CYSTOMANOMETRY – ONE OF THE ASSESSMENT METHODS OF THE URODYNAMIC INDEXES IN PATIENTS WITH INFILTRATIVE CERVICAL CANCER

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Abstract

Aim: to evaluate contractile function of urinary bladder in patients with infiltrative cervical cancer after nerve-sparing radical hysterectomy (NSRH).

Patients and Methods: ninety patients with infiltrative cervical cancer were treated with nerve-sparing radical hysterectomy (n=45, NSRH group), or radical hysterectomy (RHE III) without preservation of pelvic autonomic plexuses (n=45, RHE group). Cystomanometry was carried out using urodynamic apparatus "Uro-Pro" by standard method.

Results: using cystomanometry, we have evaluated the main urodynamic indexes such as pressure upon bladder filling (P1), first vesical tenesmus pressure (P2); change of detrusor pressure upon change of bladder volume (P), volume of urinary bladder (V), and complience of urinary bladder wall (C) at preoperative period and postoperative period in both groups of patients. While at preoperative period P1 indexes did not differ significantly between the groups, after NSRH performance, P1 values were significantly higher than P1 values in the group of patients treated with RHE III (8,29±1,1 cm H_2O versus 3,51±0,8 cm H_2O ($p<0,05$)). P2 indexes in patients from both groups before and after surgical treatment differed significantly and were 6,82±0,4 cm H_2O and 12,27±1,2 cm H_2O ($p<0,05$) in NSRH group, and 5,44±0,6 cm H_2O and 10,62±1,1 cm H_2O ($p<0,05$) in RHE III group. The P value in both patients groups before and after the surgical treatments was significantly different, and demonstrated a gradual elevation of urinary bladder pressure, especially in the patients from RHE III treated group. Urinary bladder volume at preoperative and postoperative periods in NSRH-treated group remained practically unaltered (209,78±14,2 ml and 216,86±14,9 ml ($p>0,5$) respectively), while in the patients from RHE III-treated group after surgical treatment an urinary bladder volume significantly decreased from 188,4±10,5 ml to 161,9±9,8 ml ($p<0,05$). An analysis of compliance of urinary bladder wall (C) has shown that after surgical treatment in RHE group C value decreased by 75 % while in NSE group this index decreased just by 25 %.

Conclusions: the data of urodynamic study evidence the better preservation of urinary bladder functions in patients with infiltrative cervical cancer after NSRH than in the patients treated with RHE III.

Keywords: infiltrative cervical cancer; nerve-sparing radical hysterectomy; cystomanometry.

DOI: 10.21303/2504-5679.2016.00116

1. Introduction

In last years a significant progress in the treatment of cervical cancer has been achieved. New methodological principles have been developed and applied, and equipment and surgical techniques have been improved. In locally-advanced forms of cervical cancer, urinary system could be involved in pathological process in 50 % of cases [1–3] due to a close anatomic allocation, common sources of blood supply and innervation of pelvic organs [4–7].

Sometimes, the results of surgical treatment could be dissatisfactory. Among the causes of such insufficiency one should mention various urologic complications including inflammatory diseases of urinary system, uroclepsia, decreased bladder capacity [8–11]; complications caused by trauma and denervation of urinary organs during surgery of pelvic neoplasms [10, 12–15].

At early stages of cancer development, functional changes in urinary system accompanied with morphological changes could be observed. Foremost, such anatomic-functional changes result from close anatomic-topographic relations. Ureters kinking over *linea innominata*, pass along lateral pelvic wall. Their terminal parts are located in *trigonum vesicae* region.

The distance between urinary bladder and anterior wall of vagina does not exceed 1.5–2 cm. The region of *trigonum vesicae* corresponds to upper and partially middle third of anterior wall of vagina, while upper departments of bladder adjoin endocervix. They are separated with fibrous tissue which forms vesicovaginal septum.

Lateral walls of urinary bladder are located close to mesodesma, and urethra makes contact with lower third of vagina. An extension of tumor process from uterus, uterine adnexa and vagina into urinary organs is facilitated with common sources of innervation, blood- and lymph-circulation. Even small tumor may cause certain anatomic-topographic alterations in urinary organs via reflectory or local toxic action. Malfunction of lymphatic or arterial systems cause degenerative changes in nerve elements thus promoting the development of hydroureteronephrosis. Obstruction of ureters is often observed in the places of location of the most functionally active nerve apparatus – in intramural and juxtavesical regions. Traumatic injury of neurogangliac apparatus of ureters during surgery of cervical cancer plays a role in the development of urinary stasis.

Before surgery it is important to evaluate an anatomic-functional state of urinary system. Also, urologic examination should be performed in the process of therapy and during dynamic monitoring of patients. This is the only way to reveal the initial stages of injury of urinary organs in the patients with cervical cancer, to understand their character and causes and to propose a correct curative tactics.

Ultrasonic and urodynamic methods play a central role in diagnostics of malignant tumors of lower pelvis and allow detect alterations in urinary system before and after surgical treatment. Unfortunately, until quite recently an urodynamic study of urinary system has not been used in a complete examination of the patients with gynecological cancer.

Clinical experience evidences that the severity of urologic complications increases along with tumor enlargement and expansion, and depends on the stage of disease [16]. Independent of the disease stage, urologic study should be performed in an integrated manner and include clinical and biochemical urine and blood examination, cystoscopy, ultrasonic and urodynamic examination, as far as many patients already have significant alterations of urinary system state at preoperative stage.

2. Aim of research

To evaluate contractile function of urinary bladder in patients with infiltrative cervical cancer after nerve-sparing radical hysterectomy (NSRH).

3. Materials and methods

Ninety patients with infiltrative cervical cancer were treated with radical hysterectomy (RHE) in the Department of Oncogynecology of National Cancer Institute (Kyiv, Ukraine) in 2012–2016. In 45 patients (group I) RHE was performed with preservation of pelvic autonomic plexuses, and in 45 patients RHE was performed by standard method without preservation of pelvic autonomic plexuses (group II, control group). The prognostic indexes in the groups were similar. **Table 1** presents the distribution of patients with infiltrative cervical cancer in the groups by the main prognostic criteria.

Table 1

Clinical characteristics of infiltrative cervical cancer cases

Group	Tumor stage						Tumor grade		
	1a	1b	2a	2b	3a	3b	G1	G2	G3
PHE	7 %	29 %	24 %	9 %	2 %	29 %	2.9	52.9	44.1
NCE	–	31	29	7	–	33	6.1	42.4	51.5

An informed consents were obtained from patients according to the Ethical Commission requirements of the National Cancer Institute of Ukraine.

Urodynamic study was carried out with a special system "Uro-Pro" (Ukraine) 1 day before surgery and in 3–4 days after hysterectomy.

Bladder wall compliance is measured as a change of detrusor pressure upon certain change of filling volume. Compliance is calculated by a formula: C=V/P, where P – change of detrusor pressure at the moment of change of volume. Compliance is expressed in ml/cm H_2O. Normally, compliance should be higher than 10 ml/cm H_2O at a volume up to 100 ml and higher than 25 ml/cm H_2O at a volume up to 500 ml. If compliance is low (what is usually observed upon sharp increase of pressure and moderate volume change), it is unfavorable for the state of upper urinary tract [8].

Statistical analysis of the data was performed with the use of STATISTICA 5.0 programs for Windows, Stat Soft, Inc., USA. The differences between the groups were evaluated using parametric and nonparametric criteria using Student's t-criterion.

4. Results of research

A comprehensive urodynamic study of lower urinary tract that includes uroflowmetry, cystometry, and rectomanometry, should be performed preoperatively and postoperatively. Urodynamic study in the patients with ICC is reasonable as far as it allow reproduce patients' symptoms, explain the mechanism of malfunction development, and reveal the most significant defects in the case of combined malfunction of lower urinary tract. Also an urodynamic study could be used for prognosis of possible failure and for finding the causes of inefficiency of an applied therapy.

Among the most important urodynamic methods one could mention cystomanometry. Cystometry provides information on adjustment of urinary bladder to the process of its filling as well as the CNS control of reflex of detrusor and sensor characteristics; it is a simple, informative and mostly important method of examination, allowing reveal malfunction of bladder in cancer patients.

Cystometry (cystomanometry) is a registration of the changes of intravesicular pressure during its filling and urination. For the first time cystometry was performed in XIX century, but its clinical relevance has been established just recently due to the development of urodynamics as clinical discipline [17–20].

During cystometry the fluctuations of intravesicular pressure in the process of bladder filling are recorded in graphic form.

With the use of cystometry, we have evaluated the main urodynamic indexes such as pressure upon bladder filling (P1), first vesical tenesmus pressure (P2); change of detrusor pressure upon change of bladder volume (P), volume of urinary bladder (V), and compliance of urinary bladder wall (C) at preoperative period and postoperative period in the groups of patients with infiltrative cervical cancer, treated with radical hysterectomy (RHE) with preservation of pelvic autonomic plexuses (n=45), or without preservation of pelvic autonomic plexuses (n=45). The results are presented in **Tables 2, 3**.

Table 2

Comparison of pre- and post-operative urodynamic indexes in the patients treated with NSE (n=45)

Index	M±SD	p
P1a (cm H_2O)	3.80±0.63	
P1b (cm H_2O)	8.29±1.07	0.001726
P2a (cm H_2O)	6.82±0.699	
P2b (cm H_2O)	12.27±1.22	0.0005
Pa (cm H_2O)	3.02±0.245	
Pb (cm H_2O)	3.98±0.280	0.009251
Va (ml)	209.78±14.2	
Vb (ml)	216.86±14.9	0.552150
C1a (ml/cm H_2O)	84.23±8.01	
C2b (ml/cm H_2O)	64.22±6.83	0.006682

Note: P1 – pressure upon bladder filling; P2 – first vesical tenesmus pressure; P – change of detrusor pressure at the moment of change of volume; V – volume of urinary bladder; C – compliance of urinary bladder wall; each index is measured at preoperative period (a) and postoperative period (b)

Table 3

Comparison of pre- and post-operative urodynamic indexes in the patients treated with RHE (n=45)

Index	M±SD	p
P1a (cm H_2O)	2.96±0.62	
P1b (cm H_2O)	3.51±0.757	0.50159
P2a (cm H_2O)	5.4±0.649	
P2b (cm H_2O)	10.6±1.12	0.00001
Pa (cm H_2O)	2.5±0.207	
Pb (cm H_2O)	7.7±0.866	0.00000
Va (ml)	188.4±10.5	
Vb (ml)	161.9±9.82	0.02466
C1a (ml/cm H_2O)	93.4±7.84	
C2b (ml/cm H_2O)	26.0±1.64	0.00000

Note: P1 – pressure upon bladder filling; P2 – first vesical tenesmus pressure; P – change of detrusor pressure at the moment of change of volume; V – volume of urinary bladder; C – compliance of urinary bladder wall; each index is measured at preoperative period (a) and postoperative period (b)

5. Discussion

As one may see, indexes of the pressure upon bladder filling at preoperative period in patients, treated with RHE III and NSRH did not differ significantly (2,96±0,6 cm H_2O *versus* 3,80±0,68 cm H_2O respectively ($p>0,3$)). However, after NSRH performance, P1 values were significantly higher than P1 values in the group of patients, treated with RHE III: 8,29±1,1 cm H_2O *versus* 3,51±0,8 cm H_2O ($p<0,05$). So, pressure upon bladder filling significantly increased after NSRH, but not RHE, due to the preservation of vegetative innervation of urinary bladder.

Indexes of the first vesical tenesmus pressure in patients from both groups before and after surgical treatment differed significantly and were 6,82±0,4 cm H_2O and 12,27±1,2 cm H_2O ($p<0,05$) in NSRH-treated group, and 5,44±0,6 cm H_2O and 10,62±1,1 cm H_2O ($p<0,05$) in RHE III-treated group.

The change of detrusor pressure upon the change of bladder volume in both patients groups before and after the surgical treatments was significantly different: 3,02±0,2 cm H_2O and 3,98±0,28 cm H_2O ($p<0,05$) in NSRH-treated group, and 2,5±0,2 cm H_2O and 7,7±0,8 cm H_2O ($p<0,05$) in RHE III treated group.

An analysis of the indexes of urinary bladder volume (V) at preoperative and postoperative periods has revealed the following tendency: in NSRH-treated group в V values remained practically unaltered after the surgery (209,78±14,2 ml and 216,86±14,9 ml ($p>0,5$) respectively), while in patients from RHE III-treated group after surgical treatment an urinary bladder volume significantly decreased from 188,4±10,5 ml to 161,9±9,8 ml ($p<0,05$).

An analysis of compliance of urinary bladder wall (C) has shown that after surgical treatment C indexes tended to decrease in both groups of patients: 84,23±8,0 versus 64,22±6,8 ($p<0,05$) in NSRH-treated group; 93,42±7,8 versus 26,04±1,6 ($p<0,05$) in RHE III-treated group, but in the case of NSRH the decrease is notably lower than in the case of RHE (by 20 ml/cm H_2O and by 67 ml/cm H_2O respectively). So, preservation of pelvic vegetative ganglia much better preserved a compliance of urinary bladder wall than RHE with transsection of elements of ganglia of pelvic autonomic plexuses, thus decreasing the rate of complications, developing in urinary system at postoperative period.

6. Conclusion

1. One may conclude that the type of surgical intervention has no effect in regard to the first vesical tenesmus pressure, but P2 index depends on the timing of such examination.

2. These results indicated a gradual elevation of urinary bladder pressure, especially in patients from RHE III treated group, what evidenced on lower antiperistasis of urinary bladder wall in this group due to transsection of elements of ganglia of pelvic autonomic plexuses.

3. These data allow conclude that the preservation of bladder ramous of pelvic vegetative ganglia in NSRH-treated patients improves the stability of bladder volume, while the transaction of pelvic vegetative ganglia in RHE III treated patients leads to a decrease of bladder volume.

4. The data of urodynamic study performed at preoperative and early postoperative period have shown that surgical treatment of patients with invasive cervical cancer with preservation of the major elements of pelvic vegetative ganglia allows significantly decrease the percent of postoperative complications of urinary system.

5. The use of cystomanometry at pre- and post-operative periods has shown that the performance of nerve-sparing radical hysterectomy had no significant influence on contractile function of urinary bladder (did not affect bladder volume), thus allowing provide an adequate urination and continence and improve patient's quality of life.

References

[1] Laterza, R. M., Sievert, K.-D., de Ridder, D., Vierhout, M. E., Haab, F., Cardozo, L. et. al. (2014). Bladder function after radical hysterectomy for cervical cancer. Neurourology and Urodynamics, 34 (4), 309–315. doi: 10.1002/nau.22570

[2] Axelsen, S. M., Petersen, L. K. (2006). Urogynaecological dysfunction after radical hysterectomy. European Journal of Surgical Oncology (EJSO), 32(4), 445–449. doi: 10.1016/j.ejso.2006.01.017

[3] Digesu, G. A., Basra, R., Khullar, V., Hendricken, C., Camarata, M., Kelleher, C. (2009). Bladder sensations during filling cystometry are different according to urodynamic diagnosis. Neurourology and Urodynamics, 28 (3), 191–196. doi: 10.1002/nau.20627

[4] Hsiao, S.-M., Sheu, B.-C., Lin, H.-H. (2007). Sequential assessment of urodynamic findings before and after transobturator tape procedure for female urodynamic stress incontinence. International Urogynecology Journal, 19 (5), 627–632. doi: 10.1007/s00192-007-0488-4

[5] Walz, J., Burnett, A. L., Costello, A. J., Eastham, J. A., Graefen, M., Guillonneau, B. et. al. (2010). A Critical Analysis of the Current Knowledge of Surgical Anatomy Related to Optimization of Cancer Control and Preservation of Continence and Erection in Candidates for Radical Prostatectomy. European Urology, 57 (2), 179–192. doi: 10.1016/j.eururo.2009.11.009

[6] Wang, W., Li, B., Zuo, J., Zhang, G., Yang, Y., Zeng, H. et. al. (2014). Evaluation of pelvic visceral functions after modified nerve-sparing radical hysterectomy. Chin Med J, 127, 696–701.

[7] Brooks, R. A., Wright, J. D., Powell, M. A., Rader, J. S., Gao, F., Mutch, D. G., & Wall, L. L. (2009). Long-term assessment of bladder and bowel dysfunction after radical hysterectomy. Gynecologic Oncology, 114 (1), 75–79. doi: 10.1016/j.ygyno.2009.03.036

[8] Ceccaroni, M., Roviglione, G., Spagnolo, E., Casadio, P., Clarizia, R., Peiretti, M. et. al. (2012). Pelvic dysfunctions and quality of life after nerve-sparing radical hysterectomy: a multicenter comparative study. Anticancer Res, 32, 581–588.

[9] Wu, J., Liu, X., Hua, K., Hu, C., Chen, X., Lu, X. (2010). Effect of Nerve-Sparing Radical Hysterectomy on Bladder Function Recovery and Quality of Life in Patients With Cervical Carcinoma. International Journal of Gynecological Cancer, 20 (5), 905–909. doi: 10.1111/igc.0b013e3181df99c0

[10] Chuang, F. C., Kuo, H. C. (2007). Urological Complications of Radical Hysterectomy for Uterine Cervical Cancer. Incont Pelvic Floor Dysfunct, 1 (3), 77–80.

[11] Wallner, L. P., Porten, S., Meenan, R. T., O'Keefe Rosetti, M. C., Calhoun, E. A., Sarma, A. V., Clemens, J. Q. (2009). Prevalence and Severity of Undiagnosed Urinary Incontinence in Women. The American Journal of Medicine, 122 (11), 1037–1042. doi: 10.1016/j.amjmed.2009.05.016

[12] Fujii, S., Takakura, K., Matsumura, N., Higuchi, T., Yura, S., Mandai, M. et. al. (2007). Anatomic identification and functional outcomes of the nerve sparing Okabayashi radical hysterectomy. Gynecologic Oncology, 107 (1), 4–13. doi: 10.1016/j.ygyno.2007.08.076

[13] Plotti, F., Angioli, R., Zullo, M. A., Sansone, M., Altavilla, T., Antonelli, E. et. al. (2011). Update on urodynamic bladder dysfunctions after radical hysterectomy for cervical cancer. Critical Reviews in Oncology/Hematology, 80 (2), 323–329. doi: 10.1016/j.critrevonc.2010.12.004

[14] Zhu, T., Yu, A. J., Shou, H. F., Chen, X., Zhu, J. Q., Yang, Z. Y. et. al. (2011). Feasibility of unilateral or bilateral nerve-sparing radical hysterectomy in patients with cervical cancer and evaluation of the post-surgery recovery of the bladder and rectal function. Zhonghua zhong liu za zhi [Chinese journal of oncology], 33 (1), 53–57.

[15] Long, R. M., Giri, S. K., Flood, H. D. (2008). Current concepts in female stress urinary incontinence. The Surgeon, 6 (6), 366–372. doi: 10.1016/s1479-666x(08)80010-8

[16] Uccella, S., Laterza, R., Ciravolo, G., Volpi, E., Franchi, M., Zefiro, F. et. al. (2007). A comparison of urinary complications following total laparoscopic radical hysterectomy and laparoscopic pelvic lymphadenectomy to open abdominal surgery. Gynecologic Oncology, 107 (1), S147–S149. doi: 10.1016/j.ygyno.2007.07.027

[17] Basu, M., Duckett, J. (2009). The effect of urethral dilatation on pressure flow studies in women with voiding dysfunction and overactive bladder. International Urogynecology Journal, 20 (9), 1073–1077. doi: 10.1007/s00192-009-0904-z

[18] Van Leijsen, S. A., Kluivers, K. B., Mol, B. W. J., Broekhuis, S. R., Milani, F. L., Vaart, C. H. van der et. al. (2009). Protocol for the value of urodynamics prior to stress incontinence surgery (VUSIS) study: a multicenter randomized controlled trial to assess the cost effectiveness of urodynamics in women with symptoms of stress urinary incontinence in whom surgical treatment is considered. BMC Women's Health, 9 (1), 9–22. doi: 10.1186/1472-6874-9-22

[19] Chuang, F.-C., Kuo, H.-C. (2009). Management of Lower Urinary Tract Dysfunction After Radical Hysterectomy With or Without Radiotherapy for Uterine Cervical Cancer. Journal of the Formosan Medical Association, 108 (8), 619–626. doi: 10.1016/s0929-6646(09)60382-x

[20] Manchana, T., Prasartsakulchai, C., Santingamkun, A. (2009). Long-term lower urinary tract dysfunction after radical hysterectomy in patients with early postoperative voiding dysfunction. International Urogynecology Journal, 21 (1), 95–101. doi: 10.1007/s00192-009-0996-5