

## Mortality and flexible ureteroscopy: analysis of six cases

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### Abstract

**Purpose** Advancements in the endourological equipment have made retrograde intrarenal surgery (RIRS) an attractive, widespread technique, capable of competing with traditional shock wave lithotripsy and percutaneous nephrolithotomy. Since the complication rate is generally low, even less is known about dramatic and fatal complications after RIRS.

**Methods** We performed a survey asking 11 experienced endourologists to review their RIRS series and report the cases of mortality to their best knowledge.

**Results** Six urologists reported on six fatal cases. In three cases, a history of urinary tract infections was present. Four patients died from urosepsis, one due to an anesthetic and one due to hemorrhagic complication. The use of ureteral access sheath was not common.

**Conclusion** Even respecting the standards of care, it may happen that physicians are occasionally tempted to overdo for their patients, sometimes skipping safety rules with an inevitable increase in risks. Despite the fact that RIRS has

become a viable option for the treatment of the majority of kidney stones, its complication rates remain low. Nevertheless, rare fatal events may occur, especially in complex cases with a history of urinary tract infections, and advanced neurological diseases.

**Keywords** Flexible ureteroscopy · Retrograde intrarenal surgery · Renal stone · Laser lithotripsy · Death · Complications

### Introduction

Retrograde intrarenal surgery (RIRS) represents an intriguing technique that allows surgeons to successfully treat renal stones, usually managed by both shock wave lithotripsy (SWL) and percutaneous nephrolithotomy (PCNL), even in demanding clinical scenarios such as pregnancy, anatomic malformations, coagulopathies and large stone burdens [1]. Despite its safety profile, some severe complications have been described [1, 2]. The available literature reports on only two cases of death after RIRS [3, 4]. On the contrary, we do know whether in daily practice this event is slightly more frequent, being such deaths underreported because physicians are usually not very willing to admit such a terrifying and fatal complication.

The aim of this study is to collect, report and describe all the available details concerning some cases of mortality after RIRS.

### Methods

This survey was done at the “Cottolengo Hospital,” in Turin, Italy, during the “Technology and Training in

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Endourology in 2014” Annual Meeting on November 2014. All the participants were invited to participate, and 11 gave their consent.

They reported their experience with fatal complications, sharing anonymous demographic and clinical information, stone disease characteristics, perioperative and postoperative data that were subsequently collected and analyzed.

## Results

Among the 11 certified urologists (mean age 48.6 years  $\pm$  6.8), only six reported on six cases of mortality. The mean surgeon’s experience in RIRS was 7.5 (SD 2.2) years. Table 1 summarizes the clinical profile of the fatal cases.

### Case#1

The patient was a 66-year-old obese Caucasian (BMI 34) woman, suffering from mild arterial hypertension, mitral insufficiency, cardiac arrhythmia under beta-blockers and sartans. She had a history of recurrent lower urinary tract infections (UTIs). After an episode of fever with lumbar pain, a CT scan revealed the presence of two nonobstructive renal stones (HU 550) (1 cm in the renal pelvis and 1.5 cm in the lower pole). She was admitted and successfully treated with antibiotics without urinary decompression. Urine culture after 40 days was negative. RIRS was planned and performed in July 2009. A 113-min procedure was carried out under general anesthesia without applying a ureteral access sheath (UAS); a ureteral stent and a Foley catheter were left in. At awakening from anesthesia, an immediate acute respiratory failure with hyperthermia occurred, and the patient was transferred to the intensive care unit with the diagnosis of urosepsis. She developed acute renal failure with anuria, which was managed with amines and antibiotics. She required tracheostomy for respiratory distress and hypoxia and developed bilateral hypoacusia with vascular cerebral injury. She died 74 days after RIRS for acute respiratory failure.

### Case#2

The patient was a 70-year-old Caucasian woman, hospitalized for macrohematuria and UTI. An enhanced CT scan demonstrated a 6- to 8-mm filling defect within the left renal pelvis, suspect for transitional cell carcinoma. She had no cardiologic nor metabolic or stone disease. A diagnostic RIRS was planned and carried out using a 9.5/11.5Ch UAS. A small injury of the ureteropelvic junction (UPJ) occurred during scope advancement. The procedure was suspended, and a single-J ureteral catheter left in

place: Multiple samples for urine cytology were taken with subsequent negative findings.

After a retrograde pyelography negative for contrast extravasation, the single-J ureteral catheter was replaced by a 6Ch double-J stent, and a delayed second look RIRS was scheduled. Due to the persistence of positive urine culture (*Enterococcus faecalis*), the procedure was delayed twice. For this reason, the patient preferred to refer to another hospital, where another urologist guaranteed a quick and definitive diagnosis. She underwent a diagnostic RIRS (which confirmed a small low-grade transitional cell carcinoma) with a 12/14Ch UAS, but died in intensive care unit 3 days later for urosepsis.

### Case#3

This patient was a 44-year-old Caucasian woman, with a solitary left kidney, affected by advanced multiple sclerosis and epileptic crises. She was bedridden with a percutaneous endoscopic gastrostomy in situ. Furthermore, she had an indwelling catheter, renal and bladder stones and recurrent UTIs with allergy to several antibiotics (teicoplanin, ciprofloxacin).

She was hospitalized for relapsing fever with positive urine culture (*Pseudomonas aeruginosa*); she was successfully treated with targeted antibiotics. A CT scan highlighted a 1.7-cm obstructive renal stone (HU 600) and multiple stones in the bladder. After urological consultation, the patient was scheduled for PCNL.

At admission, despite the fact that she was afebrile with negative urine culture, she changed her mind refusing PCNL. Alternatively, she accepted to undergo RIRS under general anesthesia. After the clearance of the small bladder stones, a 55-min RIRS was performed using a 12/14Ch UAS. An 8Ch double-J and a Foley catheter were left in place. Starting on the first postoperative day, she developed hyperthermia ( $>38.5$  °C) with significant leukocytosis. Broad-spectrum antibiotic therapy was scheduled, with the further addition of an antimicrobial agent after infectious disease unit consultation. Despite such an aggressive therapy, the patient developed a severe sepsis with progressive anemia requiring blood transfusions, simultaneous anuria and stupor. She died 6 days after RIRS for urosepsis, with a blood culture positive for *Candida glabrata*.

### Case#4

The patient was a 75-year-old Caucasian woman. She had hypertension and she took antiarrhythmics and antiaggregants; she had allergies to several drugs (penicillin and enoxaparine). There was a prior history of radiolucent stones treated with an alkalinizing agent. She had bilateral stones without hydronephrosis (the largest was 3.3 cm in

**Table 1** Demographic data and clinical characteristics

No.	Age/sex	Stone size (cm)/HU	Anatomic abnormalities	Metabolic comorbidity	Cardiac or neurological comorbidity	Preoperative uroculture	Preoperative stent/nephrostomy	Prophylactic antibiotics	Operative time (min)	UAS or nephrostomy	Cause of death	Pathogens
1	66/F	1 + 1.5/550	Absent	Pathologic obesity	Mitral insufficiency, cardiac arrhythmia	N	Y	Y	113	No	Septic shock and acute respiratory failure	NA
2	70/F	NA	Filling defect in the renal pelvis	Absent	–	NA	Y	Y	20	Y (12/14)	Septic shock	<i>Enterococcus faecalis</i> (?)
3	44/F	1.7/600	Solitary kidney	Absent	Advanced multiple sclerosis	N	N	Y	55	Y (12/14)	Septic shock	<i>Candida glabrata</i>
4	75/F	3.3/NA	Absent	Absent	Arterial hypertension, cardiac arrhythmia	N	N	Y	90	Nephrostomy	Hemorrhagic complication	Multiresistant <i>E. coli</i>
5	48/M	1.2/NA	Absent	Absent	–	N	N	Y	65	No	Septic shock and acute respiratory failure	<i>Proteus mirabilis</i>
6	48/M	1.1/900	Absent	Absent	–	N	N	Y	NA	NA	Cardiac arrest	–

HU Hounsfield units, UAS ureteral access sheath, Ch Charrrière, N negative, Y yes, NA not appropriate

the right pelvis). She refused surgery and opted for SWL. A CT control after 2 SWL showed no changes in stone diameters and position with the new onset of right hydronephrosis. A RIRS was planned and done. Due to the limited work space, a nephrostomy tube was applied during the procedure even to ensure a good outflow of irrigants. A laser lithotripsy was successfully performed leaving a 6Ch double-J stent and a nephrostomy. Operative time was 90 min. A few hours later the patient developed severe lumbar pain, tachycardia, tachypnea and hematuria from the nephrostomy. The thrombelastometry showed severe hypofibrinogenemia, and the CT scan revealed a growing retroperitoneal hematoma. She underwent urgent open surgery with hemostatic intent, but a right nephrectomy was necessary. She died 3 days after RIRS, in the ICU, for an hemorrhagic complication with acute respiratory failure (bilateral pulmonary collapse distress from the massive transfusion of blood and plasma) and a blood culture positive for multiresistant *E. coli*.

#### Case#5

The patient was a 48-year-old Caucasian male. He was in good clinical condition with positive anamnesis for renal lithiasis. A CT scan control revealed a 1.2-cm obstructive stone in the left distal ureter. The endoscopic procedure required an approach with the semirigid ureteroscopy to insert a guidewire since the stone was hardly impacted; the planned holmium laser lithotripsy with the flexible ureteroscopy was then performed. After the complete stone clearance, a check of the upper tract was done to retrieve eventual residual fragments. Purulent urines were found and collected for uroculture. No UAS was used, and a stent was left in situ; operative time was 65 min. On the first postoperative day, he had high fever ( $>39^{\circ}\text{C}$ ), hypotension and anuria. Hydration and amines were added. Antibiotic therapy was tailored because the uroculture was positive for multiresistant *Proteus mirabilis*. The patient died 3 days after RIRS, in the ICU, because of a severe sepsis with respiratory, renal and hepatic failure. Blood culture was positive for *P. mirabilis*.

#### Case#6

The patient was a 48-year-old Caucasian male. He was in good clinical condition, without any history of cardiologic or metabolic disease. A CT scan showed a 1.1-cm nonobstructive renal pyelic stone (HU900) with negative uroculture. A RIRS was proposed and planned. At the induction of the general anesthesia, a fulminant untreatable cardiac arrest occurred even in the operating room with all the best life care support. The RIRS was not done.

## Discussion

Over the last 10 years, the RIRS has become an increasingly important option for the treatment of all kidney stones. Its overall complication rates remain low with most complications being minor and easily managed. It is difficult to find cases of death after RIRS in the peer reviewed literature. We found one case of fatal septic shock after a RIRS for a bulky stone in 1997 [3] and one case of death due to multisystem organ failure secondary to urosepsis in a patient with severe cirrhosis and pancytopenia who was being evaluated for a liver transplant [4].

This multiinstitutional study, which reports on fatal cases after RIRS, is the first attempt to highlight how this safe procedure harbors potential dramatic and fatal complications.

Four patients died due to septic complications, one to cardiac event and one to hemorrhagic complication. In this series, only in two cases was a UAS used. This is a controversial issue. Even if there is currently no official recommendation as to the use of the UAS during RIRS and there are no guidelines on the correct UAS diameter for the definitive stone sizes, the placement of a UAS could prevent pyelolymphatic and pyelovenous bacterial backflow [5–7] with protection from the risk of bacterial dissemination during stone fragmentation. Even if the use of UAS depends on the surgeon's preference, we think that UAS might be considered among the best practices in order to prevent the risk of endotoxin resorption and bacterial dissemination after lithotripsy [5, 8]. Moreover, it is helpful to remember that we can cleverly identify the septic patient and then attune duration, dosages and choice of the antimicrobial therapy using the serum procalcitonin levels [9, 10] even in the early postoperative period.

The use of prophylactic antibiotics in patients undergoing endoscopic surgery with a negative preoperative urine culture is matter of debate because strong evidence is lacking [5]. Following the AUA Best Practice Policy, a first-generation cephalosporin or a fluoroquinolone is generally administered prior to surgery; an oral antibiotic therapy for the first days after surgery is then continued [11].

In order to minimize the septic complications, some best practices might be suggested: (1) operate only on patients with sterile urine, and administer prophylactic antibiotics, (2) try to skillfully place a UAS, (3) irrigate with caution while checking the continuous outflow from the UAS, (4) if possible, do not exceed 2 h of operative time, and (5) carefully observe patients in the first 6 postoperative hours (90 % of these rare but potential lethal complications occur within 6 h) (Table 2).

Although in almost all the described cases some aspects could have been theoretically better managed, our report

**Table 2** Best practices to minimize the risk of septic complications for endourological stone management

Practice	Reasons and alternative options	References
Operate only on patients with sterile urine	The use of prophylactic antibiotics is a recommendation (LE 4, Gr A) If history of UTIs starts antibiotics 2 days before If purulent urines are found above an obstructing stone, take a sample for culture and place an ureteral drainage, stop and delay the RIRS	[5, 8, 11]
Always try to reasonably place a UAS	If the UAS placement was impossible, a sheathless procedure should be attempted or (even if this last attempt failed) a pigtail, double-J ureteral catheter (DJ) should be placed for passive dilatation	[5]
Always irrigate with caution checking the continuous fluid outflow	If high pressures are necessary, planning a second look or the use of endoluminal isoproterenol irrigation could be helpful	[6]
Do not exceed an operative time of 2 h (1 for children)	If there is a complex case or high stone burden, a staged procedure is advisable	[1]
Carefully monitor patients in the early postoperative phase	If there is postoperative fever promptly check procalcitonin levels (90 % of septic complications occur within 6–12 h) and start with antibiotics	[9, 10]

highlights how physicians are occasionally tempted to overdo for their patients, sometimes skipping safety rules with an inevitable increase in risks. The rarity of the occurrence is comforting and reassuring; nevertheless, this possibility should be always kept in mind by both young and experienced urologists. In fact, we still believe that the “key to success is avoiding the start of RIRS on your own. Adequate training and sharing the tricks of the trade with the experts in the field during the start-up phase are necessary. Furthermore, detailed and frank counselling of the patients is strongly encouraged to inform them not only about the minimal invasiveness but also about outcomes of the surgeons/centers and the potential for staged multiple procedures in the most difficult cases and the possibility, although rare, of major complications” [1].

Several limitations should be acknowledged. This is a retrospective review spanning years and different series; not all patients had the same preoperative testing and postoperative cares; there is a variety of diagnoses (elective vs imperative indications); not all patients had stone analysis, full microbiological assessment or stone cultures. No information about the irrigation system was available. In some cases, it was impossible to collect all the possible data because of patient migration to other hospitals or units. In one case, we described a fatal case due to anesthetic complication more than to surgical reason. Nevertheless, it is very important to show this rare event in order to underline how, independently from disease-related and surgeon-related issues, a sudden death can occur.

Despite the limitations of our study, we were able to describe six cases of death in patients scheduled for RIRS. This study also highlights the impact of infection-based stones in this patient population but also the occurrence of unexplained death, as a possible common event in the greater surgical population.

## Conclusion

This survey among skilled endourologists reveals that the occurrence of fatal complication after RIRS still remains possible, even in the absence of major patient mismanagement. All the predictable measures should be applied and all efforts should be spent first to prevent and then to early recognize and treat the starting phases of sepsis. A better reporting of cases and the use of standardized systems should be encouraged.

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**Author’s contribution** Dr. Cindolo, Castellan, Giusti, Scoffone organised the project and developed the protocol. Dr. Cindolo, Cracco, Paccaduscio, Breda, Celia, Proietti did the data collection. The analysis of the data was done by Dr. Castellan, Cindolo, Cracco. Castellan, Schips, Giusti wrote and edited the manuscript. Dr. Scoffone, Giusti, Breda, Schips supervised the process.

## Compliance with ethical standards

**Disclosures** Guido Giusti is a consultant for Boston Scientific, Cook Medical, Porges-Coloplast, Karl Storz. Cesare Mario Scoffone is a consultant for Boston Scientific, Cook Medical, Porges-Coloplast, Karl Storz. Alberto Breda is a consultant for Cook Medical, Rocamed, Karl Storz.

**Informed consent** Informed consent was obtained from all individual participants included in the study.

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