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Residual Stones after Percutaneous Nephrolithotomy

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Abstract

Current EAU guide recommend the PCNL as the gold standard procedure for stones larger than 2 cm and stones larger than 1 cm if in the lower calyx in patients with unfavorable factors for SWL. Residual fragments are commonly seen after both, ESWL and after intracorporeal lithotripsy. The incidence of residual stones after PCNL ranges from 10% to 60%. But some of these studies with high success rate established the clinically insignificant residual fragments (CIRF) as being stone free. The ability to detect residual fragments is dependent on the imaging modality and this gives different outcomes when different modalities used to assess the stone free rate. Residual stones worth to be more studied because it gives rise to two major problems namely regrowth and recurrent urinary tract infection. The residual stones may pass spontaneously; remain silent with no growth, become symptomatic with pain, heamaturia, infection and obstruction or act as a nidus and increase in size. Although routine imaging follow up is mandatory and is recommended by the EAU there are no current scheduled programs for follow up. In this mini review we tried to address the residual stones after PCNL in the literature regarding definition, incidence, diagnosis, fate and the possible methods of management.

Keywords: Shock Wave Lithotripsy; Retrograde Intrarenal Surgery, Percutaneous Nephrolithotripsi

Introduction

The management of renal stones is widely variable and ranges from the non invasive medical treatment to the most invasive open surgery including the Shock Wave Lithotripsy (SWL), Retrograde Intrarenal Surgery (RIRS), Percutaneous Nephrolithotripsi (PCNL) and laparoscopic stone removal. The choice of the modality of treatment depends on several factors but the most worldwide recommended procedures are the endourologic procedures

The Current guidelines of the European Association of Urology recommend PCNL as the treatment of choice for stones larger than 2cm and lower polar stones larger than 1 cm in patients with unfavourable factors for SWL. It is also a second line modality in pelvic, upper or middle calcieal stones from 1-2 cm and a third line in stones smaller than 1 cm [1].

PCNL is effective with overall stone free rates between 76–84% and even higher [2]. Primary goal of treatment is absolute freedom of stones, since remaining fragments may cause hematuria, pain, sepsis and the need for auxiliary interventions.

The question remains, what is the fate of remaining fragments, should all residual fragments be treated, how can remain calculi be prevented and what is the best way to approach these remaining calculi?

Incidence and Definition of Residual Stones

The goal of treatment of renal calculi is removal of the entire stone burden in as few procedures and with the least morbidity possible.

Most studies showed that stone free rate after PCNL ranges from 40% to 90% depending on the size, number, composition, nature of the stone and also surgeon's experience. This means that the incidence of residual stones after PCNL ranges from 10% to 60%. But some of these studies with high success rate established the clinically insignificant residual fragments (CIRF) as being stone free [3].

Initially the term CIRF was used to describe remaining asymptomatic, non-obstructive, non-infectious fragments after SWL smaller than 4–5 mm in association with sterile urine [4]. Later, this term was extended to residual stones with similar character left behind after PCNL or RIRS [5].

In a recent study, Raman et al. [6] found that more than half of the PCNL patients with residual fragments larger than 2 mm required a second surgical procedure so that there is controversy about "insignificance" of CIRF. Currently there is a debate if complete stone clearance is important and if any residual stones are significant. It can be said that there is no worldwide agreement for the definition of residual fragments and the determination of its significance.

The Natural History of Residual Stones

Residual stones are thoroughly studied because it gives rise to two major problems namely regrowth and recurrent urinary tract infection [7]. The residual stones may pass spontaneously; remain silent with no growth, become symptomatic with pain, heamaturia, infection and obstruction or act as a nidus and increase in size. The variability of the fate of residual stones after PCNL in the literature -although only few- may be due to presence of many factors that contribute to the outcome.

In general the stone recurrence in PCNL treated patients is lower than that occurred after SWL treatment. This was confirmed by Carr et al. [8] comparing stone recurrence rates at 1 and 2 years post-surgery in patients rendered stone free after SWL and PCNL. In his study he found a higher rate of new stone formation in the SWL group (22.2% at 1 year, 34.8% at 2 years) versus the PCNL group (4.2% at 1 year, 22.6% at 2 years), suggesting that residual "dust" after SWL that may not be identifiable on standard radiographs places patients at higher risk for stone recurrence.

In two studies with nearly 2 years mean follow up, they tried to determine factors associated with non spontaneous passage of residual stones after PCNL. Ganpule and Desai found that 65.5 % of patients having residual stones after PCNL became stone free after 3 month .At

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multivariate analysis they found that previous intervention in the form of SWL, PCNL or open surgery have significantly lower clearance rate for residual stones. The problem in those patients is that stone removal from a scarred collecting system might be difficult. Also the distorted anatomy of pelvicalceal system may limit the spontaneous passage other significant factors found are the metabolic disorder, location (worse outcome for calculi in the lower pole because of the depending anatomy hindering spontaneous passage) and the size of residual fragments determining that the >100 mm^2 stones require intervention [9].

The re growth rate of residual stones determined by Altunrende et al. [10] was 21%. Struvite stones composition was the only significant risk factor.

Proper Diagnosis of Residual Fragments

The ability to detect residual fragments depends on the imaging modality. Traditionally postoperative plain X-Ray and ultrasound were the main tools of diagnosing residual stones. Many centres still depending on these modalities for evaluating the stone free rate mostly because of the availability, lower cost and less radiation exposure than computed Tomography (CT) [11-13].

Conventional CT, plain film radiography, nephrotomography and renal sonography were compared by Lehtoranta et al. [14] in detecting residual stones after PCNL 12 to 36 months post surgery. In a comparison for different modalities, residual fragments were detected by CT in 53%, by plain film in 44%, by nephrotomograms in 42% and by sonography in 28% [14]. Pires et al. [15] compared the sensitivity of residual stones detection after PCNL between plain abdominal x-ray and computed tomography and found that sensitivity was 87% and 100% respectively especially in diagnosis of small residual fragments <5mm concluding that spiral CT is justified to confirm the absence of residual fragments in patients after percutaneous nephrolithotomy despite the higher cost and irradiation compared to plain abdominal x-ray [15]. In another prospective study Park J found that 52.4 % of his patients that were diagnose as stone free by plain x ray had residual stones when they made CT after 1 month [3].

Improved intraoperative imaging also has the potential to further localize fragments and improve surgical outcome during the initial PCNL. In an attempt to increase the intraoperative detection of residual stones high magnification rotational fluoroscopy was used by Portis et al. [16] in conjunction with flexible nephroscopy. Despite these measures only 60% of patients were stone-free on postoperative day 1 CT. However 40 % of patients who were endoscopically and fluoroscopically stone-free had residual stones 4 mm or smaller.

Avoiding Residual Stones

Although PCNL has a quite good success rate, residual stones can be left behind. This is due to number of factors as migration of fragments into an inaccessible calyx, termination of procedure due to complications or length of surgery, the complexity of the collecting system or inability to visualize the stone using fluoroscopy [10].

Several approaches for prevention of residual fragments have been described. One of which is the use of single pulse mode lithotripters resulting in controlled fragmentation and formation of larger sized fragments. These fragments will be easily picked up and will have fewer chances to scatter [17]. The use of ultrasonic lithotripters with continuous suction simultaneously evacuates the stones fragments leading to fewer residues [10]. Specially designed Amplatz sheath that reduces intrarenal pressure and facilitates stone retraction by irrigation fluid without increasing the intrarenal pressure was also described [18]. Another method is the routine use of flexible nephroscopy in combination with of high resolution fluoroscopy [16]. In case of doubtful residual stones it is advisable to place a nephrostomy tube to facilitate a later 2nd look procedure [1].

The Management of Residual Fragments

Types of residual stones requiring treatment

Residual stones can be classified according their treatment into [1]

> 6-7 mm → active removal

< 4-5 mm (symptomatic) → active removal

< 4-5 mm (asymptomatic) → reasonable follow up

These recommendations were in some extent doubted by the findings of Raman et al. [6] who observed that more than half of his PCNL patients with residual fragments larger than 2 mm required a second surgical procedure.

The choice of the treatment modality

For those patients that are indicated for active removal of residual stones the selection of the modality of treatment is the same as by the primary stones [1].

Can spontaneous clearance of residual fragments be influenced?

Mechanical percussion and inversion therapy were demonstrated to improve the outcome of patients with residual lower caliceal stones after SWL in a prospective randomized study [19]. While Kang und associates observed that the remission in patients with residual stones was significantly higher (77%) in a group under medical treatment when compared to the group without medical therapy (21%) [20], Altunrende F and associates failed to prove any impact of metabolic factors on stone progression [10].

How should patients with residual fragments be followed?

For those patients that are subjected to follow up there is no current recommended protocol but several activities were suggested. The patients with residual fragments should be informed in details about the risk of any possible complications of initially (CIRF) and the eventual need for auxiliary treatment [10]. Although routine imaging follow up is mandatory there are no current scheduled programs.

Conclusions

Residual fragments are frequent after PCNL. Detection depends on quality of imaging. Since more than half of residual fragments either cause symptoms or experience regrowth, any remaining fragement should be treated. Treatment depends on size and location, but usually is managed by retrograde intervention. Spontaneous passage of residual fragments can be facilitated by physical therapy but is only feasible in small fragments located in the renal pelvis or the ureter.

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