

ARTICLE



Testing sensation of gently squeezing the testes has diagnostic value in spinal cord injury men

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STUDY DESIGN: Retrospective cohort study.

OBJECTIVES: Determine the diagnostic value of testing the sensation of squeezing the testes.

SETTING: Research group run by the University of Antwerp.

METHODS: During the clinical examination, it was evaluated if male spinal cord injury (SCI) patients felt gentle squeezing of the testes. The outcome was related to the type of SCI, to the sensations of the light touch of the dermatomes of the perineum, of bladder filling, of overactive detrusor (DOA) contractions during urodynamics, and of electrosensation elicited in different parts of the lower urinary tract. The neurological pathways elicited by these tests were compared.

RESULTS: Seventy-four patients were included, mean age 46 ± 17 years, a number of weeks post SCI 318 ± 586 . Sensation in the testes was present in 72.2%. In patients with AIS A, the sensation was found positive in 41%, while all with AIS B-D felt the sensation. Testes sensation was strongly correlated with the sensation of touch of the perineum and with the filling sensation during cystometry, proving a dorsal column pathway. The sensation of DOA contractions and electrosensation in the bladder, bladder neck/proximal, and distal urethra were not significantly related to the outcome of the testicular examination, showing that anterior and lateral spinothalamic pathways were not involved

CONCLUSIONS: Our data show that sensation from gently squeezing the testes informs about the dorsal column from spinal cord level T10–L2 upwards. The test can help refine the neurologic diagnosis after SCI. We advocate to include this easy-to-do test in the neuro-urologic clinical examination.

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INTRODUCTION

To evaluate the lumbosacral sensory innervation after spinal cord injury (SCI), clinical and technical tests can be used: the sensation of touch of the perineal area, sensations of urodynamic bladder filling and overactive bladder contractions, electrical perception threshold (EPT) of different parts of the lower urinary tract (LUT) [1]. The different sensations run in the dorsal column (skin sensation, filling sensation), lateral spinothalamic (EPT), and anterior spinothalamic tract (overactive bladder contractions). We investigated the information gained by and the diagnostic value of another test, the sensation elicited by squeezing the testes.

METHODS

We present a retrospective cohort study in male patients with SCI and neurogenic bladder. The institutional ethics committee approved the study (Edge 001176). Consecutive files of male SCI examined in one year were studied. Excluded were those with cognitive deficiencies or lack of cooperation at the time of the test. Tests repeated in the same patient during follow-up were compared.

On the day of the examination, the neurological status of the patients was determined following the ASIA/ISCoS international standards for

neurological classification of spinal cord injury (ISNCSCI) [2]. The testes' squeezing was added to our routine clinical examination, which included examining the sensation of light digital touch in the dermatomes S2–S5. During the same session, technical sensory tests routinely done in our unit were performed: filling sensation during a standardized urodynamic investigation and sensation of detrusor overactive contractions during that filling. The techniques have been previously published in detail, as well as how to interpret the results [3–5]. Another diagnostic technique for the LUT sensation, EPT of the bladder, bladder neck, and proximal and distal urethra were determined as described in detail before [1]. The squeezing of the testes was done with the testis fixed between the thumb and three fingers. The patient was asked to report if and what he felt during this test. A fake test without touching the scrotum was done, blinded to the patient, in order to evaluate reliability.

The Fisher–Freeman–Halton exact test was used to compare the absence/presence of testicle squeezing sensation with the results of the other sensory tests. Statistical significance was set at $p < 0.05$.

RESULTS

Data of 72 patients with different levels and completeness of SCI were included. The mean age was 46 ± 17 years old, and the period after the SCI mean 318 ± 586 weeks. The squeezing sensation was present in 52/72 (72.2%). The description of the

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sensation differed between a local sensation of pressure to a sharper uncomfortable feeling, but no pain. No sensation was reported when fake squeezing was done.

In patients with AIS A, the sensation was present in 18/38 (41%), while in AIS B-D all 34 (100%) felt the squeezing (Table 1). The comparison with the outcome of other sensory investigations is given in Table 2. A statistically significant correlation was found between the perineal sensation of touch and with urodynamic filling sensation. There was no significant correlation with the feeling of DOA contraction ($p = 0.243$). The presence or absence of electrosensation in the LUT ($p = 0.447$) and separately of the bladder, bladder neck/proximal, and distal urethra was not statistically correlated with the testes sensation ($p = 0.714$, $p = 1$ and $p = 1$ respectively).

There was no difference between the outcome in the left and right testicle.

In 27 patients, two tests had been done with an interval of 52 ± 16 weeks. In 24, the testicular sensory outcome was the same (88.9%). In two patients (24 and 25 years old, the first testing was negative at week 4 and week 8 after SCI while also touching the perineal area was not felt (AIS A). In both testicular sensations

became positive 16 weeks later, but no sensation in the perineal area was found during follow-up. In 1 patient of 43 years with the incomplete lesion, the sensation was reported in week 13 but could not be elicited at week 30 for unclear reasons.

DISCUSSION

The neurologic consequences of an SCI vary widely. The AIS gives a standardized description of the somatomotor and somatosensory innervation with good inter-rater reliability [6]. Its limitations for diagnosing preservation or deficit of the innervation of the autonomic pelvic organs have been shown before [7], and guidelines have been proposed as an adjunct to the ISNCSCI including the AIS [8]. The division between complete and incomplete SCI has limitations and does not always predict chronic phase independent ambulation outcomes [9] or visceral functions, including sensation [1].

After the spinal shock, neurologic pathways will become active again if the related nerves have not been irreversibly destroyed. Such was seen in 2 of our patients.

The sensory innervation in the pelvic region runs through different peripheral plexuses (hypogastric, pelvic, and pudendal) which reach the spinal cord at the low thoracic/upper lumbar or sacral level depending on the peripheral nerves involved [10]. In the spinal cord, the axons give off small collaterals (Lissauer's tract) to facilitate spinal reflexes or send part of the sensory input through the spinothalamic tracts. However, the majority will leave the dorsal horn gray matter without synapsing and enter the dorsal funiculi to constitute either the ascending medial fasciculus gracilis or the lateral fasciculus cuneatus to reach, after sensory decussation, the lower part of the medulla oblongata. The fasciculus gracilis ("column of Goll"), carries tactile and proprioceptive information from the lower half of the body (from the coccygeal nerve to T7). The lateral fasciculus cuneatus, ("column of Burdach"), of the dorsal column, carries such input from T6 to C1 spinal cord levels. This latter tract is, as far as known today, unrelated to testes sensation [11]. The spatial relationship 'lower is medial' holds for the individual fibers within each fasciculus: the most medially placed fibers arise from the coccygeal dorsal root. In contrast, the most laterally placed fibers arise from the more superior located T7 dorsal roots.

Animal studies have shown different ascending bilateral projections in the rat's ventrolateral white matter conveying information from the pelvic visceral organs [12]. There have been suggestions in the literature that in a complete SCI sensory potentials may be transmitted through vagal and para/extra-bony spinal trunk sympathetic pathways, but it remains uncertain if this exists in humans [13]. The term "discomplete" SCI will apply because neurophysiological tests in lesions above T10 can show in clinically complete spinal cord lesions continuity with spinal pathways above the lesion [14]. In cervical myelopathy, it was shown that the path subserving urinary sensation seems to be located mainly in the dorsal column of the spinal cord [15].

The different sensory tests for the pelvic region relate to different peripheral plexuses, and spinal cord tracts [16]. The sensation of touch of the perineal dermatomes S2–S5 informs about the preservation of the pudendal plexus, the sacral spinal cord, and the dorsal columns. Up to the brain. The filling sensations reported during urodynamic testing permit the evaluation of all 3 peripheral plexuses mentioned above, and the medial part of the dorsal column. Feeling bladder contraction is related to a preserved pelvic plexus and anterior spinothalamic tract. EPT electrosensation starts very localized at the electrodes' position and runs through the peripheral nerves innervating the stimulated area (bladder wall to pelvic, bladder neck/posterior urethra to hypogastric and distal urethra to pudendal) and the lateral spinothalamic tract [17]. Combining the different tests offers vast information on which pathways have been destroyed and which are preserved after SCI

Table 1. Sensation of squeezing the testes found in different levels and completeness of SCI.

Lesion code (AIS)	Testes sensation		Total
	Absent	Present	
Complete			
Incomplete			
C1–C8	7	5	12
D1–D9	12	7	19
D10–L1	1	5	6
L2–S3	0	1	1
S4–S5/ Cauda	–	–	–
C1–C8	0	17	17
D1–D9	0	5	5
D10–L1	0	4	4
L2–S3	0	5	5
S4–S5/Cauda	0	3	3
Total	20	52	72

Fisher–Freeman–Halton exact test $p < 0.000$

AIS American Association of spinal cord injury impairment scale, – no case with this AIS.

Table 2. Correlation between the sensation of squeezing the testes, the sensation of touch in the S2–S5 dermatomes, urodynamic filling sensation, and sensation of overactive detrusor contractions.

	Sensation testes			
	Absent	Present	Total	
<i>Sensation touch perineum</i>				
Absent	20	14	34	$P < 0.001$
Present all dermatomes	0	37	37	
<i>Sensation of filling during cystometry</i>				
Absent	10	16	26	$P = 0.029$
Present	4	30	34	
<i>Sensation of DOA contraction</i>				
Absent	2	0	2	$P = 0.447$
Present	1	6	7	

Fisher–Freeman–Halton exact test.

DOA overactive detrusor contraction.

[1]. In our study, the comparison of the outcome of the different tests allows confirming that sensation of the testes runs in the fasciculus gracilis of the dorsal column. Confirmation would be given by neurophysiological study.

Testing the sensory innervation of the testes is not customary in a neuro-urologic examination. Squeezing will inevitably attain skin and all related local structures, and the resulting sensation will be influenced by the innervation of the S3 dermatome, the spermatic cord, the tunica vaginalis, and the testicles [10, 11]. The sensory potentials from the testes run through the ilioinguinal nerves, and the genital branch (L2) of the genitofemoral nerve (L1, L2) of the lumbar plexus arriving at the spinal cord via the dorsal root ganglion cells of the T10 segment. That this spinal cord pathway is involved is supported by the strong statistical relation with two tests running in the dorsal columns, and the absence of such relationships in two others tests with other spinal cord pathways, as discussed above. A very powerful squeeze might cause nociceptive potentials and pain which would likely run in the spinothalamic lateralis tracts. Such maneuver has not been done in this study.

The squeezing of the testes was easy to perform in our group, was well tolerated, and was highly reproducible with an interval of more than a year. The findings were identical on both sides, but this can probably be different in other samples if one side lesions have occurred.

Evaluating sensation with testes squeezing gives supplementary information on the dorsal column/fasciculus gracilis integrity. When in our group the perineal sensation of touch was absent, testes sensation was present in 41%, and when the urodynamic filling sensation was absent, testes sensation was safeguarded in 37.5%, showing that although these sensations all run through the dorsal column, they use different parts of the fasciculus which after SCI can be lesioned or not. This demonstrates that judging on the extent of a medial dorsal column's lesion should be done with caution and should involve different tests. It is important that the testes' sensation of gentle squeezing permits to study clinically the sensory afferent nerves at spinal cord level T10–L1, a region important for the inflow of the pelvic sympathetic nerves. Other tests specific for such pathways are urodynamics and EPT, but these are invasive.

As shown before, correlation between different sensory modalities differ between sensations: with perineal sensation absent 53% had filling sensation ($p = 0.040$) and 58 % positive EPT ($p = 0.009$). With a filling, sensation absent 59% had EPT sensation (not significant). The perineal sensation was strongly associated with the level and completeness of SCI, while a significant association existed for filling sensations FSF, FDV, SDV, and EPT in the distal urethra [1]. More study will permit to put of all the different available data into a complete understanding of the sensory innervation of LUT and genitals.

Our cohort study is retrospective and our sample is not very large. Confirmation of the data in prospective studies and in larger groups in different centers needs to be done. Looking at relation with electrophysiologic tests and brain imaging will be worthwhile.

It could potentially be interesting to study if eliciting sensation with the gentle squeezing of the testes can be beneficial for sexual activity after SCI, as such sensation may be present even if touching of the genital area is not felt. There are no data on this available today.

We can conclude that sensation from gentle squeezing of the testes informs about the neurologic passage in the dorsal column/fasciculus gracilis from spinal cord level T10–L2 upwards and can help refine the neurologic diagnosis of these pathways after SCI. The neurogenic tracts of this sensation are often present when AIS scoring suggests a complete SCI. Keeping

these findings in mind we think that including the easy-to-do testes squeezing test in the clinical neurologic examination would be worthwhile.

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COMPETING INTERESTS

The authors declare no competing interests.

ADDITIONAL INFORMATION

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