DOI: https://doi.org/10.17816/uroved52482

Neurogenic urinary disorders in patients with tuberculous spondylitis before and after surgical treatment

© Aleksandr I. Gorbunov[1], Aleksandr N. Murav´ev[1, 2], Evgenij G. Sokolovich[1, 3], Petr K. Yablonsky[1, 3]

[1] Saint Petersburg State Research Institute of Phthisiopulmonology of the Ministry of Healthcare of the Russian Federation, Saint Petersburg, Russia;
[2] Saint Petersburg Medico-Social Institute, Saint Petersburg, Russia;
[3] Saint Petersburg State University, Saint Petersburg, Russia

ABSTRACT: Tuberculosis inflammation of vertebral column (spondylitis) can lead to neurogenic lower urinary tract dysfunction. There is lack of available publications for neurogenic lower urinary tract dysfunction in spinal tuberculosis.

OBJECTIVE: To evaluate urodynamic disturbances in spinal tuberculosis before and after surgery for spondylitis.

MATERIALS AND METHODS: We observed 19 patients with spinal tuberculosis, who had symptoms of micturition's impairment. 14 patients (73,6%) were male and 5 (26,4%) were female, average age was 43,7 ± 7,9 years (27–66). Control evaluation was performed after surgery on day 21–28.

RESULTS: Before surgery we found detrusor overactivity in 11 (57,9%) patients and 2 of those with detrusor overactivity had detrusor-sphincter dyssynergia. Detrusor hypo-/acontractility was diagnosed in 8 (42,1%). After surgery 5 patients (26,3%) exhibited improvement, in one case urodynamic disturbances were resolved. One patient developed detrusor overactivity and incontinence *de novo* and one patient had worsening neurological status, loss of sensitivity and acontractile bladder.

CONCLUSION: Variable lower urinary tract dysfunction can be diagnosed in spinal tuberculosis. Only 26,3% of patients have improvement after surgery. New conditions or worsening of previous neurogenic lower urinary tract dysfunctions can be observed.

Keywords: neurogenic lower urinary tract dysfunctions; spinal tuberculosis; urodynamics.

To cite this article:
Gorbunov AI, Murav´ev AN, Sokolovich EG, Yablonsky PK. Neurogenic urinary disorders in patients with tuberculous spondylitis before and after surgical treatment. *Urology reports (St. Petersburg)*. 2021;11(1):27-32. DOI: https://doi.org/10.17816/uroved52482

Received: 26.11.2020 **Accepted:** 09.01.2021 **Published:** 23.03.2021

DOI: https://doi.org/10.17816/uroved52482

Нейрогенные нарушения мочеиспускания у больных туберкулезным спондилитом до и после оперативного лечения

© А.И. Горбунов[1], А.Н. Муравьев[1, 2], Е.Г. Соколович[1, 3], П.К. Яблонский[1, 3]

[1] Федеральное государственное бюджетное учреждение «Санкт-Петербургский научно-исследовательский институт фтизиопульмонологии» Министерства здравоохранения Российской Федерации, Санкт-Петербург;
[2] Частное образовательное учреждение высшего образования «Санкт-Петербургский медико-социальный институт», Санкт-Петербург;
[3] Федеральное государственное бюджетное образовательное учреждение высшего образования «Санкт-Петербургский государственный университет», Санкт-Петербург

Актуальность. Туберкулезный спондилит может осложняться развитием нейрогенных нарушений мочеиспускания. В настоящее время опубликовано небольшое количество работ по изучению дисфункций нижних мочевыводящих путей у этой категории больных.

Цель исследования: оценить нарушения уродинамики нижних мочевыводящих путей у больных туберкулезным спондилитом до и после оперативного вмешательства на позвоночнике.

Материалы и методы. Выполнено обследование группы больных туберкулезным спондилитом (n = 19) с симптомами нарушения мочеиспускания до и после операции на позвоночнике.

Результаты. До операции в 11 случаях (57,9 %) выявлена детрузорная гиперактивность, которая в 2 случаях (10,5 %) сочеталась с детрузорно-сфинктерной диссинергией, у 8 пациентов (42,1 %) диагностирована гипо-/аконтрактильность детрузора. В послеоперационном периоде положительная динамика отмечена у 5 пациентов (26,3 %), из них в одном случае уродинамические нарушения регрессировали. У одного пациента развилась *de novo* детрузорная гиперактивность с недержанием мочи. Еще в одном случае наблюдалось ухудшение неврологического статуса с прогрессированием нарушений чувствительности и подвижности и развитием аконтрактильного мочевого пузыря.

Заключение. У больных туберкулезным спондилитом имеются разнообразные дисфункции нижних мочевыводящих путей. В раннем послеоперационном периоде улучшение уродинамики наблюдалось у 26,3 % пациентов, в некоторых случаях возможно ухудшение имеющихся нарушений, а также развитие другого типа нейрогенных дисфункций нижних мочевыводящих путей *de novo*.

Ключевые слова: нейрогенные дисфункции нижних мочевыводящих путей; туберкулезный спондилит; уродинамика.

Как цитировать:
Горбунов А.И., Муравьев А.Н., Соколович Е.Г., Яблонский П.К. Нейрогенные нарушения мочеиспускания у больных туберкулезным спондилитом до и после оперативного лечения // Урологические ведомости. 2021. Т. 11. № 1. С. 27–32. DOI: https://doi.org/10.17816/uroved52482

Рукопись получена: 26.11.2020 **Рукопись одобрена:** 09.01.2021 **Опубликована:** 23.03.2021

INTRODUCTION

Neurogenic lower urinary tract dysfunction (NLUTD) is a serious complication of spinal cord injury and nontraumatic myelopathy in diseases such as multilocular sclerosis and Parkinson's disease [1–4]. The incidence rate of lesions of the osteoarticular system in extrapulmonary tuberculosis is as high as 43.6%, and the involvement of the spine in the process and development of spondylitis is predominantly observed [5, 6]. In 75% of the cases noted, tuberculous spondylitis is complicated by various neurological disorders [7], including neurogenic dysfunctions of the lower urinary tract; however, this problem is rarely discussed in the available literature [8, 9].

The present study aimed to assess the disorders of the lower urinary tract urodynamics in patients with tuberculous spondylitis before and after spinal surgery.

MATERIALS AND METHODS

Our study included patients with tuberculous spondylitis who underwent treatment at the St. Petersburg Research Institute of Phthisiopulmonology of the Russian Ministry of Health in 2014–2018 and had clinical signs of NLUTD. Patients with other urological diseases that could affect the examination results, such as urethral stricture, prostatic hyperplasia, bladder stones, and tuberculous lesions of the urinary system, were excluded. In total, the study group included 19 patients comprising 14 (73.6%) men and 5 (26.4%) women; the average age was 42.9 ± 7.7 years (range, 27–66 years). All patients had symptoms of urinary disorders. In 12 (68.4%) patients, the bladder was drained with an indwelling urethral catheter; in the remaining seven cases, urination was preserved. Five patients used condom catheters. None of the patients underwent intermittent bladder catheterization or received treatment for NLUTD upon admission. Prior to spinal surgery, all patients underwent careful examination, including urodynamic study (UDS), ultrasound examination (US) of the kidneys and bladder with determination of residual urine volume (RUV), and multispiral computed tomography of the spine. Fourteen (73.7%) patients had a urinary tract infection and received antibiotic therapy with drugs prescribed in accordance with the data on antibiotic sensitivity based on the results of urine culture. All patients underwent the same type of radical reconstructive surgery on the spine under endotracheal anesthesia. The average volume of blood loss was 240.0 ml (range, 100–650 ml); during the surgery, a urethral catheter was installed in all patients. Four (21%) patients had grade 1–2 postoperative complications according to the Clavien classification. Repeated examination, including UDS and US of the kidneys and bladder, was performed in the interval from days 21–28 after the intervention. Nonparametric statistics, comparison of groups of dependent variables, and the Wilcoxon test were performed for data processing. Statistical significance was established at $p < 0.05$.

The prevailing level of spinal lesions in 14 (73.7%) patients was thoracic in nature, the lumbar spine was affected in 2 (10.5%), and combined lesions of the thoracic and lumbar vertebrae were observed in three patients (15.8%) cases. The neurological status of the patients was assessed in accordance with the American Spinal Injury Association (ASIA) scale. Prior to surgery, most of the examined patients had severe neurological disorders corresponding to ASIA types A (10 patients, 52.6%) and B (4 patients, 21.05%); neurological disorders corresponding to ASIA types C (4 patients, 21.05%) and aD (1 patient, 5.3%) were also noted.

Urodynamic examination was performed using the Menfis Biomedica Pico 3000 system in accordance with the recommendations of the International Continence Society [10]. All patients underwent filling cystometry. The study completion criteria were a bladder filling volume of 600 ml with low detrusor pressure (P_{det}) and no urge to urinate, terminal detrusor hyperactivity (DH) with urgent urinary incontinence, increased P_{det} of over 40 cm of the water column, intolerable urge to urinate, emergence of pain in the area of the bladder when filling, or significant vegetative manifestations. The bladder was filled with sterile water at room temperature at a rate of 20 ml/s. Pressure/flow studies in combination with pelvic electromyography were performed in patients with retained urination who could be upright or in a sitting position.

STUDY RESULTS

Table 1 presents the indicators of the clinical course of lower urinary tract dysfunctions in the patients examined.

Examination prior to surgery revealed disorders of the lower urinary tract urodynamics. DH was detected in 11 (57.9%) patients; in 2 (10.5%) cases, DH was combined with detrusor–sphincter dyssynergia (DSD). The remaining eight (42.1%) patients were diagnosed with impaired contractile functions of the bladder (i.e., detrusor acontractility [DA] or hypocontractility [HypoD]). US revealed no retention changes in the upper urinary tract in any case.

In 10 (52.6%) patients with DH, the maximum P_{det} values exceeded 40 cm of the water column; the maximum P_{det} of 1 patient was 32.4 cm of the water column. In two cases with combined DH and DSD, P_{det} reached 83.1 and 137.0 cm of the water column, with RUVs of 97 and 24 ml, respectively. The maximum cystometric capacity (MCC) of the DH patients decreased and ranged from 70 ml to 351 ml.

DOI: https://doi.org/10.17816/uroved52482

Table 1. Indicators of the clinical course of lower urinary tract dysfunctions in patients with tuberculous spondylitis before and after surgery (n = 19)

Таблица 1. Показатели клинического течения дисфункций нижних мочевыводящих путей у больных туберкулезным спондилитом до и после оперативного лечения (n = 19)

No.	Gender	Age, years	Lesion level	ASIA before surgery	UDS results before surgery	UDS results after surgery	ASIA after surgery
1	M	36	Th6-9	A	DH	DH	A
2	M	43	Th3-5	C	DH	DH	C
3	M	45	Th7-9	B	DH	DA	A
4	M	27	Th11-L1	A	DH	DH	A
5	M	43	Th3-6	A	DH	DH	A
6	M	37	Th8-11	C	DH + DSD	DH	C
7	M	38	Th8-10	A	DH	DH	A
8	M	45	Th2-5	A	DH	DH	B
9	M	43	L1-3	A	DH	DH	A
10	F	50	Th8-9	B	DH	Normal	C
11	M	36	Th4-9, L1	C	DH + DSD	DH + DSD	C
12	F	60	Th8-11	C	DA	HypoD	C
13	F	66	Th8-9	B	DA	DA	B
14	M	43	L3-4	A	DA	DA	A
15	M	29	Th7-10, L1-2	A	DA	DA	A
16	M	30	Th1-3	A	DA	DA	A
17	M	38	Th6-8	A	DA	DH	C
18	F	65	Th8-9	B	HypoD	HypoD	C
19	F	42	Th3-5	D	HypoD	HypoD	D

Note. UDS – urodynamic study, ASIA – neurological status according to the ASIA scale, DH – detrusor hyperactivity, DSD – detrusor-sphincter dyssynergia, HypoD – detrusor hypoactivity, DA – detrusor acontractility.

Among the patients with impaired bladder contractility, two (22.2%) demonstrated a pronounced impairment of the adaptive function of the detrusor and a decrease in MCC to 165 and 252 ml. The mean MCC value in patients of this group was 452.3 ± 131.7 ml. This finding is most probably due to the prolonged drainage of the bladder by an indwelling urethral catheter. In other cases, MCCs were within normal limits. In one patient with HypoD, spontaneous urination was preserved, with a maximum urine flow rate of 13.1 ml/s and RUV of 85 ml. In the rest of the patients, the bladder was drained by an indwelling urethral catheter.

During follow-up examination in the postoperative period, only five (26.3%) cases demonstrated changes that could be considered improvements; urinary disorders and urodynamic disorders persisted in most of the patients after surgery on the spine. Only one patient who initially had DH revealed normal urination and urodynamic parameters after surgery. Two patients with the initial combination of DH and DSD showed improvements in the form of decreased P_{det} and RUV; however, one of these patients also showed a decrease in MCC from 227 ml to 149 ml. Two patients with impaired contractile function of the bladder revealed a decrease in RUV. A patient with initial DA of the bladder and chronic urinary retention demonstrated spontaneous urination; however, follow-up examination revealed terminal DH with urgent urinary incontinence that developed *de novo.*

One of the patients showed deterioration after surgery, including an increase in the degree of neurological damage and loss of sensation. Urodynamic examination of this patient revealed DA.

The average values of the main urodynamic parameters before and after surgical treatment of spondylitis are presented in Table 2.

Table 2. Main urodynamic parameters in patients with tuberculous spondylitis before and after surgery, $M \pm m$ (n = 19)

Таблица 2. Основные уродинамические показатели у больных туберкулезным спондилитом до и после оперативного лечения, $M \pm m$ (n = 19)

Urodynamic diagnosis	MCC, ml		P_{det}, cm of water column		RUV, ml	
	before	after	before	after	before	after
Detrusor hyperactivity	164.8 ± 60.3	177.8 ± 69.1	64.0 ± 21.5	52.8 ± 9.6	38.1 ± 28.8	24.2 ± 16.0
Detrusor hypoactivity/acontractility	452.3 ± 131.8	432.7 ± 138.5	20.1 ± 17.7	20.6 ± 14.5	388.6 ± 166.9	297.8 ± 183.3

Note. MCC – maximum cystometric capacity, P_{det} – maximum detrusor pressure, RUV – residual urine volume. For all pairs of attributes, $p > 0.1$.

DOI: https://doi.org/10.17816/uroved52482

When the mean values of the UDS parameters (i.e., MCC, P_{det}, RUV) before and after spinal surgery were compared, we could not identify statistically significant differences in any of the parameters studied (Table 2).

DISCUSSION

The most frequent complications of tuberculous spondylitis include dysfunctions of the lower urinary tract, namely, DH, DSD, and impaired detrusor contractility. At present, few works on the study of urinary disorders in this category of patients have been published. J. Kalita et al. [8] monitored 30 patients with tuberculous spondylitis and noted 15 patients with clinical urination disorders; UDS data also revealed DH in six cases, detrusor areflexia in four cases, increased RUV in four patients, and no urodynamic disorders in one patient. The authors thus concluded that urination disorders could be associated with more pronounced neurological disorders, more significant MRI changes in the spinal cord, and poorer functional recovery compared with patients without urination disorders at follow-up examination after 1 year. Complete or partial regression of disorders was recorded in 11 patients with urination disorders. However, control UDS was performed only in three cases, which we feel is insufficient because some cases of urodynamic disorders may be asymptomatic. In our study, all 19 patients were found to have various disorders of the lower urinary tract urodynamics, which is likely due to the severe degree of neurological disorders in the majority of the patients.

We noted improvements in only five (26.3%) cases in our study group during follow-up examination after spinal surgery. The degree of neurological disorders increased and DA with urinary retention developed in one patient. In another case, DH with urgent urinary incontinence developed *de novo*. No significant changes were noted in the follow-up UDS of the other cases. Only one of five patients with improvements demonstrated no urodynamic disorders; in other cases, the abnormalities persisted. In a recently published study by N. Shrivastava et al. [9], the UDS results of 10 patients with tuberculous spondylitis showed DH in two cases and DSD in four cases. Follow-up examination 3 months after spinal surgery revealed the persistence of urodynamic disorders, and an increase in the severity of DH and DSD was noted in two cases. Our study, similar to the work of N. Shrivastava et al. [9], involved an analysis of only a small number of patients. However, the data collected are sufficient to conclude that the persistence of urodynamic disorders and even their deterioration may be expected in patients within a period of at least 3 months following spinal surgical treatment. Thus, routine monitoring and determination of the optimal timing of UDS are necessary.

CONCLUSION

The course of tuberculous spondylitis can be complicated by various neurogenic urinary disorders. In most patients in the early postoperative period, existing urodynamic disorders persist, and new lower urinary tract dysfunctions may develop. Improvement and restoration of urodynamics is observed in only a relatively small number of patients. Therefore, extensive examinations, including comprehensive UDS before and after spinal surgery, are required to monitor the functional state of the lower urinary tract and prescribe timely therapeutic measures.

REFERENCES

1. Linsenmayer TA. Neurogenic bladder following spinal cord injury. In: Kirshblum S, ed. *Spinal cord medicine*. Philadelphia: Lippincott Williams & Wilkins, 2002. P. 181–205.

2. Manack A, Motsko SP, Haag-Molkenteller C, et al. Epidemiology and healthcare utilization of neurogenic bladder patients in a US claims database. *Neurourol Urodyn*. 2011;30(3):395–401. DOI: 10.1002/nau.21003

3. Panicker JN, Fowler CJ, Kessler TM. Lower urinary tract dysfunction in the neurological patient: clinical assessment and management. *Lancet Neurol.* 2015;14(7):720–732. DOI: 10.1016/S1474-4422(15)00070-8

4. New PW, Dillon L. Neurogenic bladder and urodynamic outcomes in patients with spinal cord myelopathy. *Top Spinal Cord Inj Rehabil*. 2015;21(3):250–256. DOI: 10.1310/sci2103-250

5. Kulchavenya EV, Merganov MM, Sharipov FR. Epidemiology of extrapulmonary tuberculosis in high-burden regions. *Tuberculosis and Lung Diseases*. 2020;98(7):37–43. (In Russ.) DOI: 10.21292/2075-1230-2020-98-7-37-43

6. Sovetova NA, Vasilyeva GY, Solovyeva NS, et al. Tuberculous spondylitis in adults: clinical and radiographic manifestations. *Tuberculosis and Lung Diseases*. 2014;(10):33–37. (In Russ.) DOI: 10.21292/2075-1230-2014-0-10-33-37

7. Mushkin A, Vishnevskiy A. Clinical recommendations for the diagnosis of infectious spondylitis (draft for discussion). *Medicinskij Al'jans*. 2018;(3):65–74. (In Russ.)

8. Kalita J, Misra UK, Kumar G, et al. Bladder dysfunction in spinal tuberculosis: clinical, urodynamic and MRI study. *Spinal Cord*. 2010;48(9):697–703. DOI: 10.1038/sc.2009.199

9. Shrivastava N, Singh P, Nayak B, et al. The Spectrum of Clinical and Urodynamic Findings in Patients with Spinal Tuberculosis Exhibiting Lower Urinary Tract Symptoms, before and after Spinal Surgical Intervention with Antitubercular Treatment: A Prospective Study. *Asian Spine J*. 2019;13(4):615–620. DOI: 10.31616/asj.2018.0217

10. Schäfer W, Abrams P, Liao L, et al. Good urodynamic practices: Uroflowmetry, filling cystometry, and pressure-flow studies. *Neurourol Urodyn*. 2002;21(3):261–274. DOI: 10.1002/nau.10066.

СПИСОК ЛИТЕРАТУРЫ

1. Linsenmayer T.A. Neurogenic bladder following spinal cord injury. In: Kirshblum S., ed. Spinal cord medicine. Philadelphia: Lippincott Williams & Wilkins; 2002. P. 181–205.

2. Manack A., Motsko S.P., Haag-Molkenteller C., et al. Epidemiology and healthcare utilization of neurogenic bladder patients in a US claims database // Neurourol Urodyn. 2011. Vol. 30. No. 3. P. 395–401. DOI: 10.1002/nau.21003

3. Panicker J.N., Fowler C.J., Kessler T.M. Lower urinary tract dysfunction in the neurological patient: clinical assessment and management // Lancet Neurol. 2015. Vol. 14. No. 7. P. 720–732. DOI: 10.1016/S1474-4422(15)00070-8

4. New P.W., Dillon L. Neurogenic bladder and urodynamic outcomes in patients with spinal cord myelopathy // Top Spinal Cord Inj Rehabil. 2015. Vol. 21. No. 3. P. 250–256. DOI: 10.1310/sci2103-250

5. Кульчавеня Е.В., Мерганов М.М., Шарипов Ф.Р. Эпидемиология внелегочного туберкулеза в регионах с высокой заболеваемостью // Туберкулез и болезни легких. 2020. Т. 98. № 7. С. 37–43. DOI: 10.21292/2075-1230-2020-98-7-37-43

6. Советова Н.А., Васильева Г.Ю., Соловьева Н.С. и др. Туберкулезный спондилит у взрослых (клинико-лучевые проявления) // Туберкулез и болезни легких. 2014. № 10. С. 33–37. DOI: 10.21292/2075-1230-2014-0-10-33-37

7. Мушкин А.Ю., Вишневский А.А. Клинические рекомендации по диагностике инфекционных спондилитов (проект для обсуждения) // Медицинский Альянс. 2018. № 3. С. 65–74.

8. Kalita J., Misra U.K., Kumar G., et al. Bladder dysfunction in spinal tuberculosis: clinical, urodynamic and MRI study // Spinal Cord. 2010. Vol. 48. No. 9. P. 697–703. DOI: 10.1038/sc.2009.199

9. Shrivastava N., Singh P., Nayak B., et al. The Spectrum of Clinical and Urodynamic Findings in Patients with Spinal Tuberculosis Exhibiting Lower Urinary Tract Symptoms, before and after Spinal Surgical Intervention with Antitubercular Treatment: A Prospective Study // Asian Spine J. 2019. Vol. 13. No. 4. P. 615–620. DOI: 10.31616/asj.2018.0217

10. Schäfer W., Abrams P., Liao L., et al. Good urodynamic practices: Uroflowmetry, filling cystometry, and pressure-flow studies // Neurourol Urodyn. 2002. Vol. 21. No. 3. P. 261–274. DOI: 10.1002/nau.10066

AUTHORS INFO

***Aleksandr I. Gorbunov,** urologist, researcher;
address: 2-4 Ligovskiy av., 191036, Saint Petersburg, Russia;
ORCID: https://orcid.org/0000-0002-0656-4187;
eLibrary SPIN: 9558-8279; e-mail: alx.urolog@gmail.com

Aleksandr N. Murav'ev, Cand. Sci. (Med.);
ORCID: https://orcid.org/0000-0002-6974-5305;
eLibrary SPIN: 2243-1683; e-mail: urolog5@gmail.com

Evgenij G. Sokolovich, Dr. Sci. (Med.), Professor;
ORCID: https://orcid.org/0000-0003-4794-0588;
eLibrary SPIN: 7375-8836; e-mail: sokole@mail.ru

Petr K. Yablonsky, Dr. Sci. (Med.), Professor;
ORCID: https://orcid.org/0000-0003-4385-9643;
eLibrary SPIN: 3433-2624; e-mail: glhirurgb2@mail.ru

ОБ АВТОРАХ

***Александр Игоревич Горбунов,** врач-уролог, научный сотрудник; адрес: Россия, 191036, Санкт-Петербург, Лиговский пр., д. 2-4; ORCID: https://orcid.org/0000-0002-0656-4187;
eLibrary SPIN: 9558-8279; e-mail: alx.urolog@gmail.com

Александр Николаевич Муравьев, канд. мед. наук;
ORCID: https://orcid.org/0000-0002-6974-5305;
eLibrary SPIN: 2243-1683; e-mail: urolog5@gmail.com

Евгений Георгиевич Соколович, д-р мед. наук, профессор;
ORCID: https://orcid.org/0000-0003-4794-0588;
eLibrary SPIN: 7375-8836; e-mail: sokole@mail.ru

Петр Казимирович Яблонский, д-р мед. наук, профессор;
ORCID: https://orcid.org/0000-0003-4385-9643;
eLibrary SPIN: 3433-2624; e-mail: glhirurgb2@mail.ru