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ORIGINAL ARTICLE

Safety and efficacy of retrograde intrarenal surgery in patients of different age groups☆

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KEYWORDS
Elderly;
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Abstract

Objectives: To assess the efficacy and safety of retrograde intrarenal surgery (RIRS) to treat renal stones in different age groups of patients.

Patients and methods: We performed a retrospective analysis of 947 patients who underwent RIRS for renal calculi between January 2008 and January 2014. Age at RIRS was analyzed both as a continuous and categorical variable and patients were categorized into three age groups; aged ≤15 years at surgery (group I, $n = 51$), 16–60 years (group II, $n = 726$) and >60 years (group III, $n = 170$). We compared the 3 groups with the regard to stone characteristics, operative parameters and postoperative outcomes.

Results: The stone-free rate was 78.4% in group I, 77.5% in group II, and 81.1% in group III ($p = .587$). A multivariate logistic regression analysis showed that only stone size and stone number had significant influence on the stone-free rates after RIRS. Intraoperative complications occurred 13.7% in group I, 5.6% group II, and 7.6% in group III. Overall complication rates in children were higher than adult patients but the differences were not statistically significant. We found that only operation time was associated with the increased risk of intraoperative complications. Peroperative medical complications developed in 8 patients (.8%) in group II and 2 patients (1.1%) in group III. A 48-year-old man died from septic shock 5 days after the surgery.

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Conclusions: RIRS was observed to be a safe and effective procedure in all age groups of patients with stone disease, therefore age should not be considered as a limiting factor.

PALABRAS CLAVE
Ancianos;
Escáner;
Cirugía intrarrenal retrógrada;
Cálculo

Seguridad y eficacia de la cirugía retrógrada intrarrenal en pacientes de diferentes grupos de edad

Resumen

Objetivos: Evaluar la eficacia y seguridad de la cirugía intrarrenal retrógrada (CIRR) para tratar los cálculos renales en pacientes de diferentes grupos de edad.
Pacientes y métodos: Se realizó un análisis retrospectivo de 947 pacientes que se sometieron a CIRR para cálculos renales entre enero de 2008 y enero de 2014. La edad en la CIRR se analizó tanto como una variable continua como categórica, y los pacientes fueron clasificados en 3 grupos de edad; $\leq$15 años en la cirugía (grupo I, $n = 51$), 16–60 años (grupo II, $n = 726$) y >60 años (grupo III, $n = 170$). Se compararon los 3 grupos con respecto a las características del cálculo, los parámetros operativos y los resultados postoperatorios.
Resultados: La tasa de ausencia de cálculos fue del 78.4% en el grupo I, 77.5% en el grupo II, y 81.1% en el grupo III ($p = 0.587$). Un análisis de regresión logística multivariante mostró que solo el tamaño del cálculo y el número de cálculos tuvieron una influencia significativa en las tasas de ausencia de cálculos después de CIRR. Se produjo un 13.7% de complicaciones intraoperatorias en el grupo I, 5.6% en el grupo II, y 7.6% en el grupo III. Las tasas de complicación global en niños eran más altas que en pacientes adultos, pero las diferencias no fueron estadísticamente significativas. Se descubrió que solo el tiempo de operación esataba asociado con el aumento del riesgo de complicaciones intraoperatorias. Las complicaciones médicas perioperatorias se desarrollaron en 8 pacientes (0.8%) en el grupo II y 2 pacientes (1.1%) en el grupo III. Un hombre de 48 años de edad murió a causa de shock séptico 5 días después de la cirugía.
Conclusiones: Se observó que la CIRR era un procedimiento seguro y eficaz en todos los grupos de edad de pacientes con cálculos, por lo tanto, la edad no debe ser considerada como un factor limitante.

Introduction

The surgical treatment of urinary stone disease in elderly patients is challenging because age-related physiological changes in the cardiovascular, respiratory and nervous systems may increase the incidence of surgical complications and medical problems.[1–3] Although recent studies have demonstrated the effectiveness and safety of percutaneous nephrolithotomy (PNL) for elderly patients, most of the urologists often hesitate to recommend PNL in this population because of the increased incidence of adverse medical conditions and hemorrhagic or septic complications.[1,4]

Retrograde intrarenal surgery (RIRS) has been demonstrated as an alternative treatment modality to PNL and shock wave lithotripsy (SWL) with high success rates and minimal morbidity in the treatment of renal stones even for higher stone burdens.[5] However, no previous study has examined the outcomes of RIRS in elderly patients. In this study, we reviewed our RIRS experience in patients older than 60 years, and we compared their operative and postoperative parameters with our younger patient database.

Patients and methods

Patients

We performed a retrospective analysis of 947 evaluable patients who were treated with RIRS for renal calculi between January 2008 and January 2014 in 3 referral hospitals. Age at RIRS was analyzed both as a continuous and categorical variable and patients were categorized into three age groups; aged $\leq$15 years at surgery (group I, $n = 51$), 16–60 years (group II, $n = 726$), and >60 years (group III, $n = 170$).

Patient assessment included medical history, physical examination, urinalysis, urine culture, blood haemogram, serum biochemistry, coagulation tests, intravenous urography (IVU), and/or noncontrast computed tomography (CT). Stone size was determined by measuring the longest axis on preoperative radiologic investigation; in cases of multiple renal calculi, stone size was defined as the sum of the greatest dimensions of each stone.

Retrograde intrarenal surgery technique

Under general anesthesia, patients were placed in the lithotomy position. Initially, a 0.038-inch hydrophilic guidewire was placed into the renal pelvis through cystoscopy or rigid ureteroscopy. A ureteral access sheath (9.5/11.5F or 12/14F) was placed over the guidewire, and the flexible ureteroscope was passed through the ureteral access sheath. When necessary, the ureteral orifice dilated. If the ureteral access sheath placement failed, ureteroscope was advanced into the renal pelvis over the guidewire. The stones were fragmented with a holmium:YAG laser, using a 200 μ or 272 μ laser fiber at an energy level of 0.6–1 J and frequency of 5–10 Hz until they were deemed small enough to pass spontaneously. Basket extraction of residual fragments was not performed as a routine procedure, but some residual fragments were removed by tipless nitinol baskets for stone analysis. Postoperatively, a double-J stent was placed based on surgeon decision.

Follow-up

Stone-free status was determined in an outpatient clinic setting at 4–8 weeks after the operation with low-dose spiral CT or combination of plain radiography and urinary ultrasonography. Success was defined as a complete stone-free status or residual calculi <4 mm on imaging modality. Patients were seen every 3 months during the first year, and every 6 months thereafter. At each visit, urinalysis, serum creatinine, plain film, and abdominal US were performed.

Data analysis

The three age groups were compared with each other according to patient demographics (age, gender), stone characteristics (size, location, laterality), operative parameters (operation time, stone clearance, intraoperative complications), and postoperative data (hospitalization time, postoperative complications). The impact of patient age on the outcomes was also analyzed as a continuous variable.

All statistical analyses were performed using SPSS, version 15.0 (SPSS, Chicago, IL). The Chi-square test was used to evaluate the association between categorical variables. One-way analysis of variance and t-test were used to compare the mean of the continuous variables. A logistic model was used to determine the odds ratios for statistically significant parameters affecting complications. The data are expressed as the mean ± standard deviation. Statistical significance was defined as $p < 0.05$.

Results

Patient and stone characteristics

A total of 947 patients (545 males and 402 females) with a mean age of 44.1 ± 16.1 years (1–87 years) were included in the present study and were divided into 3 age groups. The mean patient age was 8 years (1–15 years) in group I, 41.4 years (16–60 years) in group II, and 66.5 years (61–87 years) in group III. The mean stone size was 14.4 ± 6.5 mm in group I, 15.8 ± 6.9 mm in group II, and 17.2 ± 7.2 mm in group III. As delineated in Table 1, mean stone size was significantly larger in elderly patients ($p = 0.01$). Renal pelvis (34.7%) and lower pole (30.2%) accounted for most stone locations, whereas 16.7% of the stones were in the middle or upper pole of the kidney. Slightly more than half of the procedures were on the right side and a total of 485 patients (51.2%) had a history of failed SWL. Table 1 shows the patient and stone characteristics.

Operative findings

A ureteral access sheath was used in 781 patients (82.5%), and a double-J stent was placed at the end of the procedure in 692 patients (73.1%). The mean operative time was 44.7 ± 25.9, 49.3 ± 18.5, and 53 ± 23.4 min in group I, II and III, respectively. This difference was statistically significant ($p < 0.001$). The operation time was calculated from the time of cystoscope insertion to the completion of double-J stent placement. The mean postoperative hospital stay was 1.49 ± 1.58 days (range 0–22), and no significant difference was found among the groups.

The stones were completely fragmented in 741 (78.3%) patients after single procedure. The stone-free rate was 78.4% in group I, 77.5% in group II, and 81.1% in group III. Success rate in elderly cases was higher than younger patients but the differences were not statistically significant ($p = 0.587$). The stone-free rate stratified by stone location was 84.4% in the renal pelvis, 79.3% in the lower pole, 77.1% in middle pole, 75.2% in upper pole, and 66.4% in multiple calyceal location ($p < 0.001$). To determine statistically important factors for achieving stone-free status; age, sex, use of ureteral access sheath, previous failed SWL, stone size, stone location, and stone number were considered as independent variables in the multivariate model. Only stone size ($p < 0.001$) and stone number ($p < 0.001$) had significant influence on the stone-free rates after RIRS.

Intraoperative and postoperative complications

A total of 85 (8.9%) intraoperative complications were encountered in 61 (6.4%) patients. These complications occurred 13.7% in group I, 5.6% in group II, and 7.6% in group III. Overall complications rates in children were higher than in adult patients, but the differences were not statistically significant ($p = 0.059$). We found that only operation time was associated with the increased risk of intraoperative complications ($p = 0.004$). The most common complications were mucosal injury (4.2%), bleeding (3.6%), and ureteral perforation (0.7%). Bleeding was mostly clinically insignificant and no patient required blood transfusion in either group. However, in 7 cases (0.7%) intrarenal hematoma and in 4 cases (0.4%) severely bleeding occurred, which resulted in poor visibility and the procedure was aborted.

In 55 patients (5.8%), postoperative infectious complications occurred consisting of urinary tract infection, fever, and urosepsis. The infectious complication rates for the groups were similar and not significantly different (7.8% in group I, 5.5% in group II, and 6.4% in group III; $p = 0.164$). However, in group II, a 48-year-old man died

Table 1 Patient and stone characteristics.

	Total	Group I	Group II	Group III	*p* value
No. patients (%)	947	51 (5.4%)	726 (76.6%)	170 (17.9%)	
Mean age (range [years])	44.1 (1–87)	8 (1–15)	41.4 (16–60)	66.5 (61–87)	
Gender					
Male	545 (57.6%)	23 (45.1%)	424 (58.4%)	30 (53.6%)	0.178
Female	402 (42.4%)	28 (54.9%)	302 (41.6%)	26 (46.4%)	
Stone size ± SD (mm)	16.1 ± 6.9	14.4 ± 6.5	15.8 ± 6.9	17.2 ± 7.2	0.01*
Stone location (%)					0.685
Pelvis	329 (34.7%)	21 (41.2%)	249 (34.3%)	59 (34.7%)	
Lower pole	286 (30.2%)	9 (17.6%)	226 (31.1%)	51 (30%)	
Upper/middle pole	159 (16.7%)	10 (19.6%)	123 (16.9%)	26 (15.2%)	
Multicaliceal	173 (18.3%)	11 (21.5%)	128 (17.6%)	34 (20%)	
Stone side (%)					
Right	469 (49.5%)	21 (41.2%)	377 (51.9%)	71 (41.8%)	0.005*
Left	456 (48.2%)	26 (50.9%)	333 (45.9%)	97 (57.1%)	
Bilateral	22 (2.3%)	4 (7.8%)	16 (2.2%)	2 (1.1%)	

* Statistically significant at $p < 0.05$.

Table 2 Comparison of operative and postoperative data.

	Group I	Group II	Group III	*p* value
Mean operative time ± sd (min)	44.7 ± 25.9	49.3 ± 18.5	53 ± 23.4	<0.001*
Stone-free rate (%)	40 (78.4%)	563 (77.5%)	138 (81.1%)	0.587
Mean hospitalization time (range [days])	1.8 (1–10)	1.4 (1–22)	1.6 (1–18)	0.184
Intraoperative surgical complications	7 (13.7%)	41 (5.6%)	13 (7.6%)	0.059
Postoperative infectious complications	4 (7.8%)	40 (5.5%)	11 (6.4%)	0.164
Peroperative medical complications	–	8 (0.8%)	2 (1.1%)	
Mortality (%)	–	1 (0.13%)	–	

* Significant at 0.05 level.

from septic shock 5 days after the surgery. Peroperative medical complications, such as acute coronary syndrome, pulmonary embolism, arrythmia, hypertensive crisis, cerebrovascular disease, or organ dysfunction, developed in 8 patients (0.8%) in group II and in 2 patients (1.1%) in group III. Intraoperative and postoperative findings of patients are summarized in Table 2.

Discussion

Management of renal stones in elderly patients is a controversial topic. Age-related deterioration in the renal functions and cardiopulmonary system is usually present in geriatric patients.[1,6] These physiological changes make them less tolerant to surgical complications and can increase the frequency of medical problems.[7,8] Furthermore, elderly patients typically have more medical conditions than younger patients, including diabetes, coronary artery disease, dementia, hypertension, chronic obstructive pulmonary disease, and congestive heart failure.[9] Therefore, meticulous choice of treatment modalities and using minimally invasive procedures are more critical topics in elderly patients for reducing life threatening complications.

Currently SWL, PNL, and RIRS are accepted main minimally invasive modalities for the treatment of renal stones.[10] Although PNL is considered to be a safe and effective procedure, serious complications such as blood loss, organ injuries, and serious medical complications are reported in the current series.[1,6,11] In a recent study, Unsal et al. reported their PNL series in 1406 patients with an overall complication rate of 29.3% and success rate of 83.7% after a single procedure.[11] Of the complications, 77% were related directly to surgery and others were medical complications such as acute coronary syndrome, pulmonary embolism, arrhythmia, hypertensive crisis, cerebrovascular disease, or organ dysfunction. They showed that preoperative co-morbidities were associated with postoperative complications and advanced age was significantly related to higher medical complication rates.

In another recent study, Resorlu et al. reported a large series of PNL procedures in the treatment of kidney stones in elderly patients, with a surgical complication rate of 25% and a medical complication rate of 13%.[1] The importance of favorable safety characteristics of RIRS was especially highlighted by authors and they concluded that RIRS or conservative management of renal stones might be

a safe alternative to PNL in high-risk geriatric patients. In the present study, we observed postoperative surgical complications with a rate of 6.4% and medical complications with a rate of 1%, which is lower than the reported complication rate of PNL in elderly patients. Despite these results, published data on experience with percutaneous surgery emphasized that PNL is a safe and effective therapy for the geriatric population.[4,6,12,13] However, most of these studies included only a small number of elderly patients.

Studies regarding the effect of age on the success of SWL have conflicting results.[14] Early reported studies have considered that this technique is safe and effective even in elderly patients.[7,15] However, a report by Abdel-Khalek et al., reviewed the 2954 patients with renal stones treated by SWL and showed that patients older than 40 had a significantly poorer stone fragmentation rate than younger population.[16] In another study, Ng et al. demonstrated that aging could affect the success rate of SWL for renal calculi but not ureteric stones.[17] The reason for this observed difference of aging on SWL is unknown but authors suspected that it might be related to age-related glomerulosclerosis, which has an impact on the effectiveness of shockwave transmission to renal stones.[8]

Although several articles have reported the outcomes of SWL and PNL in the geriatric population, the feasibility of RIRS has never been studied. Retrograde management of renal stones offers some advantages, such as higher success rate than SWL and lower morbidity than PNL procedures.[18] Therefore, it has become one of the preferred treatment modalities in the management of renal calculi in recent years.[19] However, this procedure may be hazardous and challenging in the geriatric population because of anesthesiologic issues and decreased cardiopulmonary reserve.[20] Furthermore, the upper urinary tract peristaltism may be affected by age-related tissue changes and this condition may lead to decreased expulsion rate of stone fragments after RIRS. But, according to the results of the present study, age does not seem to have an impact on the outcomes of RIRS. We showed that all age groups have equal stone-free rate after a single procedure despite the fact that patients older than 60 years had a relatively larger renal stones, and these success rates are comparable to other published RIRS series.[5,18–20]

Although this is the first report of RIRS in this age group, there are several limitations in the present study. The first is that the study is retrospective in nature. The second limitation is that not all patients were postoperatively evaluated with CT. This limitation arose from the multicentric and retrospective nature of the study. The third, there was a significant difference in stone size between the groups. Finally, the most important limitation of this study is that association of preoperative comorbidity status and postoperative outcomes were not compared between the groups. Therefore, larger prospective studies are required to confirm these findings.

Conclusion

In conclusion, RIRS is an effective treatment modality with high stone-free rates and low morbidity. Aging and age-related physiological changes did not alter the success rate and did not increase the intraoperative and postoperative complications. We believe our findings will be useful in preoperative decision making in elderly patients with kidney stone disease.

Conflict of interest

The authors declare that they have no conflict of interest.

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