

Dr Raji Kooner
Dr Rowan Stephenson

Advances in Minimally Invasive Prostate Surgery

INTRODUCTION

There have been a number of recent advances in minimally invasive prostate surgery. New technologies and new alternative treatments for prostatic diseases and conditions have resulted in fewer side effects, reduced morbidity and improved patient outcomes. Advancements in the treatment of benign prostatic hyperplasia (Urolift and Holmium Laser Enucleation of the Prostate) and prostate cancer (Robot Assisted Radical Prostatectomy) will be discussed in this article.



Dr Raji Kooner



Dr Rowan Stephenson

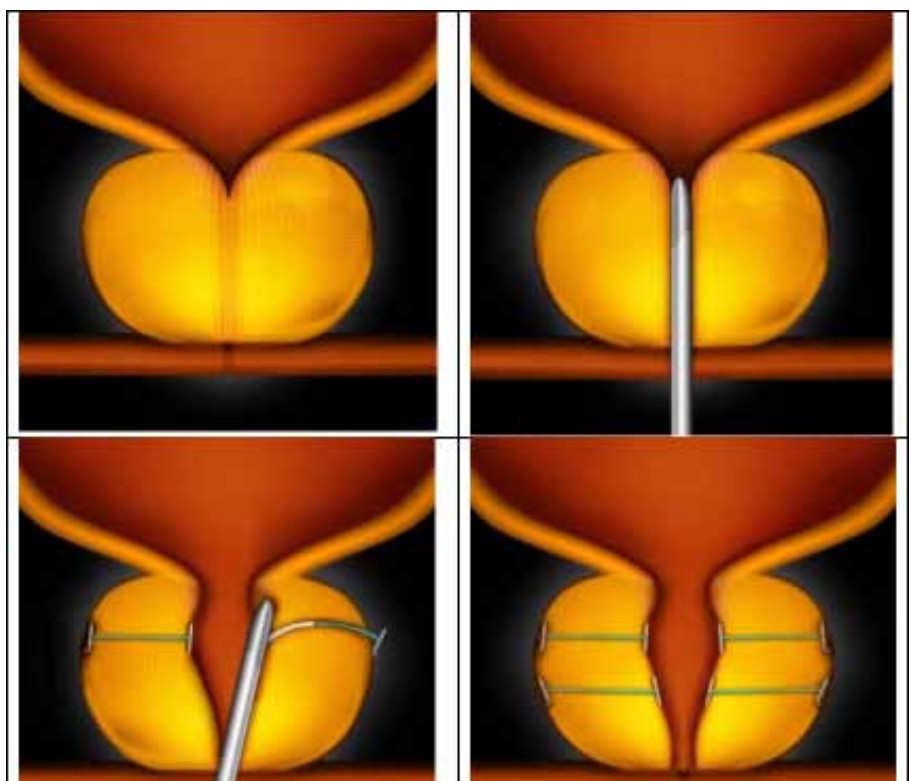


Figure 1 The Urolift System in operation. Tensioned monofilaments with stainless steel and titanium end plates are deployed and retract the prostatic urethra laterally. (Neotract Inc, Pleasonton CA)

Dr Raji Kooner MB, BS(Hons)(Syd.),
FRACS,
Robotic and Laser Prostate Specialist
St Vincent's Clinic

Dr Rowan Stephenson BSc, MBBS,
Conjoint Clinical Lecturer UNSW

ADVANCES IN THE TREATMENT OF BENIGN PROSTATIC HYPERPLASIA (BPH)

BPH is a common condition amongst middle aged men and the resultant lower urinary tract symptoms (LUTS) can significantly impact on quality of life.¹ Left untreated, LUTS can result in significant morbidity, including acute and chronic urinary retention, renal impairment and recurrent infection.

Current treatments for BPH can be divided into two categories: medical therapy and surgical intervention of varying degrees of invasiveness and complexity.² Medical therapies fall into three categories: alpha blockers (e.g. Flomaxtra), 5 alpha reductase inhibitors (e.g. Dutasteride and Finasteride) or combinations of both (DuoDart). These provide a modest improvement in LUTS but suffer from poor compliance over time and troublesome side effects.¹⁻³ Surgical options for management of BPH include transurethral resection of the prostate (TURP), laser enucleation or laser ablation of prostatic tissue. These techniques result in significant and durable improvement of LUTS but come

with a cost of increased levels of morbidity and sexual dysfunction.^{1,3}

1) Urolift

The Urolift system (Neottract Inc, Pleasonton, CA, USA) represents a novel, minimally invasive option for the treatment of BPH.² During the prostatic urethral lift procedure, Urolift implants are endoscopically implanted in the lateral lobes of the prostate under vision.³ Urolift implants are anchored in the prostatic fibromuscular capsule, retracting the more compliant and occlusive portion of the lateral lobes, subsequently reducing obstruction of the prostatic urethra³ (**Figure 1**). This results in reduced outlet obstruction and improved urinary symptoms (**Figure 2**). The number of implants inserted are tailored to the size of the prostate. The urethral end pieces of the Urolift implant embed in the prostatic adenoma, promoting epithelialisation and reducing the risk of encrustation or calcification.²

The Urolift procedure can be performed as a day or overnight procedure under general, local or spinal anaesthetic.² The procedure produces a rapid and sustained improvement in LUTS, which is intermediate in magnitude between

medical and more invasive surgical options and is associated with significantly less morbidity and preservation of sexual function.¹⁻³ In our experience, patients have some urinary frequency and urgency for 1 to 2 weeks following surgery. To date there have been no reported incidences of retrograde ejaculation or erectile dysfunction. This stands in contrast to transurethral resection of the prostate which has a reported retrograde ejaculation rate of 65-70 per cent.⁴ Importantly, prior Urolift implantation is not a contraindication for further surgical treatment if required.²

Traditional relative contraindications for the Urolift system include the presence of a prominent middle lobe, bladder neck obstruction, Prostatic Specific Antigen (PSA) >10ng/mL, or history of atonic bladder.² In our experience, however, patients with prominent middle lobes can be successfully treated with either partial resection of the middle lobe and concurrent Urolift implantation or direct lateral implantation of the middle lobe.

A total of 35 Urolift procedures have been completed from June 2014 to November 2015. Data from the initial 22 cases are presented below. The average age was 63 years (range 48-81). The average number of Urolift implants used was 4 (range 1-8). The average length of stay in hospital was 1.6 days (range 1-4 days, including patients who underwent resection of middle lobe).

The average International Prostate Symptoms Score (IPSS) decreased from 13.9 (range 6-25, including patients on pre-operative medical therapy) to 8 (range 2-20). There was a significant improvement in the mean maximum flow rate from 10.2ml/s to 15.4ml/s. The mean residual volume decreased from 68.3ml to 32.5ml (**Table 1 and 2**).

The procedure was well tolerated with few significant complications which were usually short lived. The most common post-operative complications included urinary urgency (n=13), urinary frequency (n=12), dysuria (n=7), haematuria (n=2), temporary post-operative urinary retention (n=3), post-operative vomiting (n=1), and a reaction to antibiotics (n=1). The median time for urinary urgency and frequency symptoms to resolve was 14 days (range 2-28). There were no reported cases of retrograde ejaculation or erectile

Mean Peak Flow (Q _{max})	Avg Mean Flow	Mean Flow Time	Mean Voided Volume	Mean Residual Volume
10.2ml/s (6-16ml/s)	6.0ml/s (3.5-10ml/s)	45.9s (13-105.8s)	288.4ml (86-556ml)	68.3ml (10-230ml)

Table 1: Pre-procedure Flow Studies:

Mean Peak Flow (Q _{max})	Mean Mean Flow	Mean Flow Time	Mean Voided Volume	Mean Residual Volume
15.4ml/s (5-28ml/s)	8.6ml/s (16-3ml/s)	30.6s (11-58s)	282.7ml (62-686ml)	32.5ml (12-65ml)

Table 2: Post-procedure Flow Studies:

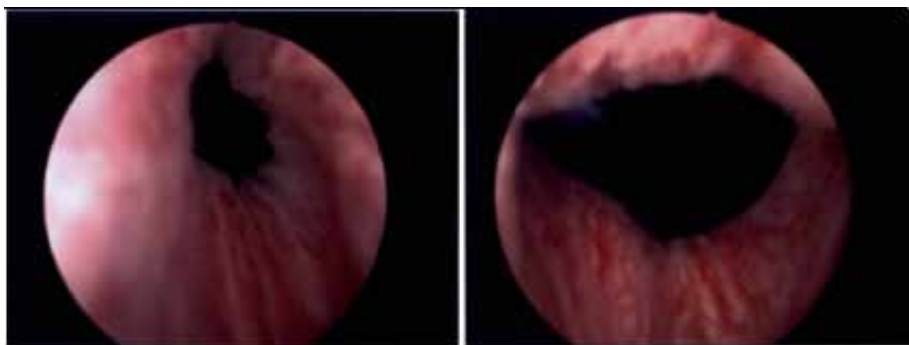


Figure 2 (Left) Narrow bladder opening from an enlarged prostate; (Right) Enlargement of the bladder opening following deployment of Urolift implants

dysfunction. 95% of patients reported high levels of satisfaction with this procedure.

In conclusion, the Urolift is a very promising procedure with multi-year published data on efficacy.² Our experience has shown that the Urolift procedure provides significant relief of symptoms with minimal side effects. It is routinely offered to suitable patients in our clinical practice and is of particular benefit to patients who are concerned with potential sexual side effects of surgery.

2) Holmium Laser Enucleation of the Prostate (HoLEP)

TURP has long been the gold standard for the treatment of bladder outlet obstruction secondary to BPH.⁵ However, 15-20% of patients undergoing TURP will have a significant complication, including bleeding, transfusion, TUR syndrome (absorption of irrigation fluid containing glycine), bladder neck stricture, and sexual dysfunction. Additionally 10-15% of patients will require reoperation within 10 years.⁶

HoLEP is the most rigorously analysed technique in the literature and has been shown in multiple randomised trials to be equivalent or superior to standard TURP with respect to efficacy and symptom relief.⁷⁻¹⁴ HoLEP is endorsed with level 1 evidence by the American Urological Association (AUA) and the European Urological Association (EUA) guidelines and is emerging as the new gold standard



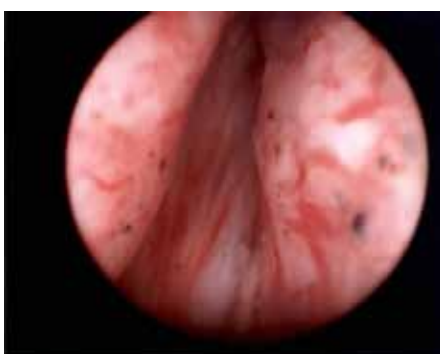
Figure 4 The Pulse 120H Holmium Laser (Lumenis Ltd. Yokneam, Israel)

for the treatment of BPH.¹⁵ Long term follow up data suggests HoLEP results to be at least as durable as TURP, with the appearance of a lower re-operation rate.^{11,13} In addition to its efficacy, HoLEP has also been shown to offer a number of clinical benefits over TURP with shorter hospital stays, reduced catheterisation time and reduced blood loss.^{5,10} Additionally, HoLEP has been found to remove more total tissue and to be more efficient with respect to prostate tissue removed per minute of energy source.^{12,14}

Holmium Yttrium Aluminium Garnet (Ho:YAG) solid state lasers produce pulsed energy at a wavelength of 2140nm with a pulse duration of 350ms. This energy is promptly absorbed by water containing tissues, resulting in effective vaporisation with limited penetration depth of thermal damage (0.4mm). The Ho:YAG laser allows for precise incision, dissection and enucleation of prostatic tissue, with excellent haemostatic properties.¹¹ Ho:YAG lasers were first used in the treatment of BPH in 1995.¹⁶ Since their initial use, the procedure has evolved from ablation into the present enucleation technique.

HoLEP involves an anatomical endoscopic enucleation of the obstructive adenomatous tissue of the prostate. It is

a)



c)



the endoscopic equivalent of an open prostatectomy. Energy from the holmium laser fibre is used to separate the adenoma from the capsule in a relatively bloodless fashion and the saline irrigation fluid used eliminates the usual risk of TUR syndrome (hyponatraemia from absorption of glycine). A large open prostatic cavity is obtained at the end of the procedure, resulting in marked improvement in obstructive prostatic symptoms (**Figure 3**). The significantly reduced bleeding and absorption facilitates endoscopic treatment of larger prostates, which would normally require either two consecutive TURs or an open prostatectomy (a procedure with significant potential morbidity). Additionally, a smaller indwelling catheter is typically required for a shorter time period post HoLEP compared to TURP.

To date, there have been over 1500 HoLEP procedures performed with a zero transfusion rate (Single Surgeon – RK). Recently, we performed the first HoLEP in Australia using the new pulse 120H Holmium laser. The pulse 120H laser offers a number of advantages compared to the previous 100W system. It allows for accelerated enucleation times with greater power and includes a new dual foot pedal control that allows for improved vaporisation and coagulation

b)



d)



Figure 3. a) Prostatic urethra before HoLEP b) Prostatic urethra during HoLEP c) Prostatic urethra after HoLEP d) Typical theatre set up for HoLEP

ADVANCES IN THE TREATMENT OF PROSTATE CANCER - ROBOT ASSISTED RADICAL PROSTATECTOMY (RARP)

Current literature suggests a surgical approach for clinically localised prostate cancer is associated with a superior survival benefit when compared to watchful waiting or radiotherapy.¹⁷ Since its inception in 2000, RARP has incorporated a number of technical advancements offering equivalent oncological outcomes when compared to open radical prostatectomy, as well as a number of other benefits.^{18,19} When compared to open prostatectomy, patients undergoing RARP had less blood loss, lower transfusion rates and shorter hospital stays.¹⁹

The DaVinci system offers stereoscopic 10x magnification and dexterity exceeding that of the human hand. These qualities facilitate the precise dissection of the delicate neurovascular bundles during nerve sparing radical prostatectomy in an effort to maximise potency post-operatively. Nerve sparing techniques have advanced to the point where the approach can be tailored to the patient's specific disease process, achieving optimal oncologic and potency outcomes.¹⁸

When undergoing RARP, the patient is placed in a lithotomy position. The DaVinci robot is docked and a total of 6 ports are inserted, 4 for robot arms and 2 for the assistant (**Figure 5-a**). Pneumoperitoneum is established, allowing for dissection in a relatively bloodless field. The robotic arms are controlled via a console in operating theatre (**Figure 5-b**) The space of Retzius is developed allowing dissection of the anterior prostate. The dorsal vein is ligated, the prostate is dissected from the anterior and posterior bladder (**Figure 5-c**), and the prostatic pedicles are ligated. Using the enhanced dexterity provided by the robot, the neurovascular bundles responsible for erectile function can be spared in appropriate cases (**Figure 5-d/e**). Great care is taken to avoid unnecessary diathermy and trauma to optimise post-operative outcomes.

After dissection, the prostate is removed via an Endocatch bag (**Figure 5-f**). The

functions, further enhancing efficiency (**Figure 4**).

To date there have been 40 cases performed using the new Pulse 120H system. data from the initial 21 cases is presented below. The mean catheterisation time has been 1.5 days. Mean age was 73.1 years (range 61-89 years). 8 patients underwent the procedure without the need for intubation, 7 had a laryngeal mask airway (LMA) and 4 an endotracheal tube (ETT). There has been a 0 per cent transfusion rate and all procedures were completed satisfactorily. Complications were minimal with 3 patients developing temporary post-operative urinary retention. Minimal post-operative irrigation was required. Mean laser time was 28.7 minutes (range 3.1-90min) and mean energy delivered was 145.4J (range 14.8-263.4J). Longer-term follow up is ongoing and we anticipate excellent outcomes similar to those of the 100 watt Holmium laser.



Figure 5 a) Robot docking and setup; b) the surgeon's console; c) bladder (A) dissection from prostate (B); d) dissection of apical prostate (B) with sparing of the neurovascular bundle (A); e) dissection of the base of prostate showing the vascular pedicle and nerve bundle (A) and the prostate (B); f) removal of prostate with Endocatch bag; g) anastomosis of urethra (A) to bladder (B); h) final anastomosis between urethra (A) and bladder (B).

bladder neck is then joined to the urethra via a precise mucosa-to-mucosa continuous anastomosis, and the urinary catheter left in situ (Figure 5-g/h).

To date, 1,050 cases have been performed by a single surgeon (RK) from January 2008 to August 2015. Of note, there was no case selection in this series and patients with high body mass index (BMI), enlarged prostate, large middle lobe, previous TURP and/or previous radiotherapy were offered the procedure.

The current robotic operative time is approximately 1 hour and 40 minutes. The median length of stay is 2 days with patients active and mobile on discharge. The average catheterisation time is 6 days. There has only been one anastomotic stricture to date (as opposed to open series which report 5-20%). There has been a 0% blood transfusion rate, 0% mortality rate, no perioperative ischaemic events and no patients to date have required an open conversion. Two patients have had pulmonary embolism (presenting post discharge).

RARP is a continually evolving field with subtle improvements in technique resulting in ongoing improvements in outcomes. There are also ongoing technological innovations. The DaVinci SiHD system offers improved vision and a greater range of motion compared to previous generations. There have been further improvements with vision, efficiency and flexibility with the new DaVinci Xi system. We anticipate the future development of a single port flexible robotic system which will further reduce the invasiveness of surgery.

SUMMARY

In summary, there have been a number of recent significant advances in the minimally invasive management of prostatic conditions. The advances include the Urolift system, HoLEP and robot assisted surgery. Each of these technologies has translated into significant benefits for patients and improved clinical outcomes. We anticipate future ongoing development and innovation in the field.

REFERENCES

- Cantwell AL, Bogache WK, Richardson SF, Tutrone RF, Barkin J, Fagelson JE, et al.** Multicentre prospective crossover study of the 'prostatic urethral lift' for the treatment of lower urinary tract symptoms secondary to benign prostatic hyperplasia. *BJU International*.113(4):615-22.
- Larcher A, Broglia L, Lughezzani G, Mistretta F, Abrate A, Lista G, et al.** Urethral lift for benign prostatic hyperplasia: a comprehensive review of the literature. *Current Urology Reports*.14(6):620-7.
- Roehrborn CG, Gange SN, Shore ND, Giddens JL, Bolton DM, Cowan BE, et al.** Durability of the Prostatic Urethral Lift: 2-Year Results of the L.I.F.T. Study. *Urology Practice*.2(1):26-32.
- Madersbacher S AG, Nordling J, et al.** Guidelines on assessment, therapy and follow-up of men with lower urinary tract symptoms suggestive of benign prostatic obstruction (BPH guidelines). *Eur Urol*. 2004(46):547-54.
- Tan A, Liao C, Mo Z, Cao Y.** Meta-analysis of holmium laser enucleation versus transurethral resection of the prostate for symptomatic prostatic obstruction. *British Journal of Surgery*. 2007;94(10):1201-8.
- Dunsmuir WD EM.** National Prostatectomy Audit Steering Group. There is significant sexual dysfunction following TURP. *Br J Urol*. 1996;77:39-40.
- Cornu J-N, Ahyai S, Bachmann A, de la Rosette J, Gilling P, Gratzke C, et al.** A Systematic Review and Meta-analysis of Functional Outcomes and Complications Following Transurethral Procedures for Lower Urinary Tract Symptoms Resulting from Benign Prostatic Obstruction: An Update. *European Urology*. 2015;67(6):1066-96.
- Gilling PJ, Mackey M, Cresswell M, Kennett K, Kabalin JN, Fraundorfer MR.** Holmium Laser Versus Transurethral Resection of the Prostate: A Randomized Prospective Trial with 1-Year Followup. *The Journal of Urology*.162(5):1640-4.
- Matsuoka K IS, Tomiyasu K, Shimada A, Noda S.** Transurethral holmium laser resection of the prostate. *J Urol*. 2000(163):515-8.
- Li S, Zeng X-T, Ruan X-L, Weng H, Liu T-Z, Wang X, et al.** Holmium Laser Enucleation versus Transurethral Resection in Patients with Benign Prostate Hyperplasia: An Updated Systematic Review with Meta-Analysis and Trial Sequential Analysis. *PLoS ONE*. 2014;9(7):e101615.
- Gravas S, Bachmann A, Reich O, Roehrborn CG, Gilling PJ, De La Rosette J.** Critical review of lasers in benign prostatic hyperplasia (BPH). *BJU International*. 2011;107(7):1030-43.
- Kuntz RM, Ahyai S, Lehrich K, Fayad AMR.** Transurethral Holmium Laser Enucleation Of The Prostate Versus Transurethral Electrocautery Resection Of The Prostate: A Randomized Prospective Trial In 200 Patients. *The Journal of Urology*. 172(3):1012-6.
- Elzayat EA, Elhilali MM.** Holmium Laser Enucleation of the Prostate (HoLEP): Long-Term Results, Reoperation Rate, and Possible Impact of the Learning Curve. *European Urology*. 2007;52(5):1465-72.
- Montorsi F, Naspro R, Salonia A, Suardi N, Briganti A, Zanoni M, et al.** Holmium Laser Enucleation Versus Transurethral Resection Of The Prostate: Results From A 2-Center, Prospective, Randomized Trial In Patients With Obstructive Benign Prostatic Hyperplasia. *The Journal of Urology*. 2004;172(5, Part 1):1926-9.
- van Rij S, Gilling P.** In 2013, Holmium Laser Enucleation of the Prostate (HoLEP) May Be the New 'Gold Standard'. *Current Urology Reports*. 2012;13(6):427-32.
- Chun SS, Razvi HA, Denstedt JD.** Laser prostatectomy with the holmium: YAG laser. *Techniques in Urology*.1(4):217-21.
- Bill-Axelson A, Holmberg L, Garmo H, Rider JR, Taari K, Busch C, et al.** Radical Prostatectomy or Watchful Waiting in Early Prostate Cancer. *New England Journal of Medicine*. 2014;370(10):932-42.
- Sood A, Jeong W, Peabody JO, Hemal AK, Menon M.** Robot-assisted radical prostatectomy: inching toward gold standard. *Urologic Clinics of North America*. 41(4):473-84.
- Alemozaffar M, Sanda M, Yecies D, Mucci LA, Stampfer MJ, Kenfield SA.** Benchmarks for Operative Outcomes of Robotic and Open Radical Prostatectomy: Results from the Health Professionals Follow-up Study. *European Urology*. 2015;67(3):432-8.