Implementing HoLEP in an Academic Department With Multiple Surgeons in Training: Mentoring Is the Key for Success

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Abstract

Objective Holmium laser enucleation of the prostate (HoLEP) has been recommended for the surgical management of benign prostatic hyperplasia (BPH) in most of the international guidelines, regardless of prostatic volume. The main advantages reported by randomized clinical studies are reduced perioperative bleeding, catheterization time, and length of hospital stay, but this technique is also described as difficult to master with a steep learning curve. The objective of this study was to describe the clinical outcomes of HoLEP in the real-life setting of an academic department with multiple operators with no previous experience.

Methods A retrospective observational study was conducted including all consecutive cases performed in our department from April 2012 to October 2020. Over the study period, 31 different operators were involved. In April 2012, 2 surgeons were trained by an experienced urologist. The 29 others learned the technique progressively with the help of the first 2 surgeons (surgical mentoring).

Results A total of 1259 patients were included. Preoperatively, the mean prostate volume and Qmax were 82.3 g and 9.4 mL/s, respectively. The mean operative time was 79.7 min. The intraoperative complication rate was 5.6% (n = 71), with the need for conversion being 0.6%. Postoperatively, the complication rate was 18.6% (n = 234). Surgeon's experience reduced the perioperative complication rates ($P = 0.01$), operative time ($P < 0.001$), and length of hospital stay ($P < 0.001$), but the difference in blood transfusion rate was statistically non-significant ($P = 0.3$).

Conclusions Most of the 31 urologists in training were able to master HoLEP progressively, with good functional outcomes and acceptable complication rates. Supervision by trained urologists was critical for the safe dissemination of the technique in our department.

Introduction

Holmium laser enucleation of the prostate (HoLEP) is recommended by the main international guidelines for the surgical management of benign prostatic hyperplasia (BPH), regardless of prostate volume[1,2]. In addition to having been evaluated in several randomized controlled trials against monopolar transurethral resection of the prostate (mTURP) and open prostatectomy (OP), HoLEP has been shown to provide long-term functional outcomes (flowmetric and quality of life data) that ensure the durability of the improvement in urinary symptoms.

If the functional outcomes were more or less similar to those of mTURP[3,4] or OP[5,6], the main advantages of HoLEP were reduced perioperative bleeding, catheterization time, and length of hospital stay[7,8]. For all these

Key Words

Benign prostatic hyperplasia, holmium, laser surgery, learning curve, mentoring

Competing Interests

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Abbreviations

BPH benign prostatic hyperplasia
HoLEP holmium laser enucleation of the prostate
mTURP monopolar transurethral resection of the prostate
OP open prostatectomy
UI urinary incontinence

reasons, HoLEP has become a recommended surgical alternative to TURP and OP, regardless of prostate size. However, its steep learning curve has considerably slowed the spread of this technique since it was first described in 1998[9].

The objective of this retrospective study was to describe the clinical outcomes of HoLEP in the real-life setting of an academic department involving multiple operators who had no previous experience with HoLEP and limited experience in endoscopic surgery.

Materials and Methods

Study population

A single-center retrospective observational study was performed with consecutive patients who underwent HoLEP between April 2012 and October 2020 in a high-volume center (180 to 200 HoLEP interventions per year). All procedures were performed by 31 different urologists. In April 2012, 2 surgeons were trained by an experienced urologist from another center and became expert surgeons in our academic hospital. Then each year, 3 to 4 new surgeons have learned the technique progressively, with the mentorship of the first 2 trained surgeons over a period of 2 years.

A surgeon was considered an expert when he or she had performed at least 50 successful procedures as defined in the study by Robert et al.[10]: a combination of complete enucleation and morcellation, within less than 90 min, without any conversion to TURP, with acceptable stress and difficulty.

At the start, mentoring began with the observation of approximately 10 procedures carried out by an expert, followed by 10 HoLEP performed by the trainee itself under the supervision of the expert surgeon. Then, the trainee performed HoLEP autonomously, starting with easy cases (prostate volume 50 g to 80 g, no anticoagulant therapy) and progressively undertaking more complicated cases. At the end of their 2-year training, the operators had performed between 20 and 40 procedures on their own.

All included patients received oral and written information explaining the principles of the procedure and its main complications and provided consent for data collection and analysis. This study was approved by the local ethics committee before data extraction and analysis.

HoLEP: equipment, technique, and follow-up

The procedure was performed in the operating room under general anesthesia or spinal anesthesia.

The equipment used included a 100 W holmium:YAG laser generator (LUMENIS), with a 550 m fiber, a 26 Fr resectoscope, and a Versacut morcellator (KARL STORZ).

The surgical technique of enucleation has evolved over the last 8 years from the original technique described by Gilling in "two or three lobes"[11] to a so-called "en bloc" technique[12].

At the end of the surgery, a 2-way bladder catheter was placed with continuous saline irrigation for a few hours. The bladder catheter was usually removed the next morning in the urology department or at home if the patient was already discharged.

Postoperative follow-up also evolved over time. During the first 3 years, follow-up check-ups were scheduled at 3, 6, 12, and 24 months postoperatively. Subsequently, follow-up was done only 3 months postoperatively.

Statistical analyses

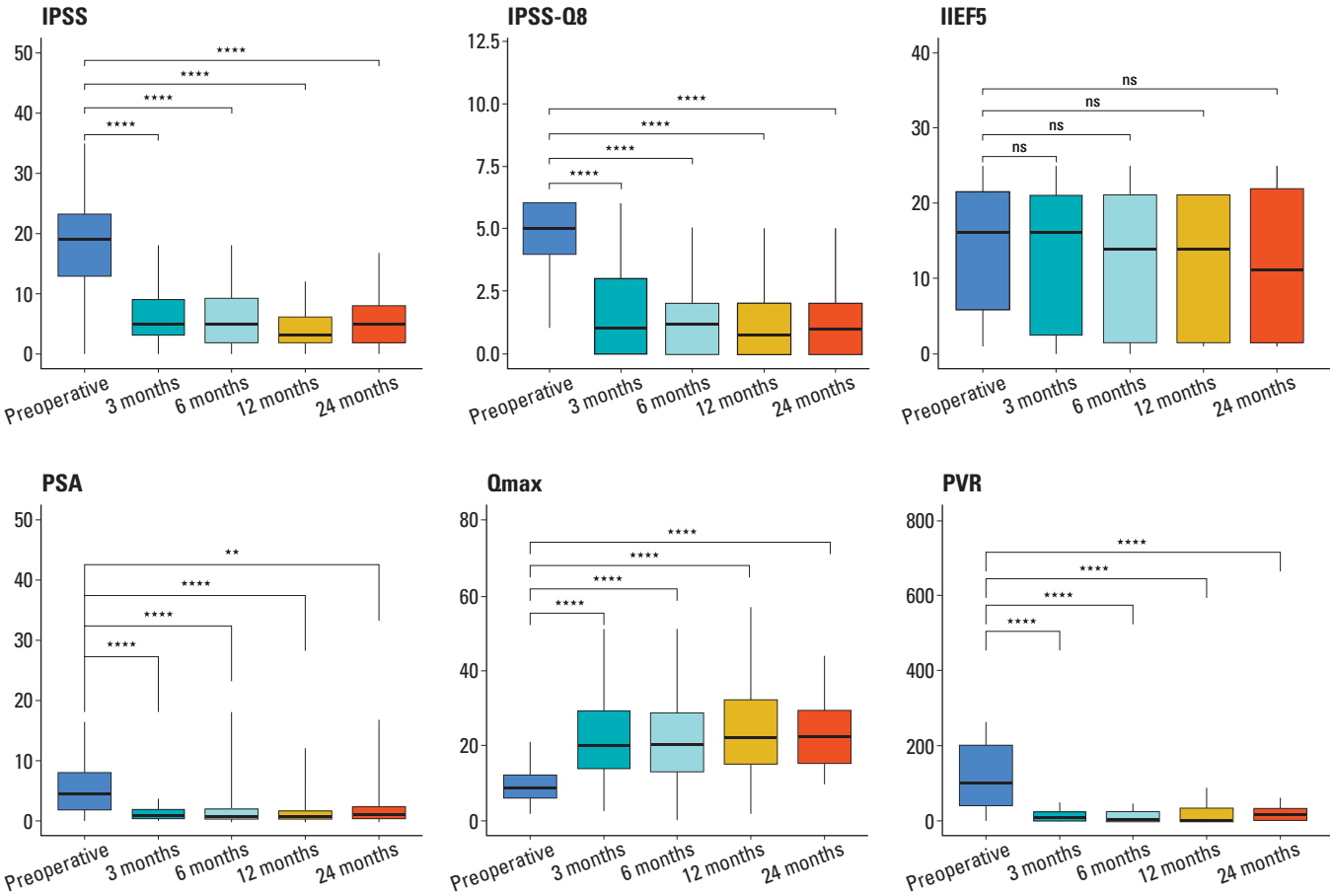
Data analysis was performed using R software (version 4.0.0). The significance level was set at 0.05 for all statistical tests, and *P*-values were 2-sided. Continuous variables were reported as means and standard deviations (SDs) or medians and interquartile ranges (IQRs), whereas categorical variables were reported as frequencies and proportions. Student *t* test and Mann-Whitney U test were used for continuous variables. The chi-square test and Fisher exact test were used for categorical variables.

Results

During the study period, 1174 patients were operated on by 31 different urologists. Preoperative characteristics are described in **Table 1**. The mean age was 70.7 ± 8.6 years. At the time of preoperative consultation, the rate of AUR was 27.7% (n = 326), and 27.9% (n = 320) of the patients had an indwelling urinary catheter at the time of surgery. At the time of surgery, 78.9% of patients (n = 926) received at least 1 drug treatment indicated for lower urinary tract symptoms (LUTS), and a previous history of surgical treatment for LUTS/BPH was retrieved in 49 (4.1%) patients.

Perioperative data are reported in **Table 2**. The overall perioperative complication rate was 6%, and 8 (0.7%) procedures required conversion (7 to TURP and 1 to

FIGURE 1.
Evolution of functional outcomes between preoperative and 3, 6, 12, and 24-month follow-up visits



*IPSS: International Prostate Symptom Score; IPSS-Q8 : question 8 of the IPSS; PSA : prostate-specific antigen; Qmax: maximum urinary flow rate; PVR: post-voiding residual urinary volume; IIEF-5: 5-items International Index of Erectile Function; ns = P > 0.05; **= P < 0.001; ****= P < 0.0001*

OP). A total of 330 patients (28.2%) had a day-case procedure (LOS < 12 h according to the French requirements for day-case procedures).

Regarding surgeon experience, the peri- and postoperative complication rates were lower in the hands of experienced surgeons (**Table 3** and **Supplementary Online Appendix S1**). The same applies to the operative time, but not blood transfusion rates.

Regarding other factors that may influence perioperative outcomes, the perioperative complication rate was higher in patients on antiplatelet therapy. The operative time was higher among patients with prostatic weight ≥ 100 g, anticoagulant therapy, and preoperative urinary catheters. Anticoagulant and antiplatelet therapy and preoperative urinary catheterization increased the postoperative complication rate. The blood transfusion rate was higher in patients with prostatic weight ≥ 100 g, anticoagulant therapy and preoperative urinary catheterization. The LOS was higher in the anticoagulant, antiplatelet and urinary derivation catheter groups.

Concerning functional results (**Figure 1** and **Supplementary Online Appendix S2**), there was a significant improvement in Qmax (+14.2 mL/s) ($P < 0.001$) and IPSS (-14 points) ($P < 0.001$) at 6 months. These results were maintained over time since the median IPSS at 3 years was 4, an improvement of 15 points. Regarding sexual function, the mean IIEF5 score at 6 months was 12 ± 8.2 and appeared to remain stable over time.

The rate of urinary incontinence (stress and urgency) requiring protection was 11.6% at 3 months and 3.8% at 6 months.

Discussion

As noted, several RCTs have proven the superiority of HoLEP over mTURP and OP regarding perioperative bleeding, duration of catheterization, and length of

TABLE 1.

Preoperative characteristics of the study population

Preoperative data	n = 1174	Values
Age, years	1174	**70.7 ± 8.6**
BMI (kg/m²)	1081	**26.3 ± 4.1**
ASA score	1113	**2 [2–2]**
Antiplatelet therapy	1174	**310 (26.4)**
Monotherapy		282 (90.9)
Bitherapy		28 (9)
Curative anticoagulant therapy	1174	**141 (12)**
Vitamin K antagonists		84 (60)
New oral anti-coagulants		54 (38.6)
Low molecular weight heparins		2 (1.4)
BPH complications (≥ 1 complication)	1174	**510 (43.4)**
AUR		326 (27.7)
Infection		173 (14.7)
Bladder stones		27 (2.3)
BPH treatment (≥ 1 oral treatment)	1174	**926 (78.9)**
Alpha blocker		850 (91.6)
5ARI		219 (23.6)
Phytotherapy		240 (25.8)
PDE5I		16 (1.7)
Monotherapy		496 (53.6)
Bitherapy		404 (43.6)
Tritherapy		26 (2.8)
History of BPH surgery	1174	**49 (4.1)**
TURP		28 (57.1)
OP		4 (8.1)
Greenlight		6 (12.2)
HoLEP		6 (12.2)
PAE		3 (6.1)
Urolift		2 (4.1)
Prostatic weight (g)	1056	**84.5 ± 43.5**
PSA (ng/mL)	916	**6.8 ± 9.4**
Qmax (mL/min)	635	**9.5 ± 4.6**
PVR (mL)	631	**150.5 ± 188.4**
IPSS	626	**19 [13–23]**
IPSS Question 8	699	**5 [4–6]**
IIEF5	459	**13.7 ± 8.3**
Indwelling urinary catheter at the time of surgery	1143	**320 (27.9)**

Values expressed as mean (SD), median [interquartile range] or n (%).
BMI: body mass index; ASA: American Society of Anesthesiologists; BPH: benign prostatic hyperplasia; AUR: acute urinary retention; PAE: prostate artery embolization.

TABLE 2.

Perioperative characteristics of the study population

Perioperative outcomes	n = 1174	Values
Surgical technique	1174	**1174 (100)**
Complete prostatic enucleation		
Hospitalization	1174	**1174 (100)**
Conventional		841 (71.8)
Day-case		330 (28.2)
Perioperative complications	1174	**71 (6)**
Capsular perforation		23 (32.4)
Bladder injury		15 (21.1)
Other (Equipment failure. Ureteral meat coagulation significant bleeding. Negative input-output)		33 (46.5)
Conversion	1174	**8 (0.7)**
TURP		7 (87.5)
OP		1 (12.5)
Operative time (min)	1079	**83.2 ± 40.9**
Irrigation (L)	882	**27.6 ± 14.7**
Delivered energy (kJ)	997	**105.7 ± 63.6**
Resected weight (g)	1151	**50.1 ± 36.6**
Postoperative outcomes	**n**	**Values**
Postoperative complications	1174	**227 (19.3)**
Clavien-Dindo 1–2		207 (91.2)
Clavien-Dindo ≥ 3		20 (8.8)
Blood transfusion	1174	**52 (4.4)**
Postoperative lengths of hospital stay (excl. the day before surgery)	1148	**1.6 ± 3.1**

Values expressed as mean (SD) or n (%).

hospital stay, but its steep learning curve has slowed its widespread adoption over the last decade[6–8].

In our cohort, the mean LOS (1.6 nights after surgery) was similar to that reported in major meta-analyses of randomized clinical studies (1.1 to 2.4 nights after surgery)[3,7]. Our results confirm that, in a non-selected patient population operated on by a high number of surgeons with or without experience in the technique, the reduction of hospital stay remains a clear advantage of the HoLEP technique. Nonetheless, we observed a significantly longer hospital stay for patients of inexperienced surgeons (2.1 versus 1 for experts; $P < 0.001$) that was balanced by a high proportion of day-case surgeries (28.2%) performed mainly by expert surgeons.

TABLE 3.

Perioperative outcomes depending on surgical experience, prostatic weight, anticoagulant therapy, antiplatelet therapy and indwelling urinary catheter

	Overall cohort	Surgeon experience expert vs in-training		Prostatic weight ≥ 100 g vs < 100 g		Anticoagulant therapy Yes vs No		Antiplatelet therapy Yes vs No		Indwelling urinary catheter Yes vs No	
	n = 1174	Expert n = 511	*P*-value[a]	≥ 100 g n = 313	*P*-value[b]	Yes n = 141	*P*-value[c]	Yes n = 310	*P*-value[d]	Yes n = 320	*P*-value[e]
Perioperative complications	71 (6)	21 (4.2)	0.01	24 (7.6)	0.2	7 (5)	0.5	29 (9.3)	0.004	25 (7.8)	0.1
Operative time (min)	83.2 ± 40.9	71.4 ± 34.3	< 0.001	103.9 ± 44.3	< 0.001	88.8 ± 42.8	0.03	81.3 ± 40.2	0.3	96.5 ± 45.5	< 0.001
Resected weight (g)	50.1 ± 36.6	51.4 ± 35.8	0.2	83.4 ± 44.5	< 0.001	51.3 ± 34.8	0.7	44.6 ± 32.6	0.002	65.8 ± 46.9	< 0.001
Resected percentage (%)	60.8 ± 25.4	62.4 ± 23.8	0.07								
Postoperative complications	227 (19.3)	82 (16)	0.01	65 (20.7)	0.5	42 (29.8)	< 0.001	85 (27.4)	< 0.001	97 (30.3)	< 0.001
Blood transfusion	52 (4.4)	19 (3.7)	0.3	23 (7.3)	0.001	15 (10.6)	< 0.001	19 (6.1)	0.08	30 (9.3)	< 0.001
Length of hospital stay	1.6 ± 3.1	1 ± 2.4	< 0.001	1.5 ± 1.9	0.8	3.3 ± 6.8	< 0.001	1.8 ± 2.2	0.05	2.4 ± 4.6	< 0.001

Values expressed as mean (SD), median [interquartile range] or n (%).
[a] P-value vs. in training; [b] P-value vs. < 100g; [c] P-value vs. no anticoagulant; [d] P-value vs. no antiplatelet; [e] P-value vs. no indwelling catheter

Significant perioperative bleeding resulting in postoperative blood transfusions was observed in 4.4% of patients in our cohort. This transfusion rate is higher than the one reported in meta-analyses of randomized studies. Indeed, in a meta-analysis of 4 randomized trials comparing HoLEP to TURP, Tan et al. reported a 0% transfusion rate[3]. This difference may be explained by strict patient selection in RCTs often excluding patients receiving anticoagulant therapy. The percentage of patients undergoing antiplatelet or anticoagulant therapy was not specified in this meta-analysis.

In a recent multicenter study that investigated factors influencing perioperative blood loss after HoLEP, the transfusion rate was 5%[13]. In this study, 26.4% and 12% of patients were on antiplatelet and anticoagulant therapy, respectively. These results are very close to ours, considering that we also included 25.9% and 11.5% of patients undergoing antiplatelet and anticoagulant therapy, respectively. Regarding perioperative bleeding and transfusion rates, our results also confirm the safety of the HoLEP technique performed by a high number of surgeons, with and without experience, in a non-selected population of patients.

The short-term (3 to 6 months) and long-term (> 5 years) functional outcomes of HoLEP have been widely described in the literature. Meta-analyses comparing HoLEP with TURP or OP found no difference between the techniques for flowmetric data (Qmax and RPM) or IPSS.

In our study, we observed a 14- to 16-point decrease in IPSS at 3 and 6 months, respectively. Similarly, Qmax was improved by 13.4 to 14.2 mL/s at 3 and 6 months, respectively.

The HoLEP technique performed by a high number of surgeons, with and without experience, in a non-selected population of patients produced results similar to those reported in meta-analyses. In RCTs, the improvement in IPSS varied between 16 and 20 points at 6-month follow-up, and Qmax varied from 14 to 18 mL/s[14–16].

Even when follow-up after 6 months was available for a minority of patients, the improvement in IPSS remained stable over time in our cohort, with a median IPSS of 4 at 3-year follow-up, similar to the score reported in other publications with longer follow-up periods[4,17,18].

Urinary incontinence (UI) (stress or urgency) is the main functional complication described after HoLEP, with a rate varying from 4% to 17% at 3 months[19–22] and from 4% to 5% at 6 months[20–22]. The definition of UI in our study was based on the International Continence Society (ICS) definition: "the complaint of any involuntary loss of urine from the urethra"[23]. The results observed in our series at 3 months are slightly higher than those observed in the literature, with a UI rate of 22.9%. However, the results at 6 months (6.4%) are consistent with those described in the previously cited studies.

There is a chance that the higher rate of UI at 3 months observed in our series could be explained by the high number of inexperienced surgeons involved, as the impact of the surgeon's experience on the rate of UI has been reported in several studies in recent years[21,22,24].

In a multicenter retrospective study including 39 surgeons and 1113 patients, Shigemura et al. evaluated how surgeon experience affected outcomes including continence after HoLEP[22]. The surgeon's experience (from 20 procedures) was associated with a significantly reduced the rate of UI at 3 months, as the more experienced surgeon paid more attention to the prostatic apex than an operator at the beginning of his or her training. This threshold is also described in the study of Houssin et al., in which the UI rate at 3 months was significantly lower in multivariate analysis for surgeons who had performed 20 procedures[21]. Similar results were reported in the prospective study by Elshal et al., in which they reported the functional results and the various perioperative and remote complications of the first 313 HoLEP procedures performed by 3 surgeons. The rate of UI at 3 months decreased significantly (8.7% vs. 23.3%) after the surgeon had completed 20 procedures[24].

In our experience, only 4 patients (0.3%) with persistent UI required surgical management. Although these results should be interpreted with caution because of the limited data available and the relatively short follow-up (26 months), the literature review also shows a rate of surgical treatment for persistent UI under 1%[25].

One of the obstacles to the diffusion of the HoLEP technique over the last decade was said to be its long and steep learning curve. It has been clearly demonstrated that HoLEP requires significant experience and endoscopic skills, and the advantages of the technique increase with the experience of the surgeon[18,26].

Our series also confirmed that the surgeon's experience plays a role in terms of perioperative results (perioperative complications, transfusion rate, and LOS) and in terms of remote functional results. However, even though results were better for expert surgeons, our cohort, with a high proportion of novice operators (< 30 surgeries) confirmed clinical results close to those published in RCTs. Conversion to mTURP or OP was necessary in only 0.7% of cases (n = 8), and major complications requiring re-intervention (Clavien-Dindo ≥ 3) were seen in only 20 patients (8.8%).

Structured mentoring and supervision by an expert surgeon were critical in our experience, as previously described by Peter Gilling. The inventor of the technique divided the learning curve in 2 phases: a "mentoring" phase and a consolidation phase[27].

The importance of support at the beginning of the experience has already been underlined in a previous publication by our group[10]. In a prospective multicenter observational study without structured mentoring during the early phase of the learning curve, we looked at the success of the procedures. Successful completion was defined as enucleation and morcellation in less than 90 min without conversion to TURP. One out of 3 surgeons included in this study dropped out before the twentieth procedure. The remaining surgeons were able to complete the procedure in only 44% of the cases according to the criteria mentioned above.

Apart from the biases linked to the retrospective nature of this work, its main limitation is the large number of patients lost to follow-up after the 6-month visit, which did not allow us to evaluate the long-term results of our cohort.

The main strength of this study is the representativeness of the results in a non-selected population of patients with multiple surgeons (real-life setting) reflecting what could be expected when implementing the HoLEP technique in other urology departments.

Conclusion

With 1174 patients and 31 urologists involved in a retrospective analysis of our experience, we were able to confirm that HoLEP can be progressively mastered by most urologists in training over a 2-year period, with good functional outcomes and acceptable complication rates close to those reported in previously published RCTs. In our experience, supervision of trainees by expert surgeons seemed to be critical for the safe adoption of the technique.

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Author Disclosure

C. Klein, T. Marquette, G. Capon, E. Alezra, JC. Bernhard, P. Blanc, V. Estrade, F. Bladou : no competing interests.

G. Robert: HoLEP proctor for EDAP/TMS.

Author Contributions

C.K.: Data collection, data analysis, article writing. T.M.: Data collection, data analysis. G.C.: Critical revision of the article for important intellectual content. E.A.: Data collection. P.B: Data collection. V.E: Data collection. J.C.B.: Critical revision of the article for important intellectual content. F.B: Critical revision of the article for important intellectual content. G.R.: Protocol development, data analysis, article writing.

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