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Mini Review

Which Endourological Technique should be Chosen for Moderate-Sized Lower Calyx Stones?-A Mini Review

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Abstract

Lower pole is the most common site of kidney stones and has the lowest chance of spontaneous passage. While endourological interventions are proposed to be used as the equivalent of SWL for this moderate-sized stones in the lower pole, it is unclear which endourological intervention (minimally invasive PNL, RIRS) should be preferred. Comparative studies and meta-analyses carried out on this subject suggest that decisions should be made on the basis of the factors belonging to stone, kidney, and patient. Beside the general evaluation criteria such as stone size, use of anticoagulants, obesity, etc., the presence of isolated lower calyx stone, stone density, anatomy of lower calyx are the parameters that can help to determine the minimal invasive technique used for the choice of RIRS and minimal invasive PNL.

ABBREVIATIONS

PNL: Percutaneous Nephrolithotomy; RIRS: Retrograde Intrarenal Surgery; SWL: Shock Wave Lithotripsy

INTRODUCTION

Lower pole is the most common location of kidney stones. Lower pole stones have a lower chance of spontaneous passage and thus, require more interventions than stones in other locations [1]. For 1 to 2 cm kidney stones, there are some options such as shock wave lithotripsy (SWL), endourological procedures or follow-up in asymptomatic patients [2]. The success of SWL in lower pole stones is affected by many factors such as the body structure of the patient, the stone density and chemical structure, lower pole anatomy and the distance between stone and skin [3]. Therefore, SWL cannot be the primary treatment option for some patients; it may even fail when it is applied as the primary treatment. When SWL is not the primary option, the endourological intervention option is preferred. However, debates about the endourological intervention option, which is the subject of this review, have been still continuing. For the reasons mentioned above, stones in this size and location are treated distinctively in the European urological guidelines [4]. The guide recommends SWL or endourology procedure as the first-line treatment for this group of stones. The term endourology refers to the PNL and URS interventions, but there is no detailed information about which of these interventions might be more appropriate for which cases. In the previous studies, micro, mini, ultramini PNL and retrograde intrarenal surgery (RIRS) interventions were compared and their respective advantages and disadvantages were indicated. In the selection of these interventions, the preferences that are made by taking the factors related to stone and kidney into account become prominent. The prominent endourological techniques are PNL and RIRS procedures.

PNL applications

PNL was initially used for stones greater than 2 cm, however, the development of new techniques such as mini-ultramini-microperc in the last decade through the reduction of tract diameters have reduced the complication rates and thus, PNL has become more useful in smaller stones [5]. The lower pole stones provide the best location for PNL because of easy access and lower complication rates. For this reason, less invasive PNL applications like mini-ultramini-microperc are rather preferred for this group of stones instead of standard PNL applications.

Tepeler et al., reported that they have used microperc for 21 cases with lower pole stones that have a mean size of 17.8 mm, and determined the stone-free rate as 85.7%. They have observed no serious complications except two complications requiring JJ stent in 2 patients [6]. However, microperc applications have some limitations such as inability to pick the stone fragments up, increased intrarenal pressure and low optical resolution. Nagele et al., reported that they performed mini-PNL on 29 patients with 8 to 15 mm stones and determined the stone-free rate as 96.5% and the hospitalization period as 3.2 days [7].

In a current study that compares SWL, RIRS, and micro and mini PNL for 1 to 2 cm stones, Kiremit et al., reported that the stone location has an effect on SWL, but has no affect on RIRS and

PNL techniques [8]. In a recent study comparing the application of microperc and miniperc in the lower calyx stones, which is more specific in terms of stone location, decreased hematocrit levels did not create a need for transfusion in both groups, although it was significantly higher in miniperc group. Stone free rates were found to be 86% in microperc and 82% in mini. This study has demonstrated significant results in favor of microperc in terms of hospitalization, tubeless PNL ratio and amount of bleeding. Therefore, microperc has been recommended as a good option for this group of patients [9].

Stone density is also one of the parameters that can affect PNL results apart from stone size and localization. Gücük et al., investigated the effects of certain parameters including HU on the outcome of 179PNL patients, and concluded that the HU value was an independent factor which affected the success of PNL. The authors have stated that as the HU value decreased, the visibility of stone under fluoroscopic imaging also decreased, which caused an increase in the amount of stones. Specifically, HU value <677.5 reduced the success of PNL by 2.65-fold [10].

Although PNL treatment has been reported to provide high stone-free rates up to 95% with PNL, this procedure has also serious complications such as bleeding, infection and adjacent organ injuries, which are seen at a rate as high as 15.6% [11]. However, it has been reported that minimally invasive PNL techniques have lower complication rates than standard PNL [12,13]. It has been stated that the best location for PNL is the lower pole, and the RIRS sometimes faces some technical difficulties in cases of lower pole stones due to requirement of excessive deflexion. Another advantage of PNL is that it can also use pneumatic and ultrasonic lithotripsy in stone disintegration in addition to laser lithotripsy However, in RIRS, laser lithotripsy is the only technique for stone disintegration. Thus, PNL seems to be a good option when the tract diameter of the lower pole is chosen appropriately to the stone size [14].

RIRS applications

RIRS is a treatment option that shows similar results to SWL and PNL on small volume lower calyx stones due to similar stone-free rates and lower complication rates. Complications like high transfusion requirement, and hydrothorax seen in PNL are not encountered in RIRS. The major disadvantage of the RIRS is that multiple sessions are required to achieve a complete stone-free status [15].

Treatment of the stones located in the lower calyx of the kidney with RIRS is more difficult and requires more experience than the treatment of the middle and upper calyx stones. Kidney anatomy is considerably important for the RIRS treatment of lower calyx stones. Grasso et al., reported lower success rates of RIRS treatment on the patients with lower calyx stone and >3 cm lower calyx infundibulum [16]. Resorlu et al., reported that for lower pole stones, the anatomy of the pelvicalyceal system had also an effect on RIRS as well as on SWL [17]. It has also been supported by different studies that RIRS has a low success rate on lower pole stones larger than 15mm when the infundibulopelvic angle is smaller than 30° [18]. The factors such as body structure of the patient, stone density, chemical structure of stone, the distance between stone and skin etc. that are effective on the success of the SWL do not affect the results because of the laser energy used in RIRS [19,20].

In comparative studies for lower calyx stones, the stone-free rate of RIRS is higher than that of SWL but lower than that of PNL. Yet, higher complication rates have been also reported in these studies unsurprisingly. The success of the use of RIRS on kidney stones on obesity, use of anticoagulants and some orthopedic and urinary anomalies is also valid on lower pole stones [21,22]. An additional benefit for RIRS over PNL is that RIRS can be applied safely and successfully after previous open renal stone surgery [23].

DISCUSSION

In the comparative studies in literature, there is no comparative and extensive series studies considering all stone and patient parameters that may be important for both PNL and RIRS for this group of stones. Guidelines cannot be a absolute advisor at this point for now. However, all in all, the endourological preferences made by taking the characteristics of stone into account, kidney and patient will be optimum.

In the examination of the characteristics of stone, the factors such as size, location and composition of stone become prominent. Because of the subject of our study, the discussion about stone location other than lower calyx and stone size lie beyond the scope of this review. However, which surgery should be chosen for patients with moderate-sized stones in both lower calyx and a different location? In this respect, when we look at the influence of stone location in the studies of Reşorlu and colleagues that compares ultramini-PNL and RIRS on lower calyx stones, stone-free rates were determined to be 93.3% in mini-PNL and 42.9% in RIRS [5]. In multicalyceal stones, stone-free rates were reported to be 62% in RIRS and 0% in ultramini PNL. In a study evaluating the stone density and location in mini-PNL and RIRS, which has not yet been published in the literature but is in phase of approval, based on our previous studies [10,22]. investigating the effect of stone density on PNL, we found that the lower calyx stone is an advantage for mini-PNL, but multicalyceal stone including lower pole is a disadvantage for mini-PNL. In the same study, it was found that while the mini-PNL had a disadvantage for stone densities lower than 677 HU, low stone density was not an effective parameter for RIRS.

In the first study comparing RIRS and PNL in lower calyx stones, PNL was chosen in cases of narrow infindibulopelvic angle and infindubular width, whereas RIRS was chosen in cases of bleeding tendency, musculoskeletal deformity, chronic obstructive lung disease, and morbid obesity. In this case, stone-free rates were found to be 92.8% in PNL and 89.2% in RIRS. No difference was observed except a longer hospitalization in PNL and a longer duration of operation in RIRS [24]. In their study evaluating the impact of the infundibulopelvic anatomy on RIRS, Resorlu et al., noted that in addition to the effect of stone size, the stone-free rate was significantly affected by the lower pole anatomy and especially the infindibulopelvic angle [17]. Negative factors such as an increase in length of lower calix neck, a decrease in calyx neck width, increase of the degree of hydronephrosis reduces the success rates in SWL as well as in RIRS. For this reason, mini-PNL is the primary option in this group of patients.

RIRS is also used in patients with morbid obesity, orthopedic problems and calyceal diverticular stone [25].

There are no specific studies taking the patient characteristics on this group of stones into consideration. However, in the studies in which standard PNL, RIRS and SWL comparisons are conducted and evaluated, it has been determined that factors such as age, obesity, anticoagulant use, skeletal malformation or renal ectopia did not have a negative effect on RIRS results, but may cause serious complications in PNLs [19]. Good results have been obtained with stag horn stones or simultaneous renal and ureteral stones used in combination intrarenal surgery [26,27]. However, there is no specific data on lower pole stones. But maybe an option in the group which also included the lower calyx stones that you may need multiple entries.

De et al., found in the meta-analyses of the studies comparing the standard PNL and RIRS that whereas stone-free rate was higher in PNL group, blood loss, complication rate and hospitalization time were also higher in the examination of the meta-analyses which allows us to assess more general data about these studies. It has been determined that while minimally invasive PNL applications had higher stone-free rates than RIRS, complication rates in PNL were higher than RIRS but less than standard PNL [28]. Another more specific meta-analysis evaluating 1-2 cm lower pole stones has reported that the three-months' results of PNL and RIRS were better than SWL but there was insufficient data to make interpretation on other issues [1]. Zhang et al., stated that PNL had the longest hospitalization period but the best stone-free rates in a systematic analysis made for lower pole stones [29].

In conclusion, considering all the evaluations, we suggest that the endourological intervention that will be chosen for this group of stones may be optimized according to the factors of stone, kidney and patient. Stone density, anatomy of lower calyx and the presence of isolated lower calyx stone are the most significant parameters that help to determine the minimal invasive technique in addition to the general evaluation criteria such as stone size, stone location, use of anticoagulants, obesity etc.

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