Holmium laser enucleation versus laparoscopic simple prostatectomy for large adenomas

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Received 17 March 2015; accepted 20 May 2015
Available online 20 December 2015

KEYWORDS
HoLEP; Laparoscopic simple prostatectomy; Benign prostatic hyperplasia; Large adenomas; Minimally invasive techniques

Abstract
Objective: The aim of this study is to compare Holmium laser enucleation of the prostate with another minimally invasive technique, the laparoscopic simple prostatectomy.

Materials and methods: We compared outcomes of a series of 40 patients who underwent laparoscopic simple prostatectomy (n=20) with laser enucleation of the prostate (n=20) for large adenomas (>100 g) at our institution. Study variables included operative time and catheterization time, hospital stay, pre- and post-operative International Prostate Symptom Score and maximum urinary flow rate, complications and economic evaluation. Statistical analyses were performed using the Student’s t test and Fisher test.

Results: There were no significant differences in patient age, preoperative prostatic size, operating time or specimen weight between the 2 groups. Duration of catheterization (p=.0008) and hospital stay (p=.0001) were significantly less in the laser group. Both groups showed a statistically significant improvement in functional variables at 3 months post operatively. The cost utility analysis for Holmium per case was 2589 euros versus 4706 per laparoscopic case. In the laser arm, 4 patients (20%) experienced complications according to the modified Clavien classification system versus 5 (25%) in the laparoscopic group (p>.99).

Conclusion: Holmium enucleation of the prostate has similar short term functional results and complication rates compared to laparoscopic simple prostatectomy performed in large glands with the advantage of less catheterization time, lower economic costs and a reduced hospital stay.

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* Please cite this article as: Juaneda R, Thanigasalam R, Rizk J, Perrot E, Theveniaud PE, Baumert H. Análisis comparativo entre la enucleación prostática con láser de holmio y la adenomectomía laparoscópica en el tratamiento de adenomas prostáticos mayores de 100 g. Actas Urol Esp. 2016;40:43–48.

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**PALABRAS CLAVE**
HoLEP; Adenomectomía laparoscópica; Hiperplasia prostática benigna; Grandes adenomas; Técnicas minimamente invasivas

**Análisis comparativo entre la enucleación prostática con láser de holmio y la adenomectomía laparoscópica en el tratamiento de adenomas prostáticos mayores de 100 g**

**Resumen**
Objetivo: Realizar una comparación entre la enucleación prostática con láser de holmio y la adenomectomía por vía laparoscópica.

**Materiales y métodos**: Se compararon los resultados entre 2 grupos de 20 pacientes cada uno (n = 40), los cuales fueron operados por adenomas prostáticos mayores de 100 g en nuestra institución. Al primer grupo se le realizó adenomectomía laparoscópica, mientras que al segundo se le realizó enucleación prostática con láser de holmio. Las variables estudiadas fueron la duración de la cirugía, el tiempo de cateterismo vesical en el postoperatorio y el tiempo de estancia hospitalaria, la puntuación de síntomas prostáticos y el flujo máximo preoperatorio y postoperatorio, así como también las complicaciones y el costo económico. Para el análisis estadístico se utilizó el test t de Student y el test de Fisher.

**Resultados**: No hubo diferencias significativas entre ambos grupos en cuanto a la edad de los pacientes, el tamaño prostático, el tiempo quirúrgico y el peso de la pieza operatoria. La duración del cateterismo vesical postoperatorio (p = 0,0008) y el tiempo de estancia hospitalaria (p < 0,001) fueron menores en el grupo del láser. Ambos grupos mostraron una mejoría significativa en las variables funcionales a los 3 meses posteriores a la cirugía. En cuanto al análisis del costo económico, el costo del grupo holmio supuso 2,589 euros, versus 4,706 del grupo laparoscópico. Cuatro pacientes sufrieron complicaciones (20%) en el grupo del láser, mientras que se registraron complicaciones en 5 pacientes (25%) del grupo laparoscópico (p > 0,99).

**Conclusión**: La enucleación prostática con láser de holmio posee similares resultados funcionales a corto plazo y complicaciones que la adenomectomía laparoscópica para el tratamiento de grandes adenomas, con la ventaja de ofrecer menos tiempo de cateterismo vesical y de estancia hospitalaria, así como también menores costos económicos. © 2015 AEU. Publicado por Elsevier España, S.L.U. Todos los derechos reservados.

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**Introduction**

Open prostatectomy (OP) has been the traditional treatment of choice for bladder outlet obstruction (BOO) due to benign prostatic hyperplasia (BPH) in glands over 100 g, offering favorable long-term outcomes (EAU Guidelines – Level of evidence 1b).¹

Laparoscopic simple prostatectomy (LSP) has been shown to have similar functional results when compared with OP in addition to decreasing total blood loss, irrigation time, duration of catheterization and hospital stay,² since it was first performed in 2002 by Mariano et al.³

Holmium laser enucleation of the prostate (HoLEP) has similar improvements in urinary flow rate (Qmax) and International Prostate Symptom Score (PSS) with a low complication profile in a number of series with long follow-up when compared with OP.⁴⁵ A meta-analysis of randomized controlled trials showed that when HoLEP was compared with OP, it was associated with significantly less blood loss, a shorter catheterization time, and a shorter hospital stay.⁴

A multi-institutional meta-analysis published in 2010 concluded that HoLEP was the only endoscopic procedure with proven superior efficacy when compared with transurethral resection of the prostate (TURP).⁶ HoLEP has become widely accepted as an endourological alternative to OP in the surgical treatment of large glands.

The aim of this study is to compare HoLEP with another minimally invasive technique, the laparoscopic simple prostatectomy.

**Patients and methods**

**Patients**

With the arrival of the Holmium Laser technology the technique for treatment of large adenomas changed in our institution (Paris Saint Joseph Hospital Trust, Paris, France) from LSP to HoLEP. We analyzed the two techniques according to pair-matched variables. We compared 20 LSPs and 20 HoLEP procedures for large adenomas (>100 g) following the achievement of the learning curve for each technique, in order to minimize bias associated with the learning curve of each procedure. Prospectively collected data from forty patients requiring surgery for large prostatic hypertrophy were analyzed. All operations were performed by the same experienced surgeon (HB) between January 2011 and December 2012, after he had achieved the learning for each respective procedure.

**Operative techniques**

**Trans-vesicoprostatic laparoscopic simple prostatectomy**

An extraperitoneal approach was used, with five ports placed in the abdomen. The camera port (10 mm) was placed
below the umbilicus and four 5 mm ports were placed bilaterally. The fat over the anterior portion of the prostate was removed. No technique of vascular control (such as ligation of the lateral prostatic pedicles or dorsal vein complex) was performed. A longitudinal opening was made in the anterior aspect of the bladder and extended to the anterior aspect of the prostatic capsule using a harmonic scalpel, according to the technique that we have previously published. We use this technique as it permits better visualization of the prostatic fossa allowing for optimal haemostasis to be performed. Stay sutures were placed between the edges of the open bladder to Cooper’s ligament on each side. The bladder neck mucosa was incised circumferentially to expose the base of the prostate and the plane between the adenoma and prostatic capsule was developed. The adenoma was enucleated using a harmonic scalpel. Capsular haemostasis was performed using bipolar cautery. The prostatic capsule was closed using a running 2:0 Vicryl suture. Once this was closed, a 3-way bladder irrigation catheter was placed. The bladder wall was closed with a running 2:0 Vicryl suture. The bladder was filled with saline to check the integrity of the closure. The lobes were placed in an endo catch bag for morcellation and removed. A suction drain was left for 24–48 h.

Holmium laser enucleation of the prostate
To perform enucleation of the prostate a pulsatile Holmium laser 2140 nm wave was used (Versapulse – Lumenis®, 2.6 J, 30 Hz, 80–100 W). A 26 Fr laser specific resectoscope adapted for a reusable laser fiber was used with normal saline irrigation. Following cystoscopic examination and identification of ureteric orifices, the enucleation was commenced as described by Gilling et al. Initially, three lines were scored at the 5, 7 and 12 o’clock positions with the laser. To remove the median lobe, a plane was created between the 5 and 7 o’clock positions from the bladder neck to the verumontanum. This plane was then developed posteriorly to the prostatic capsule and the middle lobe was subsequently removed and placed in the bladder. After this, each lobe was removed using the same technique. A plane was developed between the adenoma and the prostatic capsule retrogradely from the verumontanum to the bladder neck. This enucleation plane was developed until the adenoma was detached and placed into the bladder. Haemostasis was achieved using the Holmium laser energy source. Following enucleation of the lobes, the prostatic tissue was morcellated and removed transurethrally using a 5 mm morce-scope (Wolf®). A three-way 22 Fr urethral catheter was placed.

Economic considerations
We calculated the costs per case involved in performing the LSP and the HoLEP techniques. We analyzed the operating room (OR) costs based on cost utility analysis and the hospital stay costs.

For the HoLEP procedure, we analyzed the individual cost per use of the re-usable laser fiber, irrigation tube, serum for irrigation, morcellator kit (filter and tube), catheter, disposable drapes, and sterilization costs.

For the LSP procedure, we analyzed the individual cost of the laparoscopic ports, harmonic scalpel, sucker, sutures, catheter, CO₂ gas, insufflation tubing, drapes, and equipment sterilization.

Statistical analyses
Patients in the two groups were pair-matched according to clinical characteristics (age, ASA group) and prostate volume from the transrectal ultrasound (TRUS). Preoperative and 3-month postoperative International Prostate Symptom Score (IPSS) and urinary flow rate (Qmax), results were evaluated using the Student’s t-test. Prostate volume on TRUS, operative time, catheterization period, postoperative bladder irrigation requirement, transfusion rate, and hospitalization time were determined. Complications were classified according to the Modified Clavien Classification of Surgical Complications System and were evaluated using the Fisher’s exact test. The study was previously approved by the institution’s ethic committee.

Results

Baseline

There were no significant differences in the patient’s age and estimated preoperative prostatic size on TRUS between the 2 groups (Table 1).

Peri-operative

Duration of catheterization and hospital stay were significantly lower in the HoLEP group (Table 1).

Three patients in the LSP group and two patients in the HoLEP group had bladder calculi extracted intraoperatively. Histopathological examination revealed benign prostatic hyperplasia in all the patients with equivalent specimen weight (Table 1).

Outcomes

In the HoLEP group, mean IPSS decreased from 21 to 4.8 at three months after surgery (p < 0.0001) and mean urinary

| Table 1 Baseline and perioperative parameters. |
|-----------------|-----------------|-----------------|
| LSP             | HoLEP           | p Value         |
| Age             | 68.1            | 69.25           | 0.6630 |
| TRUS size (ml)  | 127.65          | 126.5           | 0.9181 |
| Specimen weight (g) | 85.75          | 71.05           | 0.1461 |
| Operative time (min) | 109             | 125             | 0.1694 |
| Catheterization time (h) | 87.6           | 44.8            | 0.0008 |
| Hospital stay (days) | 4.9             | 1.7             | <0.0001 |

LSP: laparoscopic simple prostatectomy; TRUS: trans-rectal ultrasound.
flow rate (Qmax) also improved from 6.45 ml/s to 24.75 ml/s (p = 0.0007). In the laparoscopic group, IPSS improved (23.5–7.65) (p < 0.0001) and Qmax increased (8.95–24.81) (p < 0.0001).

When analysing 3-month postoperative IPSS, HoLEP (4.83) showed a statistically significant difference when compared with LSP (7.65) (p = 0.0103). There was no significant difference in postoperative Qmax (p = 0.9872).

### Economic considerations

The economic costs of the equipment for performing HoLEP was 289 euros per case. This included an itemization of costs for the HoLEP generator, morcellator, and laser resectoscope. The cost for the HoLEP laser generator was calculated at 100 euros/case, based on the cost of the laser at 180,000 euros paid over 7 years (25,700 euros per year) and performing 250 HoLEP cases per year. The operating room time costs for an average HoLEP case was 1304 euros, and the average hospital stay was 996 euros. Thus, the total average cost per HoLEP case (including equipment, OR time costs, and hospital stay) was 2589 euros.

The cost of the disposable equipment used for LSP was 698 Euro’s per case. The operating room costs for an average LSP case was 1137 euros, and the average hospital stay was 2871 euros. Thus, the total average cost per LSP case (including equipment, OR time costs, and hospital stay) was 4706 euros.

### Complications

In the HoLEP arm, 4 patients (20%) experienced complications according to the modified Clavien classification system. Three of them were Clavien grade I: one patient had a fever on postoperative day 1, one patient had acute urinary retention after catheter removal, and the third patient had urinary retention secondary to blood clots. Finally, one patient had to have a bladder washout performed on the same day due to gross hematuria (grade IIb).

In the laparoscopic group, 5 patients suffered complications (25%). Four of them were grade I: one patient had a fever, one patient had hematuria, and two patients had urinary retention secondary to blood clots, and one patient had a grade II complication: urinary tract infection with signs of bacteriemia. There were no significant differences between the two groups (p: >0.99)

### Discussion

In Europe, open prostatectomy has been the most prevalent surgical technique performed for large prostate glands (>80 g). It accounts for 14–32% of all invasive procedures for BPH. However, there have been a number of drawbacks with this technique in terms of catheterization time, length of hospital stay, and the need for blood transfusion. This has resulted in an increasing demand for minimally invasive surgical techniques (MIST) for the treatment of large BPH. A number of MIST are commonly performed in Europe, with the most prevalent being bipolar TURP (bTURP), laser enucleation of the prostate (LEP), and LSP.

A number of articles exist comparing the various MIST; however, to date there are no comparative studies assessing LSP and HoLEP. In this study, we compared LSP and HoLEP and assessed their outcomes, efficacy, and safety.

In centers that have a large laparoscopic experience, LSP is an accepted alternative MIST for the treatment of large BPH (Table 2). LSP can also be considered in certain patients in whom transurethral procedures are contraindicated (i.e. urethral strictures, previous urethroplasty, and orthopedic pathologies of the hip) or patients with BPH associated with a large bladder diverticulum or a large bladder stone. Comparative studies have demonstrated that the outcomes from LSP have a lower blood loss, shorter irrigation/catheterization time and hospital stay when compared to OP. The functional results were similar in terms of IPSS and Qmax.

Bipolar TURP is an attractive alternative for the treatment of BPH with equivocal functional results and a low complication profile (particularly with respect to blood loss and TURP syndrome). Limited studies exist evaluating the use of bTURP for large BPH; however, there have been some encouraging results.

Laser enucleation has gained increasing acceptance as a MIST alternative to OP for the treatment of large BPH. The three main energy sources used for laser enucleation are Holmium, Thulium, and KtP. Of these, HoLEP has been validated by the largest number of international series with excellent functional outcomes, efficacy, and safety profile. It is recommended as the main alternative to OP in the current EAU guidelines (Level 1b
recommendation). The learning curve for the HoLEP procedure has been previously described as being over 50 cases. Our series demonstrated that both techniques (LSP & HoLEP) were highly efficient in treating obstructive symptoms in the two comparable cohorts. However, when the two techniques were analyzed, we noted that the duration of catheterization, hospital stay, and 3-month postoperative IPSS were in favor of the HoLEP group. Interestingly, the Qmax was not significantly different between the two cohorts, indicating that the difference noted in IPSS was possibly due to irritative symptoms associated with the LSP technique. There were no significant differences in the rate and type of complications according to the Clavien system between the two cohorts.

Our cost-utility analysis of each technique revealed a 2,117 euro difference between the HoLEP (2589 euros) and LSP (4706 euros) procedures per case (including equipment, OR time, costs, and hospital stay). A few studies have analyzed the difference in cost-utility between HoLEP and TURP, but our study is the first to analyze the difference between HoLEP and LSP.

The advantages of the HoLEP technique in our cohort included a short hospital stay, short catheterization time, and excellent functional results. The main potential limitations of the HoLEP technique were morcellator failure, potential bladder injury associated with the morcellator, and incomplete morcellation. However, we did not encounter any direct complications related to the morcellator.

The limitations of our study included the relatively small number in each cohort and non-randomization; however, the study was unique in that we prospectively evaluated two minimally invasive approaches for large BPH (>100 g) in comparable populations which were performed by the same surgeon.

The findings of our study demonstrated clear benefits with the HoLEP technique, which led to us changing from LSP to HoLEP for the treatment of large BPH (in the absence of significant secondary pathology).

Conclusion

HoLEP has similar short-term functional results and complication rates when compared with LSP in large glands, with the advantage of providing a shorter catheterization time, reduced hospital stay, and economic savings.

Conflict of interest

The authors declare that they have no conflict of interest.

References

