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ORIGINAL ARTICLE

International Urodynamic Basic Spinal Cord Injury Data Set

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Objective: To create the International Urodynamic Basic Spinal Cord Injury (SCI) Data Set within the framework of the International SCI Data Sets.
Setting: International working group.
Methods: The draft of the data set was developed by a working group consisting of members appointed by the Neurourology Committee of the International Continence Society, the European Association of Urology, the American Spinal Injury Association (ASIA), the International Spinal Cord Society (ISCoS) and a representative of the Executive Committee of the International SCI Standards and Data Sets. The final version of the data set was developed after review and comments by members of the Executive Committee of the International SCI Standards and Data Sets, the ISCoS Scientific Committee, ASIA Board, relevant and interested (international) organizations and societies (around 40) and persons and the ISCoS Council. Endorsement of the data set by relevant organizations and societies will be obtained. To make the data set uniform, each variable and each response category within each variable have been specifically defined in a way that is designed to promote the collection and reporting of comparable minimal data.
Results: Variables included in the International Urodynamic Basic SCI Data Set are date of data collection, bladder sensation during filling cystometry, detrusor function, compliance during filing cystometry, function during voiding, detrusor leak point pressure, maximum detrusor pressure, cystometric bladder capacity and post-void residual volume.
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Introduction

Collection of data on the urodynamic observations made during urodynamic studies is universal when individuals with spinal cord lesions are evaluated for their lower urinary tract function. This may for some individuals with spinal cord injury (SCI) be performed at regular intervals life-long when they consult their SCI physician for follow-up.

Causes of death after SCI have changed from being primarily due to urinary tract diseases to increasing numbers of deaths from cardiovascular diseases and respiratory complications;[1–4] this may partly be due to the rigorous control of the lower urinary tract function, including the use of urodynamic investigations in several SCI centres around the world.

Because of the increasing prevalence of individuals living with SCI, after a traumatic as well as non-traumatic spinal cord lesion there is an increasing need for data pertaining to SCI. To facilitate comparisons regarding injuries/lesions, treatments and outcomes between patients, centres and countries, such data should be in the form of common international data sets collected on individuals with SCI. Therefore, it is increasingly important to have comparable data so that the services affecting outcome of SCI can be assessed and compared worldwide.[5]

The purpose of this presentation of the International Urodynamic Basic SCI Data Set is to present a standardized format for the collection and reporting of a minimal amount of information from the urodynamic study in daily practice in accordance with purpose and vision of the International Spinal Cord Injury Data Sets.[5] This will also make it possible to evaluate and compare results from various published studies.

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Methods

The first draft of the International Urodynamic Basic SCI Data Set was made by a working group consisting of members appointed by the Neurourology Committee of the International Continence Society, the European Association of Urology, the American Spinal Injury Association (ASIA), the International Spinal Cord Society (ISCoS), together with a representative of the Executive Committee of the International Spinal Cord Injury Standards and Data Sets.

The process for developing this optimal version of the International Urodynamic Basic SCI Data Set followed the steps given below:

(1) The working group of the International Urodynamic Basic SCI Data Set finalized the first draft data set during a 3-day meeting in Copenhagen in November 2005. This was further elaborated by frequent e-mail contact between the group members including the development of a syllabus for the data set. In developing and harmonizing the data set, the working group has used internationally recognized definitions, in particular the definition used in Abrams *et al*.[6] The data set has been tried out in practice to test its usability, and training cases will be provided on ISCoS and ASIA web sites.
(2) The data set has been reviewed by members of the Executive Committee of the International SCI Standards and Data Sets.
(3) Comments from the committee members were discussed in the working group and appropriate responses made to the data set.
(4) Members of the ISCoS Scientific Committee and ASIA Board were also asked to review the data set.
(5) Comments from the committee/board members were discussed in the working group and a response was made and further adjustments of the data set performed.
(6) Relevant and interested scientific and professional (international) organizations and societies (around 40) and individuals with an interest were also invited to review the data set. In addition, the data set was posted on the ISCoS and ASIA websites for over 2 months to allow comments and suggestions.
(7) Comments were discussed and responded to by the working group. Where appropriate, adjustments to the data set were made.
(8) To conclude this part of the consultation members of the ISCoS Scientific Committee, Council and ASIA Board received the data set for final review and approval.
(9) Endorsement of the data set will be obtained by the relevant (international) organizations and societies.

Results

The complete data set is included in the Appendix. The complete data syllabus, data sheet and training cases are available for free at the respective websites of ISCoS (www.iscos.org.uk) and ASIA (www.asia-spinalinjury.org).

Date of data collection
This collection of data on the urodynamic investigation may be carried out at any time after the spinal cord lesion. Therefore, the date of data collection is imperative to be able to identify the data collected in relation to other data collected on the same individual at various time points (for example, in the International SCI Core Data Set,[7] and the International Lower Urinary Tract Function Basic SCI Data Set).[8] The date is thus important to have the time interval from date of birth (age), and the time interval from date of lesion (time since lesion), as well as the time relation to the clinical variables.

Bladder sensation during filling cystometry
This variable documents the bladder sensation during filling cystometry. Although the bladder sensation is assessed during filling cystometry, the assumption that it is sensation from the bladder alone, without urethral or pelvic components, may be false.[6]

Normal bladder sensation can be judged by three defined points noted during filling cystometry and evaluated in relation to the bladder volume at that moment and in relation to the patient's symptomatic complaints. First sensation of bladder filling is the feeling the patient has, during filling cystometry, when he/she first becomes aware of the bladder filling. First desire to void is defined as the feeling, during filling cystometry, that would lead the patient to pass urine at the next convenient moment, but voiding can be delayed if necessary. Strong desire to void during filling cystometry is defined as a persistent desire to void without the fear of leakage.

Increased bladder sensation is defined, during filling cystometry, as an early first sensation of bladder filling (or an early desire to void) and/or an early strong desire to void, which occurs at low bladder volume and which persists.

Reduced bladder sensation is defined, during filling cystometry, as diminished sensation throughout bladder filling.

Absent bladder sensation means that, during filling cystometry, the individual has no bladder sensation.

Nonspecific bladder sensation, during filling cystometry, may make the individual aware of bladder filling, for example, abdominal fullness or vegetative symptoms.

Detrusor function
This variable documents the function of the detrusor during filling/voiding, that is, the overactivity is determined during filling, while the acontractility during voiding.

Normal detrusor function allows bladder filling with little or no change in pressure. No involuntary phasic contractions occur despite provocation. Normal voiding is achieved by a voluntarily initiated continuous detrusor contraction that leads to complete bladder emptying within a normal time span, and in the absence of obstruction. For a given detrusor contraction, the magnitude of the recorded pressure rise will depend on the degree of outlet resistance.[6]

Neurogenic detrusor overactivity is a urodynamic observation in individuals with a neurological condition characterized by involuntary detrusor contractions during the filling phase, which may be spontaneous or provoked.[6]

Underactive detrusor is defined as a contraction of reduced strength and/or duration, resulting in prolonged bladder emptying and/or a failure to achieve complete bladder emptying within a normal time span.[6]

Acontractile detrusor is the one that cannot be demonstrated to contract during urodynamic studies.[6]

Bladder compliance during filling cystometry
Bladder compliance during filling cystometry describes the relationship between change in bladder volume and change in detrusor pressure. Compliance is calculated by dividing the volume change (ΔV) by the change in detrusor pressure (Δp_{det}) during that change in bladder volume ($C = \Delta V/\Delta p_{\text{det}}$), expressed in ml per cm H_2O.[6] International Continence Society recommends to calculate the bladder compliance using two standard points: (1) the detrusor pressure at the start of the bladder filling and the corresponding bladder volume (usually zero) and (2) the detrusor pressure (and corresponding bladder volume) at cystometric capacity or immediately before the start of any detrusor contraction that causes significant leakage (and therefore causes the bladder volume to decrease, affecting compliance calculation). Both points are measured excluding any detrusor contraction.[6]

The bladder compliance during filling cystometry in individuals with spinal cord lesions is controversial regarding the level of cut point for normal and low.[9] Therefore, today there is no specific evidence for the 10 ml per cm H_2O, which is used in this data set as cut point to give low compliance. The value used is a consensus decision based on clinical experience, but further research is needed to identify a suitable value.

Urethral function during voiding
This variable describes the function of the detrusor and urethra during voiding. The coordination of voiding in individuals with a spinal cord lesion is a concern.

Normal detrusor function during voiding is achieved by a voluntarily initiated continuous detrusor contraction that leads to complete bladder emptying within a normal time span and in the absence of obstruction. For a given detrusor contraction, the magnitude of the recorded pressure rise will depend on the degree of outlet resistance. Normal urethra function during voiding is defined as a urethra that opens and is continuous relaxed to allow the bladder to be emptied at a normal pressure.[6]

Detrusor sphincter dyssynergia is defined as detrusor contraction concurrent with an involuntary contraction of the urethral and/or periurethral striated muscle. Occasionally, flow may be prevented altogether.[6]

Non-relaxing urethral sphincter obstruction is characterized by a non-relaxing, obstructing urethra resulting in reduced urine flow.[6]

Detrusor leak point pressure during filling cystometry
Detrusor leak point pressure is defined as the lowest detrusor pressure at which urine leakage occurs in the absence of either a detrusor contraction or increased abdominal pressure.[6]

Maximum detrusor pressure during filling cystometry
This variable documents the maximum detrusor pressure in cm H_2O during filling cystometry.

Cystometric bladder capacity during filling cystometry
Cystometric bladder capacity during filling cystometry is the bladder volume at the end of the filling cystometrogram, when 'permission to void' is usually given. The end point should be specified, for example, if filling is stopped when the patient has a normal desire to void. The cystometric capacity is the volume voided together with any residual urine. In the absence of sensation, the cystometric capacity is the volume at which the clinician decides to terminate filling. The reason(s) for terminating filling should be defined, for example, high detrusor filling pressure, large infused volume or pain. If there is uncontrollable voiding, it is the volume at which this begins. In the presence of sphincter incompetence, the cystometric capacity may be significantly increased by occlusion of the urethra for example, by Foley catheter.[6]

Post-void residual volume. Post-void residual volume is defined as the volume of urine left in the bladder at the end of micturition.[6]

Discussion

The International Urodynamic Basic SCI Data Set has been developed in an iterative process with the first draft developed by specialists representing major societies or associations working within the fields of urology and SCI. Following this initial development, the data set was opened for review by around 40 organizations working with people suffering from spinal cord lesions, together with other interested parties and individuals who were invited to offer comments and suggestions. The working group reviewed all responses and made adjustments in the data set where appropriate.

The data in this International Urodynamic Basic SCI Data Set shall be seen in conjunction with data in the International SCI Core Data Set,[7] and the International Lower Urinary Tract Basic SCI Data Set.[8] The International SCI Core Data Set includes, among other things, information on date of birth and injury, gender, the cause of spinal cord lesion and neurologic status, while the International Lower Urinary Tract Function Basic SCI Data Set includes variables on urinary tract impairment unrelated to spinal cord lesion, awareness of the need to empty the bladder, bladder emptying, average number of voluntary bladder emptying per day during the last week, incontinence within the last 3 months, collecting appliances for urinary incontinence, any drugs for the urinary tract within the last year, surgical procedures on the urinary tract and any change in urinary symptoms within the last year.

A spinal cord lesion may be of traumatic or non-traumatic aetiology. All lesions to the spinal cord, conus medullaris and cauda equina are included in the present context.

It is extremely important that data be collected in a uniform manner. For this reason, each variable and each response category within each variable has been specifically defined in a way that is designed to promote the collection and reporting of comparable minimal data.

Use of a standard format is essential for combining data from multiple investigators and locations. Various formats and coding schemes may be equally effective and could be used in individual studies or by agreement of the collaborating investigators.

Ideally, this International Urodynamic Basic SCI Data Set will need to be continually reviewed and, where necessary, updated by the working group and ASIA/ISCoS. In addition, requests by groups and individuals will be welcomed to address the working group, through the corresponding author, with ideas for improvement. However, it should be recognized that what has been presented in this paper is a Basic SCI Data Set, and as such it should be kept simple so as to provide the most easily assimilated information for follow-up consultations of people with spinal cord lesions.

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References

1 DeVivo MJ, Krause JS, Lammertse DP. Recent trends in mortality and causes of death among persons with spinal cord injury. *Arch Phys Med Rehabil* 1999; **80**: 1411–1419.
2 Frankel HL, Coll JR, Charlifue SW, Whiteneck GG, Gardner BP, Jamous MA *et al*. Long term survival in spinal cord injury: a fifty year investigation. *Spinal Cord* 1998; **36**: 266–274.
3 Hartkopp A, Brønnum-Hansen H, Seidenschnur A-M, Biering-Sørensen F. Survival and cause of death after traumatic spinal cord injury. A long-term epidemiological survey from Denmark. *Spinal Cord* 1997; **35**: 78–85.
4 Soden R, Walsh J, Middleton JW, Craven ML, Rutkowski SB, Yeo JD. Causes of death after spinal cord injury. *Spinal Cord* 2000; **38**: 604–610.
5 Biering-Sørensen F, Charlifue S, DeVivo M, Noonan V, Post M, Stripling T *et al*. International spinal cord injury data sets. *Spinal Cord* 2006; **44**: 530–534.
6 Abrams P, Cardozo L, Fall M, Griffiths D, Rosier P, Ulmsten U *et al*. The standardisation of terminology of lower urinary tract function: report from the standardisation sub-committee of the international continence society. *Neurourol Urodyn* 2002; **21**: 167–178.
7 DeVivo M, Biering-Sørensen F, Charlifue S, Noonan V, Post M, Stripling T *et al*. International spinal cord injury core data set. *Spinal Cord* 2006; **44**: 535–540.
8 Biering-Sørensen F, Craggs M, Kennelly M, Schick E, Wyndaele JJ. International lower urinary tract function basic spinal cord injury data set. *Spinal Cord* 2007; [epub ahead of print: 27 November 2007].
9 Weld KJ, Graney MJ, Dmochowski RR. Differences in bladder compliance with time and associations of bladder management with compliance in spinal cord injured patients. *J Urol* 2000; **163**: 1228–1233.

Appendix

URODYNAMIC BASIC DATA SET—FORM

Date performed: YYYYMMDD ☐ Unknown.

Bladder sensation during filling cystometry:
☐ Normal ☐ Increased ☐ Reduced
☐ Absent ☐ Nonspecific ☐ Unknown.

Detrusor function:
☐ Normal ☐ Neurogenic detrusor overactivity
☐ Underactive detrusor.
☐ Acontractile detrusor ☐ Unknown.

Compliance during filing cystometry:
Low (<10 ml per cm H_2O) ☐ Yes ☐ No
☐ Unknown.

Urethral function during voiding:
☐ Normal ☐ Detrusor sphincter dyssynergia
☐ Non-relaxing urethral sphincter obstruction
☐ Not applicable ☐ Unknown.

Detrusor leak point pressure ____________cm H_2O
☐ Not applicable ☐ Unknown.

Maximum detrusor pressure ___________ cm H_2O
☐ Not applicable ☐ Unknown.

Cystometric bladder capacity ___________ ml
☐ Not applicable ☐ Unknown.

Post-void residual volume ___________ ml
☐ Not applicable ☐ Unknown.