

Best surgical treatment for very large benign prostatic obstruction

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Abstract

AIM: To investigate the best surgical treatment for very large benign prostatic obstruction (BPO).

METHODS: A revision of literature was conducted in PubMed database with 167 search results. Key words for the search were benign prostatic hyperplasia, surgical treatment, large, and volume. Inclusion criteria for this study were surgical treatment of benign prostatic obstruction for prostates equal to or larger than 80 cc. Among article search results, 9 completed inclusion criterion and were revised. Each surgical technique included in those articles was compared to each other. The results were observed, and conclusions derived from this are presented. There is no statistical analysis.

RESULTS: Of the 5 techniques presented in the revised articles [open transvesical enucleation, holmium

laser enucleation of the prostate (HoLEP), photoselective vaporization of the prostate using potassium titanyl phosphate laser, transurethral resection with bipolar energy, and transurethral enucleation with bipolar energy], open transvesical enucleation best permits the resolution of obstructive symptoms. It presents excellent maximum flow rates, high resected tissue volume and maintenance of results over time. These characteristics explain why it has been the gold standard treatment for prostates greater than 80 cc. However, it is at the expense of greater blood loss, urethral catheter and hospital stay times. Since its initial application in 1996, the transurethral enucleation of the prostate by means of a holmium laser has become a procedure that has similar surgical outcomes with fewer complications when compared to open surgery making it an interesting alternative for very large BPO. Nonetheless, no procedure has removed open surgery as the gold standard for very large BPO.

CONCLUSION: Open surgery has proved to be the gold standard for very large BPO. HoLEP appears as a minimally invasive alternative with same benefits but less morbidity.

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Key words: Benign prostatic obstruction; Surgical treatment; Prostatectomy; Holmium laser enucleation of the prostate

Core tip: Though the gold standard for surgical treatment of very large benign prostatic obstruction has been open prostatectomy, in the last three decades there has been a notorious absence of publications showing the outcomes of this surgery. The only procedure with similar results and fewer complications seems to be the holmium laser enucleation of the prostate making it an interesting alternative when confronted with large sized prostates. New methods of treating

large prostates have an interesting challenge since both open surgery and holmium laser enucleation of the prostate present favorable results.

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INTRODUCTION

Open prostatectomy has been one of the oldest procedures practiced in urology to treat large benign prostatic obstruction (BPO) and it still remains valid today. Historical accounts divide open prostatectomies according to different techniques: perineal, suprapubic and retropubic approach^[1,2].

The first open prostatectomy described was through the perineal approach by Covillard. In 1639, he became the first to remove a prostatic middle lobe through perineal approach. However, it was Goodfellow that became the first to perform open perineal prostatectomy routinely. Numerous physicians perfected the technique employed afterwards but it was Young at Johns Hopkins University in 1905 who published his operative technique^[3].

Suprapubic prostatectomy techniques followed perineal approaches. In 1894, Eugene Fuller is regarded as the first man to perform a complete suprapubic removal of a prostatic adenoma. However, it was Peter Freyer in 1900 that gained most fame performing a transvesical prostatectomy. His publication of cases in the *British Medical Journal* popularized this procedure^[4].

In terms of retropubic prostatectomy, Van Stockum is regarded as the first person to complete an enucleation of prostatic adenoma using this surgical approach in 1908. It was Millin, in 1945, who popularized this approach publishing his operative technique and results^[5]. His technique has been employed then since worldwide for over 65 years with minor modifications.

The introduction of instruments such as the Stern-McCarthy resectoscope in 1926 opened a new era in urology and BPO surgery. It became one of the leading discoveries in the field of urology in the 20th century. This resectoscope was utilized worldwide as one of the first endourological approaches to BPO. It became the first minimally invasive procedure for endoscopic treatment of pathologies such as bladder neoplasms and BPO. Perhaps the most important advance made to this instrument was provided by Iglesias in 1975 who modified it to allow both irrigation and suction^[6]. With the development of new lenses this enhanced vision of the operatory field and shortened operatory times.

Numerous endoscopic techniques have been described and published since Iglesias published his results with his

modified resectoscope. The most important breakthrough since then has been the development of transurethral resection of the prostate (TURP). Initially developed with monopolar and posteriorly with bipolar energy, TURP became the treatment of choice of BPO, especially with prostate sizes between 30 and 80 cc^[7]. Utilized to this day worldwide, TURP has fulfilled a crucial role in the treatment of prostatic obstructions symptoms with small and middle sized prostates. Nonetheless, there is little evidence that discusses the role of TURP in prostates sized over 80 cc and especially over 120 cc.

Numerous articles have been published showing that novel techniques may be the new state of the art treatment for such condition. Procedures such as transurethral incision of the prostate, transurethral needle ablation of the prostate, transurethral ultrasound guided laser induced prostatectomy, Prostatron, Thermex and visual laser ablation of the prostate have been employed to treat small and middle sized prostates. With initially positive results, most of these techniques have failed in their attempt to become the new gold standard treatment for such a disease. Most have never been an option for the treatment of very large BPO. They have been employed only in the setting of small and middle sized prostates. These instruments have quickly fallen from being strongly advertised solutions to BPO to adorning the basements of hospitals around the world.

Various other techniques have been developed to defy open prostatectomy as the treatment of choice for very large BPO. The most accepted of these has been that of the holmium laser enucleation of the prostate (HoLEP). Initially described in 1996 in New Zealand by Gilling *et al*^[8], this procedure has seen to have benefits over other endoscopic procedures such as TURP for the treatment of large prostates.

MATERIALS AND METHODS

To evaluate the best surgical treatment for very large BPO we conducted a meticulous search and revision of available literature.

A systematic search was conducted at PubMed database with the following keywords: benign prostatic hyperplasia, surgical treatment, large, volume. A total of 167 articles were found (including randomized controlled trials, prospective and retrospective series). All publications were reviewed and those that fulfilled inclusion criterion were considered in our study. These criteria were the following: prostatic volume greater than 80 mL sized by transrectal ultrasound (TRUS), measurement of international prostate symptoms score symptoms, maximum urinary flow, prostatic specific antigen (PSA) values pre and post surgery and registry of surgical complications with a follow up of at least 12 mo. Studies in which authors employed resective techniques had to include measurement of enucleated or resected tissue. Those who used vaporization techniques had to include exclusively measurement of prostatic volume by TRUS before and

Table 1 Overview of the published studies

Ref.	Follow up (mo)	Patients (n)	Change in PSA		Change in symptoms (IPSS)		Change in Q max		Amount of tissue removed		Time urethral catheter (h)	Length of stay (h)
			ng/dL	%	Absolute	%	mL/seg	%	mL	%		
Transvesical												
Alvizatos <i>et al</i> ^[9] , 2008	12	60	-4.3	-68.2	-13	-62	7.1	88.7	86	89.5	120	144
Ou <i>et al</i> ^[10] , 2013	12	49	-4.4	-78.5	-19.3	-76.8	11.8	231.3	109.8	77.8	182	223
Rao <i>et al</i> ^[11] , 2013	12	40	-3.91	-86.5	-21	-85.7	19.7	333.8	75.2	68.3	148	223
HoLEP												
Elzayat <i>et al</i> ^[12] , 2006	24	225	-8.1	-90	-14.3	-79.4	20	250	86	68.2	30	29
Matlaga <i>et al</i> ^[13] , 2006	12	86	-8.86	-90.2	-14.5	-73.9	15.8	173.6	1.40	82.3	15.1	26
Kuntz <i>et al</i> ^[14] , 2008	60	42			-19.2	-86.4	20.5	539.4				
PVP with KTP												
Rajbabu <i>et al</i> ^[15] , 2007	24	54	-4.6	-41.8	-16.3	-74	11	137	59	43.7	23	11
Alvizatos <i>et al</i> ^[9] , 2008	12	65	-3.8	-61.2	-11	-55	7.4	86	38	40.8	24	48
Bipolar TURP												
Zhu <i>et al</i> ^[16] , 2009	36	132	-4.17	-57.3	-18.5	-86.4	15.7	237.8	58.1	72.9	69	117
Enucleacion bipolar												
Rao <i>et al</i> ^[11] , 2013	12	43	-4.22	-88.4	-21.4	-86.2	20.8	358.6	65.9	56.8	79.2	129
Ou <i>et al</i> ^[10] , 2013	12	45	-4.3	-72.8	-17.6	-75.8	9.6	162.7	98.7	74.7	103	139

PSA: Prostatic specific antigen; IPSS: International prostate symptoms score; HoLEP: Holmium laser enucleation of the prostate; TURP: Transurethral resection of the prostate; KTP: Potassium titanium phosphate; PVP: Photo vaporization of the prostate.

after the intervention as well.

Of the 167 articles selected for revision, only 9 fulfilled criteria for inclusion (Table 1). These investigations analyze 5 therapeutic alternatives for benign prostatic hyperplasia surgery: transvesical or transcapsular enucleation of the prostate, endoscopic resection with bipolar energy, vaporization with potassium titanium phosphate (KTP) laser, transurethral enucleation with Holmium laser and transurethral enucleation-resection with bipolar energy (mushroom technique). A detailed analysis of these articles is presented, grouped by operative technique.

RESULTS

Simple open prostatectomy (transvesical)

Developed by Freyer in 1900 and still a valid procedure today, three contemporary articles describe this technique. Alvizatos *et al*^[9], Ou *et al*^[10] and Rao *et al*^[11]. Together they compile 149 patients with a mean follow-up of 12 mo. With an average prostate volume of 115 cc, they achieve a mean enucleation of 78 cc of prostatic tissue. This corresponds to the greatest resected volume of all techniques analyzed. PSA values dropped 77% (from an average of 5.3 to 1.2 ng/dL). This technique owns the highest recatheterization rate with an average of 4.7% of patients (Rao *et al*^[11] has a 7.5% recatheterization rate). This series also has the greatest number of reinterventions with 5.3% of patients undergoing a new surgical intervention.

This technique has the longest need of urethral catheterization and hospital stay with 150 and 196 h, respectively. This procedure also has the highest transfusion rate, with an average of 9.8% of patients transfused.

Holmium laser enucleation of the prostate

Published by Gilling *et al*^[8] in 1996, this technique uses the Holmium YAG laser, allowing to transurethrally enucleate prostatic lobes in a similar fashion as when done with fin-

Table 2 Complication rates of each technique

Technique	Reoperation (%)	Urethral stenosis (%)	Transfusion (%)
Transvesical	5.3	7.9	9.8 (6.1-13.3)
HoLEP	1.33	0.66	0.84 (0-7.14)
PVP (KTP)	2.52 (0-3)	1.68 (0-2)	0
Bipolar TURP	4.5	4.5	0
Bipolar enucleation	2.5 (0-2.2)	2.4 (2.2-2.5)	7.5 (0-6.6)

HoLEP: Holmium laser enucleation of prostate; PVP: Photo-selective vaporization of prostate; KTP: Potassium titanyl phosphate; TURP: Transurethral resection of prostate.

ger enucleation in open techniques.

Three study groups employ this technique with a total of 353 patients and a 32 mo average follow-up (Elzayat *et al.*^[12], Matlaga *et al.*^[13], Kuntz *et al.*^[14]).

It is the technique that resects the second greatest amount of prostatic tissue with an average 75.2% reduction of prostate volume. It also has the greatest PSA drop with a 90.1% reduction rate (from 9.41 to 0.93 ng/dL). It provides the greatest improvement of maximum urinary flow with an average increase of 17.9 mL/seg with respect to baseline values.

Nonetheless, this technique is known to be the slowest procedure. In effect, it is the slowest of all with 121 min mean intervention time.

Only 1 patient required recatheterization and 1 required reintervention due to persistent hematuria. Transfusion rate was 0.34% (3 of 353 patients). Patients needed a total of 22.5 h of urinary catheterization, while hospital stay was 27.5 h, second shortest of techniques compared.

Photoselective vaporization of the prostate using KTP laser

This is the only non resective technique reviewed. It does not extract tissue, hence, there are no biopsy results or accurate total tissue removal volumes (% prostatic size reduction is obtained with the difference between pre and post operative transrectal echography). This does not permit adequate comparison with other techniques.

This technique is presented in 2 series (Rajbabu *et al.*^[15], Alivizatos *et al.*^[9]), with a total of 119 patients and 18 mo mean follow-up.

Reduction of prostatic volume is 42%, constituting the technique with the lowest volume drop. PSA drop and maximum urinary flow are also the lowest with an average decrease of 51.5% (from 8.6 to 4.4 ng/dL) and 9.2 mL/s improvement, respectively.

It has no transfusion rate and has a short catheter and hospital stay time (23.5 h and 29.5 h, respectively).

Bipolar energy

Two techniques utilize this method and were included for revision.

Transurethral resection with bipolar energy

Basically, it is similar to classical TURP but with the use of bipolar energy. This allows irrigation with a saline solution, consequently permitting to extend operatory times with less risk of post TURP syndrome.

There is one article that uses this procedure (Zhu *et al.*^[16]), with a total 132 patients and a 36 mo follow-up.

This series presents a reduction of prostatic volume of 72.9%, behind transvesical adenectomy and HoLEP. Drop of PSA was 57.3% (7.27 to 3.1 ng/dL), while improvement of flow was 15.7 mL over baseline.

This study group published a 4.5% reoperation rate (second after open surgery). Average usage of urinary catheter and hospital stay was that of 69 and 117 h, respectively.

Transurethral enucleation with bipolar energy (mushroom technique)

Two articles employed this procedure (Rao *et al.*^[11], Ou *et al.*^[10]). Both compared this intervention with transvesical open surgery (results previously mentioned).

These studies comprise a total of 88 patients and have a follow up of 12 mo. Preoperative mean volume was 124 cc with a reduction of tissue of 65.7%. This places it in fourth place, only overcoming vaporization with KTP laser. However, it has the second greatest PSA fall, behind HoLEP, with a reduction of 80.6% (5.33 to 1.07 ng/dL). Requirements of catheterization and total hospital stay were just behind open transvesical surgery, with average times of 91.1 and 134 h.

DISCUSSION

Within the spectrum of techniques employed to treat prostatic obstructive hyperplasia, TURP is considered the gold standard for small and medium sized prostates (80 mL or smaller). When confronted with larger sized prostates, studies do not compare TURP to other techniques. Also, no significant sized series have been published to show results in this large volume subgroup.

Of the 5 techniques presented, there are no doubts that open transvesical enucleation permits the resolution of obstructive symptoms. It presents excellent maximum flow rates, high resected tissue volume and maintenance of results over time. In fact, it is the treatment of choice for very large BPO according to american urological association (AUA) and European guidelines. These characteristics explain why it has been the gold standard treatment for prostates greater than 80 cc^[12] but at the expense of greater recatheterization, blood loss, urethral catheter and hospital stay times (Table 2). Favoring open surgery is the fact that this procedure can be completed in basically equipped surgical wards and should be mastered by all urologists worldwide.

In the last few years HoLEP has had an important role in the discussion of the best treatment of large benign prostates. This technique has similar results when compared to open prostatectomy both in resected vol-

ume and long term studied parameters. In particular, Kuntz *et al*¹⁴ has a 5 years follow up in which the score symptoms of the AUA and maximum flow rate have maintained inalterable over time in both the open adenectomy and HoLEP groups. This has not been reported for other techniques, converting HoLEP in the sole option that equals benefits to open surgery but with lesser transfusion and shorter catheter and hospital stay rates.

Some benefits reported for KTP laser fulguration are similar to those obtained with HoLEP. These include lower catheter requirements, hospital stay and transfusion rates. However, HoLEP reports better flow rate and symptom results in the long term.

Most urologists state that the HoLEP learning curve is slow and is estimated at a mean of 30 cases. It also requires highly sophisticated equipment and trained personnel to implement this procedure efficaciously.

Other interesting results are those achieved by the fall of PSA by enucleation with the bipolar loop (mushroom), situating itself immediately behind HoLEP, even better than open surgery. This may be due to both the enucleation of tissue as well as the fulguration of the prostatic capsule, which reduces the number of glandular cells of the prostate. It would be interesting to have a close follow up and comparison of these techniques on prostatic cancer incidence in the very long term.

In light of this review, it seems valid to state that the ideal technique for treating prostates larger than 80 cc is enucleation. While this is performed transvesically or minimally invasively, it is this condition that differences results from resective or fulgurative techniques.

In attempts to maintain this condition of enucleation, alternative techniques have appeared that combine the benefit of being less invasive and the advantages of open surgery. Small series of laparoscopic enucleation, utilizing the Millin technique or through a unique transvesical trocar were first described by Mariano *et al*¹⁷ in 2002. Recent publications such as García-Seguí *et al*¹⁸ in 2012 compared 17 laparoscopic extraperitoneal to 18 open Millin technique patients. The laparoscopic group had a lower hemorrhage rate and lower irrigation, catheterization and hospital stay time. There are no reports in the medium or long term. The largest series employing this technique is McCullough *et al*¹⁹, who publishes in 2009 a series of 280 cases, 96 of them laparoscopically approached, with results discretely superior to open surgery. There are no prospective randomized trials with adequate follow up that permit to conclude the potential benefits of these techniques. Hence, we do not recommend it over those analyzed in this revision.

It would be of great use to incorporate user satisfaction and hospital cost surveys to treated patients to permit a more valid conclusion on whether to incline the balance toward open surgery or HoLEP.

Open prostatectomy has been the gold standard of treatment of very large BPO for the last 65 years. It is a procedure that is practiced routinely worldwide and solves obstructive symptoms efficaciously. In the past

years, new technologies have been developed to treat very large BPO. This review shows that of these procedures, HoLEP is the only one that has come to compete with open surgery side by side. However, it is still an incognito if HoLEP will resist the trial of time and become the standard of care surgery for this illness in 65 more years.

COMMENTS

Background

Management of very large benign prostatic obstruction (BPO) (80 cc or greater) remains a challenge in urological practice. For the past 65 years, open prostatectomy has been the gold standard procedure for these cases. Nowadays, in the minimally invasive era, the search for an alternative with less morbidity, shorter hospitalization stay and recovery time force the authors to evaluate and become familiar with other techniques recently developed but that remain unknown or are unavailable for the majority of urologists worldwide.

Research frontiers

Of the minimally invasive alternatives available to manage very large BPO, there is little evidence published to sustain Holmium laser enucleation of the prostate (HoLEP) as the best surgical approach. More research is needed to compare HoLEP with other minimally invasive procedures and open surgery to sustain it is a new gold standard for this morbid condition.

Innovations and breakthroughs

Open surgery remains the sole alternative for very large BPO when associated with certain comorbid conditions. Such is the case when very large BPO coexists with significant bladder stone burden and/or large bladder diverticula. No other procedure simultaneously resolves these comorbid conditions as effectively as open surgery. It is also important to note that HoLEP was described over 18 years ago. Since its introduction it has proved great effectiveness, but with limited diffusion. Most articles portraying the benefits of this technique have only been published in the last few years. A possible explanation of this phenomenon is the country of origin where it was initially described. If HoLEP had been developed in Europe or in the United States of America, would it have taken over 15 years to become a worldwide recognized technique for BPO treatment?

Applications

According to the authors' research, they consider it necessary to be familiar with minimally invasive approaches to treat BPO. Of these techniques, perhaps urologists should be specifically acquainted with HoLEP, as it has proven to be a minimally invasive and less morbid alternative for these patients.

Terminology

HoLEP: Holmium laser enucleation of the prostate. It is an endoscopic approach that allows enucleating hyperplastic tissue in a similar manner as open surgery but using a resectoscope tip as a fingertip. Laser energy fulgurates the perforating vessels in the enucleation plane. At the end of the procedure, prostate lobes resected placed in the bladder lumen are morcelated and aspirated by an endoscopic morcellator introduced through the resectoscope; PVP: Photoselective vaporization of the prostate. It consists in the ablation of prostatic tissue of the transition zone as potassium titanyl phosphate laser energy is applied using a side fire fiber.

Peer review

The paper is a thoroughly insight in the surgical treatment of large (> 80 mL) and very large (> 120 mL) prostates.

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