Safety and efficacy of retrograde intrarenal surgery for urolithiasis in octogenarians

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Research Article

Keywords: Complications, Octogenarians, Retrograde intrarenal surgery, Stone-free rate, Urolithiasis

Posted Date: May 13th, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1633480/v1

Abstract

Kidney stone disease is a common urological disorder worldwide. However, little evidence is reported to support retrograde intrarenal surgery (RIRS) for urolithiasis in octogenarians. Therefore, this study aimed to examine the safety and efficacy of RIRS for urolithiasis in octogenarians. A total of 1,207 patients were analyzed, 166 in the octogenarian patient group and 1041 in the younger patient group. The proportion of female patients ($p < 0.001$), American Society of Anesthesiologists (ASA) score ($p < 0.001$), rate of preoperative pyelonephritis ($p < 0.001$), and diabetes mellitus ($p = 0.003$) were higher in the octogenarian group than in the younger group. No statistically significant differences were found between the two groups in terms of stone size, location, operative time, and intraoperative complications. Postoperative complications, which reached a significant difference, were observed in 34 (20.5%) octogenarians and 117 (11.2%) younger patients ($p = 0.002$). However, age itself was not significantly associated with the occurrence of complications in multivariate analysis. Female sex ($p < 0.001$), ASA score of ≥ 3 ($p = 0.045$), history of diabetes mellitus ($p = 0.029$), and prolonged operative time (≥ 120 min) ($p = 0.043$) were the significant predictors of complications. The stone-free rate in the octogenarian group was superior to that in the younger patient group (80.1% vs. 68.2%, respectively; $p = 0.014$), indicating that RIRS in the octogenarians was an effective treatment with a high success rate. In conclusion, our results suggest that RIRS for urolithiasis can be safely and effectively applied to octogenarians in selected cases.

Introduction

Kidney stone disease is one of the most common urological disorders worldwide. Previous epidemiological studies have reported an increased prevalence of kidney stone disease, which is becoming more common in the elderly [1–4]. The retrograde intrarenal surgery (RIRS) for urolithiasis has become widely embraced and employed as the first-line treatment in the European Association of Urology guidelines for urolithiasis of < 20 mm [5]. However, few studies have demonstrated the differences in the outcomes of RIRS for urolithiasis in the elderly compared with the general population[6, 7], and little evidence support RIRS in patients older than 80 years[8]. Therefore, this study aimed to examine the safety and efficacy of RIRS for urolithiasis in octogenarians compared with younger patients and identify preoperative risk factors for the incidence of postoperative complications.

Methods

This study was approved by the Institutional Review Boards of Ijinkai Takeda General Hospital (#R2020005). Data of 1,235 patients who underwent RIRS for urolithiasis from January 2012 to December 2019 at a single institution were retrospectively collected. Exclusion criteria were cases with urinary diversion after cystectomy and horseshoe kidney. After excluding those patients, 1,207 patients were included in the analysis. Demographic and medical data were gathered, including age, sex, body mass index (BMI), American Society of Anesthesiologists (ASA) score, stone size, and location. Stone size and location were preoperatively assessed using computed tomography (CT). Patients were divided into octogenarians (age: ≥80 years) and younger patients (age: <80 years) for comparison. The groups

were compared regarding intraoperative and postoperative complications and stone-free rate (SFR). Intraoperative complications were assessed according to the ClassIntra classification system [9]. Postoperative complications were assessed according to the modified Clavien-Dindo classification [10]. Patients were assessed by kidney-ureter-bladder radiography (KUB) to appraise the SFR within a month after RIRS. The “stone-free” status was defined as complete stone clearance or residual stone fragment of <2 mm on KUB. The primary study endpoint was postoperative complication rates. The secondary endpoints included intraoperative complication rates and SFR.

All patients underwent urine culture test, and a double-J ureteral stent (Polaris, Boston) was implanted 6–8 days before RIRS, in case of kidney and/or upper ureter stones other than the lower ureter, to dilate the ureter and avoid intraoperative ureteral injury. Patients with obstructive pyelonephritis due to ureteral stones were treated with a single-J ureteral stent (Vortek, Coloplast), and RIRS was performed after an improved general condition.

Surgical procedure

First, the ureter was carefully evaluated by semi-rigid ureteroscopy to identify stones or stricture. A stone found in the ureter was crushed using a pneumatic lithotripter (Lithoclast, Boston) in principle, and the crushed stone fragment was removed from the body or into the bladder using grasping forceps. After the ureteral stones were fragmented and extracted, a ureteral access sheath (12/14 Fr or 14/16 Fr, Bard) was inserted. A flexible digital ureteroscopy (URF-V3, 8.4 F. or URF-V, 9.9 Fr, Olympus) was used for renal stone fragmentation. A 200-μm Holmium laser lithotripsy was performed depending on the stone size, and a stone basket (THS stone basket, Takai) was employed to retrieve fragments if required. The postoperative double-J stent (Inlay, Bard) was routinely placed for 2–4 days.

Statistical analysis

Statistical analyses were performed using EZR (Saitama Medical Center, Jichi Medical University, Saitama, Japan), which is a graphical user interface for R (The R Foundation for Statistical Computing, Vienna, Austria) [11]. For variables, the different groups were compared using the chi-square test or Mann-Whitney U-test, as appropriate. Postoperative complication predictors were assessed using logistic regression models. Propensity score matching was performed for sex, ASA score, performance status, BMI, estimated glomerular filtration rate, comorbidities, stone location, pre-stent, pyelonephritis, and stone size to control patient characteristics that may affect surgical outcomes in a one-to-one manner using a caliper width of 0.2 for the standard deviation. P-values of <0.05 were used to denote statistical significance.

Results

A total of 1,207 patients were included in the present study. The octogenarian group included 166 patients, and the younger patient group consisted of 1,041 patients. Table 1 shows a summary of patient characteristics. Of the patients, 21.7% of the octogenarian group had an ASA score of 3, whereas 5.5% in

the younger patient group ($p < 0.001$). The octogenarian group had a significantly higher proportion of females ($p < 0.001$) and lower BMI ($p < 0.001$). Moreover, the octogenarian group had more diabetes mellitus ($p = 0.003$), cerebrovascular comorbidities ($p < 0.001$), and a higher rate of preoperative pyelonephritis ($p < 0.001$). The younger patient group had more extracorporeal shock wave lithotripsy history before RIRS ($p < 0.001$). The mean stone size was 10.0 mm and 11.5 mm for the octogenarian and the younger patient groups, respectively. No statistically significant differences were found between the two groups in terms of stone size and location.

Next, we examined perioperative factors in both groups to clarify the safety and efficacy of RIRS. The mean operative time, intraoperative and postoperative complications, and SFR are shown in Table 2. The mean operative time was 62.2 min for the octogenarian group and 61.2 min for the younger patient group. The occurrence of all intraoperative complications during RIRS were 105 (8.7%) patients, which were minor complications (ClassIntra classification system grade Ⅰ to Ⅱa) except in one case. Of the 105 patients, 11 (6.6%) were octogenarians, and 94 (9.0%) were younger patients. No significant differences were noted in the operative time and intraoperative complications in the octogenarian group compared with the younger patient group. All postoperative complications after RIRS were observed in 151 (12.5%) patients, of whom 34 (20.5%) were octogenarians and 117 (11.2%) were younger patients, which had a significant difference ($p = 0.002$). Similarly, a difference in the occurrence of grade III or higher complications was found between 4 (2.4%) for the octogenarian group and 8 (0.8%) for the younger patient group; however, the difference was not statistically significant ($p = 0.062$). The most frequent postoperative complication was fever. Of the 151 patients who had complications, 128 patients (30 octogenarians and 98 younger patients) experienced febrile episodes after the procedure. A fever of grade III or higher was observed in 8 patients (4 octogenarians and 4 younger patients). The occurrence of Grade V complications was not noted. The SFR was 80.1% in the octogenarian group and 68.2% in the younger patient group ($p = 0.014$). The SFR was significantly higher in the octogenarian group than in the younger patient group.

Then, we analyzed our data by performing a multivariate analysis to investigate the factors associated with postoperative complications. Multivariate logistic regression analysis showed that age (the octogenarian vs. younger patient) was not a risk factor for postoperative complications (odds ratio [OR], 1.02; 95% confidence interval [CI], 0.60–1.75; $p = 0.92$). As shown in Table 3, independent risk factors for postoperative complications included female sex (OR, 2.08; 95% CI, 1.41–3.06; $p < 0.001$), ASA score of ≥ 3 (OR, 1.88; 95% CI, 1.06–3.57; $p = 0.045$), history of diabetes mellitus (OR, 1.69; 95% CI, 1.05–2.45; $p = 0.029$), and prolonged operative time (≥ 120 min) (OR, 1.77; 95% CI, 1.02–3.12; $p = 0.043$).

Finally, we performed a propensity score matching and adjusted for the patient backgrounds between the octogenarian and younger patient groups to examine the contribution of age to perioperative outcomes. Then, 71 matched pairs were selected for the final analysis (Table 4). Postoperative complications were observed in 8 octogenarians and 13 younger patients ($p = 0.24$). Similar to the multivariate analysis results, the propensity score-matched analysis did not result in a significantly higher incidence of postoperative complications in octogenarians compared to younger patients. The SFR was 87.3% in the

octogenarian group and 71.8% in the younger patient group, with significantly higher success rates in the octogenarian group ($p = 0.044$).

Discussion

This study revealed no significant difference in the incidence of intraoperative complications of RIRS for urolithiasis between the octogenarian and younger patient groups. The incidence of postoperative complications was significantly higher in the octogenarian; however, the difference in multivariate analysis and propensity score-matched analysis between the octogenarian and younger patient groups was not significantly associated with the occurrence of postoperative complications. Furthermore, RIRS in the octogenarian was an effective treatment with a high success rate.

A variety of conditions that affect stone formation (reduced fluid intake due to immobility and dysphagia) and comorbidities (urinary tract infection, hypertension, diabetes, and decreased renal function) are thought to contribute to stone morbidity in the elderly [12]. Previous epidemiological studies have reported an increased prevalence of kidney stone disease in the elderly [3, 4]. According to global demographic data, the prevalence of kidney stones among the elderly aged 65 years and older in developed countries is estimated to increase up to 19.1% in males and 9.4% in females by 2050 [13]. Additionally, the elderly are at increased risk of infections due to kidney stones [14]. However, to our best knowledge, few studies have examined the safety and efficacy of RIRS for urolithiasis in the elderly, and little evidence support RIRS in patients over 80 years of age. Japan has one of the highest ratios of elderly people in the world [15], therefore, we believe that reporting clinical outcomes of RIRS for urolithiasis in octogenarians at an institution in Japan is very meaningful.

This study included 1,207 patients, of whom 166 (13.8%) were octogenarians. Our data showed that all intraoperative and postoperative complications were found in 105 (8.7%) and 151 (12.5%) patients, respectively. The occurrence rate of perioperative complications in this study was similar to those reported in the previous studies [16–19]. This study revealed no significant difference in the incidence of intraoperative complications of RIRS between the octogenarian and younger patient groups, and age itself was not significantly associated with the occurrence of postoperative complications in multivariate analysis and propensity score-matched analysis. Generally, aging is related to a gradual decline in a reserve capacity, even in individuals without underlying comorbidities, which decreases the ability of elderly patients to tolerate stress [20]. Thus, older age is an independent predictor of increased postoperative complications [21]. However, few studies have focused on the elderly; however RIRS for urolithiasis has been reported as a feasible procedure in the elderly, and age itself should not be considered a limiting factor, similar to our study [6, 7]. Additionally, it has also been reported that RIRS could be safely applied to octogenarians [8]. Considering these findings and our data, RIRS for urolithiasis was considered a feasible operation even in octogenarians, and age itself may not be a risk factor for postoperative complications following RIRS.

This study showed significant predictors of complications, including female sex, ASA score of ≥ 3, diabetes mellitus history, and prolonged operative time. Similar to our study, female gender and medical complexity were predictive of urinary tract infection in the Clinical Research Office of the Endourological Society Ureterorenoscopy Global Study (CROES Global Study URS) database [18]. Furthermore, past reports indicate that female sex and ASA score were the independent predictors of the occurrence of postoperative complications following RIRS [22–24]. Moreover, longer operative time was associated with postoperative fever [19, 23]. Moses et al. reported that operative times of > 120 min were associated with postoperative fever, similar to our study [25]. As other predictors of complications, a history of pyelonephritis obstructive or positive urine culture has been reported as a risk factor for postoperative fever [26, 19, 23]. In our study, postoperative complications occurred more frequently in patients with a history of pyelonephritis, but this was not statistically significant. Reducing postoperative complications after RIRS for urolithiasis is important; however, preventing complications in patients at high risk of complications, such as gender and medical history as described above, may not be easy. However, the operative time can be somewhat managed by urologists. For patients who are expected to undergo lengthy RIRS, a two-step RIRS or an alternative approach for urolithiasis should be considered.

Currently, the optimal definition of SF has no universally accepted protocol. Patients with residual fragments of > 2 mm are more likely to require retreatment; thus, a consensus is emerging that SF should be ≤ 2 mm [27]. Our institution has also previously reported that a residual fragment of ≥ 4 mm was a risk factor for future intervention [28]. Therefore, we defined SF as no evidence of > 2 mm stones on postoperative KUB. CT is the most accurate modality for detecting urinary calculi and is capable of detecting uric acid calculi at the expense of high cost and radiation exposure. KUB is hindered by lower sensitivity for stones of < 5 mm and cannot detect radiolucent stones [29]. Additionally, obesity may decrease sensitivity. However, it has the advantage of low exposure and low cost. In our study, the SFR was significantly higher in the octogenarian group than in the younger group, which was 80.1% in the octogenarian group and 68.2% in the younger group, and was comparable to the SFR of 65–79% reported in the literature [30]. The kidney stones were smaller and the operative time was slightly longer in the octogenarian group. The physicians might have tried SF more diligently on the octogenarians with lower activity levels, which may have been a bias. However, considering some errors in imaging modalities or surgical bias, RIRS for urolithiasis could be effectively applied to octogenarians with a high success rate.

This study has certain limitations. A major limitation of this study is its retrospective design. Another limitation is the potential for patient selection bias. The choice of observing patients with kidney and/or ureter stones, performing RIRS, or performing other treatments, such as extracorporeal shock wave lithotripsy or percutaneous nephrolithotomy, depends on many factors, including the surgeon’s preference and the patient’s clinical condition. However, regardless of these limitations, our present study supports the clinical benefit of RIRS for urolithiasis in octogenarians.

Conclusion

RIRS for urolithiasis is a feasible procedure in octogenarians, and age itself is not a risk factor for postoperative complications. Furthermore, RIRS in octogenarians is an effective treatment with a high success rate. Hence, our results suggest that RIRS for urolithiasis is safe and effective for selected octogenarians.

Declarations

Shigeki Koterazawa, Toru Kanno and Hitoshi Yamada contributed to study conception and design. Toshifumi Takahashi, Shinya Somiya, Katsuhiro Ito, Takao Haitani, Ryuichiro Arakaki, and Norio Kawase contributed to acquisition of patients' data. Shigeki Koterazawa and Toru Kanno contributed to analysis and interpretation of the data and statistical analysis. Shigeki Koterazawa, Katsuhiro Ito, and Yoshihito Higashi contributed to drafting the manuscript. Toru Kanno, Katsuhiro Ito, and Hitoshi Yamada contributed to revising it. All authors read and approved the final manuscript.

Conflict of interest: All authors declare that they have no conflict of interest.

Ethical approval: This study was approved by the Institutional Review Boards of Ijinkai Takeda General Hospital (#R2020005)

Funding: No funding was received for this article.

Acknowledgment

The authors would like to thank all patients who patriated in this study for their important contributions.

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Tables

Table 1-4 are available in the Supplementary Files section.

Supplementary Files

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