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Original Article

Retrospective comparison of the modified and traditional holmium laser transurethral prostatectomy based on a 1-year follow-up

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Abstract: Holmium laser enucleation of the prostate (HoLEP) is becoming a very promising technique that can challenge the gold standard of TURP. To further promote the HoLEP technology, we modified the technique and applied this technology into practicality. From Mar. 2013 to Jul. 2013, 122 cases have received this surgery, the validity and safety of the modified and traditional methods for HoLEP were retrospectively evaluated. 105 cases received the traditional trivalvular method of surgery from Aug. 2012 to Dec. 2012 were included as the comparison. No differences were found in both groups in basic preoperative characteristics and no serious complications were observed after the surgery. Compared with the preoperative baseline, significant improvements were occurred in international prostatic symptomatic score (IPSS), quality of life (QOL) and maximum flow rate (Qmax) at 1, 6 and 12-month follow-up. The tunnel group was superior to the traditional one in mean operation time, mean volume of irrigating fluid, hospital stays and hemoglobin decrease during the operation ($P<0.05$). No significant differences in catheter times and the 1, 6, 12-month follow-up data for I-PSS, QOL and Qmax between the 2 groups were found. In conclusion, the modified HoLEP is more effective and safer with less risk of hemorrhage and urinary incontinence and less operation time as well as bladder irrigation.

Keywords: Benign prostatic hyperplasia, holmium laser, enucleation

Introduction

In 1995, Peter Gilling first introduced holmium laser prostatectomy for the treatment of benign prostate hyperplasia (BPH) [1]. Since then, though transurethral resection of the prostate can still be considered as the gold standard for BPH treatment, HoLEP has been increasingly performed. In recent years, the HoLEP has been proven to be a safe and effective treatment, and it is a minimally invasive surgical procedure for BPH associated with less catheter times, hospital stay and blood loss, compare to the TURP or open prostatectomy [2-4]. In addition, a latest study shows that HoLEP did not influence overall sexual function, including erectile function, in addition, sexual satisfaction improved in proportion with the improvement of LUTS [5, 6]. Thus the likelihood to replace the traditional TURP as the gold standard for the surgical treatment of BPH appears to be more prominent [7-11]. However, HoLEP has been criticized for its long operative time, steep learning curve and higher cost [12-15]. Thus, for 5 years in our department we have done about 800 cases of holmium laser enucleation surgery. According to our experience, though HoLEP is an excellent technique with durable efficacy and less complications than other surgical methods, further development should be done to make it more safely and more efficiently. In order to make the procedure easier, from Jan. 2013 to Feb. 2013, we modified the technique and during this period the surgery was also mastered the new technique. Then the modified HoLEP was well used in the clinic for a sequence of days, and the validity and safety of the two different methods for HoLEP were retrospectively analyzed and compared.

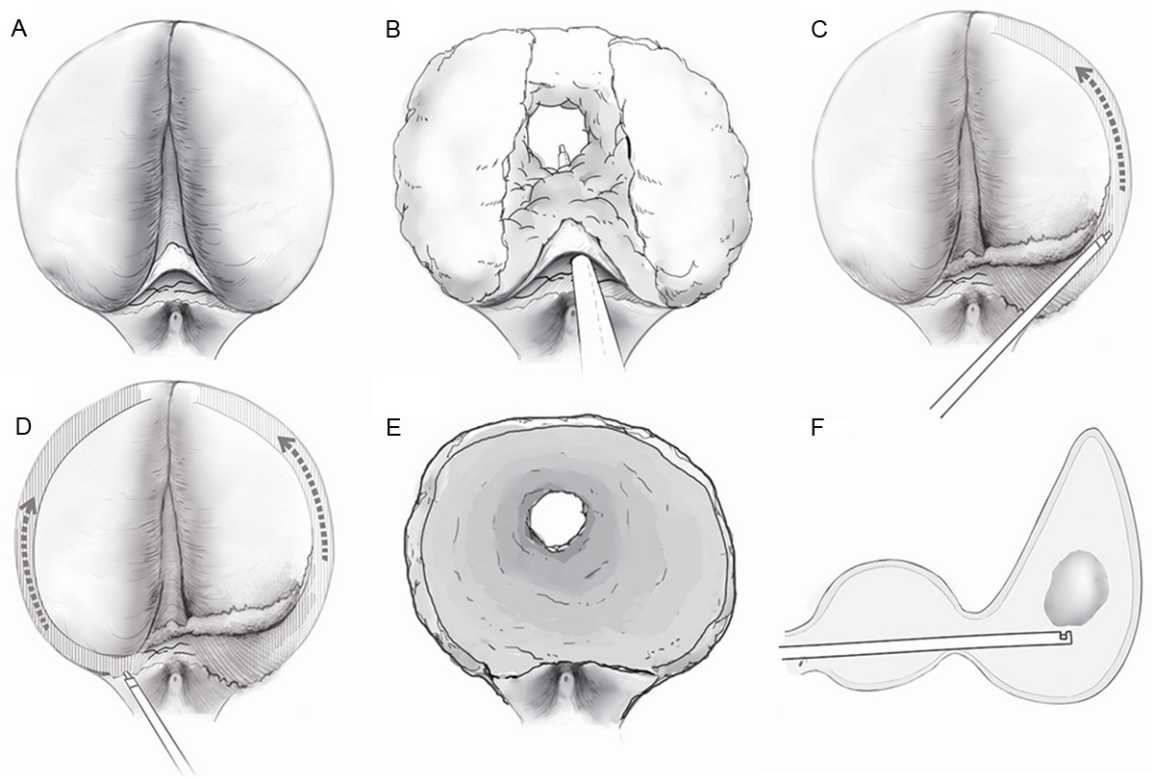

Figure 1. Illustrations of the modified HoLEP procedure and the schematic of BPH. A. Cut a short horizontal incision and expose the surgical capsule of the prostate before apex; B. Beneath the median lobe along the surgical capsule dug a tunnel from apex to the bladder neck; C. From 6 to 12 o'clock enucleate the left lateral lobe; D. From 6 to 12 o'clock enucleate the right lateral lobe; E. push the entire prostate off the prostatic wall and push it into the bladder; F. Morcellate the enucleated prostatic tissue.

Materials and methods

Patients

From Aug. 2012 to Jul. 2013 a total of 227 BPH patients who have been performed HoLEP surgery in our department (excluding 41 cases in Jan, and Feb of 2013) were Included in this study. The choice of surgery was based on clinical assessment. Inclusion criteria were self-administered I-PSS 9 or greater, QOL score 3 or greater, Qmax 15 ml per second or less, or post-void residual urine volume 50 ml or greater. Patients were excluded if they had prostate cancer or voiding disorders not related to BPH, including urethrostenosis and neurogenic bladder. 105 cases underwent traditional trivalvular method in the first half of the period, and 122 cases underwent our modified technique tunnel at 6 o'clock method in the second half of the period, no patient needs to catheterize before surgery. All operations were performed by an experienced surgeon named ZW that who are capable in both operations. Perioperative data were recorded, including total operating time, enucleation time, morcellation time, serum hemoglobin decrease, resected tissue weight and some relevant complications. I-PSS, QOL score, Qmax and PSA were reassessed at 1, 6 and 12-month follow-up.

This study has been approved by the ethics committee of Ninth People's Hospital, school of Medicine, Shanghai Jiaotong University.

Technique

In our department HoLEP was performed using a 550-μm end-firing laser fiber and a 100-W Versa pulse holmium laser (Lumenis, Inc., Tel Aviv, Israel). The power settings were 80-100 W at 1.6-2 J/s and 40-50 Hz. Transurethral morcellation was performed with a 26F nephroscope (Storz, Tuttlingen, Germany) using a mechanical morcellator (VersacutMorcellation; Lumenis, Inc.). The irrigation fluid used was 1 L of normal saline (0.9%) that also can be used

Table 1. Perioperative data

	Group 1	Group 2	*P* Value
Age	69.57±6.46	70.35±6.31	0.359
TRUS vol (ml)	52.38±17.47	54.69±18.52	0.363
Gm resected wt	44.81±13.32	44.01±12.46	0.641
Minsoperative duration	60.19±13.60	55.45±8.55	0.0049
Minsenucleation	47.24±8.23	44.04±7.72	0. 003
Minsmorcellation	11.41±2.08	11.37±2.22	0. 845
Hemoglobin decrease (g/dl)	1.25±0.75	0.92±1.24	0.0185
Hrs bladder irrigation (L)	37.56±6.20	27.69±3.65	<0.001
Days hospital stay (d)	3.90±0.85	3.58±1.07	0.0165
Hrs catheter time (h)	70.97±13.22	69.39±7.98	0.272

Group 1 is the trivalvular group and group 2 is the tunnel group.

for intravenous drip, and all of the irrigation bags were hung 60 cm above the operating table. An irrigating catheter was inserted after surgery. Bladder irrigation was used until hematuria resolved, and the standard for catheter removal was clear urine without gross hematuria.

Operative methods

Trivalvular group: For the traditional trivalvular group, we used the normal enucleation procedure introduced by PeterGilling et al [11, 16]. The division of prostate into its three anatomical lobesis one of its main characteristics. The first step of this HoLEP procedure is to create bladder neck incisions at the 5 and 7 o'clock positions down to the surgical capsule. Enucleation of the median lobe: that is done retrogradely by joining the distal ends of the bladder neck incisions just proximal to the verumontanum and dissecting on the surgical capsule between them in a 'side-to-side' manner. The median lobe is detached at the bladder neck and allowed to float into the bladder. Enucleation of the lateral lobes: by extending the bladder neck incisions laterally and circumferentially, the lateral lobes are undermined inferiorly. A bladder neck incision is made at the 12 o'clock position and dissected with a sweeping motion on each side, and then the superior aspect of the lateral lobe is gradually peeled down off the capsule, working back gradually towards the verumontanum to join the lower incision. Once all three lobes have been enucleated, haemostasis is achieved by defocusing the beam on bleeding vessels. Haemostasis is very important to allow morcellation to proceed safely. After haemostasis, a transurethral morcellator is used to extract the tissue.

Tunnel group: For the tunnel group, the modified procedure-a new type of HoLEP was used, with processes shown in below figure. It includes some different steps. Firstly, we observed the urethra carefully and confirmed the location of verumontanum, external urethral sphincter and the neck of the bladder, then cut a short horizontal incision in the front of verumontanum, also means cut a short horizontal incision at 6 o'clock, exposing the surgical capsule of the prostate at apex (**Figure 1A**). Secondly, from the incision, at 6 o'clock, beneath the median lobe and along the surgical capsule we dug a tunnel proximally to the bladder neck. Attention should be paid to this tunnel which is cambered. When the laser is close to the bladder neck, the head of the cystoscope sheath should be raised in order to avoid damaging the bladder neck (**Figure 1B**). After digging the tunnel though verumontanum to bladder neck, the procedure of the surgery will become easier. Thirdly, we begin to enucleate the both lateral lobes, the left lateral lobe was enucleated begin at the tunnel near verumontanum, and is circumferentially anti-clockwise rotation extended up to 12 o'clock by rotating the laserable resecto scope (**Figure 1C**). During the surgery, the sheath of the laserable resectoscope is used to bluntly push and peel the left lateral lobe off the surgical capsule. Notably, the well exposures of the surgical capsule following the pushing of the sheath of the laserable resectoscope indeed quicken the enucleation the lateral lobe. Due to the tunnel at 6 o'clock was dug, there is a nonexistent median lobe left to enucleate, then we could enucleate the right lateral lobe begin at the tunnel near verumontanum. The right lateral lobe enucleation is performed in a way similar to that of the left lateral lobe. The only difference is we enucleate it to 12 o'clock through the clockwise direction (**Figure 1D**). During the enucleation phase, if the texture of the prostate tissue were considered to be as positive for a smooth surface and/or solid texture, we enu-

Table 2. Follow-up data

	Baseline	1 Mos	6 Mos	12 Mos
I-PSS				
Group 1	19.55±2.87	9.54±2.13	8.94±2.00	7.44±2.00
Group 2	20.05±3.33	9.17±1.92	8.63±1.85	7.07±1.73
p Value	0.226	0.174	0.225	0.139
QoL				
Group 1	4.33±0.83	2.73±0.69	2.53±0.65	2.11±0.82
Group 2	4.36±0.81	2.66±0.70	2.48±0.66	1.94±0.77
p Value	0.810	0.413	0.506	0.112
Qmax (ml/s)				
Group 1	6.97±2.32	21.02±3.89	21.75±4.00	23.41±4.88
Group 2	7.22±2.03	20.39±3.98	22.72±4.29	24.23±4.75
p Value	0.392	0.229	0.083	0.205
PSA (ng/ml)				
Group 1	3.34±4.54	1.22±0.84	1.05±0.74	1.04±0.82
Group 2	3.12±4.15	1.29±0.92	1.08±0.85	1.07±0.73
p Value	0.704	0.344	0.725	0.639

Group 1 is the trivalvular group and group 2 is the tunnel group.

cleated off the lobes except the position of 12 o'clock. All lobes were enucleated off the surgical capsule while the tissue is still hanging at 12 o'clock in the fossa, then the laser was used to make some holes inside the tissue, this step is beneficial to morcellation. At last we pushed the entire prostate off the prostatic wall, pushed it into the bladder (**Figure 1E**) and the morcellator is then inserted into the bladder to morcellate the enucleated entire prostatic tissue (**Figure 1F**).

Statistical analysis

All measurement data were statistically analyzed with a 2-tailed Student's t-test and are presented as mean ± SD. The results were analyzed using descriptive statistics with the independent t-test and *P* value ≤0.05 denotes statistical significance. Odds ratios with 95% confidence intervals were used to estimate the association between independent and dependent variables. All statistical analysis was performed using a commercially available statistical package (SPSS 19.0).

Results

To compare the two procedures, some perioperative data, such as the dates of general information, operation time, volume of irrigating fluid and associated complications of all patients were collected (**Table 1**). The postoperative data, I-PSS, QoL and Qmax included, covered up to 1, 6, and 12-month (**Table 2**). All of these patients were available for evaluation at 1, 6 and 12-month, but not everyone's PSA were followed up to 6 and 12-month, at the six-month there were 154 (trivalvular group 71 VS tunnel group 83) people and at the twelfth-month there were 92 (trivalvular group 42 VS tunnel group 50) people were followed up. Compared with the baseline, the postoperative data including I-PSS, QoL, Qmax and PSA were improved a lot in both groups, however, there were no significant differences between the 2 groups. Complications were reported within 12 months, within which there were no transurethral resection syndrome detected and no patient required recatheterization and reoperation in either group. The mean hemoglobin decrease of our patients was 0.92±1.24 g/L in tunnel group vs 1.25±0.75 g/L in trivalvular group (P=0.0185). No blood transfusion was needed in tunnel group, while 2 patients in the trivalvular group, according to the changes in blood pressure and roughly estimated blood loss, required blood transfusion due to intraoperative blood loss. Both of the 2 patients were transfused with 400 ml blood. Some degree of incontinence was present in both groups (7 patients in the trivalvular group and 2 in the tunnel group), 6 patients (4 patients in the trivalvular group and 2 in the tunnel group) recovered continence within 1 month, and the others recovered continence within 6 months. Meanwhile, capsular perforation was one of the major complications of HoLEP, no prostatic capsula perforation occurred in tunnel group, with 2 cases of prostatic capsula perforation in trivalvular group. No serious complications were founded in the patients treated with our technique. For I-PSS, QOL and Qmax, no significant differences were found between the 2 groups in the 12-month follow-up data.

Discussion

For many years, TURP has been the gold standard surgical treatment for BPH, but now HoLEP with no risk of TUR syndrome and a minimal hospital stay is becoming a promising technique that can challenge the gold standard of TURP [17]. Though the efficacy and safety of HoLEP has been proven to be excellent in the treatment of benign prostatic hyperplasia, it has not been widely used due to its technical difficulties. The advantage of HoLEP depends on the ability to use the native anatomical plane between the prostate adenoma and surgical capsule, thus in the enucleation phase, it is of paramount importance to find the right layer (the surgical capsule) promptly at the beginning of the enucleation. In theory the surgical capsule always has an appearance distinct from the prostatic tissues and the incision depth, which seems easy to decide. However, in clinical practice it becomes difficult, even for an experienced operator, to discern the surgical capsule when the prostatic tissues are adherent to the surgical capsule when bleeding. If surgeons deviating laterally and incising the inferior aspect of the prostate tissue, the surgery will become especially difficult, therefore, we designed the improved procedure to make the surgery easier. Compared with the traditional enucleation procedure, we began enucleation at the apex of the prostate, cut a short horizontal incision in the front of verumontanum, it deepened to the level of the surgical capsule, which can be clearly identified as a smooth fibrous layer in about 20 to 30 seconds, in another group of participants it always cost more than 5 minutes to find the right layer. And then from the horizontal incision we used the holmium laser to dig a tunnel along the surgical capsule until 6 o'clock of the bladder neck. During this procedure, the beak of the resectoscope was used to elevate the lobe and provide counter traction while working beneath it. What is noteworthy is that the risks of capsular perforation and injury to the sphincter are also averted, especially when approaching the bladder neck. To solve this, when approaching the bladder neck, we should upwarp the head of the cystoscope sheath, and reduce the rate of the process. When encountering something like circular fibers and color changes (it's the color of water that was seen through the prostate tissue), it means the laser fiber is about to get near to the neck of the bladder, it's the right time to get through the tunnel. Following the procedure, the neck of the bladder won't be hurt. On the basis of our past experience, the learning phase of this new technic took only two months. So, 41 cases in Jan, and Feb of 2013 were not included in this retrospective study. After the learning phase, cases in same length of a continuous time were systematically compared with previous ones.

According to the date of IPSS, QOL and Qmax at 12 month follow-up, there are no significant differences between the 2 groups, but our modified technical is less likely to have complications after surgery. Compared with other studies the outcomes of our two kinds of treatments are at least equivalent to theirs [3, 18, 19].

In general, our modified method has the following advantages

According to our clinical experience and prostate images of TRUS, in most cases, the hyperplasia of median prostate lobes of BPH patients is not obvious as the lateral lobes. In other words, the median lobe of BPH patient is usually thinner than the lateral lobes, so near the apex of the prostate at 6 o'clock under the median lobe, it is more easily to find the surgical capsule and avoid direct injury of the striated urethral sphincter.

According to the anatomy knowledge of the prostate, compared with 5 and 7 o'clock, the prostate tissue at 6 o'clock has less blood vessels [20]. The operation started at 6 o'clock could avoid damaging many vessels, instead it could find the vessels and stop bleeding under direct vision. In this way it will be less bled, and it can provide a wider and better field of vision.

During surgery, after discerning the surgical capsule, all procedures of the modified technical do not contained vertical cut to the external urethral sphincter and it avoid incising the inferior aspect of the prostate tissue, so make tunnel at 6 o'clock is easier than make incisions like trench at 5 and 7 o'clock and it can reduce the damage of external urethral sphincter and/or bladder neck.

Compared with an enlarged median lobe which is particularly ideally suited to traditional tech-

nique, our modified method of HoLEP can be performed both effectively and safely with regardless of the size of prostate. During surgery when the encountered median lobe is large, we can broaden the tunnel appropriately to provide a wide view, this will not affect the speed of operation.

For the learning curve, it is remarkable for such a new surgical procedure that can actually shorten the learning curve. For us, the new surgical procedures improves overall performance, simplifies operation and strengthens our security model, it will not cost a long span of time to master the new technology. Our simplified diagram in **Figure 1** gives an overview of the operation, it shows every detail of the operation. Once someone masters those elements, they then can easily perform the operation. We have not summed up "How long does it take to learn to use", so just as with the traditional operational style reported, about 40 cases in the first stage were not included in our research field.

In addition, HoLEP composed of a two-stage procedure: enucleation and morcellation, the morcellation, which is a time-consuming step in the procedure has to be optimized in order to save time and reduce incidence of adverse events too. According to our prior research, during the enucleation phase the texture of the prostate tissue should be considered, when the assessment is positive for a smooth surface and/or solid texture, the surgeon should roughen the surface outside the prostatic lobe and make some holes inside the gland using a laser, while the lobe is still hanging at 12 o'clock in the fossa. This step will make the prostate that has enucleated easier to catch and harvest during the morcellation phase [21]. To accomplish this step, compared with the traditional method our modified one is more easily attainable, this is an empirical knowledge and more research is necessary for confirmation.

Conclusions

Compared with the conventional procedure, the modified holmium laser prostatectomy is effective and safe when treating benign prostatic hyperplasia, involving less risk of inconvinence, decreased bladder irrigation and operation time. Although the disadvantages of HoLEP have been improved through the development of our modified enucleation techniques, further well designed randomized trials with extended follow up and larger sample sizes may be needed to better define the role of this modified HoLEP in treating patients with symptomatic BPH.

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Disclosure of conflict of interest

None.

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