

Evaluation of the Hazards of Flexible Ureteroscope for the Treatment of Renal and Ureteral Calculi during the Learning Curve

AHMED S. ISMAIL, M.Sc.; MOHAMED A. EL-BAKARY, M.D.; MAGED M. RAGAB, M.D. and
AYMAN A. HASSAN, M.D.

The Department of Urology, Faculty of Medicine, Tanta University, Tanta, Egypt

Abstract

Background: Management of urolithiasis varies from simple clinical observation and medical expulsive therapy to the use of refined endourologic techniques to extract the stone. The therapeutic technique currently available comprises ureteroscopy with or without the need for intracorporeal lithotripsy, percutaneous therapy, (PCNL) Extracorporeal Shock Wave Lithotripsy (ESWL), and surgical modalities (4,5).

Objective: Urolithiasis (UL) is one of the most common diseases, with worldwide increasing incidence and prevalence.

Aim of the Work: Was to report the hazards of Flexible Ureteroscopy (FURS), the re-treatment rate and its complication outcomes for the treatment of renal and ureteral calculi during the learning curve.

Patients and Methods: This study was conducted prospectively on forty patients divided into two groups; Group I (ureteric stone group) and Group II (renal stone group) to compare the complications after the introduction of FURS. They underwent FURS and Holmium: YAG laser lithotripsy. The complications were classified using modified stave and the Clavien system (I-IV).

Results: The mean patient age in the total procedures was 45.63 ± 10.98 years (range 27.0-62.0 years), and the mean stone size was 1.36 ± 0.37 cm (range 0.6-2cm). Group I: Mean stone size 1.36 ± 0.37 cm, the stone free rate for all cases was 77.3% (100% for stones <1.5cm and 50% for stones ≥ 1.5 cm). The overall intra-operative complications rate in all cases was 27.2% (8.3% for stones <1.5 and 50% for stone size ≥ 1.5 cm). The overall post-operative complications rate was 27.4% (9% for stones <1.5cm and 60% for stones ≥ 1.5 cm).

Group II: The mean stone size 1.46 ± 0.31 , the stone free for all cases was 44.4% (70.0% for stones <1.5cm and 12.5% for stones ≥ 1.5 cm). The overall intra-operative complications rate in all cases was 72.2% (52% for stones <1.5cm and 100% for stones size ≥ 1.5 cm). The overall post-operative

complications rate was 77.7% (60% for stones <1.5cm and 100% for stones ≥ 1.5 cm was).

Conclusions: The results of the current study indicated that stone size, stone site and surgeon experience were factors affecting complication rates after FURS.

Key Words: Flexible ureteroscopy – Learning curve – Complication – Urolithiasis.

Introduction

UROLITHIASIS (UL) is one of the most common diseases, with worldwide increasing incidence and prevalence, affecting 3-5% of the population in developed countries [1,2]. Management of urolithiasis varies from simple clinical observation and medical expulsive therapy to the use of refined endourologic techniques to extract the stone. The therapeutic technique currently available comprises ureteroscopy with or without the need for intracorporeal lithotripsy, percutaneous therapy, (PCNL) Extracorporeal Shock Wave Lithotripsy (ESWL), and surgical modalities [3,4]. Stone size and location are the most important factors influencing treatment success rates [4,5]. The rapid advances in endourology includes improved ureteroscopes technology, new complementary instruments and development of new techniques applied to ureteral lithotripsy, these result in less frequent use of traditional methods to treat ureteral lithiasis. The development of semi-rigid and flexible ureteroscopes with a working channel, through which forceps and instruments are handled, makes endoscopic treatment of urinary calculi a feasible, safe and effective procedure [6]. The last 3 decades have witnessed great improvements in the technology and clinical applications of many minimally invasive procedures in the urological field. During the past 20 years the use of lasers has expanded to most fields of

Correspondence to: Dr. Ahmed S. Ismail, The Department of Urology, Faculty of Medicine, Tanta University, Tanta, Egypt

medicine and, in many cases has treated different types of diseases and in some cases help in its diagnosis [7]. A better acknowledgment of the laser-tissue interaction will aid in guidance the clinical operators in identifying optimal laser parameters for the application and to achieve a more efficient and safer outcome [8]. A number of lasers are commercially available and this presents the urologist with a bewildering choice of wavelengths, pulse energies, pulse durations, pulse repetition rates, and fibre sizes [9]. The output parameters determine the nature of the laser-calculus interaction and this is crucial in order to understand and optimize the application. Some laser lithotripters are referred to as 'LISL' systems-Laser Induced Shock-wave Lithotripsy-such as those using a Q-switched neodymium YAG laser, on account of the observed shockwave effects during fragmentation [10].

Flexible Ureteroscopy (FURS) with the aid of Holmium: Yttrium Aluminium Garnet (YAG) laser lithotripsy has advanced considerably to become a widely utilized diagnostic and therapeutic tool for multiple upper urinary tract pathologies [11].

In the present study we reported the hazards of Flexible Ureteroscopy (FURS), the re-treatment rate and its complication outcomes for the treatment of renal and ureteral calculi during the learning curve.

Patients and Methods

Approval for the study was granted by the Local Ethics Committee of Faculty of Medicine, Tanta University.

This study was conducted in a Urology Department, Tanta University Hospitals. A total of 40 patients suffering from renal or proximal ureteral stones underwent FURS and laser lithotripsy between July 2016 and May 2017. All patients underwent the following: Medical history, physical examination. Laboratory investigations including complete blood count, serum creatinine, coagulation profiles, urinalysis and urine cultures were tested. Imaging methods (plain X-ray on urological tract, ultrasonography on abdomen and pelvis and Spiral CT on urological tract) were done pre-operatively. Data on baseline characteristics, intraoperative details and post-operative outcomes were evaluated. Analysis was focused on complications (intraoperative or post-operative). Intraoperative complications were assessed using the Satava classification system [12,13], and postoperative complications were graded according to the modified Clavien system [14,15].

Surgical technique:

All procedures were performed under general anesthesia. The ureteral access sheaths (12/14 F) were used in all cases. An 8 F flexible ureteroscope (Karl Storz, FlexXC, GmbH, Tuttlingen, Germany) was used in all cases. Stone fragmentation was achieved using a holmium laser (Holmium 100 WV versa pulse device) with 200-or 365- μ m laser fibers, the pulse energy was raised up to 0.8J or 1.0J for tough stones, and the frequency was increased up to 20Hz if necessary. The fiber tip was always visualized few millimeters away from the tip of the ureteroscope before firing the laser. Larger stone gravels was retrieved by the use of (Zero Tip Nitinol Retrieval Basket 3.5F) in a retrograde manner. JJ stent was placed at the end of the procedure on all cases and was removed approximately 4-8 weeks post-operatively.

Follow-up patients were assessed with plain X-ray on urological tract and spiral CT on abdomen and pelvis. Patients who were stone free 1 month post-operatively were considered as successful.

Statistical analysis of the data [16]:

Data were analyzed using IBM SPSS software package Version 20.0. (Armonk, NY: IBM Corp) [17]. Qualitative data were described using number and percent. The Kolmogorov-Smirnov test was used to verify the normality of distribution. Quantitative data were described using range (minimum and maximum), mean, standard deviation and median. Significance of the obtained results was judged at the 5% level.

The used tests were:

- 1- *Chi-square test*: For categorical variables, to compare between different groups.
- 2- *Fisher's Exact or Monte Carlo correction*: Correction for chi-square when more than 20% of the cells have expected count less than 5.
- 3- *Student t-test*: For normally quantitative variables, to compare between two studied groups.

Results

Patient and stone characteristics:

The data showed that there were no significant differences between both groups as regard patients'age ($p=0.152$) and sex ($p=0.482$), Body Mass Index (BMI) ($p=0.133$), stone size ($p=0.405$) and stone side (0.385). Table (1) showed that the mean operation time decreased significantly from Group II to Group I ($p<0.001$) and was shorter in patients with stone size <1.5 cm than in patients with stone size >1.5 cm.

Table (1): Comparison of patients pre-operative characteristics of both groups.

	Flexible ureteroscopic laser lithotripsy				P
	Ureteric stone (n=22)		Renal stone (n=18)		
	N	%	N	%	
Sex:					
Male	11	50.0	11	61.1	0.482
Female	11	50.5	7	38.9	
Age (years):					
Min.-max.	30.0-54.0		27.0-62.0		0.152*
Mean ± SD.	38.83±9.24		45.63±10.98		
Median	34.50		46.50		
BMI (Kg/m²):					
Min.-max.	23.0-29.0		24.0-30.0		0.133
Mean ± SD.	26.25±1.86		27.63±2.0		
Median	27.0		28.0		
Side:					
Right	14	63.6	9	50.0	0.385
Left	8	36.4	9	50.0	
Size:					
<1.5	12	54.5	10	55.6	0.949
≥1.5	10	45.5	8	44.4	
Min.-max.	0.60-1.90		1.0-2.0		0.405
Mean ± SD.	1.36±0.37		1.46±0.31		
Median	1.35		1.40		
Procedure time (min.):					
Min.-max.	30.0-65.0		80.0-120.0		<0.001
Mean ± SD.	46.23±12.49		95.06±13.91		
	No.	%	No.	%	
Stone free rate after 1 month	17	77.3	8	44.4	0.033*

The stone-free rate was also significantly higher in Group I compared to Group II ($p=0.033$) and the rate was higher for stones <1.5cm than for stones ≥1.5cm.

Details of complications of FURS for both groups during the learning curve.

The rate of intra-operative complications (according to modified stave and Clavien grading scale II-IV) in Group I was 27.2% and it was 72.2% in Group II. The rate of intra operative complications tended to be lower in Group I than Group II ($p=0.038$) and in patients with stone size <1.5cm than in patients with stone size ≥1.5cm. Also the rate of intra operative complications decreased gradually with increasing surgeon experience. The intra operative complications that were reported in both groups include the following; mild bleeding (10%), minimal mucosal injury (tear) (12.5%), Stone migration with inability to reach stone (10%) which was treated later with stent insertion and shockwave lithotripsy, mucosal injury requiring stent insertion (7.5%). Ureteral perforation managed

by placing a ureteral stent (5%) and severely bleeding requiring termination of the procedure and secondary procedure later on (2.5%).

The rate of post-operative complications in Group I was 31.8% and it was 77.7% in Group II. The rate of post-operative complications tended to be lower in Group I than Group II ($p=0.034$) and for stones <1.5cm than for stones ≥1.5cm ($p=0.030$). Also the rate of post-operative complications decreased gradually with increasing surgeon experience. The post-operative complications that were reported in both groups include the following Colic was reported in 7 patients (17.5%) this was mostly due to passage of small fragments of stones. The colic was mild in all cases and was managed by antispasmodics and analgesics and improved within few hours. Fever occurred in 5 cases (12.5%). All cases were mild and properly managed by antibiotic and antipyretic and disappeared within 1-2 days. Hematuria occurred in 3 cases (7.5%). Hematuria in all cases was mild and properly managed by coagulants and fluids and disappeared within 1-3 days. Urinary tract infection occurred in 2 cases (5%). Steinstrasse occurred in (4 cases 10%).

Table (2): Complications (intra and post-operative in both groups).

	Flexible ureteroscopic laser lithotripsy				MC _p
	Ureteric stone (n=22)		Renal stone (n=18)		
	N	%	N	%	
Intra-operative complications:					
a- Minimal mucosal injury	2	9.1	3	16.7	0.038*
b- Mild bleeding	1	4.5	3	16.7	
c- Migration of part of stone	1	4.5	3	16.7	
d- Mucosal injury requiring stent insertion	1	4.5	2	11.1	
e- Ureteral perforation managed by placing ureteral stent.	1	4.5	1	5.5	
f- Severe bleeding	0	0.0	1	5.5	
Post-operative complication:					
a- Colic	2	9.1	5	27.8	0.034*
b- Fever	2	9.1	3	16.7	
c- Hematuria	1	4.5	2	11.1	
d- Urinary tract infection	0	0.0	2	11.1	
e- Steinstrasse	2	9.1	2	11.1	

For identification of impact of surgeon experience on the intra-operative and post-operative complications rate all cases were divided into Group A (include 23 cases in the period from July 2016 to October 2016) and B (include 17 cases in the period from November 2016 to February 2017). Table (3) showed that the rate of complications

(intra-operative and post-operative) was significantly lower in Group B compared to Group A.

The rate of secondary procedure was lower in Group I compared to Group II (*p*-value 0.028) and lower for stones <1.5cm than for stones ≥ 1.5cm (*p*-value 0.020).

The hospital stay in our study after FURS ranged from 1-4 days, the mean was 2.5 ± 1.5 days.

Table (3): Overall complications according to surgeon experience.

	Flexible ureteroscopic laser lithotripsy				MC _p
	Group A (July 2016- Oct. 2016) (n=23)		Group B (Nov. 2016- Feb. 2017) (n=17)		
	N	%	N	%	
<i>Intra-operative complications:</i>					
a- Minimal mucosal injury(tear)	3	13	2	11.7	0.015
b- Migration of part of stone	3	13	1	5.8	
c- Mild bleeding	3	13	1	5.8	
d- Sever bleeding	1	4.3	0	0.0	
e- Ureteral perforation managed by placing ureteral stent	1	4.3	1	5.8	
f- Mucosal injury requiring stent insertion	1	4.3	1	5.8	
<i>Post-operative complications:</i>					
a- Colic	5	21.7	2	11.7	0.025
b- Fever	3	13	2	11.7	
c- Hematuria	2	8.6	1	5.8	
d- Urinary tract infection	2	8.6	0	0.0	
e- Steinstrasse	2	8.6	2	11.7	

Discussion

In the last 20 years, treatment options for upper urinary tract stones shifted from open to minimally invasive techniques. Developments in technology and in minimally invasive treatment modalities have enabled a stone-free status to be achieved more rapidly, with greater patient comfort [18,19]. Treatment for asymptomatic calyceal calculi is recommended based on the premise that 70% of these stones increase and will cause symptoms requiring treatment during a 5-year period [20]. Advancements in endoscope and operative techniques have led to a broader application of FURS in the management of urolithiasis. The other major factor that made it possible to expand the FURS use for upper tract stones was the introduction of holmium: YAG laser energy. This energy is rapidly absorbed by water and has minimal tissue effect through a 200 μm core sized fiber while allowing for greater ureteroscope deflection without compromising irrigant flow and consequently visibility

[21]. FURS is an important method for treating both renal and ureteral calculi. This relatively new technique is particularly beneficial for patients who are unsuitable for Extracorporeal Shock Wave Lithotripsy (ESWL) or Percutaneous Nephrolithotripsy (PCNL), patients with repetitive ESWL failure, obesity, hemorrhagic disease, lower calyceal calculi, or calyceal diverticular calculi, and patients who require multiple ESWL [22]. The major advantage of FURS is that it can reach all parts of the urinary tract. However, despite its therapeutic benefits, the use of FURS for renal and ureteral calculi may be associated with some minor or major complications [23]. Several studies have reported the complications of FURS for renal and ureteral calculi. However, the literature is lacking studies evaluate the complications of RIRS during the learning curve. In the present study we recorded the complications of FURS in the management of renal and ureteral calculi during the learning curve.

The present study was conducted on 40 adult patients with single renal or upper ureteric stone ≤2cm. They underwent RIRS using FURS (Karl Storz 8 Fr.) and Holmium: YAG laser lithotripsy. The procedure was performed under general anesthesia, since it allows temporary respiratory motion interruption enhancing the precision of the laser probe as well as reducing the rate of urothelial injury and operation time [20]. The operative time was prolonged in Group II (95.06±13.91min) compared to Group I (46.23 ± 12.49min). The ureteral access sheath was used in all cases its main advantages include easy endoscope placement, decreased intra renal irrigant pressures and reduces cost of the procedure by extending the life of the FURS [24]. It has been documented that the lack of a uniform way of reporting negative surgical outcomes has been recognized as an obstacle in interpreting the related literature, and the need for a standardized system to report complications following urological procedures has been acknowledged. In the present study we used the modified Satava Classification System (SCS) that has been proposed as a standard tool to report complications, which should be used accordingly to increase the quality of the related urological procedures [12,13]. We found that the overall incidence of intra-operative complications were 47.5%. (Grade 1 in 22.5% of the patients, grade 2 in 24.5%, and no grade 3 complications). In agreement with our results, Oguz et al., in 2014 documented the predominance of grade I complications in intra-operative RIRS for urinary calculi [25]. In the present study the incidence of intra-operative complications was higher in renal stones compared to upper ureteric stones and in stone size ≥ 1.5cm.

Complications decreased gradually with increased surgeon experience. The results of our study indicated that stone size, site and surgeon experience were factors affecting complication rates after FURS. Al-Qahtani et al., in 2012 revealed that severe mucosal injuries and ureteral perforation can be treated by placing a JJ-stent [26]. An important point which has to be emphasized is that insignificant events like mucosal tears or insignificant bleeding were not considered as a complication in previous series of ureteroscopy. The existence of grade 1 complications which need no specific treatment had exaggerated the percentage of complications. In the current study, although the overall complication rate was 47.5%, grade 1 complications made up more than a half of all cases (22.5%). Grade 2a were detected in 22.0% and grade 2b 2.5% complications and grade 3 were not experienced in any of the patients. These results were consistent with current literature of Best and Nakada 2011 & Resorlu et al., in 2012 [27,28].

Another important classification of post operative complications is Clavien classification system which was widely used for especially postoperative complications of different endourological surgeries [14,15]. Dogan et al., used the SCS and Clavien classification system for semi-rigid ureteroscopy in children [29].

Postoperative complications rate was 52.5%. The majority of complications were Clavien grade I (37.5%) then grade III (10% of patients), and grade II complications in (5%) of the patients.

In the present study, the overall stone free rate was 62.5% which was higher in group I (77.3%) than in group II (44.4%) and in patients who had stone size <1.5cm. Breda et al., in 2009 showed that the overall stone-free rates after one and two procedures in the patients in their study was 64.7% and 92.2%, respectively. The stone-free rates for patients with a stone burden greater than and less than 20mm were 85.1% and 100%, respectively. The overall complication rate was 13.6%; 97.6% of cases were performed as outpatient procedures [30]. Brito et al., in 2006 reported that complication was not seen in situation with a stone size smaller than 5mm, but complication was seen with stones >5mm, and complication rate was the highest in situations with stones >15mm. Another study of Degirmenci et al., in 2014 also showed that proximal location increases the complication risk by about 2 fold [31,32].

In the current study, post-operative JJ stent was inserted in all patients. The mean post-operative

stent duration was prolonged in Group I which was 7.67 ± 0.59 weeks due to higher rate of complications and lower stone free rate than in Group II which was 3.86 ± 1.04 weeks. In the current study, the overall incidence of secondary procedures was 37.5% which was lower in Group I (22.7%) than in Group II (55.5%) and in patients who have stone size <1.5cm. These secondary procedures include JJ stent insertion and ESWL session.

Conclusions:

We concluded stone size, site and surgeon experience were the most important factors affecting complication rates after FURS.

Additionally the modified Satava (SCS) and Clavien classification systems are easy and quick method for grading intra-operative and post-operative complications following FURS and laser lithotripsy. These classification systems helps patients to understand the safety of this surgery as much as its success.

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تقييم المخاطر المصاحبة لمنظار الحالب الضوئي المرين أثناء علاج حصوات الكلى والحالب خلال منحنى التعليمي

المقدمة: حصوات الجهاز البولي منتشرة عالميا بشكل كبير، وتؤثر في ٢-٥٪ من سكان البلدان المتقدمة وعمليات تكوين حصوات الجهاز البولي معقدة ومتعددة العوامل، وتظل غير مفهومة تماما.

علاج حصوات الجهاز البولي يختلف من الملاحظة الإكلينيكية والأدوية الطاردة إلى استخدام تقنيات المناظير لإستخراج الحصوات والعلاجات الحديثة تشمل منظار الحالب الضوئي مع أو بدون الحاجة لتفتيت الحصوات داخل الجسم، والعلاج عن طريق منظار الكلى خارج الجسم وعمل تفتيت الحصوات بالموجات التصادمية وعن طريق العمليات الجراحية. ويعتبر حجم الحصوة، ومكانها من أهم العوامل التي تؤثر على نجاح العلاج.

وقد أدى التقدم السريع في جراحة المناظير بالمسالك البولية إلى ظهور أدوات تكميلية جديدة وتطوير تقنيات جديدة تطبق على تفتيت حصوات الحالب في إستخدام طرق أقل خطورة من الطرق التقليدية لعلاج حصوات الكلى والحالب.

شهدت الثلاث عقود الماضية تحسينات كبيرة في مجال التكنولوجيا والتطبيقات للعديد من الإجراءات التنظيرية في مجال المسالة البولية ويعتبر منظار الحالب الضوئي المرين بمساعدة هولميوم ليزر أداة فعالة لتفتيت الحصوات بالليزر وقد تقدمت بشكل كبير لتصبح أداة تستخدم على نطاق واسع تشخيصية وعلاجية لعدة أمراض المسالة البولية.

خلال العشرين سنة الماضية، شهدت توسع في إستخدام الليزر في معظم مجالات الطب، وفي كثير من الحالات كان يعالج أنواعا مختلفة من الأمراض، وفي بعض الحالات يساعد في تشخيصها.

وتعد المعرفة الجيدة بالتفاعل الذي يحدث بين الليزر والأنسجة من أهم العوامل التي تساعد في إيجاد العوامل الأمثل للتطبيق وتحقيق نتيجة أكثر كفاءة وأكثر أمنا.

وهناك عدد من أجهزة الليزر المتاحة تجاريا وهذا يضع أطباء المسالك البولية في خيارات متعددة من حيث تعدد الأطوال الموجية، طاقات النبض، ومدة النبض، ومعدلات تكرار النبض، وأحجام الألياف.

الهدف من هذه الدراسة: هو تقييم المخاطر المصاحبة لمنظار الحالب الضوئي المرين أثناء علاج حصوات الكلى والحالب خلال منحنى التعليمي.

المرضى وطرق البحث: وقد أجريت هذه الدراسة على ٤٠ مريضا (٢٢ ذكور و١٨ إناث) يعانون من حصوات بالكلية والحالب أجريت لهم منظار الحالب الضوئي المرين وتم تفتيت الحصوات بجهاز الليزر في قسم جراحة المسالك البولية بجامعة طنطا في الفترة ما بين شهر يوليو ٢٠١٦ إلى شهر مايو ٢٠١٧.

النتائج: وقد أظهرت نتائج هذه الدراسة أن أعمار المرضى تتراوح ما بين ٢٧ إلى ٦٢ سنة ومتوسط أعمارهم ٤٥.٦٣ ± ١٠.٩٨ وأن عدد الذكور ٢٢ والإناث ١٨.

قد تم تقسيم المرضى إلى مجموعتين الأولى (تتضمن المرضى الذين يعانون من حصوات بالحالب وعددهم ٢٢ مريض) والمجموعة الثانية (تتضمن المرضى الذين يعانون من حصوات بالكلية وعددهم ١٨ مريض).

وقد أظهرت هذه الدراسة عدم وجود فرق كبير بين المجموعتين من ناحية السن والجنس وحجم ومكان الحصوة.

بالنسبة لنتائج المجموعة الأولى التي تتضمن ٢٢ مريض يعانون من حصوات بالحالب وقد أجرى لهم منظار الحالب المرين وتفتيت الحصوات بجهاز الليزر فكان متوسط مدة العملية ٤٦.٢٣ ± ١٢.٤٩ دقيقة لجميع الحالات وكان هذا المعدل أقل للمرضى الذين يعانون من حصوات أصغر من ١.٥ سم.

وبالنسبة لمعدل النجاح العملية فقد كان يعادل ٧٧.٣٪ وكان هذا المعدل أعلى بين المرضى الذين يعانون من حصوات أصغر من ١.٥ سم وبالنسبة لمعدل المضاعفات التي حدثت أثناء العملية فكانت تعادل ٢٧.٢٪ وكانت هذه النسبة أكبر ما بين المرضى الذين يعانون من حصوات أكبر من أو يساوي ١.٥ سم ونسبة المضاعفات التي حدثت بعد العملية فكانت تعادل ٢٧.٤٪ وكانت هذه النسبة أقل في المرضى الذين يعانون من الحصوات الأصغر من ١.٥ سم.

بالنسبة لنتائج المجموعة الثانية التي تتضمن ١٨ مريض يعانون من حصوات بالكلية وقد أجرى لهم منظار الحالب المرن وتفقيت الحصوات بجهاز الليزر فكان متوسط مدة العملية كان 13.91 ± 95.06 دقيقة لجميع الحالات وكان هذا المعدل أقل للمرضى الذين يعانون من حصوات أصغر من ١.٥ سم كان متوسط مدة العملية من الذين يعانون من حصوات أكبر أو يساوي ١.٥ سم وبالنسبة لمعدل النجاح العملية فقد كانت نسبته ٤٤.٤٪ وكان هذا المعدل أعلى بين المرضى الذين يعانون من حصوات أصغر من ١.٥ سم وبالنسبة لمعدل المضاعفات التي حدثت أثناء العملية فكانت تعادل ٧٢.٢٪ وكانت هذه النسبة أكبر ما بين المرضى الذين يعانون من حصوات أكبر من أو يساوي ١.٥ سم أما بالنسبة للمضاعفات التي حدثت بعد العملية فكانت تعادل ٧٧.٧٪ وكانت هذه النسبة أقل في المرضى الذين يعانون من الحصوات الأصغر من ١.٥ سم.

الإستنتاج والخلاصة: من خلال هذه الدراسة قد توصلنا إلى أن معدل المضاعفات المصاحبة لمنظار الحالب الضوئي المرن تعتمد على مكان وحجم الحصوة وعلى خبرة الجراح.

بالإضافة إلى ذلك تم عمل أنظمة متعددة لتصنيف المضاعفات الوارد حدوثها أثناء وبعد العملية ويعتبر تصنيف ساتافا وكلافين المعدل هما أفضل طريقتين من ناحية السهول والسرعة لتصنيف المضاعفات الممكن حدوثها أثناء وبعد العملية والغرض من هذه الأنظمة مساعدة المرضى على فهم طبيعة العملية والمضاعفات الوارد حدوثها ومعدل نجاح وسلامة هذه العملية.