as infection, lithiasis and renal impairment.
- **Incontinence:** This is defined as any involuntary emission of urine, which implies a social disorder. Although it can be considered a filling phase disorder (except for paradoxical or due to overflow, which is the voiding phase), we describe it as an independent condition given its high frequency and the severe repercussions on self-esteem and individual autonomy.
- **Complications:** Those conditions arising from poor functioning of the urinary apparatus, which may be present from the start or during later evolutionary phases.



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Voiding phase disorder

Botulinum toxin

Indication: Detrusor-sphincter dyssynergia, with the objective of eliminating sphincter obstruction in a reversible manner.

Technique: As outpatient surgery, endoscopic or paraurethral infiltration of the external urethral sphincter. Standard dose: 100 U Botox® or 250 U of Dysport®. After the injection, the IDC is left for 2 to 21 days or if possible, management is performed with intermittent catheterisation.

Assessment of results: Quarterly checks for one year with assessment of the post void residual, dysreflexia symptoms, UTI. The duration of its effects vary depending on the response to the voiding manoeuvres and on their performance.

Endoscopic deobstruction

- External sphincterotomy
- Cervical sphincterotomy
- Endoscopic urethrotomy
- TUR of the prostate
- Endoscopic diverticulectomy

Indication: Functional and organic obstruction and its consequences.

Technique: Uroendoscopy / laser / plasma coagulator.

Assessment of results: Deobstruction.



Filling phase disorder

Botulinum toxin

Indication: Overactive bladders (with bladder management using intermittent catheterisation) that present urinary incontinence despite treatment with oral anticholinergic agents or that presented adverse side effects with anticholinergic agents.

Technique: As outpatient surgery, endoscopic infiltration of the detrusor muscle at 30 sites, respecting the trigone and bladder dome. Standard dose of 300 UI Botox®.

Assessment of results: Continence between catheterisations. Approximate duration of 6 months, with reinjection required after 9 months.

Neuromodulation

We define neuromodulation as the change in behaviour of the nerve pathways induced through electrical or chemical stimulus. The most accepted and considered method is the sacral root neuromodulation using an implanted neurostimulator.

Indication: Neurogenic detrusor overactivity in patients with incomplete spinal cord injuries, multiple sclerosis, etc., with symptoms of pollakiuria, incontinence and urgency.

Technique: Tined lead catheter test. Sacral neuromodulator implant (InterStim®).

Assessment of results: Continence, autonomy.



Incontinence

Submucosal injection of hyaluronic acid and other bulking substances

Indication: Incontinence due to sphincter or cervical deficiency. Stress urinary incontinence.

Technique: As outpatient surgery, endoscopic injection in 4 points. IDC is maintained for 48 hours.

Assessment of results: Continence, although with modest results.

Cervicopexy and/or adjustable suburethral slings

Indication: Stress urinary incontinence, pure or mixed.

Technique: Open surgery with variable traction suburethral sling.

Assessment of results: Continence. Allows for the regulation of the tension of the sling on the tissues whenever necessary, even years after the surgery.

Artificial sphincter

Indication: Incontinence due to sphincter urethral deficiency.

Technique: Open surgery with periurethral hydraulic cuff.

Assessment of results: Continence. Take into account that its duration is limited and there are frequent complications.



Bladder expansion / Bypass

Indication: Low-capacity detrusor or low compliance. Urinary incontinence. Dilation of the upper urinary tract.

Technique: Open abdominal surgery with the use of intestine, except in cutaneous ureterostomy.

Assessment of results: Control of incontinence or deterioration of the upper urinary tract

SARS (Sacral anterior root stimulator)

Indication: Overactive detrusor associated with complications: Incontinence, dilation of the upper urinary tract, reflux, infections. Also, improvements in intestinal evacuation and erections.

Technique: Open surgery with implantation. Sacral posterior rhizotomy (intradural or extradural) and implantation of sacral root electrostimulator electrodes.

Assessment of results: Control of incontinence or deterioration of the upper urinary tract. Reduction in the rates of infection and lithiasis. Improvement in the symptoms of dysreflexia. Facilitation of evacuation and erections.

Complications

Retractable penis

Indication: Retractable penis that impedes the proper use of the urine collector.



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Technique: Cavernosopexia associated with a graft of the penile-scrotal angle and/or lipectomy. IDC is maintained, with bed rest for one week and avoiding exertion for one month.

Assessment of results: Improved placement of the collector, avoiding repeated drops.

Urethral stricture

Indication: Urethral stricture and urethral necrosis

Technique: Urethroplasty.

Assessment of results: Functional urethra.

Urinary fistulae / Complex fistulae

Indication: Urethrocutaneous, urointestinal or urogenital fistulae.

Technique: Fistulectomy.

Assessment of results: Resolution of the fistulae.

Lithiasis

Indication: Urinary lithiasis.

Technique: Ureteroscopy, shock waves, percutaneous surgery, endoscopic lithotripsy and open surgery.

Assessment of results: Lithiasic elimination.



Vesicoureteral reflux

Indication: Vesicoureteral reflux with an indication of surgery.

Technique: Submucosal injection of bulking substances. Open surgery. Laparoscopic surgery.

Assessment of results: Resolution of the reflux.

Hydronephrosis

Indication: Pyeloureteral junction stenosis, ureteral stenosis

Technique: Pyeloplasties, ureteral stents.

Assessment of results: Resolution of the hydronephrosis.

Severe infections / abscesses / necrotising fasciitis (Fournier's gangrene)

Indication: Pyonephrosis, abscess (scrotal, prostatic, etc.), Fournier's gangrene.

Technique: Open surgery, debridement.

Assessment of results: Resolution of the infectious process.

Bibliografía

BURKS, F.N.; BUI, D.T.; PETERS, K.M., Neuromodulation and the neurogenic bladder. Urol Clin North Am. 2010 Nov;37(4): 559-65. Review. PubMed PMID: 20955907.



- CHAABANE, W.; GUILLOTREAU, J.; CASTEL-LACANAL, E.; ABU-ANZ, S.; DE BOISSEZON, X.; MALAUDAUD, B.; MARQUE, P.; SARRAMON, J.P.; RISCHMANN, P.; GAME, X., Sacral neuro-modulation for treating neurogenic bladder dysfunction: clinical and urodynamic study. *Neurourol Urodyn.* 2011 Apr;30(4):547-50. doi: 10.1002/nau.21009. PubMed PMID: 21488095.
- 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(Pt 1):333-9. PubMed PMID: 17691394.
- LEIPPOLD, T.; REITZ, A.; SCHURCH, B., Botulinum toxin as a new therapy option for voiding disorders: current state of the art. *Eur Urol.* 2003 Aug; 44(2): 165-74. Review. PubMed PMID: 12875934.
- PERKASH, I., Transurethral sphincterotomy provides significant relief in autonomic dysreflexia in spinal cord injured male patients: long-term followup results. *J Urol.* 2007 Mar;177(3):1026-9. PubMed PMID: 17296404.
- PURI, P.; CHERTIN, B.; VELAYUDHAM, M.; DASS, L.; COLHOUN, E., Treatment of vesicoureteral reflux by endoscopic injection of dextranomer/hyaluronic Acid copolymer: preliminary results. *J Urol.* 2003 Oct;170(4 Pt 2):1541-4; discussion 1544. PubMed PMID: 14501655.
- SEIF, C.; BOY, S.; WEFER, B.; DMOCHOWSKI, R.; BRAUN, P.M.; JÜNEMANN, K.P. [Botulinum toxin for the treatment of overactive bladder--an overview]. *Urologe A.* 2008 Jan;47(1): 46-53. Review. German. PubMed PMID: 18034331.
- SEOANE-RODRÍGUEZ, S.; SÁNCHEZ, R.; LOSADA, J.; MONTOTO-MARQUÉS, A.; SALVADOR-DE LA BARRERA, S.; FERREIRO-VELASCO, M.E.; ALVAREZ-CASTELO, L.; Balsa-Mosquera, B.;



- RODRÍGUEZ-SOTILLO, A., Long-term follow-up study of intraurethral stents in spinal cord injured patients with detrusor-sphincter dyssinergia. *Spinal Cord*. 2007 Sep; 45(9): 621-6. Epub 2007 Jan 9. PubMed PMID: 17211463.
- VIGNES, J.R.; DE SEZE, M.; DOBREMEZ, E.; JOSEPH, P.A.; GUÉRIN, J., Sacral neuromodulation in lower urinary tract dysfunction. *Adv Tech Stand Neurosurg*. 2005;30:177-224. Review. PubMed PMID: 16350455.







9 | Complications and risk factors

Ledesma Romano, L.







The risk of complications in para/quadruplegic patients occurs from the moment the spinal cord injury occurs.

The placement and the care that should be taken when placing an indwelling urinary catheter (IDC) in the first days following the spinal cord injury are essential because if they are not performed properly they can be a source of later complications.

- Early complications, arising from the use of IDC:

- Urethrorrhagia
- UTI
- Decubitus in penoscrotal angle
- False passage

- Late complications:

- Lithiasis
- Hypospadias due to lying down
- Urethral diverticulum
- Penoscrotal fistulae

Urological complications related to the neurogenic bladder are the primary cause of morbidity in SCI. Mortality has declined from 45% in 1950 to 10% in 1980-1990. This is due to a better understanding of the behaviour of the neurogenic bladder and improved treatment of the SCI (comprehensive treatment in specialised units and centres for spinal cord injuries).

UTI: The most typical complication and the primary cause of morbidity in SCI, which leads to the suspicion of poor



voiding of the bladder with the presence of residue. The risk factors for poor bladder voiding include the following: bladder overdistension, high bladder pressures, detrusor sphincter dyssynergia, lithiasis, inadequate and/or incautious bladder instrumentation and especially IDC. The patient will be shown how to correct it through the use of intermittent catheterisation. We should differentiate **bacterial colonisation**, which does not require treatment, from **infection**. For SCIs, the following symptoms should lead us to suspect a UTI and prescribe an antibiotic treatment for the condition: **the febrile process, spiking fever**, the onset of changes in the **appearance of the urine** (colour, odor, presence of sediment, haematuria), changes in **bladder behaviour** (difficulty in voiding, incontinence, pollakiuria), and the onset or increase in **spasticity**, especially abdominal wall spasms. The UTI should be confirmed by the presence of urinary sediment with leukocyturia >50 per field at 400x magnification, pyuria and positive culture >100,000 colonies. These are all indicative of UTI and should be treated in SCIs. The presence of vesicoureteral reflux (VUR) and/or hydronephrosis is indicative of treatment of any episode of bacteriuria. Prior to initiating antibiotic treatment, samples should be taken for bacteriological and urinary sediment studies. An empirical treatment should be administered until the results of the culture and antibiogram have been obtained. If a pyelonephritic process is suspected, the treatment should be parenteral. If the patient is self-administering IC, an IDC will be implanted, and the patient will be advised to increase their fluid intake. Serial urine cultures are not recommended if asymptomatic bacteriuria appear, and the bacteriuria should not be treated except in the presence of the clinical signs of urinary tract infection listed above.



Urethral stricture has been reported in patients with sustained intermittent catheterisation over time in relation to microlesions of the urethral wall. This complication is also reported in relation to urethral trauma and false passages, which involve lesions of the urethral wall and fibrous scarring that cause stenosis.

Orchitis: Its onset is more common in the first 2 years following the injury. It may be related to recurrent UTI, post void residual, urethritis, traumatic catheterisation and urethral disorders such as diverticulum and fistulae. We will conduct imaging studies, urethrocystoscopy and analytical and bacteriological controls, we withdraw the catheterisation. If necessary, a suprapubic bladder drainage can be performed to leave the urethra at rest. Antibiotic, anti-inflammatory and postural treatment will be applied.

Urethral scrotal fistulae: This is an uncommon complication related to the presence of urethral diverticulum, typically in the penoscrotal angle, which is often caused by indwelling catheter decubitus or by a traumatic injury of the urethral wall due to catheterisation.

Bladder lithiasis: Typically found in the presence of alkaline pH of the urine, with recurrent UTI due to ureolytic germs that promote the precipitation of phosphate, in the presence of oxalates, with deficient bladder voiding. Urinary hygiene with the sufficient intake of fluids (1500-2000 cc/day) and effective bladder voiding will prevent the onset of this complication. Its presence requires assessment by the neuro-urologist who will decide what regimen needs to be followed.



Ureterolithiasis: This is related to recurrent infections. The genetic factor will have to be ruled out by investigating with an appropriate anamnesis. Its presence requires assessment by the neuro-urologist who will decide what regimen needs to be followed.

Pyelocaliceal ectasia: This is the first step in the onset of ureterohydronephrosis and is related to high pressures in the bladder and low compliance, which hinder the arrival of urine from the kidneys to the bladder. The cause needs to be studied (sphincter overactivity, sphincter detrusor dyssynergia, detrusor overactivity), and action needs to be taken.

Vesicoureteral reflux: This condition presents when the intravesical pressure is high due to detrusor overactivity, poor bladder neck opening, external sphincter overactivity or sphincter detrusor dyssynergia. This places the urinary apparatus at risk, and its treatment is a priority.

Autonomic dysreflexia: This is an acute syndrome related to an excessive and uncontrolled sympathetic discharge, which may appear in patients with SCI above T6, characterised by a clinical picture of **abrupt hypertension**, and is more frequent in complete injuries. This is caused by damage below the level of the injury, which stimulates the sympathetic neurons of the lateral intermediate grey matter with the massive release of dopamine and noradrenaline, resulting in severe vasoconstriction with an increase in blood pressure (BP). The parasympathetic system reacts by attempting to slow this phenomenon, which results in a bradycardia that is insufficient for stabilising the BP.



The syndrome may originate from the following:

- **Genitourinary:** The cause in 75-80% of dysreflexia cases: Bladder distension, UTI, lithiasis, sphincter detrusor dys-synergia, epididymitis, ejaculation, electroejaculation, sexual relations.
- **Non-urinary:** Pressure ulcers (PU), ingrown nails, burns, restrictive clothing.
- **Digestive system:** This is the second leading cause: Faecal impaction, abdominal distension, gastroenteritis, ulcers, biliary lithiasis, colonoscopy, haemorrhoids, anal fissure.
- **Other:** Pregnancy and childbirth, paraosteoarthropathy and heterotopic ossification (PAO), deep vein thrombosis (DVT), pulmonary thromboembolism (PTE), electrostimulation.

The **symptoms** may manifest as **throbbing headaches**, sweating and supralesional flushing, pallor and coldness below the injury, blurred vision, nasal congestion, nausea, piloerection, **hypertension, and bradycardia**.

Treatment is based on the search and elimination of triggers for the dysreflexia and its symptoms.

The most common trigger originates from the urinary system: bladder distension with the inability to empty. **Catheterisation** with slow drainage of the bladder is therefore essential. **Place the patient in an upright sitting position. Never lay the patient down.** Monitor the patient's BP, loosen their belt, and remove their socks and any other restrictive clothing. BP



monitoring should be maintained for 2 hours after the patient is stabilised. Antihypertensive treatment, captopril, prazosin and nifedipine may be added.

Monitoring of patients with spinal cord injuries

The approach to follow after hospital discharge is as follows:

- Follow-up in external consultation at 3 months.
- Review at 6 months from hospital discharge, following the guidelines listed in Chapter 4: **Neurological diagnosis**.

After this initial follow-up, we will perform annual follow-ups similar to those discussed earlier. If the patient reports any change in their situation, we will expand the studies. The invasive cystography and urodynamic studies, as well as the urography, will be performed when there are changes in bladder behaviour that have appeared since the previous follow-up or when the patient requests a consultation for disorders in bladder functionalism that require any or all of the referenced studies.

Monitoring and control of chronic spinal cord injury at discharge (annual check)

Blood biochemistry: general biochemistry, total and free PSA in males >45 years of age. Creatinine clearance every 2-3 years.

**Blood count****Haemostasis****Urinalysis with sediment****Urine culture and antibiogram****Urinary apparatus ultrasound**

Simple radiodiagnosis of the abdomen: Patients prone to forming lithiasis when the ultrasound does not show the bladder.

Urodynamic, videourodynamics, cystography, urography.

These will be required by changes in the behaviour of the bladder or the onset of complications that require this or other invasive examinations. These complications include:

- Recurrent UTI
- Lithiasis
- Detrusor overactivity
- Sphincter detrusor dyssynergia
- Pathway dilation
- Repeated dysreflexia crises
- Low-pressure bladder
- Vesicoureteral reflux

These will indicate the need for performing studies such as those listed above.





10 | **Quality of life related to the Neurogenic Bladder in patients with spinal cord injuries**

González Viejo, M.A.







Quality of life and spinal injury

In 1984, the World Health Organisation (WHO) declared that health is not only the absence of disease but also a state of physical, mental and social well-being. Quality of life (QOL) is a complex concept that does not have a simple definition. The WHO defines it as a person's perception of their position in life in relation to the context of their culture, system of values where they live and their objectives and expectations. Another concept of QOL that is linked to health also covers healthcare concepts and includes multidimensional aspects that cover various categories: personal competence, perceived quality of life, environment and psychological well-being. The analysis of QOL serves to identify the patients' preferences for certain medical interventions and assess the probable benefits, especially in severely disabling processes. There is the hope of an improved life, providing information on late problems and the effect these medical decisions have on certain aspects of the disability.

The factors that affect QOL and that should be evaluated must provide sufficient information to the clinicians. This information can be used to improve the patients' QOL and includes two categories:

1. Individual and demographic factors, related to the characteristics of the deficit and that often cannot be changed.
2. Medical, functional and social factors, which may improve with rehabilitation.



QOL is a good mechanism for predicting long-term survival. Given that urological impairment in spinal cord injury patients causes disabilities, it is an extremely important element of QOL, as it can also affect morbidity, mortality and social and occupational integration.

There is sufficient information to indicate that patients with SCI have a lower quality of life due to urinary impairment. One study concluded that continent patients have better QOL and that treatment of this impairment is a substantial element in the improvement of their QOL.

There is insufficient information on the actual influence on QOL of each of the methods of continence maintenance and urinary evacuation in this group of patients. These methods include intermittent self-catheterisation, permanent catheterisation or suprapubic catheterisation.



QOL and spinal injury questionnaires

The two most used questionnaires for measuring QOL in patients with spinal cord injuries, regarding the neurogenic bladder, are Outcomes Study SF-36™ Health Survey (SF-36) and the King's Health Questionnaire (KHQ).

The most commonly used scale is the Medical Outcomes Study SF-36™ Health Survey, developed in 1993, which assesses the state of health and generically uses physical, social and emotional aspects of the disease. However, it does not use specific categories that exclusively assess the effect that the neurogenic bladder has on QOL. The scale consists of 36 questions on physical and mental measures. Physical health is divided into scales to determine the physical function (10 items), physical role (4), pain (2) and general health (5). The subscale of mental health includes vitality (4 items), social function (2), emotional role (3) and mental health (5). An abbreviated scale may also be used: the Satisfaction with Life Scale (SF-12).

The other far more extensive questionnaire for assessing patients with urinary incontinence is the King's Health Questionnaire (KHQ), which has a version in Spanish. This questionnaire also measures the physical, social and emotional aspects of the condition, and the impact of urinary inconti-



nence (UI) in physical, social and mental areas. It consists of 21 items distributed over 9 dimensions: perception of the state of general health (1 item); the impact of the UI (1 item); the limitations on daily activities (2 items); social limitations (2 items); physical limitations (2 items) personal relationships (3 items); emotions (3 items); sleep/energy (2 items), and the impact of incontinence (5 items). An additional dimension assesses the severity of the urinary symptoms. Each item on the KHQ has a Likert response scale that provides 4 or 5 options for responses.

The questions are formulated so that the greater the result of the given response, the poorer the QOL reported by the patient. The score on the questionnaire is obtained for each dimension and is the result of the sum of the responses to the items, thereby standardising the score to facilitate its interpretation $[(\text{actual score} - \text{minimum score}) / (\text{maximum score} - \text{minimum score}) * 100]$.

The final score varies between 0 (best QOL) and 100 points (worst QOL). For unanswered questions, no assumptions are made, and the score for that dimension is not calculated. The KHQ has been shown to be a questionnaire that is easily to understand, answer and self-administer, which serves to confirm the significant impact that urinary continence has on the quality of life of these patients.

There is a recently developed questionnaire that specifically targets patients with spinal cord injuries, called Qualiveen. It is available in French and is pending registration by Coloplast A/S, DK-3050 Humlebaek, Denmark in its English version. It is a 30-item questionnaire, validated in 281 patients with spinal cord injuries, 55% of whom were paraplegics and 78%



of whom were males. In the validation of the questionnaire, clinical validity was determined to relate QOL with the length of urination, the well-being of the patients when urinating and the patient satisfaction with urination, the frequency or episodes of incontinence.

Conclusions

Given the available evidence, the best assessment method for measuring QOL related to the neurogenic bladder in patients with spinal cord injuries is the Medical Outcomes Study SF-36™ Health Survey. However, given that it does not provide sufficient information and has significant limitations in certain aspects of impairment of urinary origin, the use of the KHQ is recommended. An alternative to these tools is the use of the Qualiveen.



References

- BADIA LLACH X., CASTRO DÍAZ D., CONEJERO SUGRAÑES J.: Validez del cuestionario King's Health para la evaluación de los pacientes con incontinencia urinaria. *Med Clin, Barcelona*, 2000;114:647-652.
- BARKER R.N., KENDALL M.D., AMSTERS D.I., PERSHOUSE K.J., HAINES T.P., KUIPERS P.: The relationship between quality of life and disability across the lifespan for people with spinal cord injury. *Spinal Cord* 2009, 47:149-155.
- COSTA, P.; PERROUIN-VERBE, B.; COLVEZ, A.; DIDIER, J. P.; MARQUIS, P.; MARREL, A.; AMARENCO, G.; ESPIRAC, B.; LERICHE, A., Quality of Life in Spinal Cord Injury Patients with Urinary Difficulties. Development and Validation of Qualiveen. *Eur Urol* 2001;39:107-113.
- FORCHHEIMER, M.; MCAWENEY, M.; TATE, D.G., Use of the SF-36 among persons with spinal cord injury. *Am J Phys Med Rehabil* 2004, 83:390-395.
- HICKENS, B.L.; PUTZE, J.D.; RICHARDS, J.S., Bladder management and quality of life after spinal cord injury. *Am J Phys Med Rehabil* 2001;80:916-922.
- LIU, C.W.; ATTAR, K.H.; GALL, A.; SHAH, J.; CRAGGS, M., The relationship between bladder management and health-related quality of life in patients with spinal cord injury in the UK. *Spinal Cord* 2010;48:319-324.
- MAGASI, S.; HEINEMANN, A.W.; WILSON, C.S., Psychological aspects of living with Spinal Cord Injury: Emotional health, Quality of Life and Participation. Chapter 9 En: *Spinal Cord Injury Rehabilitation*. Edelle C. Field-Fote. F.A Davis Company. Philadelphia 2009. p.211-228.
- WAGNER, T.H.; PATRICK, D.L.; BAVEDAM, T.G.; MARTIN, M.L.; BUESHING, D.P., Quality of life of persons with urinary



- incontinence: Development of a new measure. *Urology* 1996;47:67-72
- WELD, K.J.; DMOCHOWSKI, R.R., Effect of bladder management on urological complications in spinal cord injured patients. *J Urol* 2000; 163: 768–772.
- WYNDAELE, J.J.; MADERSBACHER, H.; KOVINDHA, A., Conservative treatment of the neuropathic bladder in spinal cord injured patients. *Spinal Cord* 2001; 39: 294–300.







Appendix. Questionnaires





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SF-36 Health Survey

This set of questions asks for your views about your health. This information will help keep track of how you feel and how well you are able to do your usual activities. Answer every question by marking the answer as indicated. If you are unsure about to answer a question please give the best answer you can.

1. In general, would you say your health is:

- ☐ Excellent
- ☐ Very Good
- ☐ Good
- ☐ Fair
- ☐ Poor

2. Compared to one year ago, how would you rate your health in general now?

- ☐ Much better than one year ago
- ☐ Somewhat better now than one year ago
- ☐ About the same as one year ago
- ☐ Somewhat worse now than one year ago
- ☐ Much worse now than one year ago

The following questions are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

3. Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports.

- ☐ Yes, limited a lot.
- ☐ Yes, limited a little.
- ☐ No, not limited at all



4. Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf?
- ☐ Yes, limited a lot.
- ☐ Yes, limited a little.
- ☐ No, not limited at all
5. Lifting or carrying groceries.
- ☐ Yes, limited a lot.
- ☐ Yes, limited a little.
- ☐ No, not limited at all
6. Climbing several flights of stairs.
- ☐ Yes, limited a lot.
- ☐ Yes, limited a little.
- ☐ No, not limited at all
7. Climbing one flight of stairs.
- ☐ Yes, limited a lot.
- ☐ Yes, limited a little.
- ☐ No, not limited at all
8. Bending, kneeling or stooping.
- ☐ Yes, limited a lot.
- ☐ Yes, limited a little.
- ☐ No, not limited at all
9. Walking more than one mile.
- ☐ Yes, limited a lot.
- ☐ Yes, limited a little.
- ☐ No, not limited at all
10. Walking several blocks.
- ☐ Yes, limited a lot.
- ☐ Yes, limited a little.
- ☐ No, not limited at all



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11. Walking one block.

- ☐ Yes, limited a lot.
- ☐ Yes, limited a little.
- ☐ No, not limited at all

12. Bathing or dressing yourself.

- ☐ Yes, limited a lot.
- ☐ Yes, limited a little.
- ☐ No, not limited at all

During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

13. Cut down the amount of time you spent on work or other activities?

- ☐ Yes
- ☐ No

14. Accomplished less than you would like?

- ☐ Yes
- ☐ No

15. Were limited in the kind of work or other activities.

- ☐ Yes
- ☐ No

16. Had difficulty performing the work or other activities (for example, it took extra effort).

- ☐ Yes
- ☐ No



17. During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)? Cut down the amount of time you spent on work or other activities?

☐ Yes
☐ No

18. Accomplished less than you would like.

☐ Yes
☐ No

19. Didn't do work or other activities as carefully as usual.

☐ Yes
☐ No

20. During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbours, or groups?

☐ Not at all
☐ Slightly
☐ Moderately
☐ Quite a bit
☐ Extremely

21. How much physical pain have you had during the past 4 weeks?

☐ None
☐ Very mild
☐ Moderate
☐ Severe
☐ Very severe



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22. During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and house-work)?

- ☐ Not at all
- ☐ A little bit
- ☐ Moderately
- ☐ Quite a bit
- ☐ Extremely

These questions are about how you feel and how things have been with you during the past 4 weeks. Please give the one answer that is closest to the way you have been feeling for each item.

23. Did you feel full of life?

- ☐ All of the time
- ☐ Most of the time
- ☐ A good bit of the time
- ☐ Some of the time
- ☐ A little of the time
- ☐ None of the time

24. Have you been a very nervous person?

- ☐ All of the time
- ☐ Most of the time
- ☐ A good bit of the time
- ☐ Some of the time
- ☐ A little of the time
- ☐ None of the time



25. Have you felt so down in the dumps that nothing could cheer you up?

- ☐ All of the time
- ☐ Most of the time
- ☐ A good bit of the time
- ☐ Some of the time
- ☐ A little of the time
- ☐ None of the time

26. Have you felt calm and peaceful?

- ☐ All of the time
- ☐ Most of the time
- ☐ A good bit of the time
- ☐ Some of the time
- ☐ A little of the time
- ☐ None of the time

27. Did you have a lot of energy?

- ☐ All of the time
- ☐ Most of the time
- ☐ A good bit of the time
- ☐ Some of the time
- ☐ A little of the time
- ☐ None of the time

28. Have you felt downhearted and blue?

- ☐ All of the time
- ☐ Most of the time
- ☐ A good bit of the time
- ☐ Some of the time
- ☐ A little of the time
- ☐ None of the time



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29. Did you feel worn out?

- ☐ All of the time
- ☐ Most of the time
- ☐ A good bit of the time
- ☐ Some of the time
- ☐ A little of the time
- ☐ None of the time

30. Have you been a happy person?

- ☐ All of the time
- ☐ Most of the time
- ☐ A good bit of the time
- ☐ Some of the time
- ☐ A little of the time
- ☐ None of the time

31. Did you feel tired?

- ☐ All of the time
- ☐ Most of the time
- ☐ A good bit of the time
- ☐ Some of the time
- ☐ A little of the time
- ☐ None of the time

32. During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives etc.)?

- ☐ All of the time
- ☐ Most of the time
- ☐ Some of the time
- ☐ A little of the time
- ☐ None of the time



How TRUE or FALSE is each of the following statements for you?

33. I seem to get sick a little easier than other people.

- ☐ Definitely true
- ☐ Mostly true
- ☐ Don't know
- ☐ Mostly false
- ☐ Definitely false

34. I am as healthy as anybody I know.

- ☐ Definitely true
- ☐ Mostly true
- ☐ Don't know
- ☐ Mostly false
- ☐ Definitely false

35. I expect my health to get worse.

- ☐ Definitely true
- ☐ Mostly true
- ☐ Don't know
- ☐ Mostly false
- ☐ Definitely false

36. My health is excellent.

- ☐ Definitely true
- ☐ Mostly true
- ☐ Don't know
- ☐ Mostly false
- ☐ Definitely false



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King's Health Questionnaire (KHQ)

1. How would you describe your health at the present?

Please tick one answer

- | | |
|-----------|-----------------------|
| Very good | <input type="radio"/> |
| Good | <input type="radio"/> |
| Fair | <input type="radio"/> |
| Poor | <input type="radio"/> |
| Very poor | <input type="radio"/> |

2. How much do you think your bladder problem affects your life?

Please tick one answer

- | | |
|------------|-----------------------|
| Not at all | <input type="radio"/> |
| A little | <input type="radio"/> |
| Moderately | <input type="radio"/> |
| A lot | <input type="radio"/> |

Please turn the page



Below are some daily activities that can be affected by bladder problems. How much does your bladder problem affect you? We would like you to answer every question. Simply tick the box that applies to you.

3. Role limitations

	1 Not at all	2 Slightly	3 Moderately	4 A lot
--	-----------------	---------------	-----------------	------------

- | | | | | |
|---|-----------------------|-----------------------|-----------------------|-----------------------|
| A. Does your bladder problem affect your household tasks? (cleaning, shopping etc) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| B. Does your bladder problem affect your job, or your normal daily activities outside the home? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

4. Physical/social limitation

	1 Not at all	2 Slightly	3 Moderately	4 A lot
--	-----------------	---------------	-----------------	------------

- | | | | | |
|--|-----------------------|-----------------------|-----------------------|-----------------------|
| A. Does your bladder problem affect your physical activities (e.g. going for a walk, running, sport, gym etc)? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| B. Does your bladder problem affect your ability to travel? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| C. Does your bladder problem limit your social life? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| D. Does your bladder problem limit your ability to see and visit friends? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

5. Personal relationships

	0 Not applicable	1 Not at all	2 Slightly	3 Moderately	4 A lot
--	---------------------	-----------------	---------------	-----------------	------------

- | | | | | | |
|--|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| A. Does your bladder problem affect your relationship with your partner? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| B. Does your bladder problem affect your sex life? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| C. Does your bladder problem affect your family life? | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |



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	1 Not at all	2 Slightly	3 Moderately	4 Very much
6. Emotions				
A. Does your bladder problem make you feel depressed?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
B. Does your bladder problem make you feel anxious or nervous?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
C. Does your bladder problem make you feel bad about yourself?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7. Sleep/energy	1 Never	2 Sometimes	3 Often	4 All the time
A. Does your bladder problem affect your sleep?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
B. Does your bladder problem make you feel worn out and tired?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8. Do you do any of the following?	If so how much?			
	1 Never	2 Sometimes	3 Often	4 All the time
A. Wear pads to keep dry?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
B. Be careful how much fluid you drink?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
C. Change your underclothes because they get wet?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
D. Worry in case you smell?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



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We would like to know what your bladder problems are and how much they affect you, From the list below choose only those problems that you have at present. Leave out those that don't apply to you.

How much do they affect you?

FREQUENCY: going to the toilet very often

1. A little

☐

2. Moderately

☐

3. A lot

☐

NOCTURIA: getting up at night to pass urine

1. A little

☐

2. Moderately

☐

3. A lot

☐

URGENCY: a strong and difficult to control desire to pass urine

1. A little

☐

2. Moderately

☐

3. A lot

☐

URGE INCONTINENCE: urinary leakage associated with a strong desire to pass urine

1. A little

☐

2. Moderately

☐

3. A lot

☐

STRESS INCONTINENCE: urinary leakage with physical activity eg. coughing, running

1. A little

☐

2. Moderately

☐

3. A lot

☐

NOCTURNAL ENURESIS: wetting the bed at night

1. A little

☐

2. Moderately

☐

3. A lot

☐



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INTERCOURSE INCONTINENCE: urinary leakage with sexual intercourse

1. A little



2. Moderately



3. A lot



WATERWORKS INFECTIONS

1. A little



2. Moderately



3. A lot



BLADDER PAIN

1. A little



2. Moderately



3. A lot



Thank You For Your Time



To Calculate Scores

PART 1

1) *General Health Perceptions*

Very good	1
Good	2
Fair	3
Poor	4
Very poor	5

$$\text{Score} = ((\text{Score to Q1} - 1)/4) \times 100$$

2) *Incontinence Impact*

Not at all	1
A little	2
Moderately	3
A lot	4

$$\text{Score} = ((\text{Score to Q2} - 1)/3) \times 100$$

PART 2

Individual scores as recorded at the top of each column of possible responses

3) *Role limitations*

$$\text{Score} = (((\text{Scores to Q 3A} + 3\text{B}) - 2)/6) \times 100$$

4) *Physical limitations*

$$\text{Score} = (((\text{Scores to Q 4A} + 4\text{B}) - 2)/6) \times 100$$



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5) *Social limitations*

[If 5C >= 1] Score = (((Score to Q 4C + 4D + 5C)
– 3)/9) x 100

[If 5C = 0] Score = (((Score to Q 4C + 4D) – 2)/6)
x 100

6) *Personal relationships*

[If 5A+5B >=2] Score = (((Scores to Q 5A + 5B) – 2)/6)
x 100

[If 5A+5B =1] Score = (((Scores to Q 5A + 5B) – 1)/3)
x 100

[If 5A+5B =0] Treat as missing value

7) *Emotions*

Score = (((Score to Q 6A + 6B + 6C) – 3)/9) X 100

8) *Sleep / energy*

Score = (((Scores to Q 7A + 7B) – 2)/6) x 100

9) *Severity measures*

Score = (((Scores to Q 8A + 8B + 8C + 8D) – 4)/12)
x 100

PART 3

Scale	score
Omitted	0
A little	1
Moderately	2
A lot	3



Centre N° _____

Patient N° _____

Patient's initials _____

First 2 letters
of surnameFirst 2 letters
of first name

QUALIVEEN Questionnaire

How to answer the questionnaire:

The following questions are about the bladder problems you may have and how you deal with them.

Please fill in this questionnaire in a quiet place and preferably on your own. Take the time you need. There are no right or wrong answers. If you are not sure how to answer a question, choose the answer which best applies to you. Please note that your answers will remain strictly anonymous and confidential.

When answering the questions, think about how you pass urine at present.

Thank you for your participation.

✓ Before filling in this questionnaire, please write today's date:

Day Month Year

THE INFORMATION CONTAINED IN THIS QUESTIONNAIRE IS
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*YOUR BLADDER PROBLEMS AND HOW YOU PASS URINE
AT PRESENT: WHAT BOTHERS YOU*

Please answer all the questions by ticking the appropriate box.

Are you bothered:

	Not at all	Slightly	Moderately	Quite a bit	Extremely	Not applicable
1. by urine leaks during the day	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₀
2. by urine leaks at night	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₀
3. by having to wear continence pads/penile sheaths	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₀
4. by having a set timetable for passing urine during your activities	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₀
5. by the time spent passing urine	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₀
6. because your nights are disturbed	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	
7. when travelling	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₀
8. by personal hygiene problems when away from home	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	
In general:	Not at all	Slightly	Moderately	Quite a bit	Extremely	
9. Do your bladder problems complicate your life?	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	



YOUR BLADDER PROBLEMS AND HOW YOU PASS URINE AT PRESENT: WHAT YOU ARE RESTRICTED OR FORCED TO DO

Please answer all the questions by ticking the appropriate box.

	Never	Rarely	From time to time	Often	Always
10. Can you go out without planning anything in advance?	<input type="checkbox"/> ₄	<input type="checkbox"/> ₃	<input type="checkbox"/> ₂	<input type="checkbox"/> ₁	<input type="checkbox"/> ₀
11. Have you given up going out?	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
12. Are you more dependent on others, due to your bladder problems?	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
13. Is your life regulated by your bladder problems?	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄

Do you have to:

	Never	Rarely	From time to time	Often	Always
14. plan everything?	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
15. think about taking a change of clothes and/or continence pads/penile sheaths with you?	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
16. wear continence pads/penile sheaths as a precaution?	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄
17. be careful about how much fluid you drink?	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄



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*YOUR BLADDER PROBLEMS AND HOW YOU PASS URINE AT
PRESENT: WHAT YOU WORRY ABOUT*

Please answer all the questions by ticking the appropriate box.

Do you worry about:

	Not at all	Slightly	Moderately	Quite a bit	Extremely	Not applicable
18. smelling of urine?	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	
19. having urinary infections?	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	
20. your bladder problems worsening?	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	
21. disturbing your partner at night?	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₀
22. having urine leaks during sexual intercourse?	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	<input type="checkbox"/> ₀
23. any side effects from the drugs you have to take?	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	
24. having skin problems?	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	
25. having money problems due to the expenses involved with your bladder problems?	<input type="checkbox"/> ₀	<input type="checkbox"/> ₁	<input type="checkbox"/> ₂	<input type="checkbox"/> ₃	<input type="checkbox"/> ₄	



YOUR BLADDER PROBLEMS AND HOY YOU PASS URINE AT
PRESENT: WHAT YOU FEEL

Please answer all the questions by ticking the appropriate box.

- | | Not
at all | Slightly | Moderately | Quite
a bit | Extremely |
|---|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| 26. Do you feel embarrassed because of your bladder problems? | <input type="checkbox"/> ₀ | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ |
| 27. Do you feel a loss of self-respect because of your bladder problems? | <input type="checkbox"/> ₀ | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ |
| 28. Do you have to conceal your bladder problems? | <input type="checkbox"/> ₀ | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ |
| 29. Do you worry about other people's reactions if you have to spend a long time in the toilet? | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |
| 30. Do you feel worried because of your bladder problems? | <input type="checkbox"/> ₁ | <input type="checkbox"/> ₂ | <input type="checkbox"/> ₃ | <input type="checkbox"/> ₄ | <input type="checkbox"/> ₅ |



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*THE FOLLOWING QUESTIONS DEAL WITH HOW YOU FEEL
IN GENERAL*

Please answer all the questions by ticking the appropriate box.

You feel things are going...

	Very badly	Fairly badly	Neither well nor badly	Fairly well	Very well
31. About the attitude of people towards you and the way they look at you because of your situation/disability	<input type="checkbox"/> ₋₂	<input type="checkbox"/> ₋₁	<input type="checkbox"/> ₀	<input type="checkbox"/> ₊₁	<input type="checkbox"/> ₊₂
32. About your morale	<input type="checkbox"/> ₋₂	<input type="checkbox"/> ₋₁	<input type="checkbox"/> ₀	<input type="checkbox"/> ₊₁	<input type="checkbox"/> ₊₂
33. About your relationships with other people	<input type="checkbox"/> ₋₂	<input type="checkbox"/> ₋₁	<input type="checkbox"/> ₀	<input type="checkbox"/> ₊₁	<input type="checkbox"/> ₊₂
34. About your ability (or difficulty) with daily activities, whether in the home (housework, upkeep,...) or outdoors	<input type="checkbox"/> ₋₂	<input type="checkbox"/> ₋₁	<input type="checkbox"/> ₀	<input type="checkbox"/> ₊₁	<input type="checkbox"/> ₊₂
35. About how much time you need to do things in general	<input type="checkbox"/> ₋₂	<input type="checkbox"/> ₋₁	<input type="checkbox"/> ₀	<input type="checkbox"/> ₊₁	<input type="checkbox"/> ₊₂
36. About your sex life	<input type="checkbox"/> ₋₂	<input type="checkbox"/> ₋₁	<input type="checkbox"/> ₀	<input type="checkbox"/> ₊₁	<input type="checkbox"/> ₊₂
37. About your ability (or difficulty) to relax	<input type="checkbox"/> ₋₂	<input type="checkbox"/> ₋₁	<input type="checkbox"/> ₀	<input type="checkbox"/> ₊₁	<input type="checkbox"/> ₊₂
38. About your ability (or difficulty) to go out or move about outside the home	<input type="checkbox"/> ₋₂	<input type="checkbox"/> ₋₁	<input type="checkbox"/> ₀	<input type="checkbox"/> ₊₁	<input type="checkbox"/> ₊₂
39. About all the expenses involved, due to your physical condition	<input type="checkbox"/> ₋₂	<input type="checkbox"/> ₋₁	<input type="checkbox"/> ₀	<input type="checkbox"/> ₊₁	<input type="checkbox"/> ₊₂
40. About how you pass urine	<input type="checkbox"/> ₋₂	<input type="checkbox"/> ₋₁	<input type="checkbox"/> ₀	<input type="checkbox"/> ₊₁	<input type="checkbox"/> ₊₂

Did you fill in this questionnaire on your own?

<input type="checkbox"/> ₁	yes
<input type="checkbox"/> ₂	no



• Your date of birth:
Day Month Year

- Your sex: ☐₁ male
☐₂ female
- Do you live: ☐₁ alone
☐₂ as a couple
☐₃ other
- Your highest academic level:
☐₁ less than a level certificate
☐₂ a level or final year level
☐₃ higher education
- What is your current job situation?
☐₁ salaried activity
☐₂ unemployed
☐₃ pensioner
☐₄ other
- What is your normal way of moving about?
☐₁ walking
☐₂ manual wheelchair
☐₃ electric wheelchair
☐₄ none
- Do you need someone's help in your daily life?
- At home: ☐₁ yes
☐₂ no
- Outside your home: ☐₁ yes
☐₂ no



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CONCERNING YOUR SPINAL CORD INJURY

- Are you: ☐₁ paraplegic
☐₂ tetraplegic
☐₃ suffering from cauda equina syndrome
- Is this a complete spinal cord injury?
☐₁ yes
☐₂ no
☐₃ do not know
- What year did your spinal cord injury occur? _ _ _ _ _
- Do you know the level of your spinal cord injury?
☐₁ yes
☐₂ no

If yes, what is it? _ _ _ _ _

(put 1 letter and 1 number, e.g. C5-C6, D4-D5, L1-L5, S1)

- Is your spinal cord injury:
☐₁ of traumatic origin (accident)
☐₂ due to multiple sclerosis
☐₃ congenital (spina bifida,...)
☐₄ due to another cause (infectious, vascular, disc herniation,...)



CONCERNING YOUR BLADDER PROBLEMS

- Are you currently on a medical treatment for your bladder problems?

☐₁ yes
☐₂ no

- Have you had an operation for your bladder problems?

☐₁ yes
☐₂ no

If yes, how many times? _____

- Have you had any symptomatic urinary infections (e.g.: fever, cloudy urine,...) in the last 30 days?

☐₁ yes
☐₂ no

If yes, how many? _____

- Do you wear a continence protection or urinary catheter?

☐₁ yes
☐₂ no

If yes, is it?

☐₁ as a precaution
☐₂ because you have urine leaks regularly between urinations
☐₃ because you have been «made incontinent»
☐₄ because you are permanently incontinent

- Do you pass urine by? (several possible answers)

☐₁ self-catheterisation
☐₂ catheterisation by another person
☐₃ percussion
☐₄ abdominal or manual pressing
☐₅ continuous urine leaking
☐₆ urinary diversion
☐₇ continuous drainage (indwelling catheter, suprapubic catheter,...)
☐₈ other

- Have you changed the way in which you pass urine in the last 6 months?

☐₁ yes
☐₂ no



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- Do you need someone to help you to pass urine?
☐₁ yes
☐₂ no
- If you can empty your bladder (e.g. spontaneously, by percussion, catheterisation):
 - ↳ How many times do you empty (even partially) your bladder (spontaneously, by percussion, catheterisation):
in the day?
at night?
 - ↳ How much time do you spend emptying your bladder? minutes
 - ↳ What is the normal time interval between two «bladder emptyings»? hours
- Do you have any other problems besides your bladder problems? For example:
 - ↳ depression: ☐₁ yes
☐₂ no
 - ↳ digestive and intestinal problems: ☐₁ yes
☐₂ no
- Do you have anal incontinence? ☐₁ yes
☐₂ no
 - ↳ If yes, in what form? ☐₁ gas
☐₂ liquid
☐₃ solid
 - ↳ Do you have to wear continence pads? ☐₁ yes
☐₂ no
- Do you suffer from constipation? ☐₁ yes
☐₂ no
- Do you have pressure sores? ☐₁ yes
☐₂ no

Please check that you have fully completed this questionnaire and post it back to us in the prepaid envelope provided.

Thank you for your valuable help.



