An Improved Morcellation Procedure for Holmium Laser Enucleation of the Prostate

Qi Chen, M.D.,* Yan-Bo Chen, M.D.,* Zhong Wang, M.D., Ph.D., Yu-Bing Peng, M.D., Ph.D.,
Da-Chao Zheng, M.D., Zhi-Kang Cai, M.D., Wen-Ji Li, M.D., Ph.D., and Juan Zhou, M.D.

Abstract

Purpose: We modified the conventional morcellation procedure for holmium laser enucleation of the prostate (HoLEP), and its outcomes are presented in this article.

Materials and Methods: As 395 patients were included, the conventional morcellation procedure was performed in the first 100 cases (group 1, cases 1–100), and an improved procedure was used in the last 100 cases (group 2, cases 296–395). The improved morcellation process has three steps to execute. The morcellation time, collected tissue weight, morcellation rate, and associated complications were recorded.

Results: The tissue-resected weight was similar between group 1 (60.7 ± 33.9 g) and group 2 (62.4 ± 36.8 g). The mean morcellation time in group 1 was greater than that in group 2 (11.3 ± 7.1 and 8.3 ± 4.1 minutes, respectively), and the mean morcellation rate was better in group 2 than in group 1 (5.75 ± 1.7 g/minutes in group 1 v 7.3 ± 1.1 g/minutes in group 2). Complications, such as bladder injury, were similar in both groups.

Conclusion: The improved morcellation procedure described in this article can be used in various situations of suction and can be performed in a more fluent manner and with better efficiency.

Introduction

HOLMIUM LASER ENUCLEATION OF THE PROSTATE (HoLEP) is currently performed by many urologists worldwide. It is a very promising technique that challenges the gold standard of transurethral resection of the prostate. Many studies have been published that emphasize the enucleation aspect of HoLEP; however, to our knowledge, the morcellation aspect of HoLEP remains poorly evaluated. However, since its appearance, it has contributed to the success of HoLEP surgery.^{1,2} Before the development of the morcellation procedure, surgeons used the mushroom method to remove glands after enucleation was performed, which was a very time-consuming process.^{3,4} The conventional morcellation procedure has been employed proficiently by some urologists. However, the learning curve for morcellation, based on fears of bladder injury and on unstable suction efficiency, has prevented the spread of this technique among urologists. To make morcellation easier to perform and to increase suction efficiency, we developed an improved morcellation procedure, and the outcomes are presented.

Patients and Methods

This study was performed in our medical center between January 2009 and January 2012. A total of 395 consecutive

patients undergoing HoLEP and morcellation procedures were enrolled. All of the procedures were performed by one surgeon (Z.W.), who is quite skilled in HoLEP and morcellation and who has performed more than 200 of these surgeries. Ethical approval and informed written consent from the patients were obtained. The baseline patient characteristics, including prostate volume, were recorded. The morcellation time, tissue weight, and complications were also noted.

HoLEP was performed using a 550- μ m end-firing laser fiber and a 100-W Versapulse holmium laser (Lumenis, Inc., Tel Aviv, Israel). The power settings were 80–100 W at 2–1.5 J/s and 50–40 Hz. Transurethral morcellation was performed with a 26F nephroscope (Storz, Tuttlingen, Germany) using a mechanical morcellator (Versacut Morcellation; Lumenis, Inc.). The irrigation fluid used was 3 L of normal saline (0.9%), and all of the irrigation bags were hung 60 cm above the operating table.

For the first 100 consecutive cases (group 1, cases 1–100), we used the normal morcellation procedure introduced by Gilling et al.² For the last 100 cases (group 2, cases 296–395), we used an improved procedure to finish the morcellation. The new procedure process is shown in Figure 1, which includes three steps. Step 1 is executed during the enucleation phase, just before the gland is put into the bladder. The

Department of Urology and Andrology, Ninth People's Hospital, School of Medicine, Shanghai Jiaotong University, Shanghai, China.

*Both authors contributed equally to this work.

FIG. 1. An improved morcellation procedure.

surgeon should have a judgment on the gland tissue texture (1. The soft tissue usually has a weak enucleation resistance and better tissue elasticity, while the firmness tissue is opposite. 2. The loose and soft tissue can be easily vaporized and incised by laser. However, the firmness tissue can be hardly vaporized and has lower incision efficiency.). If one considers that the gland has a firmness tissue and a smooth surface, which is difficult for morcellation, he should use laser to rough the surface of the gland and dig several holes in the gland. The aim of step 1 is to make the gland tissue loose and soft and the gland surface rougher, which is easy for suction. This duration lasts 30 seconds to 1 minute. Step 2 is executed during the morcellation phase. If the prostate tissue is loose and soft and the volume is moderate or small, we could use the conventional upward method for morcellation. Otherwise, when we meet with big volume glands and firmness tissue, we use the inverse technique to deal with the glands. On some occasions, medium- and small-sized glands leave residual material because of morcellation difficulty. Fibrotic, spherical glands with smooth surfaces and firm tissue can lead to difficulties in catching the pieces and suctioning them. Our methods for overcoming these challenges are listed in Figure 1- Step 3 and described below.

1. For medium-sized glands, the surgeon can catch the tissue, drag it to the prostatic fossa, and then perform suction. The stabilized fossa will greatly reduce the activity of the gland and keep the gland in contact with the blade. Although it has a very low likelihood of causing vessel hemorrhage (one occurred in this study and required the use of a laser), it is an effective approach to removing tissue residue.
2. If the above methods fail, the surgeon should use a laser to cut the firm tissue into small pieces.
3. For small-sized glands, the surgeon can remove the tissue using a clamp or the alligator forceps. Morcellation is performed using a 26F laser resectoscope (27050SL; Storz) combined with a nephroscope (27292AMA). To avoid damaging the urethra, the tissue clamp should pass through the resectoscope, which has a 24F inner diameter (8-mm diameter). Thus, in theory, the clamped tissue should not have a diameter greater than 8mm. Therefore, before performing this step, we used the size

of the cutter head (5-mm diameter) to measure the tissue size and determine whether it could pass through the 8-mm inner sheath.

In addition, we use the following method to evaluate the gland size. In the morcellation period, when the maximum diameter of the gland is more than two sights range, we consider it as a big volume gland. For a medium volume gland, its diameter should be smaller than two sights range and bigger than one sight range. For a small volume gland, its whole body could be seen clearly within one sight range.

To compare the two procedures, we assessed them with regard to morcellation time, collected tissue weight, morcellation rate, and associated complications. When the surgeon felt that the blade was becoming dull, a new reciprocating blade was used to replace it. Before morcellation, the surgeon thoroughly sealed the bleeding vessel to keep the view clear and to distend the bladder to its full capacity.

The following are contingencies for special conditions.

1. Sudden difficulties due to initiation or loss of suction without equipment failure can occur due to blockage of tissue, which can stick to the lumen of the hollow inner sheath. This situation can occur when encountering firm tissue or if the surgeon is unskilled in morcellation. To prevent this situation, just when finishing a gland, the surgeon should keep one foot on the foot pedal for two to three seconds to let the tissue pass through the sheath by inertia and suction.
2. When the bladder mucosa comes into contact with the blade, the surgeon should immediately release the pedal to stop the mechanical suction and should clamp the suction tube to block the siphon effect, while slowly rotating the cutter head to release the mucous membrane. He or she should use a laser to seal any vessel that is bleeding.

All of the measurements of the data were statistically analyzed with the Student's two-tailed *t*-test, and the data are presented as the means (SDs). The results were analyzed using descriptive statistics by a paired *t*-test. Differences were considered statistically significant at $p < 0.05$.

Results

The baseline characteristics between group 1 and group 2 were not significantly different (Age, 69.8 years *v* 70.6 years, $p = 0.13$; prostate volume, 87.4 mL *v* 89.1 mL, $p = 0.23$). A comparison of the data between the two groups is provided in Table 1. The resected tissue weight was similar between group

TABLE 1. COMPARISON BETWEEN TWO PROCEDURES OF MORCELLATION

	Normal procedure Group 1	Improved procedure Group 2	<i>p</i>
Morcellation time (minutes)	11.3 ± 7.1	8.3 ± 4.1	<0.0001
Tissue weight (g)	60.7 ± 33.9	62.4 ± 36.8	0.598
Morcellaiton rate (g/minutes)	5.75 ± 1.7	7.3 ± 1.1	<0.0001
Bladder injury	3	2	N/A

TABLE 2. MORCELLATION EFFICIENCY RATE

<i>Authors</i>	<i>Publication yr</i>	<i>Morcellation time (minutes)</i>	<i>Tissue weight (g)</i>	<i>Morcellation efficiency rate (g/minutes)</i>	<i>Complication</i>
Montorsi et al ⁹	2004	12.09 ± 10	36.08 ± 27.03	N/A	Bladder injury in 10 cases (18.2%)
Vavassori et al ¹⁰	2004	18.3 ± 12.8	36.3 ± 25.6	1.7 ± 1.5	Bladder injury in 16 cases (8.1%) Tissue residual in bladder in 3 cases
Kim et al ¹¹	2005	Indian 9.9 New Zealand 7.7	27.1 22.9	3.4 4.3	N/A N/A
SEKI et al ¹²	2007	11.6 ± 6.6	32.1 ± 21.7	N/A	Bladder injury in 7 cases (7.2%)
Elzayat et al ¹³	2007	12 ± 11	30 ± 19	N/A	Bladder injury in 1 cases (0.8%)
Vavassori et al ¹⁴	2008	17.3 ± 14.5	40 ± 27.5	2.3 ± 1.5	Bladder injury in 19 cases (5.7%)
Du et al ¹⁵	2008	17.8 ± 8.7	30 ± 14.4	N/A	Bladder injury in 3 cases in learning curve stage
Hwang et al ⁷	2010	Upward suction 14.3 ± 8.6 Inverse suction 6.1 ± 7.4	N/A N/A	1.93 ± 1.14 4.06 ± 0.95	Bladder injury in 11 cases (13%) Bladder injury in 2 cases (2.5%)
Ishikawa et al ⁸	2011	Inverse suction 9.9	46.8	6.7	Efficiency significantly worsens when tissue > 100g

1 (20–205 g) and group 2 (25–235 g) ($p=0.598$). In addition, the mean morcellation time in group 1 was greater (4–50 minutes) than in group 2 (3–29 minutes) ($p<0.0001$). Furthermore, the mean morcellation rate was better in group 2 than in group 1 (3.33–10.33 g/minutes in group 1 *v* 4–9.21 g/minutes in group 2, $p<0.0001$). The complications, such as bladder injury, were similar in both groups. One case of residual tissue occurred in group 1 and required remorcellation. One prostatic fossa hemorrhage occurred in group 2 due to an accidental blade injury.

Discussion

The usage of morcellation is not without complications. Kuo et al reported four cases of residual tissue arising from problems with morcellation.⁵ One case of residual tissue with a firm texture resulted in successful suction only after the adenoma was incised with a laser into more manageable pieces. Problems with dull blades occurred in another two cases. A fourth case required open cystotomy due to an extremely large, 376-g prostate. A similar case of open cystotomy due to hard tissue and a large prostate was reported by Krambeck et al.⁶ Conversely, medium and small glands have also caused problems. Shah et al⁷ used two methods to cope with morcellation failure (sectioning of the tissue with a serrated loop and retrieving medium- and small-sized tissue with the alligator forceps).

As we concluded the procedure, the smooth surface of the gland and the great mobility of the enucleated pieces made it difficult to catch the targeted pieces. The firmness of the tissue greatly lowered the suctioning efficiency. These three factors yielded a reduction in the morcellation rate. In group 1, we treated these types of glands by the conventional morcellation method with a low efficiency. And one case of tissue residual occurred.

Therefore, when we designed the improved procedure, the three factors mentioned above were considered. First, roughening the surface of the gland made it easier to catch it with the blade. Second, we limited the mobility of the gland to keep it in contact with the blade. Third, we loosened firm and dense tissue.

In the enucleation phase, the texture of the tissue should be considered before undertaking morcellation. When the as-

essment is positive for a smooth surface and solid texture, the surgeon should roughen the surface outside the prostatic lobe and make holes inside the gland using a laser for several seconds, while the lobe is still hanging in the fossa. This step will make it easier to catch and harvest the tissue during the morcellation phase.

The upside-down technique (the same as the inverse technique) was first proposed by Asian authors.^{8,9} Their method was to reverse the blade and suction the gland between the blade and the bladder wall. There are three advantages of this technique that facilitate the improvement of the morcellation rate, namely: it greatly reduces the mobility of the glands, the blades always remain in contact with the tissue, and it provides clear visualization of the posterior wall of the bladder. As reported by Hwang et al,⁸ this technique can reduce the risk of bladder injury and increase the morcellation rate (Table 2).

As listed in Table 2, several authors have reported morcellation times, tissue weights, and morcellation rates in their articles.^{8–16} With the continued improvement of techniques over time, surgeons will continue to improve their morcellation efficiency and prevent bladder injury more often. Our improved morcellation procedure provides a more fluent process and better efficiency, and it can address the vast majority of situations that arise during morcellation. Additionally, it is easy to learn and perform, especially for beginners.

One deficit of this study was that the two groups did not undergo surgery during the same period of time. However, as we have noted, the surgeon (Z.W.) was proficient in HoLEP and morcellation. His average morcellation time (conventional method) was 11.3 minutes, and his rate was 5.75 g/minutes. This morcellation efficiency was similar to that reported by Tan and Gilling¹⁷ (up to 10 g/minutes with an average of 3–5 g/minutes). Thus, the influence of personal skill and experience on the study results can be reduced to a minimum.

Conclusion

Morcellation is an important aspect of HoLEP. The improved morcellation procedure developed in this study can

address the various situations that might arise during HoLEP. Compared to the conventional procedure, it results in a more fluent process and better efficiency.

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Disclosure Statement

No competing financial interests exist.

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Address correspondence to:
Zhong Wang, M.D., Ph.D.
Department of Urology
Ninth People's Hospital
School of Medicine
Shanghai Jiaotong University
639 Zhi Zaoju Road
Shanghai 200011
China

E-mail: zhongwang2001@yahoo.com

Yubing Peng, M.D., Ph.D.
Department of Urology
Ninth People's Hospital
School of Medicine
Shanghai Jiaotong University
639 Zhi Zaoju Road
Shanghai 200011
China

E-mail: pybkzt@yahoo.com.cn

Abbreviation Used

HoLEP = holmium laser enucleation of the prostate