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Robotic Flexible Ureteroscopy Versus Classic Flexible Ureteroscopy in Renal Stones: the Initial Romanian Experience

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Rezumat

Ureteroscopia flexibilă robotică versus ureteroscopia flexibilă clasică în litiaza renală: experiența românească inițială

Introducere: Roboflex Avicenna reprezintă o nouă platformă pentru ureteroscopia flexibilă, capabilă să ofere o litotriție mai eficientă pentru calculii renali, Bucureștiul reprezentând al patrulea oraș din lume unde se folosește această tehnică.
Material și Metodă: Studiul a fost prospectiv și a inclus un număr de 132 de pacienți egal randomizați, tratați pentru litiază renală prin ureteroscopie flexibilă standard și robotică, în perioada iulie 2015 – februarie 2016. Toate procedurile au fost efectuate utilizând un ureteroscop flexibil de tip STORZ XC în asociere cu dispozitivul robotic Avicenna Roboflex. Fragmentarea litiazică s-a efectuat utilizând un laser de tip holmium, Dornier Medilas 20H, cu o putere de 20 wati power și o lungime de undă de 2.1 μm.
Rezultate: Vârsta medie a fost de 48 de ani (interval de 26-77 ani) iardimensiuneamedie a calculilor a fost de 2.1 cm (interval de 1.1-3.6 cm) pentru primul grup (ureteroscopie flexibilă), în timp ce pentru al doilea grup (ureteroscopie flexibilă robotică) vârsta medie a fost de 51 de ani (interval de 25-74 ani) iar dimensiunea medie a calculilor a fost de 2.4 cm (interval de 1.0-3.7 cm). Timpul de fragmentare al calculilor a fost mai bun pentru ureteroscopia flexibilă robotică (37 min versus 39 min). Rata de *stone free* după 3 luni a fost de 89.4% versus 92.4%, ceea ce reprezintă o performanță evidentă a tehnicii robotice față de cea clasică. În unele cazuri au fost consemnate fragmente reziduale mai mici de 3 mm, la 13.6% din pacienții la care s-a efectuat ureteroscopie flexibilă standard comparativ cu 12.1% din pacienții la care s-a efectuat ureteroscopie flexibilă robotică.
Concluzii: În concluzie, tratamentul robotic al litiazei renale reprezintă o alterntivă comparabilă cu ureteroscopia flexibilă standard, cu rezultate în general similare acesteia.

Cuvinte cheie: ureteroscopie flexibilă robotică, calculi renali, laser homium

Abstract

Introduction: Roboflex Avicenna represents a new device for flexible ureteroscopy, able to provide an efficient lithotripsy for renal calculi, Bucharest being the fourth place in the world where such a device is already in use.
Material and methods: The study was prospective and included a number of 132 patients equally randomized which underwent standard flexible ureteroscopy and robotic flexible ureteroscopy for renal calculi between July and February 2016. All the procedures were performed with aStorz XC flexible ureteroscope in association with Avicenna Roboflex. Stone fragmentation was performed using a Dornier Medilas 20H,

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Holmium Laser of 20 watt power and 2.1 μm wavelength.
Results: The mean age was 48 years (range 26-77 years) and the mean stone size was 2.1 cm (range 1.1-3.6 cm) for the first group (FURS), while for the second one (robotic FURS) the mean age was 51 years (range 25-74 years) and the mean stone size was 2.4 cm (range 1.0-3.7 cm). The fragmentation time of the stones was better for robotic FURS (37 min versus 39 min). After 3 months, the stone free rate was 89.4% versus 92.4%, that representing a performance of the robotic technique over the classical one. In some cases were noticed residual fragments smaller than 3 mm, in 13.6% of patients who underwent FURS, respectively in 12.1% of robotic FURS' cases.
Conclusions: The robotic treatment of kidney stones represents a comparative alternative to flexible ureteroscopy, with overall similar outcomes.

Key words: robotic flexible ureteroscopy, renal calculi, holmium laser

Introduction

The treatment objectives for urolithiasis are represented by complete stone clearance associated with low morbidity. However, there are a lot of parameters to take into account when selecting the best option for treatment: stone composition, location, size, patient characteristics, instrument availability and technical experience of the surgeon.Ureteroscopy represented a preferred approach for the treatment of mid- and distal ureteral stones (1), while for renal calculi, SWL and PCNL represented the main treatment option for calculi under 2 cm, respectively over 2 cm. Flexible ureteroscopy cameto change the management of kidney stones, being a relatively minimally invasive procedure, with superior outcomes in terms of stone free rates and of morbidity for selected cases when comparing with SWL and with PCNL (2). This progress was associated with the widely introduction of different models of lasers capable to perform a safe and effective lithotripsy. In this context, flexible ureteroscopy (FURS) evolved rapidly in the last years, due to its high efficiency in treating renal calculi and not at least, to the quality improvement of the utilized armamentarium (3). In the same time, FURS may represent a challenging technique especially in complicated cases where Roboflex Avicenna could provide a suitable and safe platform for robotic FURS (4).The new robot for flexible ureteroscopy "Avicenna Roboflex" produced by Elmed-Turkey is used now in four Urologic Departments (Ankara, Paris, Heilbronn and Bucharest).

The aim of this study was to presentan initial comparison from our experience, between flexible ureteroscopy and robotic flexible ureteroscopyin the treatment of renal lithiasis after flexible robotic ureteroscopy.

Material and methods

The study was prospective and included a number of 132 randomized patients which underwent flexible ureteroscopy (66 cases) and robotic flexible ureteroscopy (66 cases) for renal calculi between July 2015 and February 2016. The inclusion criteria consisted in patients aged >18 years, pre-stented with double J stent anteriorly, with single or multiple stones, having a maximal total diameter of 35 mm, the absence of urinary tract infection, without previous ureteral surgery. Exclusion criteria included concomitant ipsilateral ureteral calculi, ipsilateral ureteral stricture or obstruction, baselinerenal insufficiency, a solitary kidney and anatomical renalanomalies. The patients were investigated before, all having preoperative baseline hematology, serum biochemistry and urine culture sensitivity tests, contrast spiral CT (*Fig. 1*) or IVP. Positive urine cultures were adequately treated with appropriate antibiotics and all patients had a negative urine culture before surgery. All the interventions were performed by a very experienced surgeon (individual surgical experience with classic flexible ureteroscopies from 6 years and 25 years of semi-rigid ureteroscopies). The evaluation of the ergonomic level was made using the adapted criteria utilized by Saglam et al.

Operatory technique

All procedures were performed with the patient under general anesthesia,a flexible ureteroscopeStorz XC being used in (*Fig. 2*), association with Avicenna Roboflex which consisted of a console and a manipulator (*Fig. 3*). The hand piece of the scope was locked to the robotic arm. The

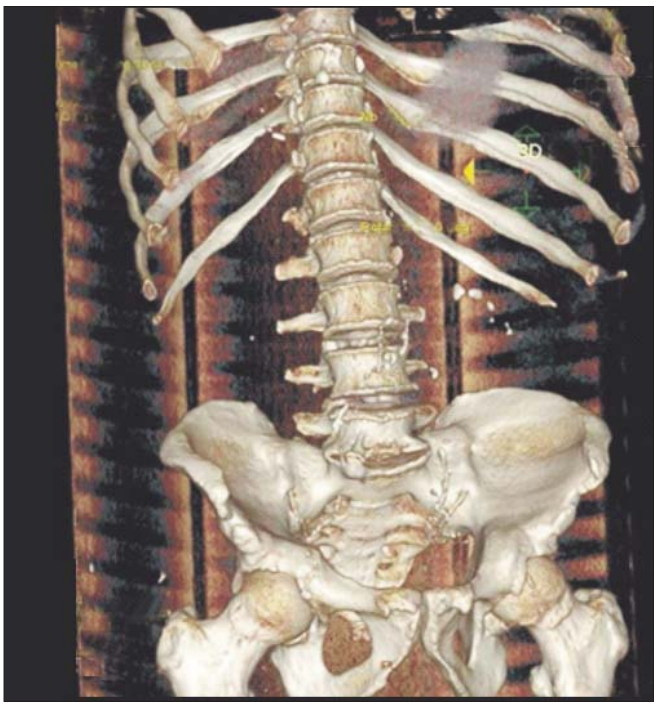


Figure 1. *CT reconstruction – renal lithiasis on the left side*

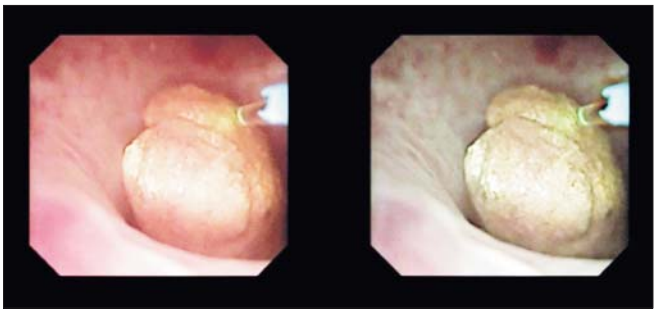


Figure 2. *Flexible ureteroscopy with Laser Holmium lithotripsy*

surgeon operated from the console,controlling two joy-sticks to manipulate the rotation, deflection and in and out movement of the endoscope. The operator could rotate the flexible device robotically at 440 degrees, thus minimizing the torsion risk of the endoscope. Once the tip came on the stone it was usually decreased to 2 mm per second to provide the precision of stone lithotripsy. The flexible robotic catheter system was manually introduced into the renal collecting system over a guide wire under fluoroscopic control. All intrarenal maneuvers, including stone relocation and fragmentation into 1 to 2 mm particles, were done exclusively from the remoterobotic console. Stone fragmentation was performed using a Dornier Medilas 20H, Holmium Laser of 20 watt power and 2.1 μm wave length (*Fig. 2*).

Results

The mean age was 48 years (range 26-77 years) and the mean stone size was 2.1 cm (range 1.1-3.6 cm) for the first group (FURS), while for the second one (robotic FURS) the mean age was 51 years (range 25-74 years) and the mean stone size was 2.4 cm (range 1.0-3.7 cm). The proportion of the stones in the kidney (Right/Left) was 31/35 cases for FURS and 29/37for robotic FURS. Among the cases which underwent FURS and robotic FURS, 51 cases respectively 43 cases presented single stone while 15 and 23 cases presented multiple stones. Depending on the position of the stones, the most calculi were situated in renal pelvis, then in lower calyx, middle calyx and the less number of calculi were situated in the upper calyx (*Table 1*). Perioperative parameters are included in *Table 2*. The treatment time was relatively similar between the two types of the procedures, while fragmentation time of the stones was significantly better for robotic FURS. Concerning the intraoperative complications, there was only one case of intraoperative bleeding during classical FURS which was conservatively treated. The number of cases which required retreatment was significantly lower for robotic FURS than for classical FURS (9.1% versus 15.1%). For all those patients, a double J stent was left in place between the interventions. When is about the outcomes, in 95.4% of cases respectively in 98.5% of patients with FURS and robotic FURS were performed acomplete stone disintegration. The stone free rate after 3 months was 89.4% versus 92.4%, thus representing a clear

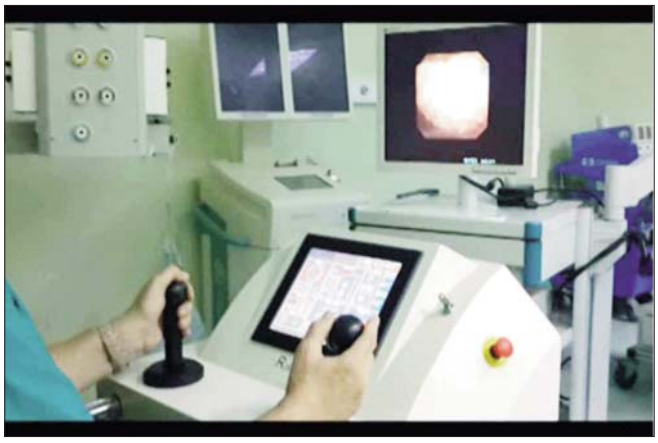


Figure 3. *During the intervention – robotic flexible ureteroscopy*

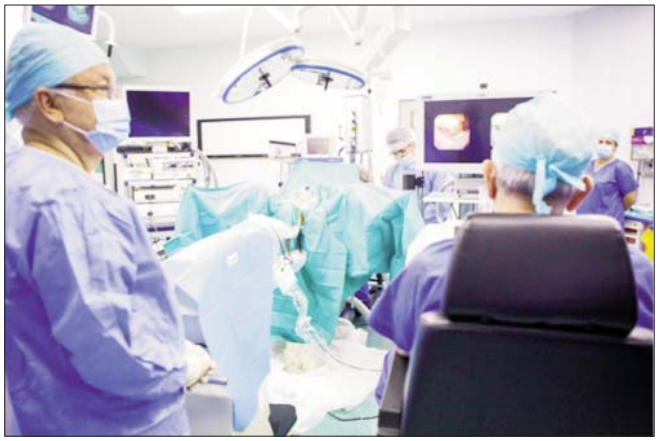


Figure 4. *Avicenna Roboflex – robotic flexible ureteroscopy for renal lithiasis*

performance of the robotic technique over the classical one. In some cases were noticed residual fragments smaller than 3 mm, in 13.6% of patients who underwent FURS, respectively in 12.1% of robotic FURS' cases (*Table 3*). Concerning the ergonomic position, robotic flexible ureteroscopy offers a better operatory comfort than flexible ureteroscopy, because of the position of the surgeon (*Fig. 4*).

Table 1. *General information about the included cases*

Criteria	Classical fURS	Robotic fURS
Age (Years)	48 (26-77)	51 (25-74)
Sex (Female – Male)	39 / 27 (26-70/29-77)	40/27 (25-64/31-74)
Kidney (Right/Left)	31/35	29/37
Single / Multiple stones	51/15	43/23
Upper calyx	2	5
Middle calyx	4	6
Lower calyx	14	15
Pelvis	45	40
Size of the stone	2.1 cm (1.1-3.6)	2.4 cm (1.0-3.7)

Table 2. Perioperative parameters for classical and robotic flexible ureteroscopy

Criteria	Classical fURS	Robotic fURS
Treatment time (min.)	50 (41-115)	51 (38-103)
Fragmentation/ dusting time (min.)	39 (32-94)	37 (27-86)
Intraoperative Complications	1.5%	0 %

Table 3. The outcomes for classical and robotic flexible ureteroscopy

Criteria	Classical fURS (%)	Robotic fURS (%)
Complete stone disintegration (1, 2 or 3 steps)	63 / 66 patients (95.4%)	65 / 66 patients (98.5%)
Stone free rate after 3 months	59 / 66 patients (89.4%)	61 / 66 patients (92.4%)
Residual fragments smaller than 3 mm.	9 / 66 patients (13.6%)	8/ 66 patients (12.1%)

Discussions

According to the literature, it is evident that flexible ureteroscopy became a very important alternative for the treatment of renal lithiasis. Our outcomes concerning the operatory time and the stone free rate in the flexible ureteroscopy reflect quite similar results with those from the literature. Turna et al. reported an overall stone-free rate of 96%, with a mean operation time of 50 min (between 40 and 100 min) (5). Hussain et al. reported a mean stone-free rate of 96.5% in patients with stones < 2 cm and a mean stone-free rate of 58.3% for stones > 2 cm (6). Depending on the stone location, Cohen et al. reported an overall stone free rate of about 87%, with a rate of 85% for the calculi situated in the upper calyx, 93% for the middle calyx and 83% for lower calyx (7). The literature data for robotic flexible ureteroscopy are quite limited due to the recent introduction in the urological armamentarium. However, Saglam et al. is one of the first authors who reported valid outcomes using this operatory technique. The treatment time was 74 min (range 40-182) in his study, with the mention that in that study the time was calculated including access sheath and double J stenting (4). The stone free rate was 80% at three months and 20% of patients presented residual calculi smaller than 3 mm, but there are now authors like Swearingen et al. who reported a total stone free rate of 100% after the robotic procedure (8). Concerning the post-operative complications, for robotic flexible ureteroscopy were not reported any incident by Desai et al., (3) while Saglam et al. reported one intra-operative complication. For flexible ureteroscopy, Bagley et al. reported an intra-operative complication rate of about 1.4%, which is similar with our outcomes (9). When is about the ergonomic position of the surgeon, there are studies that observed the necessity to develop more ergonomic platforms with the aim of reducing the endourologist's exposure to the occupational hazards (10). In this context, robotic flexible ureteroscopy, has a certain advantage of a comfortable position of the main operator.

Conclusions

Flexible ureteroscopy represents one of the major indications in upper urinary tract lithiasis with confirmed results and clear indications. The robotic treatment of kidney stones represents a comparative alternative to flexible ureteroscopy, with an increased ergonomic position for the surgeon but with an overall relatively similar outcome.

References

1. Perez Castro E, Osther PJ, Jinga V, Razvi H, Sravodimos KG, Parikh K, et al. Differences in ureteroscopic stone treatment and outcomes for distal, mid-, proximal, or multiple ureteral locations: the Clinical Research Office of the Endourological Society ureteroscopy global study. Eur Urol. 2014;66(1):102-9. doi: 10.1016/j.eururo.2014.01.011. Epub 2014 Jan 23.
2. Wright AE, Rukin NJ, Somani BK. Ureteroscopy and stones: Current status and future expectations. World J Nephrol. 2014;3(4):243-8. doi: 10.5527/wjn.v3.i4.243.
3. Desai MM, Grover R, Aron M, Ganpule A, Joshi SS, Desai MR, et al. Robotic flexible ureteroscopy for renal calculi: initial clinical experience. J Urol. 2011;186(2):563-8. doi: 10.1016/j.juro.2011.03.128. Epub 2011 Jun 16.
4. Saglam R, Muslumanoglu AY, Tokatlı Z, Caşkurlu T, Sarica K, Taşçi Aİ, et al. A new robot for flexible ureteroscopy: development and early clinical results (IDEAL stage 1-2b). Eur Urol. 2014;66(6):1092-100. doi: 10.1016/j.eururo.2014.06.047. Epub 2014 Jul 21.
5. Turna B, Stein RJ, Smaldone MC, Santos BR, Kefer JC, Jackman SV, et al. Safety and efficacy of flexible ureterorenoscopy and holmium: YAG lithotripsy for intrarenal stones in anticoagulated cases. J Urol. 2008;179(4):1415-9. doi: 10.1016/j.juro.2007.11.076. Epub 2008 Mar 4.
6. Hussain M, Acher P, Penev B, Cynk M. Redefining the limits of flexible ureterorenoscopy.J Endourol. 2011;25(1):45-49.
7. Cohen J, Cohen S, Grasso M. Ureteropyeloscopic treatment of large, complex intrarenal and proximal ureteral calculi. BJU Int. 2013;111(3 Pt B):E127-31.
8. Swearingen R, Madi R, Klaassen Z, Badani K, Sood A, Elder J, et al. A multicenter evaluation of zero-fragment nephrolithotomy: robotic pyelolithotomy and nephrolithotomy for treating renal stones. J Urol. 2015; 193(4S):e266.
9. Bagley DH, Healy KA, Kleinmann N. Ureteroscopic treatment of larger renal calculi (>2 cm). Arab J Urol. 2012;10(3):296-300. doi: 10.1016/j.aju.2012.05.005. Epub 2012 Jul 19.
10. Healy KA, Pak RW, Cleary RC, Colon-Herdman A, Bagley DH. Hand problems among endourologists. J Endourol. 2011;25(12):1915-20. doi: 10.1089/end.2011.0128. Epub 2011 Oct 17.