Original Article

Alteration in Resistive Index (RI) of Renal Vasculature after Extracorporeal Shock Wave Lithotripsy (SWL) for Renal Stones

Hamid Dahmarde[1] and Mohammad Behnampour[2*]

[1]Department of Radiology, Zahedan Medical School, Zahedan University of Medical Sciences, Zahedan, Iran; [2]Student Research Committee, Zahedan University of Medical Sciences, Zahedan, Iran

Corresponding author:
Mohammad Behnampour,
Student Research Committee, Zahedan University of Medical Sciences,
Zahedan, Iran,
Tel: +2348033897283
E-mail: Zhn.search@gmail.com

Abstract

Background and Objective: Since 1980, the first extracorporeal shock-wave lithotripsy (SWL) was introduced which brought a revolution in the treatment of urinary tract stones. Some of the effects and side effects of this method is still unknown. This study aimed to investigate the changes in vascular resistance index (RI) in ipsilateral and contralateral kidney, as well as its relations to time that these changes was carried out. **Method:** The RI of the interlobar renal arteries was measured for the regions near the calculi, far from it and contralateral kidney, before, one hour after, and 2 week after SWL. Changes in the RI values and their relation with sex and age were evaluated and analyzed by SPSS. **Results:** The mean age of the patients was 46.5 and they were 56.7% men and 43.3% women. The mean calculus size was 11.8 mm. The RI near and remote from the calculus increased one hour after SWL (p=0.003), but returned to the pre-SWL values 2 week later. The RI values of contralateral kidney did not change significantly. **Conclusion:** This study suggest that SWL of the kidney calculi changes the RI only in ipsilateral kidney which is immediate, transient, and after 2 weeks return to pre-SWL value.

Keywords: Extracorporeal Shock Wave Lithotripsy (SWL); Vascular resistance index; Kidney calculi

Introduction

Nephrolithiasis affects approximately 1.5% of the European population [1] since 1980, when the first wave of stone crushing was introduced by the shock of excited waves; a revolution in the treatment of urinary stones has been developed and widely used. [2] However, some effects and complications of this method are still unknown, [3-5] which include the effects of the mechanical and dynamic forces created for the destruction of stones on the thin artery wall in the kidneys and adjacent organs, which causes bleeding, cytokine release, Inflammatory mediators and secretion of inflammatory cells into the tissues. [6] These effects increase the transient liver enzymes and bilirubin. It also has an effect on the pancreas that can increase transient blood glucose in the first 24 hours after crushing. Decreased heart rate was also observed in the first 24 hours after crushing. [7] This mechanism causes some degree of kidney destruction following crushing that is done by the waves in the first week after crushing, which occurs in varying degrees of parenchymal and peri-renal edema and bleeding. Also, some degrees of decrease in renal blood flow in the first 24 hours after crushing. This is evidenced by the increase in the resistive index in the renal arteries. [8,9] Reduced renal blood flow is important because it can lead to post-stroke renal failure, especially in patients with single kidneys. [10,11] So far studies have been conducted in this area that the mark crushing has been shown to cause changes in the resistive index, as well as the relationship between these changes with factors such as age. [11,12] Considering the above mentioned, the study of vascular resistance index in pre and post stone patients. A breakdown with the outside waves of the kidneys treated as well as the opposite kidney and following these changes at successive times after crushing can be a sign for potential complications of this method and the sustainability of these complications. Also, the study of these changes at different ages is a better understanding of the pathophysiology of these complications and can lead to the necessary precautions in patients with different conditions (such as single kidneys). This study can also provide a platform for access to the treatments and modifying agents of the above-mentioned damage after the breakdown. [13] Therefore, this study was conducted to evaluate changes in the vascular resistance index in the kidneys undergoing treatment, as well as the opposite kidney and the relationship of time available to make these changes.

Methods

This descriptive-analytical study was performed on all people with normal blood pressure without any parenchymal kidney disease and in a gray scale ultrasound scan and were candidates for the treatment of kidney stone by extracellular stroke. The subjects before and after the crushing were examined by Doppler ultrasonography and the indices of resistance of the arterial interlobular kidney were determined. Data were collected through a Doppler information and Doppler Sonography report. After collecting information and descriptive results, the relationship between quantitative variables and the use of Pearson's coefficient was measured; then, for measuring the quantitative variables with qualitative variables, t-test and

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chi-square test were used to investigate the relationship between qualitative variables.

Results

This study was performed on 30 patients treated with external shock wave excitation (ESWL) in Ali-Ibn Abitaleb Hospital in Zahedan. The mean age of the patients was 42.5 (range 26 to 66). 56.7% were male and 43.3% were female (17 and 13 respectively). The mean weight of the body was 72.2 ± 7.4 [Tables 1 and 2].

The position of the stone was in 5 people in the upper calyx, 3 in the middle of the central and 13 in the Sub-Calyx. There were 9 patients with stones in the pelvic floor. The average size of stones is 11.8 mm. Clinical parameters related to SWL are shown in Table 3. As shown in this table, the mean serum creatinine level was constant before and after SWL.

In the Kidney, the RIs remained constant after the SWL, while on the same side, the RIs measured in the near-to-stone area showed a slight increase in the measurement of an hour after the SWL, which in size, two weeks later, these values returned to their previous size. The average of these values is shown in Table 4.

There was no significant difference in the level of RIs based on gender. Only the RIs close to the stone (same kidney) had a significant difference before and one hour after SWL, which was higher immediately after SWL (p=0.003, Confidence interval 95%) [Tables 4 and 5]. There was a weak correlation between age and RI measured in distal regions before and after two weeks after SWL (r=0.03, r=0.02, respectively). There was no significant relationship between age and RI in other areas.

Table 1: Frequency of patients based on gender.

Gender	Male		Female		Total
	Number	Percentage	Number	Percentage	
Number	17	56.70%	13	43.30%	30 people

Table 2: Locations of stones in all patients.

Variables	Upper Calyx	Middle Calyx	Inferior Calyx	The Pelvis
Number	5	3	13	9
Percentage	16.60%	10%	43.40%	30%

Table 3: Clinical parameters and SWL-related sizes.

Variables	Amount (Average)
Shock Wave Numbers	3290
Voltage	18.73 KV
Total Energy	5700 KJ
Systolic blood pressure before SWL	mm Hg 122
Diastolic blood pressure before SWL	mm Hg 68
Serum creatinine before SWL	mg/dL 1.10
Serum creatinine after SWL	mg/dL 1.10

Table 4: Comparison of RI levels at previous times, one hour later, and two weeks after treatment.

Location	Time of Measuring the RI		
	Before SWL	One hour after SWL	Two weeks after SWL
Near the stone in the same kidney	0.054 ± 0.584	0.062 ± 0.622	0.056 ± 0.587
Far from stones in the same kidney	0.058 ± 0.595	0.052 ± 0.631	0.066 ± .0.594
The opposite kidney	0.062 ± 0.578	0.044 ± 0.584	0.066 ± 0.597

Table 5: Relationship of the measured RIs before and one hour after the SWL.

Location	Paired t-test		P
	Before SWL	One hour before SWL	
Near the Stone in the Same Kidney	0.054 ± 0.584	0.062 ± 0.622	0.003
Far from the Stone in the same kidney	0.058 ± 00.059	0.052 ± 0.631	0.003
The Opposite Kidney	0.062 ± 0.578	0.044 ±. 0.584	0.566

Discussion

Since 1980, when the first wave of stone crushing was introduced by the shock of excited waves, a revolution in the treatment of urinary stones has been developed and widely used. [1,2] However, some effects and complications of this method remains unclear. [3-5] Reduced renal blood flow is important because it can lead to post-kidney renal failure, especially in patients with single kidney. [10,11] Past studies have been done in this area that showed that crushing can lead to changes in the resistive index. [11,12] So far, in several studies, changes in RI after SWL have been studied. However, the use of lithotripsy electro mechanics, which has more complications in relation to sub capsular hematoma, has been less studied. Also, the place of measurement and the timing of the measurement of RI and its different amounts in relation to the SWL is discussed. [14-16] while Many studies in past have shown the effect of shockwaves on the contralateral kidney in form of increase in RI, [17-19] some studies do not mention significant changes. [16] In a study conducted by Nazaroglu et al. on 43 patients (30 of whom had kidney stones), RI was associated With SWL, before, 30 minutes later, 3 hours later and two weeks later, in areas close to the stone, far away from the stones and the kidneys were examined. [20] In this study, it was observed that in those who had stones, RI increased in near and far-reaching areas 30 minutes and 3 hours after SWL, which was more pronounced in the near areas. In the kidneys, this increase was observed only in 3 hours after the SWL, which was lower than that of the kidney that had stones. The doppler study of renal vasculature in a study by Rahul Jain in ipsilateral kidney showed a significant increase in RI 3 hours post ESWL treatment, indicating vascular compromise in the area where the shock waves were targeted. [21] In our study, RI was treated in the near and distant areas of the same kidney, an hour later after SWL, and returned two weeks later to a level close to the values before the SWL, which is consistent with the results of some previous studies. [17-20] It was also observed that RI was not significantly increased in the kidneys, which is also consistent with some other studies. [20] Although in this study, a weak relationship was found between RI in the distant and age-old regions. Rahul Jain reported no significant relationship between RI and age, [21] no specific age-related changes were achieved.

Conclusion

In short, it can be concluded that the SWL technique for kidney stones can increase the RI values in the kidney that was treated immediately (one hour after SWL), but this amount is two weeks after the treatment returns to the first level. Also, these changes are not related to age and do not occur in the opposite side

Conflict of Interest

The authors disclose that they have no conflicts of interest.

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