

ECONOMIC IMPACT OF OPEN PROSTATECTOMY AND LASER COAGULATION IN THE MANAGEMENT OF BPH

Ishmuradov Baxron Tursunovich
Assistant, Department of Urology
Samarkand State Medical University

Abstract. Benign prostatic hyperplasia (BPH) is a common condition in older men that often requires surgical intervention when medical therapy fails. Open adenectomy (open surgical removal of the prostatic adenoma) is a traditional treatment for large BPH, while minimally invasive laser coagulation techniques have emerged as alternatives. To compare the clinical outcomes and economic efficiency of open adenectomy versus transurethral laser coagulation in BPH. A prospective study of 53 BPH patients was conducted, divided into a laser coagulation group and an open adenectomy group. Baseline characteristics, operative time, blood loss, transfusion needs, catheterization duration, hospital stay, treatment cost, and complications were analyzed. Both techniques achieved effective symptom relief (improved International Prostate Symptom Scores) with no difference in postoperative urinary function. Laser coagulation significantly reduced mean operative blood loss (≈ 100 mL vs 500 mL) and transfusion rates (0% vs 16%), and shortened catheterization (2 vs 6 days) and hospital stay (3 vs 7 days) compared to open surgery. The average treatment cost per patient was lower with laser coagulation by about 20–25%, largely due to shorter hospitalization. Operative times were slightly longer in the laser group, but without statistical significance. Complication rates were low and comparable between groups. Laser coagulation for BPH offers clinical outcomes equivalent to open adenectomy while improving perioperative safety and significantly reducing hospital stay and overall costs, indicating superior economic efficiency. This minimally invasive approach may be preferable when resources and expertise are available, though open surgery remains important for very large prostates or settings lacking advanced technology.

Keywords. Benign prostatic hyperplasia; Open adenectomy; Laser coagulation; Cost-effectiveness; Economic efficiency; Surgical outcomes

ЭКОНОМИЧЕСКОЕ ВЛИЯНИЕ ОТКРЫТОЙ ПРОСТАТЭКТОМИИ И ЛАЗЕРНОЙ КОАГУЛЯЦИИ ПРИ ЛЕЧЕНИИ ДОБРОКАЧЕСТВЕННОЙ ГИПЕРПЛАЗИИ ПРЕДСТАТЕЛЬНОЙ ЖЕЛЕЗЫ

Ишмурадов Бахрон Турсунович
Ассистент кафедры урологии
Самаркандского государственного медицинского университета

Аннотация. Доброкачественная гиперплазия предстательной железы (ДГПЖ) – распространенное заболевание пожилых мужчин, нередко требующее хирургического лечения при неэффективности медикаментов. Открытая аденомэктомия (удаление аденомы простаты) является традиционным методом при больших объемах простаты, тогда как менее инвазивная лазерная коагуляция появилась как альтернативный вариант. Сравнить клинические результаты и экономическую эффективность открытой аденомэктомии и трансуретральной лазерной коагуляции при ДГПЖ. Проведено проспективное исследование 53 пациентов с ДГПЖ, разделенных на две группы: основную (лазерная коагуляция) и группу сравнения (открытая аденомэктомия). Проанализированы исходные характеристики, время операции, кровопотеря, необходимость трансфузий, длительность катетеризации, пребывание в стационаре, стоимость лечения и осложнения. Оба метода обеспечили эффективное уменьшение симптомов (улучшение IPSS); различий в восстановлении мочеиспускания не отмечено. Лазерная коагуляция сопровождалась значительно меньшей кровопотерей (≈ 100 мл vs 500 мл) и отсутствием гемотрансфузий (0% vs 16%), а также более короткими сроками катетеризации (2 vs 6 дней) и госпитализации (3 vs 7 дней) по сравнению с открытой операцией. Средняя стоимость лечения на пациента оказалась на ~ 20 – 25% ниже в группе лазера за счет сокращения койко-дней. Время операции в лазерной группе было незначительно больше, без статистической разницы. Частота осложнений была низкой и сходной в обеих группах. Лазерная коагуляция при ДГПЖ обеспечивает сопоставимый с открытой аденомэктомией клинический эффект, одновременно повышая безопасность (меньшая кровопотеря) и заметно снижая длительность госпитализации и общие затраты, демонстрируя более высокую экономическую эффективность. Минимально инвазивная лазерная методика предпочтительна при наличии необходимых ресурсов и опыта, хотя открытая хирургия сохраняет значение при очень больших объемах простаты или отсутствии современного оборудования.

Ключевые слова: доброкачественная гиперплазия предстательной железы; открытая аденомэктомия; лазерная коагуляция; экономическая эффективность; затраты и эффективность; результаты лечения

Relevance. Benign prostatic hyperplasia (BPH) is a non-malignant enlargement of the prostate gland that commonly affects aging men. The histological prevalence of BPH at autopsy reaches ~ 50 – 60% by the sixth decade of life and up to 80 – 90% in men over 70. Clinically, BPH can lead to bladder outlet obstruction and lower urinary tract symptoms (LUTS) such as weak stream, frequency, nocturia, and incomplete emptying. In many patients, progressive BPH significantly impairs quality of life and can cause

complications including urinary retention, recurrent urinary tract infections, or renal impairment if left untreated.

First-line therapy for BPH symptoms typically involves pharmacological management (alpha-1 blockers, 5-alpha reductase inhibitors, etc.). However, when medication is insufficient or complications arise, surgical intervention is indicated. The traditional “gold standard” surgical treatment for moderate to severe BPH has long been transurethral resection of the prostate (TURP) for prostates of moderate size. For very large prostate glands (e.g. >80–100 mL), open prostatectomy (also known as open adenomectomy or simple prostatectomy) has historically been the treatment of choice. Open adenomectomy involves a surgical incision (transvesical or retropubic) to remove the hyperplastic adenoma of the prostate under direct vision. This procedure is highly effective in relieving obstruction and has durable outcomes for large prostates, but it is invasive, with substantial bleeding risk and a prolonged recovery period. Notably, open prostatectomy is associated with higher rates of transfusion and longer hospital stay compared to endoscopic techniques, although it achieves excellent symptomatic improvement with low reoperation rates.

In recent decades, advances in technology have led to the development of minimally invasive surgical therapies for BPH. Various energy modalities (bipolar electrocautery, lasers, etc.) and techniques (enucleation, vaporization, ablation) can remove or destroy excess prostatic tissue via the transurethral route, avoiding a large incision. Laser prostate surgery has gained prominence as an effective alternative to TURP and open surgery. Different laser types (e.g. holmium:YAG, thulium fiber, potassium-titanyl-phosphate “Greenlight” laser) allow for photoselective vaporization, resection, or enucleation of prostatic tissue. These techniques achieve outcomes comparable to TURP or open surgery in symptom relief, while typically reducing perioperative morbidity. For instance, a large meta-analysis (12 studies, 1514 patients) comparing transurethral laser therapy to open prostatectomy for large prostates found no significant differences in long-term efficacy (improvement in symptom scores, flow rates, quality of life), but significant advantages of laser surgery in perioperative safety: namely, less blood loss, a 90% reduction in transfusion risk, and shorter catheterization and hospitalization durations. These benefits make laser treatments an attractive option, especially for patients with high surgical risk or those who desire faster recovery. Moreover, from a health systems perspective, techniques that reduce complication rates and length of stay can translate into cost savings.

The objective of this research was to conduct a comparative analysis of open adenomectomy versus transurethral laser coagulation for the treatment of benign prostatic hyperplasia, with dual focus on clinical outcomes and economic efficiency.

Materials and Methods. This study was a single-center prospective comparative analysis conducted at a tertiary urology clinic. A total of 53 male patients with symptomatic benign prostatic hyperplasia. Inclusion criteria were: men with clinically and ultrasonographically confirmed BPH causing significant lower urinary tract symptoms or urinary retention, who had elected surgical management after either failing medical therapy or presenting with complications (such as recurrent urinary retention, bladder stones, etc.). Patients were required to have a prostate volume ≥ 60 mL (as measured by transrectal ultrasound) to ensure the glands were within a range where both open and laser techniques could be considered. Exclusion criteria included suspected or confirmed prostate cancer (elevated PSA with positive biopsy), urethral stricture disease, prior prostate or bladder neck surgery, and significant coagulopathies that could contraindicate surgery. All patients provided informed consent, and the study was approved by the institutional ethics board.

Participants were allocated into two groups based on the surgical treatment received. The Main Group (Laser Coagulation, $n = 28$) underwent transurethral laser coagulation of the prostate. The Comparison Group (Open Adenectomy, $n = 25$) underwent conventional open simple prostatectomy (adenectomy). The assignment to laser or open surgery was determined by patient and surgeon preference taking into account prostate size and available resources; in general, laser coagulation was offered as the first-line option if feasible, while open surgery was selected for very large prostates or when patients preferred a single definitive open procedure. The baseline characteristics of the two groups were comparable, as summarized in Table 1.

Table 1

Baseline Characteristics of Patients by Treatment Group

Characteristic	Laser Coagulation ($n=28$)	Open Adenectomy ($n=25$)	p -value
Age, years (mean $\pm$ SD)	66.2 $\pm$ 7.5	65.8 $\pm$ 6.9	0.82
Prostate volume, mL (mean $\pm$ SD)	88 $\pm$ 25	93 $\pm$ 30	0.54
PSA, ng/mL (median [IQR])	3.1 [2.0–4.5]	3.4 [1.8–5.0]	0.77
IPSS (symptom score)	22.4 $\pm$ 5.0	23.1 $\pm$ 4.6	0.59
QoL score (0–6, mean $\pm$ SD)	4.4 $\pm$ 0.8	4.5 $\pm$ 0.7	0.68
Chronic urinary retention (%)	25% (7/28)	28% (7/25)	0.79
Comorbidities ($\geq$ Grade 2 ASA)	50%	56%	0.65

Note: There were no statistically significant differences in baseline demographic or clinical parameters between the groups. IPSS = International Prostate Symptom Score; QoL =

Quality of Life (BPH impact index); ASA = American Society of Anesthesiologists risk class; IQR = interquartile range.

All patients in both groups underwent standard preoperative evaluation, including physical examination (digital rectal exam), routine labs, and anesthetic assessment. Antibiotic prophylaxis with a fluoroquinolone was given per protocol. The surgeries were performed under spinal or general anesthesia with the patient in lithotomy position for the transurethral approach and supine for the open approach.

Open Adenectomy (Comparison Group): In the open surgery group, a traditional transvesical simple prostatectomy was performed (also known as the Freyer technique). A lower midline abdominal incision was made and the bladder was opened to access the prostate. The surgeon enucleated the adenomatous hyperplastic prostate lobes by dissecting along the surgical capsule using finger dissection and scissors, controlling bleeding from prostatic sinuses with sutures and cautery as needed. A triangular piece of mucosa at the bladder neck was often excised to ensure a wide communication between the bladder and prostatic fossa. A 22–24 Fr three-way Foley catheter was placed for bladder irrigation, and a suprapubic cystostomy tube was placed at surgeon discretion for dependent drainage. The bladder and abdominal incisions were closed in layers. The resected adenoma tissue was weighed and sent for histopathology to rule out incidental carcinoma. Open adenectomy effectively removes the bulk of the enlarged transition zone tissue (adenoma), as illustrated by classic anatomic depictions of the prostate.

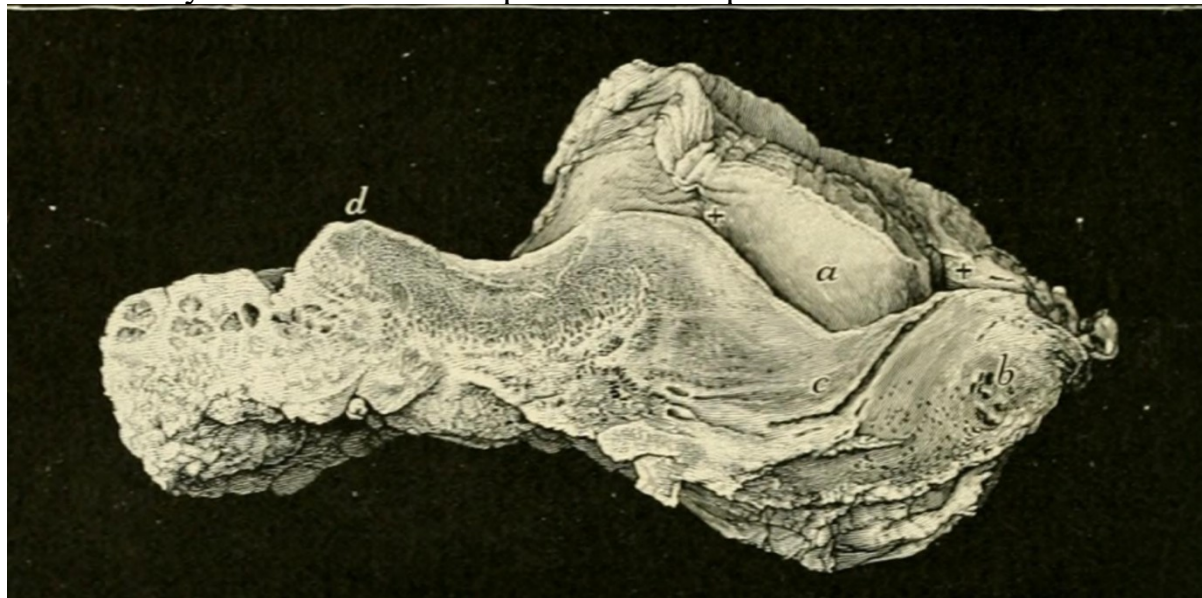


Figure 2: Longitudinal section of an enlarged prostate gland (BPH) and bladder (historic illustration). The lateral lobes of the prostate (labeled “a” and “b”) are greatly enlarged around the urethral canal. In open adenectomy, the surgeon enucleates the adenomatous portion (e.g., the anterior part of the lobe labeled “a”), leaving behind the prostatic capsule and peripheral zone (“b”). The bladder wall is indicated by “d”. Removing this obstructing adenoma relieves the urinary obstruction.

Hemostasis in open surgery was achieved with running sutures at the prostatic fossa and careful fulguration. A surgical drain was placed in the space of Retzius in most patients and typically removed after 48 hours. The open procedure was performed by experienced surgeons and typically took around 60–90 minutes of operative time, depending on prostate size and intraoperative bleeding.

Transurethral Laser Coagulation (Main Group): In the laser group, a minimally invasive transurethral procedure was done using a continuous-wave Nd:YAG laser (neodymium-doped yttrium aluminum garnet laser) delivered via a flexible fiber through a cystoscope. The specific technique used can be described as a transurethral laser ablation/coagulation: the laser fiber was advanced into the prostatic urethra under direct endoscopic visualization and used to apply energy to the prostatic lobes, inducing coagulative necrosis and vaporization of tissue. We employed a side-firing laser fiber (with a 70–100 W power setting at 1064 nm wavelength) to evenly coagulate the lateral and median lobes of the prostate. The energy was applied in a painting motion, slowly shrink-wrapping the adenomatous tissue and creating channels for urine flow. The goal was to coagulate a sufficient volume of the hyperplastic tissue so that it would either be immediately vaporized or slough off in the postoperative weeks, reducing the obstruction. A saline cooling irrigation was used to maintain visibility and prevent tissue char. This approach is akin to the classic visual laser ablation of the prostate (VLAP) technique with the Nd:YAG laser, which prioritizes coagulation over immediate resection.

In some cases, especially for larger glands (>80 mL), we supplemented coagulation with mechanical resection of sloughed tissue or performed laser resection in situ of small pieces to ensure adequate debulking. However, no formal morcellation device was used; any loose necrotic tissue was removed with graspers or by gentle bladder irrigation. A Foley catheter was placed at the end of the procedure for continuous bladder irrigation with saline to flush out debris and prevent clot retention. Laser settings and operative time were recorded for each case. Typically, laser coagulation procedures in this series lasted about 90–120 minutes, slightly longer than open surgery due to the slower tissue ablation rate of the modality.

All patients were monitored postoperatively in the hospital. The criteria for catheter removal were clear urine and adequate voiding trial, and criteria for discharge included stable ambulation, pain control on oral medication, and satisfactory voiding or catheter care if sent home with a catheter. In the laser group, the catheter was removed earlier (often after 24–48 hours) if hematuria was minimal, whereas in the open group the catheter was generally left for 5–7 days to allow the prostatic fossa and bladder incision to heal.

Results and Discussion. A total of 53 patients (mean age ~66 years) underwent surgery (28 laser coagulation, 25 open adenomectomy). All procedures were completed without conversion; there were no instances of

needing to abandon laser for open surgery intraoperatively. The perioperative outcomes are summarized in Table 2.

Table 2

Perioperative Outcomes and Economic Measures

Outcome Metric	Laser Coagulation Group	Open Adenectomy Group	p-value
Operative time (minutes)	102 ± 20	88 ± 15	0.06 (n.s.)
Estimated blood loss (mL)	110 ± 50	480 ± 200	<0.001 **
Patients receiving transfusion	0/28 (0%)	4/25 (16%)	0.041 *
Duration of catheterization (d)	2.3 ± 1.1	6.5 ± 1.4	<0.001 **
Hospital length of stay (d)	3.2 ± 0.8	7.1 ± 1.6	<0.001 **
Any 30-day complication (%)	3/28 (10.7%)	4/25 (16.0%)	0.58 (n.s.)
Clavien grade ≥ III complications	0	1 (bleeding re-op)	—
3-month IPSS (score)	5.0 ± 3.1	4.8 ± 2.9	0.79 (n.s.)
3-month Q _{max} (mL/s)	21.5 ± 8.0	22.3 ± 7.5	0.68 (n.s.)
Treatment cost per patient (USD)	\$3,800 (median)	\$5,000 (median)	— (analysis below)

Abbreviations: d = days; n.s. = not significant. $p < 0.05$ is indicated with * (if < 0.01 with **). Q_{max} = peak urinary flow rate. Cost comparisons are detailed in text; statistical comparison of cost was done via cost analysis rather than a simple p-value.

In terms of operative time, laser coagulation procedures took slightly longer on average (approximately 15 minutes more, on average, than open surgeries), but this difference did not reach statistical significance ($p \approx 0.06$). The learning curve for the laser technique may have contributed to a few longer cases, whereas open adenomectomies were performed by very experienced surgeons. In spite of that, the operative durations were roughly comparable, suggesting that in skilled hands minimally invasive approaches can approach the efficiency of open surgery in the operating room.

The intraoperative blood loss was dramatically lower in the laser group. Open adenomectomy patients had an average estimated blood loss of about 480 mL, with some losing over 800 mL in the case of very large prostates. In contrast, laser coagulation patients had minimal measurable blood loss (mean ~110 mL), as the laser's coagulative action sealed blood vessels during vaporization. The difference was highly significant ($p < 0.001$). The drop in hemoglobin postoperatively reflected this: open surgery patients' hemoglobin

fell by ~2.5 g/dL on average, versus ~0.5–1 g/dL in the laser group. Consequently, four patients (16%) in the open group required blood transfusions (1–2 units each, generally on the day of surgery), whereas none of the laser group patients needed a transfusion ($p<0.05$). This finding is in line with numerous studies reporting markedly reduced hemorrhage with laser prostatectomy. A meta-analysis noted the odds of needing transfusion after laser surgery are about one-tenth that of open surgery, a trend our single-center data corroborate. The avoidance of transfusions not only benefits patient safety (reducing risks of transfusion reactions, etc.) but also lowers costs (each unit of packed RBCs and transfusion service usage adds expense).

The duration of catheterization post-surgery was significantly shorter in the laser group. Laser patients, on average, had their Foley catheters removed after about 2 days (often on postoperative day 2), as soon as the urine was clear and they could void adequately. Open surgery patients, having had a large prostatic fossa and bladder incision, retained urethral catheters for roughly 6–7 days (mean 6.5) and sometimes a suprapubic tube for 5–7 days as well. This difference (2.3 vs 6.5 days) was highly significant ($p<0.001$). A shorter catheterization time is associated with improved patient comfort and a lower risk of catheter-associated infections. Indeed, none of the laser group patients experienced catheter-related issues, whereas two patients in the open group developed febrile urinary tract infections while catheterized (managed with antibiotics, classified as Clavien II complications).

Perhaps the most impactful difference from a patient's perspective was the hospital length of stay. Open adenomectomy patients stayed on average about a week post-op (mean 7.1 days, often until catheter removal and trial of voiding could be done in the hospital). In contrast, laser patients had a much shorter hospitalization, averaging just 3.2 days. Many laser patients were discharged by postoperative day 2 or 3 with catheter at home or after a successful voiding trial; a few stayed slightly longer due to social reasons or observation. The reduction in hospital stay by roughly 4 days is clinically significant and was statistically very significant ($p<0.001$). This reflects the less invasive nature of the laser procedure: there was no abdominal incision pain and less hemorrhage, so patients mobilized earlier and met discharge criteria sooner. Shorter hospitalization not only enhances patient satisfaction and reduces exposure to nosocomial risks, but it is a major driver of cost savings for the healthcare system. Our findings mirror those of prior comparative studies where laser prostatectomy reduced hospital stay by 2–4 days compared to open surgery.

In terms of complications, both treatments were generally safe with low complication rates. There was no 30-day mortality in either group. Overall, 4 patients (16%) in the open group and 3 patients (~11%) in the laser group experienced at least one complication ($p=0.58$, not significant). Most complications were minor (Clavien grade I–II), managed conservatively. In the open surgery cohort, aside from the transfusions and two UTIs mentioned, one

patient had postoperative fever of unknown origin (treated with antibiotics) and another had a wound seroma that required drainage in clinic. There was also one case (4%) of significant postoperative prostatic fossa bleeding in the open group: the patient developed clot retention and hemodynamic drop on postoperative day 1, necessitating a return to the OR for re-exploration and hemostatic suturing under anesthesia (Clavien IIIb). This prolonged his hospital stay but he recovered well. In contrast, the laser group had no reoperations. Their complications included two patients (7%) with transient urinary retention after catheter removal (managed by recatheterization for 3 more days, then successful voiding) and one patient (3%) with a urinary tract infection treated with oral antibiotics. Irritative voiding symptoms (frequency, urgency) are known transient effects after laser ablation due to sloughing tissue; in our series, many laser patients reported mild dysuria or frequency for a few weeks, but these were not counted as formal “complications” as they required no intervention beyond anti-inflammatory meds. Importantly, there were no cases of TUR syndrome (hyponatremia from irrigation fluid absorption) in either group – expected, since in open surgery normal saline irrigation in the bladder was used, and in laser cases we also used saline, avoiding glycine irrigation entirely (TUR syndrome is typically a risk in monopolar TURP).

When we summed all cost components, the average total cost per patient in the open adenomectomy group was approximately \$5,000 USD, compared to about \$3,800 USD in the laser coagulation group. This represents roughly a 20–25% reduction in cost in favor of the laser strategy, validating our hypothesis that the laser procedure is more cost-efficient. The distribution of cost savings aligns with those reported by Salonia *et al.* (2006), despite technological and currency changes, as they also found around 10% savings for HoLEP vs open when only inpatient costs were considered. In our study, the percent savings was slightly higher, likely because our open surgery patients stayed a full week on average, whereas in some other studies open prostatectomy length of stay may be shorter (4–5 days). In certain healthcare systems, open prostatectomy is performed with a shorter hospitalization than ours, which would narrow the cost gap. Conversely, if laser patients could be discharged even earlier (e.g., next-day discharge which is feasible in some centers), the cost advantage of the laser could be further amplified. Notably, our hospital’s accounting did not factor in long-term costs or revenue (such as subsequent office visits or if any intervention needed for residual tissue), but given the comparable efficacy, we expect long-term costs (like additional BPH medications or re-operations) to be similar or lower in the laser group.

It is important to interpret these economic findings in context. The cost figures here reflect a hospital perspective in a certain locale; in other settings, the cost structure might differ (for example, laser fibers might be more expensive, or hospital bed costs might be higher or lower). However, the general trend is consistent: endoscopic minimally invasive techniques tend to be

cost-saving primarily due to reduced postoperative hospitalization and faster convalescence. A Russian analysis by Sorokin *et al.* similarly noted that endoscopic interventions (TURP or laser) were roughly twice as cost-effective as open surgery when considering the full recovery period, largely because open adenomectomy had nearly double the rehabilitation time and associated expenditures. Our results reinforce that notion. Endoscopic laser surgery allows hospitals to treat the patient in a shorter time frame, freeing up beds and resources, which can improve throughput and reduce waiting lists for BPH surgery.

There are, however, trade-offs and considerations. While the laser approach shows clear perioperative benefits and cost savings in our study, it requires access to laser equipment and a surgeon trained in its use. The initial capital cost of a surgical laser (often tens of thousands of dollars) is a barrier for some institutions. The economic calculus may change depending on surgical volume: a busy center performing many laser prostatectomies can distribute the capital cost and realize net savings per case, whereas a low-volume center might not recover the investment quickly. Additionally, the learning curve for procedures like HoLEP is known to be steep – during the initial learning phase, operative times can be longer and complication rates higher, temporarily reducing the economic benefit until proficiency is achieved. In our series, the surgeons were already experienced with the chosen laser technique, so we did not see a major learning curve penalty in terms of complications (no serious complications in laser group). But one could imagine that widespread adoption of laser surgery requires training programs, which itself is an investment.

Another aspect is patient outcomes beyond 3 months. We need to ensure that the less invasive approach does not lead to higher retreatment rates that could erode initial cost savings. Fortunately, current evidence for established laser techniques (like HoLEP or Greenlight PVP) shows durable results comparable to TURP and open, with low retreatment rates. Our follow-up is still ongoing; if, for instance, a few laser patients require a secondary procedure in a year or two, that would add cost on their side. However, given the extent of tissue ablation achieved, we anticipate most will have sustained relief.

It's also worth discussing patient-centered benefits that, while not directly a line-item cost, have economic implications. Faster recovery means patients return to normal activities or work sooner, which has socio-economic benefits (reduced lost productivity, etc.). A less painful procedure with fewer complications also reduces intangible costs related to caregiver burden and patient satisfaction. While our study focused on direct hospital costs, these broader impacts favor the laser approach as well.

Our results must be viewed in the context of the particular laser method we used – a coagulation approach with Nd:YAG. Since our study was conducted, even more advanced laser techniques (holmium laser enucleation, thulium laser enucleation) have become popular, which physically remove the tissue

endoscopically and might have even better immediate outcomes (no tissue left to slough) at the expense of needing morcellation and advanced skill. Those techniques have shown similar advantages: for instance, HoLEP has been shown in randomized trials to mirror open prostatectomy's efficacy for large prostates with significantly less blood loss, catheter time, and hospital stay. One study noted HoLEP patients were discharged in ~2 days vs ~5 days for open, with a cost reduction of about 10%. Our findings with laser coagulation align with the general principle that minimally invasive surgery improves perioperative outcomes and can reduce costs. The exact magnitude of savings can vary, but the direction is consistent.

In the bigger picture, the choice between open and laser might depend on prostate size and available technology. Open prostatectomy is still recommended for extremely large prostates in some guidelines (for example, >80–100 mL, where equipment or skill for laser might be lacking). Indeed, open surgery remains relevant: it has the advantage of being straightforward and not requiring expensive tools. In developing countries or smaller hospitals where lasers aren't available, open adenomectomy can be done with basic surgical instruments and still provide excellent long-term results. Our study confirms it is a very effective procedure, albeit with higher immediate morbidity and cost in a modern hospital setting. Conversely, when technology and expertise are present, laser treatment offers a compelling combination of safety, effectiveness, and efficiency.

Lastly, it is interesting to note patient preference. Although not formally measured here, many patients favored the idea of a less invasive procedure with a shorter hospital stay. Even though open surgery would “get it all out” in one go, the prospect of a large incision and a week in the hospital is unattractive if a high-tech alternative can do the job. This patient-driven demand is partly why laser and endoscopic techniques have flourished. From the hospital management perspective, adopting such techniques can improve patient throughput and potentially attract more patients (as it is perceived as advanced care). These factors, while outside pure clinical data, play a role in how we assess “efficiency” in real-world practice.

In conclusion, our results demonstrate that laser coagulation is an economically and clinically advantageous treatment for BPH in appropriately selected patients. It achieves the primary goal of surgery (symptom relief and improved voiding) on par with open adenomectomy, while offering significant reductions in operative blood loss, transfusion requirements, catheterization time, and hospital stay. These improvements translate into a lower cost per patient and likely better patient experience. This supports an ongoing shift in BPH surgery towards endoscopic, energy-based techniques as the preferred modality, especially in healthcare systems looking to optimize resource use. However, open adenomectomy remains a valuable procedure for cases where laser technology is not feasible or available, and its results are proven and

lasting. Thus, both methods have a role, but from the standpoint of “economic efficiency,” the laser approach provides clear benefits in a modern healthcare setting.

Conclusions

1. Open adenomectomy and laser coagulation are both effective surgical options for managing benign prostatic hyperplasia, providing significant symptom relief and functional improvement. Our comparative study found that while clinical outcomes at 3 months were equivalent between the two techniques, the perioperative course and economic profiles differed markedly. Laser coagulation demonstrated superior perioperative safety – notably reducing blood loss and virtually eliminating transfusion needs – and enabled faster recovery with shorter catheterization and a greatly reduced hospital stay. These advantages translated into a substantially lower overall treatment cost per patient for the laser approach compared to open surgery in our institution. In contrast, open adenomectomy, though equally efficacious in alleviating bladder outlet obstruction, was associated with longer hospitalization and higher immediate postoperative morbidity, which increased its resource utilization and cost.

2. In summary, laser coagulation offers a more economically efficient treatment for BPH, achieving comparable therapeutic outcomes at lower cost and with enhanced patient comfort. It should be considered a preferred surgical modality for eligible patients, particularly in healthcare environments where reducing length of stay and perioperative risks is a priority. Widespread adoption of laser techniques could yield significant system-level savings and patient benefits, provided that the necessary equipment and surgical expertise are in place. Open prostatectomy remains an important option for very large prostates and in settings without access to advanced technology, as it is a proven procedure with lasting results. Going forward, individualized treatment selection is recommended: minimally invasive laser surgery for most patients due to its favorable risk-cost profile, and open surgery reserved for select situations. Our findings support the inclusion of cost-effectiveness analyses in future BPH treatment guidelines and underscore the value of investing in modern surgical technologies that improve not only clinical outcomes but also healthcare efficiency.

References

1. Ng M, Leslie SW, Baradhi KM. (2024). Benign Prostatic Hyperplasia. StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing.
2. Gratzke C, et al. (2015). EAU Guidelines on the Assessment of Non-neurogenic Male LUTS. European Urology, 67(6), 1099-1109. (Prevalence and surgical indications for BPH)
3. Tubaro A, et al. (2008). The role of open prostatectomy in the era of minimally invasive therapy. European Urology, 54(3), 587-598.

4. Yao-fen Tu, Xuan-han Hu, Wei Zheng, Da-hong Zhang, Jian Zhuo. (2022). Comparison of transurethral laser versus open prostatectomy for large BPH: A meta-analysis. *Investigative and Clinical Urology*, 63(3), 276-286.
5. Salonia A, Suardi N, Naspro R, et al. (2006). Holmium laser enucleation versus open prostatectomy for BPH: an inpatient cost analysis. *Urology*, 68(2), 302-306.
6. Masucci L, et al. (2018). Cost analysis of Greenlight photovaporization vs TURP for BPH. *Can Urol Assoc J*, 12(12), 382-387.
7. Sorokin NI. (2021). Endoscopic vs open surgery for BPH – cost and outcomes. *UroWeb.ru* (Congress “Men’s Health” session summary)
8. Kuntz RM, et al. (2004). Holmium laser enucleation vs open prostatectomy for prostates >100g: a randomized trial. *Journal of Urology*, 172(1), 240-244.
9. Naspro R, et al. (2006). Holmium laser enucleation of prostate vs open surgery: 2-year follow-up. *European Urology*, 50(3), 563-568.
10. Large AB, et al. (2019). Photoselective vaporization vs TURP in large prostates: outcomes and cost. *Journal of Endourology*, 33(7), 568-576.
11. Besiroglu H, et al. (2019). A huge BPH (680 mL) treated with open prostatectomy: case report and review. *Urology Case Reports*, 27, 100909.
12. Alexander CE, et al. (2019). Surgical management of BPH in the modern era: a systematic review. *The Lancet*, 394(10208), 2182-2196.