ORIGINAL PAPER

Optimizing Nerve Sparing in Robotic-Assisted Radical Prostatectomy: A Comparative Investigation of Traditional and Modified Endopelvic Fascia Preservation Techniques

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ABSTRACT

Background: Prostate cancer (PCa) is the second most common cancer and the sixth leading cause of cancer-related mortality in men. In 2000, Abbou performed the first robot-assisted radical prostatectomy, and radical prostatectomy has developed rapidly. Robot-assisted radical prostatectomy (RARP) is a valuable therapeutic option for the management of localized Pca. ***Objective***: To present the functional outcome of robot-assisted laparoscopic radical prostatectomy using traditional and modified endopelvic fascia preservation methods in a single center in Vietnam. **Methods:** We prospectively analyzed a series of 65 patients diagnosed with prostate cancer from 2020 to 2023. All of those were operated by DaVinci Si system robot-assisted laparoscopic prostatectomy. Twenties patients were applied with a modified nerve-sparing technique, intrafascial dissection, and lateral prostatic fascia preservation, leaving the lateral tissue, including the neurovascular bundle, untouched and covered. We used the traditional approach, intrafascial nerve-sparing with open endopelvic fascia and lateral prostatic fascia in 45 cases. Patients were followed up to 12 months to assess the continence and erectile function by using IIEF-5 and EPIC questionnaires. **Results:** The study sample included 65 cases; the mean patient age was 64.21 ± 6.68, erection rate after surgery at six months in bilateral NS was 36.58% (15/ 41) in the traditional group, and 68.42% (13/19) in the modified group (p=0.028). The patient did not recover erectile ability in the group of elderly patients (>65 years old) and unilateral nerve-sparing group. The continence rate six months after surgery was 86.66 % in the conventional group and 85% in the modified group, with no significant difference between the two groups. In the potency group, the IIEF-5 score was 13 ± 4.9, and the EPIC-26 score was 62.20 ± 10.04. Erectile ability in the modified group was better than the traditional group at six months after surgery. **Conclusion:** Our results showed better potency recovery in the modified group. These results should be tested in future research with randomized studies.

Keywords: Nerve Sparing, Intrafascial, Radical Prostatectomy, Continence rate, Potency rate.

1. BACKGROUND

Prostate cancer (PCa) is the second most common cancer and the sixth leading cause of cancer-related mortality in men (1). In 2000, Abbou performed the first robot-assisted radical prostatectomy (2), and radical prostatectomy has developed rapidly. Robot-assisted radical prostatectomy (RARP) is a valuable therapeutic option for the management of localized Pca. The intraperitoneal approach is the most widely accepted, with low complication rates and good long-term functional and oncological outcomes (3, 4). Thanks to the development of robotic technology with 3-dimensional vision, flexible robotic tools have reduced the learning curve significantly. Robotic assisted-radical prostatectomy is increasingly popular and applied at major urology centers around the world.

Although the primary outcome of the operations is the oncological outcome, the new perspective raises two issues related to the quality of life after surgery: urinary incontinence and sexual life. The purpose of the neurovascular bundle preservation technique is to solve the above two problems. More-

over, when used appropriately, nerve-sparing does not affect oncological outcomes, even in high-risk patients (5, 6). The operation outcomes have been evaluated as trifecta results in measuring the oncological outcome, continence, and erectile (7). Later, with the addition of negative surgical margins and early post-surgical complications to this concept, the pentafecta outcomes were reported to reflect the surgeons' experience (4).

In the series of RARP, The potency rate ranges from 50-90 % (4, 8-12), the continence rate also improves after nerve-sparing compared to non-nerve-sparing 73% vs 66% (3), 85.4% vs 70.5% (14). Of 20-40% patient fail to radical prostatectomy and present biochemical recurrence (15, 16). Recent studies at centers with a large number of patients around the world confirm that it is still possible to improve urine continence and erectile function (17).

With the advantage of robotic surgery, which has a clear surgical field and flexible movements in preserving the nerve bundle, the surgical technique acts as a modifiable factor that impacts functional recovery after surgery (18). When operating, the principle of Nerve Sparing is not to use an electric knife when preserving and to limit damage to the vascular bundles during surgery, so we made this report. To share the experience of the first cases of nerve Sparing in robot-assisted radical prostatectomy, comparing two methods of nerve sparing using traditional method and modified method with preservation of the endopelvic fascia. The neurovascular bundle is still located in the fascia plane, prostatic fascia in the media, endopelvic fascia in the lateral, and Denonvillier's fascia in the posterior, thus minimizing damage.

2. OBJECTIVE

The aim of this study is to evaluate functional outcomes in 2 groups after surgery.

3. MATERIAL AND METHODS

Study design and participants

It was a prospective case series study. We recruited a series of 65 patients, including 45 cases of nerve sparing by the traditional method and 20 cases by the modified method, diagnosed with local prostate carcinoma (in stage T1, T2, T3, and life expectancy of more than ten years) from November 2019 to June 2023 (approved by the medical ethic council of Pham Ngoc Thach Medical University–number 701/TDHYK-PNT-HDDD). All of those were normal continence and erectile function with a Shim score of 12 points and more priority to surgery. They agreed to use the DaVinci Si robotic system for robot-assisted laparoscopic prostatectomy.

The participants underwent a thorough clinical, imaging, and laboratory investigation to make the definitive diagnosis of prostate carcinoma.

- Preoperative variables: age, BMI, comorbidities, PSA index, Gleason scores, TNM cancer stage based on MRI and pathology, prostate size. Erectile evaluated by IIEF-5 questionnaire.

- Intraoperative variables: surgery time, blood loss, surgical margins. Intraoperative complications, drain removal time, hospital discharge time, bilateral nerve sparing, or unilateral nerve sparing (depending on the size, location, and tumor stage to proceed).

- Postoperative variables: pTNM, Postoperative complications (Clavien-Dindo scale), continence is defined as Patients who do not use diapers after surgery or have only occasional stress incontinence. Erectile function: evaluated by the international index of erectile function (IIEF-5) questionnaire, EPIC-26 specializes in prostate cancer patients. Potency was defined as the ability to achieve and maintain erections firm enough for sexual intercourse, with or without the use of phosphodiesterase type 5 (PDE5) inhibitors (4). Patients were seen in the outpatient clinic at two weeks, then 3 and 6 months postoperatively. Prostate-specific antigen (PSA), IIEF-5 score, and continence status were evaluated at this time. Complications occurring after surgery were documented and classified by the modified Clavien-Dindo system.

Surgical technique

Lateral prostatic fascia preservation (modified technique)

The patient underwent a transperitoneal six-port procedure with an anterior approach. The anterior bladder neck is open first, followed by the bladder neck dissection, creating the plane between the prostate and rectum. The plane of NVB is developed from the underside of the prostate, followed by the posterior release of the NVBs; we go anteriorly and develop a plane medial to the lateral prostatic fascia at the base; the NVBs are unseen and untouched lateral to the fascial opening (Figure 1). That protects the NVBs from traction and trauma. In this procedure, the puboprostatic ligaments' apical complex and endopelvic fascia are left intact. A deep venous complex was stitched, followed by vesicourethral anastomosis using the van-**Velthoven technique.**

Conventional technique

In the conventional group, we followed these steps: identified and mobilized the seminal vesicles and vas deferens and posterior dissection of the prostate, developing entry into the retropubic space of the Retzius, incision of the endopelvic fascia and identification of dorsal venous complex, Ligation of Santorini plexus, following, dissection of the bladder neck. We perform the nerve-sparing technique in an antegrade manner. We were incising the Denonvilliers' fascia and the endopelvic fascia's visceral layer covering the prostate's postero-lateral surface. The intrafascial surgical plane is identified and developed. Mobilized tissue on the lateral side of the prostate will enable the prostatic capsule and the neurovascular bundle (NVB) to be identified. No thermal energy is used during the dissection of the NVB or ligation of the pedicle. After the upward traction of vas and seminal vesicles, the prostatic pedicle is observed and controlled athermally at the base of the prostate. Then, the prostate is pulled to the opposite side, and the lateral pelvic fascia is exposed. The triangular space between the lateral pelvic fascia, the Denonvilliers' fascia, and the prostate is observed, and the NVB is defined. The lateral pelvic fascia is exposed, and the interfascial or intrafascial dissection is performed. We placed two clips on the pedicle away from the NVB and a sharp incision to release the prostate completely. It is essential to release the NVB to the apex of the prostate to prevent injury during the apical dissection. Finally, we perform apical dissection and urethrovesical anastomosis.

Statistical analysis

Data obtained in the study were analyzed statistically using

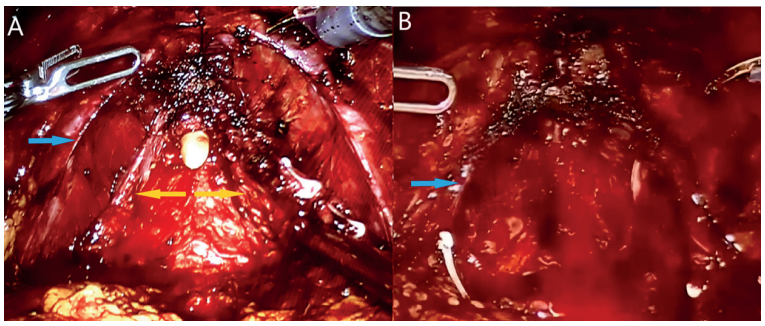

Figure 1. A conventional Approach: open endopelvic fascia, B modified Approach: lateral prostatic fascial Preservation (yellow arrow: nerve vascular bundle, blue arrow: lateral prostatic fascia).

SPSS 22.0 software. Categorical variables were presented as percentages (%) and were analyzed using the Chi-square test. Continuous variables were shown as mean ± standard deviation (SD) values and were analyzed using a *t*-test. p-value < 0.05 were considered to be statistically significant.

4. RESULTS

We performed 65 robotic assisted-prostatectomy cases with nerve-sparing technique; this research comprises 45 cases in the conventional group and 20 cases in the modified group.

Perioperative characteristics

There is no statistical difference in baseline and perioperative characteristics between two group (Table1). The mean operative time and console time in conventional group is not different from the modified group. Two cases needed blood transfusion post-operative in conventional group and 1 case in modified group (this complication was low grade, Clavien grade II).

Pathological and oncological characteristics

Gleason Score, extraprostatic extension, and positive surgical margin (PSM) rates were similar between the two groups. PSM rates in modified group is 25.00% compare to 33.33%% in conventional group (p = 0.703) (Table 1).

Pathological stage 2 (<pT2c) account for 85 % in modified group 84.4% in conventional group, Pathological stage 3 (T3a and T3b) account for 15% in modified group, 15.56% in conventional group (Table 1). At a mean follow-up of 12 4 months, biochemical recurrence rate in modified group is higher than conventional group (30.00% vs 22.22%) but it is not statistical difference (p = 0.542) (Table 1).

Functional outcomes

The potency rate six months after the operation is 43.07% (28/65). Patients who do not recover erectile belong to the unilateral nerve-sparing group. With bilateral nerve sparing, The potency rate is and 46.66% (28/60), the potency rate in the modified group is better than that of the conventional group; the modified potency rate is 68.42% (13/19) compared to 36.58% (15/41) in the conventional group (p = 0.028) (Table 2) IIEF-5 score in the erectile group is 13.64 ± 3.54 at six months after the operation, the EPIC-26 score in this group is 62.20 ± 10.04 (Table 3).

The continence rate at six months was 86.66% in the conventional group and 85% in the modified group. There is no difference in continence rate between the modified group and the conventional group at three and six months after the operation (p = 0.583 and p = 1.000).

Multivariate analysis reveals that age, bilateral nerve-sparing, and modified technique are independent predictors of erectile recovery.

The patients in a group with no erectile dysfunction (22-25) and mid-erectile dysfunction (17-21) prior to the operation have better potency recovery than those in a group with mild to moderate erectile dysfunction (12-16) (Table 4).

Parameters	mod-RALP (n=20)	conv-RALP (n=45)	p-value
Age, mean ± SD	64.62 ± 6.8	64.53 ± 7	0.86
BMI, mean ± SD	22.91 ± 2.00	23.13 ± 1.80	0.66
Co-comorbidities, n (%) Hypertension Diabetes Hypertension, diabetes	 8 (40.0%) 1 (5%) 2 (10.0%)	 16 (35.6%) 1 (2.2%) 4 (8.9%)	0.864
Pathological stage ≤pT2c pT3a pT3b	 17 (85.00%) 1 (5.00%) 2 (10.0%)	 38 (84.44%) 2 (4.44%) 5 (11.11%)	1.000
PSA	22.77 ± 24.06	21.32 ± 21.40	0.809
Biopsy Gleason score 3+3 3+4 4+3 ≥4+4	 3 (15.00%) 8 (40.00%) 8 (40.00%) 1 (5.00%)	 16 (35.56%) 15 (33.33%) 5 (11.11%) 9 (20.00%)	0.023
Total operative time, mean ± SD	218±59	201±68	0.344
Blood loss, Mean (Q1-Q3)	200 (100-300)	300 (125-500)	0.113
Nerve sparing, n (%) Unilateral Bilateral	 1 (5.00%) 19 (95.00%)	 4 (8.89%) 41 (91.11%)	1.000
Estimated tumor volume, mean ± SD	37.62 ± 11.01	37.8 ± 19.86	0.970
Pathological GS, n (%) 3+3 3+4 4+3 ≥4+4	 1 (5.0%) 9 (45.0%) 8 (40.0%) 2 (10.0%)	 9 (20.0%) 19 (42.2%) 12 (26.7%) 5 (11.1%)	0.572
Positive surgical margin, n (%)	5 (25%)	15 (33.33%)	0.703
Biochemical recurrence rate, n (%)	6 (30%)	10 (22.22%)	0.542
Clavien Dindo , n (%) None Clavien I Clavien II	 19 (95.0%) 0 (0.0%) 1 (5.0%)	 43 (95.6%) 0 (0.0%) 2 (4.4%)	1.000

Table 1. Baseline and perioperative characteristics

	Modified	Conventional	P value
Continence rate at 3 months	9/20 (45%)	16/45 (35.5%)	0.583
Continence rate at 6 months	17/20 (85%)	39/45 (86.66%)	1.000
Potency rate at 6 month (bilateral NS)	13/19 (68.42%)	15/41 (36.58%)	0.028

Table 2. Functional characteristics

Trifecta and pentafecta outcomes following the operation

40% (26/65) patients achieved the trifecta outcomes, and 26,2% (17/65) patients achieved pentafecta outcomes six

Time of assessment	IIEF-5 both group		IIEF-5 modified		IIEF-5 conventional	
	n	Mean ± SD	n	Mean ± SD	n	Mean ± SD
Preoperative	65	17.91±2.76	20	18.65±2.34	45	17.58±2.88
3 months	14	11±2.77	7	10.14±2.73	7	11.86±2.73
6 months	28	13.64±3.54	13	13.23±3.32	15	14.29±3.77

Table 3. IIEF-5 on erectile patients

IIEF-5	12 -16	17-21	22-25
Conventional (n=45)	0/14 (0%)	12/28 (42.85%)	3/3 (100%)
Modified (n=20)	1/4 (25%)	10/14(71.42%)	2/2 (100%)
p	0.222	0.108	.

Table 4. Potency recovery rate in three patient groups according to IIEF-5 scores

outcomes	Modified group	Conventional group	p
Trifecta at 6 months	60% (12/20)	31.1% (14/45)	0.055
Pentafecta at 6 months	45% (9/20)	17.8% (8/45)	0.046

Table 5. Trifecta and pentafecta outcomes

months after surgery. There are 60% (12/20) patients in the modified group and 31.1% (14/45) patients in the conventional group who achieved trifecta outcomes six months after NS-RARP (p=0.055). 45% (9/20) of patients in modified groups and 17.8% (8/45) patients in the conventional group achieved pentafecta outcomes (p = 0.046). (Table 5).

5. DISCUSSION

Robotic radical prostatectomy has become a minimally invasive treatment for prostate cancer in general and the treatment of choice for localized prostate cancer (19). In this surgery, the quality of life post-operation is based on two criteria: continence and sexual function. The numerous advantages of robotic surgery include a greatly magnified view of the important structures and manipulation of wristed instruments that provide a range of motion better than the human wrist. In radical prostatectomy, robotic-assisted surgery contributes to the optimal preservation of vital structures such as nerve vascular bundles, improving the quality of patient life after surgery.

Some modified techniques in nerve-sparing include Retzius sparing, the Veil of Aphrodite, and the Hood Technique. These techniques are also fascia preservation. Some techniques are challenging due to maximizing the remaining fascia, like the Veil of Aphrodite and Hood technique. Anterior tumor locations are contradicted by these techniques. Retzius Sparing technique was concerned with a positive anterior margin due to small operating space (20). In this research, we preserve the lateral prostatic fascia, just enough fascia to cover the nerve vascular bundle, leaving the nerve vascular bundle untouched, so it optimizes the ability of continence and potency recovery after the surgery. This technique was also reported by Covas in 2020 (21).

The potency rate in bilateral nerve-sparing patients is 46.66% compared to some authors, with the potency rate ranging from 50 – 90% (4, 8-12). Differences in exclusion criteria, evaluation methods, nerve-sparing techniques, approaches, surgeon experience, and follow-up time can explain this difference. Furthermore, the definition of potency also varies across studies.

Our research demonstrates that the modified procedure results in better potency recovery than the standard approach. The potency rate is better than the conventional approach 6 month after operation in bilateral nerve-sparing patients. At 6 months post-operation, the potency rate in the modified group is 68.42 % compared to 36.58% in the conventional group (p=0.028) (Table 2). Without incision of the lateral prostatic fascia, we optimize the preservation of the nerve vascular bundle; this reduces the trauma to the nerve bundle, leading to better recovery of erectile function. Voluntary contraction of the puboperinealis muscle pulls the urethra and prostate forward and upward, leading to urethral closure (22, 23). Within this muscle are fibers of the long pelvic nerve, or levator ani nerve, which runs on the external levator ani surface adjacent to the fascial tendinous arch (24). This nerve needs to be preserved to maintain the functional integrity of the pubic perineal muscle and rapid urinary control. It can be injured when cutting the endopelvic fascia and moving the levator ani muscle away from the prostate (24).In the modified technique, the lateral prostatic fascia is preserved to prevent damage to the levator ani, so optimizing urinary continence post-operation. However, there is no statistical difference in continence between the two groups in our study (p=1.000).

On multivariate analysis, younger age and bilateral nerve-sparing are associated with better continence rates in both groups. The positive surgical margin in the conventional group is higher than that of the modified group, but it is not statistically significant (p=0.703).

In the potency recovery group, we use IIEF-5 and EPIC-26 to evaluate erectile functions. The IIEF-5 at the time 6 months post operation in erectile patients is 13.64±3.54 (n=28). It is the score of mild to moderate erectile dysfunction. However, this study was performed in Asian countries where older adults do not have a strong desire for sex due to cultural reasons (grandparents taking care of their grandchildren, psychological factors). They can maintain potency, but they do not have sexual intercourse, leading to meager scores in sentence 3,4,5 on IIEF-5 questionnaires. We also use EPIC-26 questionnaires specific to patients after radical prostatectomy. In this evaluation, EPIC-26 does not emphasize sexual intercourse scores, so the mean EPIC-26 score in sexual function is rather good (62.20±10.04). Continence and potency after radical prostatectomy are two factors that contribute to patients' quality of life.

Our research has some limitations. The first is a small sample size. Second, our study research comes from two high-volume surgeons, which is not as good as a study with a highly experienced single surgeon. Conducting the study at one single medical center may limit the external validity of our result. Finally, our study lacks long-term follow-up for oncological outcome.

6. CONCLUSION

The modified robotic-assisted radical prostatectomy is a safe and effective treatment for prostate cancer patients. It is associated with a better potency rate post-operation. Although it is rather challenging to identify the anatomical landmark in this procedure, with the advantage of robotic surgery, the learning

curve evolves phenomenally. These findings should consider counseling men regarding postoperative outcomes.

Abbreviations

- NS : Nerve-Sparing
- IIEF-5 : The International Index of Erectile Function (IIEF-5) Questionnaire
- EPIC 26 : Expanded Prostate Cancer Index Composite-26
- PCa : Prostate Cancer
- RARP : Robot-Assisted Radical Prostatectomy
- NS-RARP : Nerve-sparing
- NVB : Neurovascular bundle
- Mod-RALP : Modified Robot-assisted radical prostatectomy
- Conv-RALP : Conventional Robot-assisted radical prostatectomy
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- **Ethical statement:** This study is approved by the medical ethic council of Pham Ngoc Thach Medical University–number 701/TDHYKP-NT-HDDD and conducted according to the ethical standards of the 1964 Declaration of Helsinki and its later amendment.
- **Informed consent:** Informed consent was waived by the medical ethic council of Pham Ngoc Thach Medical University for prospective nature, the analysis used anonymous clinical data.
- **Author's contributions:** Research conception and design: MVNT and NPCH. Statistical Analysis: NTV. Data analysis and interpretation: MVNT, NPCH, NTV. Drafting of the manuscript: MVNT and NTV. Critical revision of manuscript: all author. Administrative, technical, or material support: MVNT. Supervision: NPCH, NTK, DVP. Approval of the final manuscript: all authors.
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