



FUNCTIONAL AND EARLY ONCOLOGICAL RESULTS IN 2D VS 3D LAPAROSCOPIC PROSTATECTOMY

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For citation: Bogomolov OA, Shkolnik MI, Belov AD, et al. Functional and early oncological results in 2D vs 3D laparoscopic prostatectomy. *Urologicheskie vedomosti*. 2018;8(3):5-10. doi: 10.17816/uroved835-10

Received: 02.08.2018

Accepted: 18.09.2018

Aim. To evaluate functional and early oncologic results with 2D and 3D laparoscopic prostatectomy in patients with localized prostate cancer. **Materials and methods.** In 2016 to 2017, 124 laparoscopic radical prostatectomies were performed for localized prostate cancer, 71 using 2D-HD and 53 using 3D-HD laparoscopic systems (Karl Storz). Data on total operative time, time required for prostatectomy and for anastomosis, estimated blood loss, intraoperative and early postoperative complications (Clavien-Dindo grade), early functional results, surgical margins, upgrading of clinical stage, and frequency of biochemical recurrence were recorded. **Results.** The total operative was significantly higher in the 2D than in the 3D group (152 min [range 100–192 min] vs 126 min [90–154 min]), ($p < 0.05$). The shorter time in the 3D group was achieved by a decrease in the anastomosis time (38 ± 4 min vs 26 ± 4 min, $p < 0.05$). Significant blood loss was significantly greater in the 2D group (240 ± 80 ml vs 190 ± 70 ml, $p < 0.05$). The two groups did not differ significantly in terms of the incidence and severity of postoperative complications. **Conclusion.** Compared with traditional 2D devices, using stereoscopic 3D laparoscopic devices for prostatectomy reduces total operative time, particularly during the reconstructive stage, as well as the volume of intraoperative blood loss. Additional prospective, randomized trials and longer postoperative follow-up are needed to confirm these findings.

⊗ **Keywords:** laparoscopic radical prostatectomy; 3D laparoscopy; 2D laparoscopy.

ФУНКЦИОНАЛЬНЫЕ И РАННИЕ ОНКОЛОГИЧЕСКИЕ РЕЗУЛЬТАТЫ ПРИ ВЫПОЛНЕНИИ 2D- И 3D-ЛАПАРОСКОПИЧЕСКОЙ ПРОСТАТЭКТОМИИ

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Для цитирования: Богомолов О.А., Школьник М.И., Белов А.Д., и др. Функциональные и ранние онкологические результаты при выполнении 2D- и 3D-лапароскопической простатэктомии // Урологические ведомости. – 2018. – Т. 8. – № 3. – С. 5–10. doi: 10.17816/uroved835-10

Дата поступления: 02.08.2018

Статья принята к печати: 18.09.2018

⊗ **Цель исследования** — оценить функциональные и ранние онкологические результаты при выполнении 2D- и 3D-лапароскопической простатэктомии у больных локализованным раком предстательной железы. **Материалы и методы.** В 2016–2017 гг. выполнены 124 лапароскопические радикальные простатэктомии по поводу локализованного рака предстательной железы: 71 с использованием 2D-HD- и 53 — 3D-HD-лапароскопических систем Karl Storz®. В ходе исследования оценивали общее время операции, отдельно время этапа простатэктомии и время формирования везикоуретрального анастомоза, кровопотерю, интраоперационные и ранние послеоперационные осложнения по системе Clavien-Dindo, ранние функциональные результаты, хирургический край, изменение клинической стадии и частоту развития биохимиче-

ского рецидива. **Результаты.** Общее время операции в обеих группах достоверно различалось — 152 мин (100–192 мин) в группе 2D и 126 мин (90–154 мин) в группе 3D ($p < 0,05$). При этом сокращение времени операции во второй группе было достигнуто за счет уменьшения продолжительности реконструктивного этапа (38 ± 4 мин против 26 ± 4 мин, $p < 0,05$). Достоверные различия также были установлены по показателю объема кровопотери. В первой группе данный параметр составил 240 ± 80 мл, во второй — 190 ± 70 мл ($p < 0,05$). Вместе с тем по ранним онкологическим и функциональным результатам, так же как и по частоте и тяжести послеоперационных осложнений, достоверных различий в зависимости от используемой лапароскопической установки выявлено не было. **Заключение.** Полученные данные свидетельствуют о преимуществе использования стереоскопических лапароскопических установок перед традиционными 2D по показателям продолжительности операции и времени реконструктивного этапа, а также по объему интраоперационной кровопотери. Необходимы дополнительные проспективные рандомизированные исследования, анализирующие значительный клинический материал с длительным периодом послеоперационного наблюдения.

Ключевые слова: лапароскопическая радикальная простатэктомия; 3D-лапароскопия; 2D-лапароскопия.

INTRODUCTION

Radical prostatectomy (RP) is the “gold standard” of treatment for localized prostate cancer (PC) [1]. Minimally invasive techniques for RP have demonstrated advantages over an open approach in terms of reduced intraoperative complications and improved early functional results with similar oncologic safety [2]. Additionally, robotic-assisted RP offers maximal precision of manipulations and high-definition (HD) visualization, but is moderately expensive, and thus impedes wider implementation in the clinical practice of oncologic in-patient clinics. At the same time, improving the functional results of RP is the main goal of current oncurology [3]. Over the past decade, the growing application of 3D laparoscopic equipment providing HD stereoscopic visualization is especially important for the reconstructive steps of the surgery. For domestic health care, implementing such optic systems is the optimal decision to improve the functional results of RP. Thus, this necessitates evaluating the advantages and disadvantages of 3D-HD laparoscopic equipment for minimally invasive RP.

Aim – To evaluate the functional and early oncologic results with 2D and 3D laparoscopic prostatectomy in patients with localized PC.

MATERIAL AND METHODS

From 2016 to 2017 in Academician A.M. Granov Russian Scientific Center of Radiology and Surgical Technologies, 124 laparoscopic RP procedures were performed for localized PC: 71 cases using 2D-HD (group 1) and 53 cases using 3D-HD (group 2) laparoscopic systems (Karl Storz). The minimal follow-up was 3 months and the maximal follow-up

was 24 months. Two surgical teams performed all surgeries using the same surgical technique. An extraperitoneoscopic approach was used in all cases. A central 10-mm optic trocar was inserted in the midline 1 cm beyond the umbilicus. For the conventional 2D-HD laparoscopic tower, a 10 mm 0° angle of view was used; for the 3D-HD laparoscopic tower, a 3D-HD camera with a 10 mm 0° angle of view 2-channel stereoscopic laparoscope was used. A 3D-video was shown on a 3D-HD monitor and polarized glasses were used by the surgical team. Additionally, 4 trocars were placed under optic control in the right and left iliac regions: one of 12 mm, and three of 5 mm. Prostatectomy was performed using an anterograde approach, with the bladder neck sparing technique. Seminal vesicles were removed in all cases, and when indicated, one or two neurovascular bundles were preserved. The dorsal venous complex was divided by bipolar coagulation or scissors after ligation. A vesicourethral anastomosis was created using a running suture with 3–0 *V-loc* 23 cm. All patients had bilateral obturator lymph node dissection. A 22-Fr Foley catheter was inserted into the bladder and all patients had pelvic suction drainage.

Data were recorded on the total operative time, time required for prostatectomy, time for anastomosis, estimated blood loss, intraoperative and early postoperative complications (Clavien–Dindo grade) [4], early functional results, surgical margins, and upgrading of clinical stage, frequency of biochemical recurrence. Biochemical recurrence was defined as consecutively elevated PSA values above 0.2 ng/mL [1].

Statistical data were analyzed by MedCalc 14.12.0 (MedCalc Software, Belgium). For interval vari-

ables with a normal distribution, the mean (M) and standard deviation (s) were used; for ordinal and interval variables without normal distribution, the median (Me) and interquartile range (IQR) were used. For values with a normal distribution, Student's t -test was used to evaluate differences between groups. Differences between two groups without a normal distribution of values were evaluated by the Mann–Whitney U test. Cross-tabulation (Pearson's chi-squared test) was used to analyze correlations between attributes. The level of significance was defined as $p < 0.05$.

RESULTS

The characteristics of enrolled patients with PC are shown in Table 1. There was no significant difference in age, body mass index, preoperative PSA level, or the Gleason score between the two groups.

The total operative time was significantly higher in the 2D than in the 3D group (152 [range, 100–192] vs. 126 [90–154] min, respectively, $p < 0.05$). The shorter time in the 3D group was achieved by a decrease in anastomosis time (2D: 38 ± 4 min vs. 3D: 26 ± 4 min, $p < 0.05$). There were no significant differences in the prostatectomy time. The estimated blood loss was significantly greater in the 2D group (240 ± 80 ml) than in the 3D group (190 ± 70 ml, $p < 0.05$). All procedures were completed without a conversion to an open surgical approach. The vesical catheter was maintained until postoperative day 7 ± 2 in both groups. The duration of pelvic suction drainage did not differ between groups and was 2.3 ± 0.6 and 2.4 ± 0.7 days in the 2D and 3D groups, respectively. The two groups did not differ significantly in terms of hospital stay.

Analysis of early postoperative complications was performed using the Clavien–Dindo sys-

tem (Table 2). In both groups of patients with PC, the complication rate was up to 22%, with more than 90% of mild and moderate (grade 1–2) complications. In the 2D group, there was a single severe complication – vesicourethral anastomotic leak which required stenting of both ureters under epidural anesthesia. In the 3D group, one patient required ultrasound-guided drainage of clinically significant lymphocele under local anesthesia. The two groups did not differ significantly in terms of the incidence or severity of postoperative complications.

Late complications (more than 90 days after prostatectomy), that is, urinary continence and the vesicourethral anastomotic stricture rate, were assessed. Three months after surgery, urine incontinence occurred in 15.5% of patients in the 2D group and in 13.2% in the 3D group; the difference was not significant. Only 4.2% and 3.8% ($p > 0.05$), respectively, required more than 3 pads. Vesicourethral anastomotic stricture was determined in 1 patient in the 2D group, who subsequently underwent successful internal laser urethrotomy.

Based on pathology results in the 2D group, extracapsular extension (stage pT3a) was determined in 5 patients (7.0%), seminal vesicle invasion (stage pT3b) in 5 (7.0%), positive surgical margins (R+) in 7 (9.9%), and lymph node metastasis (pN+) in 2 (2.8%) patients. The median follow-up time was 12.2 months. Biochemical recurrence was determined in 7 (9.9%) patients.

In the 3D group, 3 (5.7%) patients were classified as stage pT3a, 2 (3.8%) as stage pT3b, R+ in 6 (11.3%) patients, and pN+ in 1 (1.9%) patient. The median follow-up time was 10.8 months. Biochemical recurrence was determined in 3 (5.7%) patients.

During the follow-up period, disease progression occurred in 3 patients of the 2D group and in 1 patient of the 3D group.

Table 1

Characteristics of patients

Parameter	Group 1 ($n = 71$)	Group 2 ($n = 53$)	p
Age. $M \pm s$, years	61.2 ± 3.4	63.1 ± 3.6	$>0.05^*$
Body mass index. $M \pm s$	25.7 ± 2.1	26.8 ± 1.9	$>0.05^*$
PSA. Me (IQR), ng/mL	8.1 (6.2–14.8)	8.9 (5.9–16.8)	$>0.05^{**}$
Gleason score. $M \pm s$	6.5 ± 0.6	6.4 ± 0.5	$>0.05^*$

Note. * Student's t -test; ** Mann–Whitney U test.

Table 2

Early postoperative complications

Grade of complication	Group 1 (n = 71)	Group 2 (n = 53)
Grade 1		
Scrotal lymphedema	3	1
Hematuria	2	2
Urethral catheter falling out	2	1
Fever	3	3
Grade 2		
Blood transfusion	2	0
Orchiepididymitis	1	0
Lymphorrhea	2	4
Grade 3a		
Drainage of lymphocele	0	1
Grade 3b		
Vesicourethral anastomotic leak	1	0
Grade 4a-b/5	0	0
Total number of complications ($p > 0.05^*$)	16 (22.5%)	12 (22.7%)

Note. * Pearson's chi-squared test.

Choline positron emission tomography (PET)/computed tomography (CT) revealed a residual tumor growth in the surgical bed in 1 patient of the 2D group. Another 3 patients had pelvic lymph node metastases. None of the patients died during the follow-up period.

DISCUSSION

The wide implementation of a PSA-based population screening resulted in a sharp rise in the incidence of PC, specifically among young men. Oncologic results of the surgical treatment of localized PC are encouraging, but presently, functional results are suboptimal and require further improvement. Currently, urinary continence and sexual function are essential criteria of successful RP-like oncologic results [5]. Numerous studies have suggested that oncologic results are similar regardless of surgical approach (open, laparoscopic, or robotic-assisted). In contrast, minimally invasive techniques significantly reduce surgical trauma, blood loss, and blood transfusion rate. This improves outcomes by reducing the length of hospital stay, duration of catheterization, and rehabilitation period [6].

We believe that robotic-assisted RP with the Da Vinci system has the best functional results. However,

the high cost of surgery prevents the wide implementation of this technique in clinical practice. According to recent data presented at the 2018 Annual European Association of Urology Congress in Copenhagen, implementing the Da Vinci system in developing countries does not make sense economically [1].

Good functional results are largely predicated on the HD visualization during surgical intervention. Hence, conventional 2D laparoscopy with no sense of depth makes instrument manipulation more difficult, especially during reconstruction. It is for this reason that there is a steep learning curve for young surgeons [7].

Implementing 3D laparoscopy in clinical practice serves to improve dimensional orientation during surgery and also to reduce the learning curve without a significant increase in surgery cost. Early studies suggest advantages to the speed of learning in young professionals on simulators and trainers [8, 9]. However, more recent work shows controversial findings for both the learning parameters and the clinical results of 3D laparoscopic device use in real surgical practices [10–12].

Several studies showed that surgeons who worked on 3D systems often suffer from headache and nausea during the operation [13]. This problem remains unsolved and presents a limitation to the wider application of these devices.

Our analysis clearly demonstrates that laparoscopic devices do not differ significantly in terms of early oncologic and functional results, or in the incidence and severity of postoperative complications. But 3D visualization can reduce time needed for vesicourethral anastomoses creation consequently thus reducing the overall operative time. Significant advantages of a stereoscopic system were determined in better visualization of blood vessels which consequently lowers intraoperative blood loss. However, this pilot study has a number of limitations because it is retrospective and has a relatively short follow-up period. Additional prospective, randomized clinical trials with a large number of patients and a longer follow-up period are required.

REFERENCES

1. EAU Guidelines. Edn. presented at the EAU Annual Congress Copenhagen 2018. ISBN 978-94-92671-01-1.
2. Hakimi AA, Feder M, Ghavamian R. Minimally invasive approaches to prostate cancer: a review of the current literature. *Urol J*. 2007;4(1):130-137.
3. Patel VR, Sivaraman A, Coelho RF, et al. Pentafecta: a new concept for reporting outcomes of robot-assisted laparoscopic radical prostatectomy. *Eur Urol*. 2011;59(5):702-7. doi: 10.1016/j.eururo.2011.01.032.
4. Dindo D, Demartines N, Clavien P. Classification of surgical complications. *Ann Surg*. 2004;240:205-213. doi: 10.1007/978-1-4471-4354-3_3.
5. Schroeck FR, Krupski TL, Sun L, et al. Satisfaction and regret after open retropubic or robot-assisted laparoscopic radical prostatectomy. *Eur Urol*. 2008;54(4):785-793. doi: 10.1016/j.eururo.2008.06.063.
6. Robertson C, Close A, Fraser C, et al. Relative effectiveness of robot-assisted and standard laparoscopic prostatectomy as alternatives to open radical prostatectomy for treatment of localised prostate cancer: a systematic review and mixed treatment comparison meta-analysis. *BJU Int*. 2013;112(6):798-812. doi: 10.1111/bju.12247.
7. Abdelshahid CS, Eichel L, Lee D, et al. Current trends in urologic laparoscopic surgery. *J Endourol*. 2005;19(1):15-20. doi: 10.1089/end.2005.19.15.
8. Patel HRH, Ribal MJ, Arya M, et al. Is it worth revisiting laparoscopic three-dimensional visualization? A validated assessment. *Urology*. 2007;70(1):47-9. doi: 10.1016/j.urology.2007.03.014.
9. Peitgen K, Walz MV, Holtmann G, Eigler FW. A prospective randomized experimental evaluation of three-dimensional imaging in laparoscopy. *Gastrointest Endosc*. 1996;44(3):262-7. doi: 10.1016/s0016-5107(96)70162-1.
10. Chan ACW, Chung SCS, Yim APC, et al. Comparison of two-dimensional vs three-dimensional camera systems in laparoscopic surgery. *Surg Endosc*. 1997;11(5):438-40. doi: 10.1007/s004649900385.
11. Wenzl R, Lehner R, Vry U, et al. Three-dimensional video endoscopy: clinical use in gynaecological laparoscopy. *Lancet*. 1994;344(8937):1621-1622. doi: 10.1016/s0140-6736(94)90412-x.
12. Hanna GB, Cuschieri A. Influence of two-dimensional and three-dimensional imaging on endoscopic bowel suturing. *World J Surg*. 2000;24(4):444-448. doi: 10.1007/s002689910070.
13. Taffinder N, Smith SGT, Huber J, et al. The effect of a second-generation 3D endoscope on the laparoscopic precision of novices and experienced surgeons. *Surg Endosc*. 1999;13(11):1087-1092. doi: 10.1007/s004649901179.

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