

NON-STENTED HOLMIUM:YAG URETEROSCOPIC MANAGEMENT OF LOWER URETERAL CALCULI

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Objective To evaluate the clinical outcome of non-stented ureteroscopic Holmium:YAG laser lithotripsy of lower ureteral calculi with respect to efficacy, safety, postoperative pain and hospital stay.

Patients and Methods In this randomized prospective study, 35 patients with lower ureteral calculi underwent ureteroscopy without prior ureteral dilatation followed by Holmium:YAG laser lithotripsy. No stenting was carried out at the end of the procedure. A second group of 35 age and sex matched patients who underwent the same procedure with placement of stents served as a control group. The patients were evaluated 24 and 48 hours, as well as 1 and 4 weeks postoperatively to determine postoperative pain and analgesic requirements. Radiological follow-up consisted of renal ultrasound and plain KUB film, while excretory urography was done 3 months postoperatively.

Results Five patients (14.2%) of the study group showed dilatation of the pelvicalyceal system and the upper ureter which improved completely by the seventh post-

operative day. Patients with stents had statistically significantly more postoperative pain ($P < 0.001$) and a higher requirement of analgesics ($P < 0.001$) compared to the non-stented study group. Hospitalization was 1.8 ± 1.6 and 5.7 ± 1.7 days, respectively ($P < 0.001$), and the time to return to normal activities was 7.3 ± 1.2 and 9.7 ± 1.3 days, respectively ($P < 0.001$) in the non-stented and the stented group. None of the 27 patients (77.1%) of the non-stented group who had follow-up excretory urography at 3 months had a newly identified ureteral stricture.

Conclusion Non-stented uncomplicated ureteroscopic Holmium:YAG laser lithotripsy without ureteral dilatation is safe and offers numerous advantages over routine stent placement. It will minimize the postoperative pain, the requirements for analgesia and the hospital stay and is at the same time cost effective.

Key Words ureteral calculi, ureteroscopy, holmium laser lithotripsy

INTRODUCTION

The use of stents in ureteroscopy patients is controversial since ureteral stents require dilatation of the ureteral orifice¹. Stents are foreign bodies that should be used for strict indications only. However routine placement of stents following ureteroscopic stone removal or disintegration is widely accepted^{2,3}.

The rationale for stent insertion is to reduce postoperative ureteral obstruction which may occur early due to oedema or late due to stricture formation⁴.

This study was carried out to evaluate the clinical outcome of non-stented ureteroscopic Holmium:YAG laser lithotripsy of lower ureteral

calculi with respect to efficacy, safety, postoperative pain and hospitalization.

PATIENTS AND METHODS

This randomized prospective clinical study was carried out between April 1999 and October 2000 at the urology department of Assiut University, Egypt. A total of 35 patients (23 men and 12 women) aged between 16 and 62 years (mean 37.85 years) were included in the study. Preoperative evaluation included abdominal ultrasonography, plain X-ray of the urinary tract and excretory urography, urinalysis, antibiotic culture and sensitivity and antibiotic treatment to render the urinary tract sterile before the procedure.

After obtaining informed consent, each patient was given a preoperative pain questionnaire and a demonstration of the visual analogue scale. Inclusion criteria for this study were a unilateral lower ureteral stone burden <16 mm and a normally excreting contralateral kidney. Patients were excluded from the study when the ureteral orifice could not be negotiated directly by ureteroscope without dilatation, when the stone was impacted or incompletely disintegrated or when ureteral mucosal trauma occurred during the procedure. Under these circumstances ureteral stenting would routinely be performed.

All patients received standard spinal anaesthesia using 10 mg Bupivacaine at L4-5 interspace to achieve the T8-T10 level. Patients and urologists were blinded between stented and non-stented groups until the procedure started. A floppy tip 0.035-inch guide wire was introduced into the upper collecting system using a standard rigid cystoscope (19 Fr.) under fluoroscopic control. Direct access to the ureter was achieved by using a 7.5 Fr. semirigid ureteroscope with a rotation of the ureteroscope of 180 degrees, so that the protruding nose of the ureteroscope did not catch the free ureter. Then the ureteroscope was moved up into the ureter without prior dilatation until the stone was visualized.

Appropriate laser safety measures were followed for laser lithotripsy. The holmium:YAG unit wavelength has a power output range from 1 to 60 W. A 365 μm holmium:YAG end fiber was used. The holmium:YAG settings had a frequency ranging from 10 to 15 Hz, an energy pulse ranging from 0.8 J to 1.2 J and a power ranging from 0.29 kJ to 14.39 kJ (mean 2.63 ± 2.86). The laser fiber was positioned in contact with the stone and the power was increased as needed to achieve calculus vaporization down to fine dust that could pass spontaneously without extraction maneuvers^{5,6}.

The "ablate and chip" technique was used. The pattern described as "ablate and chip" is started with a hole drilled in the surface of the stone. A circular movement of the fiber around this hole will enlarge it. The fiber is continually applied to the edge of the crater. In this way a large central crater is formed and the edges of the stone can be removed circumferentially. Care was taken to uniformly vaporize the stone to avoid back walling the mucosa through a stone trough^{7,8}. At the end of the procedure

careful endoscopic inspection of the ureter revealed a non-traumatized ureteral mucosa without any residual fragments and the procedure was terminated without ureteral or urethral stents⁸.

The pain and symptom questionnaires were completed preoperatively and 24, 48 hours, 1 and 4 weeks postoperatively. The pain scale was assessed with regard to the overall pain including flank and bladder pain and urinary symptoms. Pain assessment was done after analgesic administration⁹. After the procedure the patients were admitted to the post-anaesthesia care unit for assessment of pain and analgesic requirements. The post-operative pain was managed by intra-muscular administration of 30 mg ketorolac followed by oral administration of 10 mg ketorolac tablets.

All patients were followed up on the first postoperative day by abdominal ultrasound and plain X-ray urinary tract film to demonstrate pelvicalyceal system dilatation and any residual calculi. The patients were discharged after the second postoperative day provided they had no flank pain, that renal ultrasound showed no pelvicalyceal system dilatation and that plain X-ray revealed a stone-free status or fine dust only (less than 2 mm in diameter). Follow up was carried out at 1 and 4 weeks and at 3 months postoperatively to evaluate the safety of the procedure. The stone-free status was determined at the end of ureteroscopy and 3 months later by KUB film.

The study group of 35 patients was compared to a control group of 35 age, sex and procedure matched patients who had undergone the standard procedure (direct ureteroscopic holmium:YAG laser lithotripsy without prior ureteral dilatation) routinely terminated by ureteral catheterization in 29 (82.9%) patients and double-J stents in 6 (17.1%) patients for 3 to 5 days and 7 to 21 days, respectively.

Both groups were compared with regard to postoperative pain, analgesic requirements, duration of hospital stay, time to return to normal activities and complications. Twenty-seven (77.1%) patients were available for follow-up excretory urography at 3 months. Statistical analysis was performed using computer software.

The rank sum two sample (Mann Whitney) test was used for skewed data and the chi-square test was used for categorical data

Table 1: Patient Characteristics and Operative Data

| Patient Data | Study Group | Control Group |
|--|------------------|------------------|
| Number male patients (%) | 24 (68.8%) | 27 (77.1%) |
| Number female patients (%) | 11 (31.4%) | 8 (22.9%) |
| Mean age (years) | 35.4 | 31.4 |
| Mean stone burden (mm) | 10.5 | 11.2 |
| Number impacted stones | 0 | 6 |
| Mean disintegration time \pm SD (min) | 10.20 \pm 2.97 | 10.28 \pm 3.17 |
| Mean operative time \pm SD (min) | 12.28 \pm 3.22 | 17.62 \pm 3.40 |
| Percentage of stone-free patients: | | |
| At the end of URS | 98% | 94% |
| 3 months after URS | 100% | 98% |
| Percentage of patients with calcium oxalate monohydrate stones | 86% | 78% |

with ($P < 0.05$) considered statistically significant.

RESULTS

There was no significant difference between the study and control groups concerning age, sex, stone burden and stone composition (Table 1). The mean time of disintegration did not differ between the groups (10.20 \pm 2.97 versus 10.28 \pm 3.17 minutes, respectively) ($P > 0.05$), but there was a highly significant difference between the groups in the mean operative time (12.28 \pm 3.22 versus 17.62 \pm 3.40 minutes for the study and control group, respectively) ($P < 0.001$).

In the study group, silent persistent pelvicalyceal and upper ureteral dilatation was found in 5 (14.27%) patients, which improved completely by the end of the first postoperative week, while in the control group 2 (5.7%) patients had macroscopic haematuria that improved spontaneously following conservative measures.

Of the 35 patients of the study group, 24 (68.6%) did not have postoperative pain, 5 (14.2%) had postoperative overall pain in the evening of the procedure, 4 (11.4%) had pain on the first postoperative day lasting for 2 days, and 2 (5.7%) suffered from pain for more

than 2 days (Fig. 1). No emergency visits for analgesic intake were reported after discharge.

Of the control group, 11 (31.5%) patients did not have postoperative pain, 9 (25.7%) had postoperative pain on the evening of the procedure, 7 (20%) had pain on the first postoperative day lasting for 2 days and 8 (22.9%) suffered from pain for more than 2 days (Fig. 1).

The patients of the study group required a total of 810 mg intramuscular (IM) ketorolac (51.81 \pm 23.58 mg) compared to a requirement of 2190 mg ketorolac (IM) (106.25 \pm 64.99 mg) in the control group ($P < 0.05$) (Fig. 2), while oral ketorolac intake was 690 mg (62.72 \pm 14.20 mg) compared to 770 mg (32.08 \pm 4.14 mg) in the study and control groups, respectively ($P < 0.001$).

The average hospital stay for the study group was 1.8 \pm 1.6 days compared to 5.6 \pm 1.7 days for the control group ($P < 0.001$), (Fig. 3). The patients of the study group returned to normal activities after an average of 7.3 \pm 1.2 days compared to 9.7 \pm 1.3 days for the patients of the control group ($P < 0.001$).

The mean follow-up interval was 37.6 weeks (range from 7 to 76 weeks).

None of the 27 (77.1%) patients of the study group who were available for follow-up

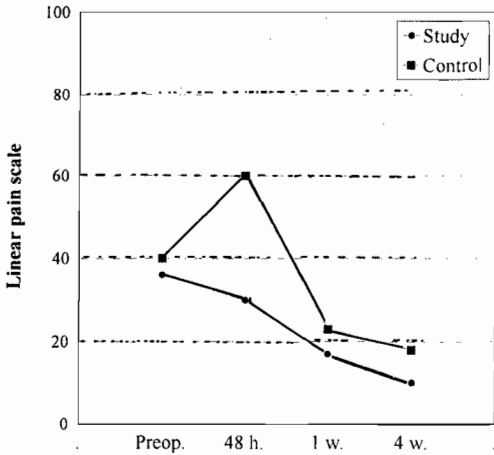


Fig. 1: Mean overall pain score measured in the study and control groups

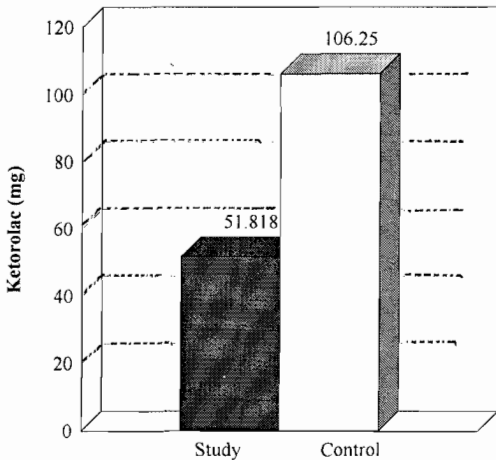


Fig. 2: Analgesia requirements of the study and control groups

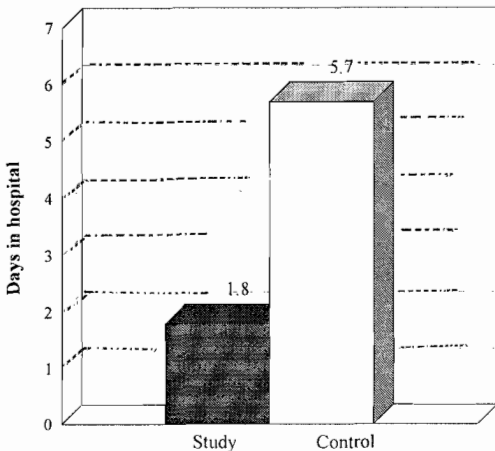


Fig. 3: Hospitalization for the study and control groups

excretory urography at 3 months demonstrated ureteral stricture formation.

DISCUSSION

It is a traditional endourologic practice after any ureteroscopy for stone treatment to stent the ureter to prevent the development of ureteral stricture, although there have been no clinical studies in humans to demonstrate that stenting prevents stricture^{4, 10}.

In an experimental study on minipigs, Boddy et al.¹¹ demonstrated the effects of acute ureteral dilatation using Teflon, low or high pressure balloon dilators on the ureteral wall. They reported that there was upper tract dilatation for 96 hours or more, and histology after 24 hours showed no evidence of ischaemic necrosis or ureteral stricture formation.

Regarding the postoperative overall pain following ureteroscopic stone treatment, there have been no clinical studies demonstrating the frequency and severity of postoperative discomfort. Pryor et al.¹² reported that all 73 patients in their study had symptoms related to ureteral stents. Also Bregg and Riehle reported that 22 patients (44%) of their study experienced postoperative discomfort that was relieved after removal of the stents¹³.

In our study we demonstrated that the non-stented procedures resulted in a reduction of postoperative discomfort, requirements for postoperative analgesia, hospital stay and days to return to normal activities. This is in agreement with the findings of Hosking et al.¹⁴ on their 93 patients undergoing non-stented ureteroscopic treatment for distal ureteral calculi. Similar results were also obtained by Borboroglu et al.¹⁵ who randomly studied 113 patients divided into stented and non-stented groups after ureteroscopy and intracorporeal lithotripsy for distal ureteral calculi. They found that patients with stents had statistically significantly more postoperative overall pain ($P < 0.001$) and total narcotic use ($P < 0.001$) than the non-stented group. Also they reported that intraoperative ureteral dilatation and intracorporeal lithotripsy did not statistically significantly affect postoperative pain or narcotic use in either group ($P > 0.05$).

The advantages of stent placement are that it reduces the peristaltic amplitude, the frequency and ureteral tonicity. It also prevents

postoperative ureteral oedema^{3,4}. On the other hand, there are many disadvantages of stent placement following ureteroscopy as it increases the duration of the procedure⁸, carries the risk of bacterial colonization and encrustation¹⁶ and even a risk of cephalic migration. There is a potential risk of trauma to the pelvicalyceal system, especially the upper calyx. Also its removal may need anaesthesia and, lastly, adds to the patient's discomfort apart from its cost and prolongation of hospital stay^{8,15,16}.

In conclusion, non-stented uncomplicated ureteroscopic Holmium:YAG laser lithotripsy without ureteral dilatation is safe and offers numerous advantages over routine stent placement. It will minimize the postoperative pain, the requirements of analgesia and the hospital stay and is at the same time cost effective.

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RESUME

La Lithotritie Par Laser Holmium-YAG sans Drainage Urétéral dans le Traitement des Calculs du Bas Uretère

Objectif Evaluer les résultats cliniques de la lithotritie par Laser Holmium-YAG sans drainage urétéral, quant à l'efficacité, la sécurité, la douleur post-opératoire et la durée du séjour hospitalier. **Patients and Méthodes** Trente cinq patients présentant un calcul du bas uretère ont bénéficié d'une urétéroscopie sans dilatation urétérale préalable suivie d'une lithotritie par Laser Holmium-YAG. Aucun drainage urétéral n'a été posé à la fin de la procédure. Un second groupe de 35 patients appariés par le sexe et l'âge qui ont été bénéficié de la même procédure mais avec drainage urétéral a servi de

groupe témoin. Les patients ont été évalués à 24 h et 48 h, mais aussi 1 et 4 semaines après l'intervention pour déterminer la douleur opératoire et le besoin en prise d'analgésiques. Le suivi radiologique consistait en une échographie rénale et une radiographie de l'abdomen sans préparation. Une UIV a été réalisée 3 mois après l'opération. **Résultats** Cinq patients du groupe d'étude (14,2%) ont présenté une dilatation pyélo-calicielle et de la portion supérieure de l'uretère qui se sont complètement amendées au 7ème jour post-opératoire. Les patients qui ont bénéficié d'un drainage post-opératoire ont de façon statistiquement significative présenté plus de douleurs post-opératoires ($p < 0.001$) et ont nécessité plus d'analgésiques ($p < 0,001$) que ceux du groupe sans sonde. La durée d'hospitalisation était de 1.8 ± 1.6 et 5.7 ± 1.7 jours respectivement ($P < 0,001$), et le temps de retour à une activité normale était de $7,3 \pm 1.2$ et $9,7 \pm 1,3$ jours respectivement ($P < 0,001$) dans le groupe sans drainage et le groupe avec sonde de drainage. Aucun des 27 patients (77,1%) qui n'avaient pas de sonde et qui ont bénéficié d'une UIV à 3 mois n'avait une sténose urétérale nouvellement identifiée. **Conclusion** Une urétéroscopie non compliquée sans dilatation préalable et sans pose de sonde post-opératoire peut être effectuée en toute sécurité chez des patients sélectionnés utilisant la lithotritie par Laser Holmium-YAG. Elle permet de réduire la douleur post-opératoire, la nécessité de prise d'analgésique, la durée d'hospitalisation et est d'un bon rapport coût efficacité.

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