

ASSESSMENT OF ACUTE RENAL OBSTRUCTION BY USING DOPPLER SONOGRAPHY

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ABSTRACT

Background: Acute renal colic disease is among the commonest presentation observed in outpatient departments of urologic practice. Urolithiasis is among the most common cause of renal obstruction and seen frequently. Unilateral obstruction encountered more frequently than bilateral obstruction and resultant for maximum patient load, however bilateral obstruction presents with deteriorate renal functions but it is less common. **Material & Methods:** The present case-control, study patients who were presenting to the emergency department with unilateral acute renal colic from 24 hours of symptoms were enrolled for the study. The obstructed kidney was taken as a case kidney and the normal kidney was taken as the control. **Results:** The site of obstruction was proximal in 47% of patients and distal in 63% of patients. The mean RI of the obstructed kidneys which were proximally obstructed was (0.71 ± 0.02) and the mean RI of the obstructed kidneys which were distally obstructed was (0.69 ± 0.02) . However, this difference was statistically non-significant. Out of total patients, 68 patients had a complete obstruction, while 32 patients had a partial obstruction. The mean RI values in completely obstructed kidneys were 0.73 ± 0.02 and mean RI values in partially obstructed kidneys were 0.70 ± 0.01 . This difference was statistically significant; $p<0.05$. **Conclusion:** Doppler sonography has high sensitivity and specificity in the detection of acute unilateral renal obstruction and better diagnostic tools than conventional USG. The resistivity index values are significantly higher incomplete obstruction than partial obstruction. The resistivity index values were also higher in proximal obstruction than distal obstruction.

Keywords: Acute renal obstruction, Doppler sonography, Resistivity index.

INTRODUCTION

The acute renal colic disease is among the commonest presentation observed in outpatient departments of urologic practice. Urolithiasis is among the most common cause of renal obstruction and seen frequently (1). Unilateral obstruction encountered more frequently than bilateral obstruction and resultant for maximum patient load, however bilateral obstruction presents with deteriorate renal functions but it is less common (2).

Males are reportedly more affected than females in previous studies. Studies also revealed that there were urinary tract structure changes also reported due to the effects of renal obstruction from urolithiasis (3). Hence, to combat these changes it is beneficial to detect renal obstruction in early stages.

There are many diagnostic approaches available nowadays for the detection and diagnosis of acute

renal obstruction. These included plain film x-rays, ultrasonographic procedures including doppler sonography, intravenous urography and retrograde urography, CT scan and MR urogram (4). Among primary diagnostic modality plain abdominal X-ray and USG is among the routinely used diagnostic procedures for acute renal obstruction, however, the sensitivity of plain abdominal X-ray has reported low. On the other hand, USG detects proximal dilatation of the urinary system prior to the obstruction level, but it fails to differentiate between obstructive and nonobstructive etiology of dilatation (5). The sensitivity of USG in the detection of renal obstruction was reported up to 90% but specificity was only 65-85% reported in previous studies (6).

Nowadays Intrarenal duplex Doppler ultrasonography has been applied for the diagnosis of renal obstruction as a better diagnostic tool that can differentiate between obstructive and nonobstructive dilatation of urinary system (7). In addition to that doppler, USG gives a detailed picture of intrarenal blood flow changes and also provides a description of renal pathophysiologic conditions. (8).

Results are interpreted as elevated mean resistivity index (RI) value of the obstructed kidney in comparison of normal kidney and this difference in mean resistivity index (RI) value of both kidneys is measured as delta RI (9).

The aim of the present study was to assess the Doppler ultrasonography in the patients of acute renal obstruction with the other normal kidney and compare the functions of a normal kidney with an obstructed kidney.

MATERIALS & METHODS

The present prospective study was conducted at the department of Radiodiagnosis of our tertiary care hospital. The study duration was of six months from September 2019 to February 2020. A sample size of 100 was calculated at a 95% confidence interval at a 10% acceptable margin of error by epi info software version 7.2. All the patients who were presenting to the emergency department with unilateral acute renal colic from 24 hours of symptoms were enrolled for the study. The obstructed kidney was taken as a case kidney and the normal kidney was taken as the

control. Clearance from Institutional Ethics Committee was taken before the start of the study. Written informed consent was taken from each study participant.

All study participants were subjected to Doppler USG using a 3.5 to 5 MHz transducer. Assessment of urinary system dilatation done in both kidneys by the gray-scale images. Three Doppler spectrum was taken from interlobar arteries using the lowest possible wall filter corresponding to the border of medullary pyramids. Doppler sample width was set at 2-5 mm. To maximize spectrum size lowest pulse repetition frequency was used. The mean resistivity index and delta RI was calculated for each kidney. Data analysis was carried out using SPSS v22. All tests were done at alpha (level significance) of 5%; means a significant association present if the p-value was less than 0.05.

RESULTS

In the present study 100 patients were enrolled, out of the 71 were males and 29 were females. The mean age of males was 32.48 ± 14.12 years which is nearly similar to the mean age of females 33.76 ± 15.39 years. However, this difference in age groups was statistically non-significant. The mean resistivity index (RI) values were found to be higher in obstructed kidneys in all study participants. The delta RI values were ranged from 0.08 ± 0.02 to 0.09 ± 0.02 with a mean delta of 0.09. Most of the study participants (60%) were assessed between 6-12 hours after the onset of symptoms, 22% patients within 13-18 hours and 18% patients during 19-24 hours. The difference between RI values among these three groups was statistically non-significant. (Table 1)

In the present study, the site of obstruction was proximal in 47% of patients and distal in 63% of patients. The mean RI of the obstructed kidneys which were proximally obstructed was (0.71 ± 0.02) and the mean RI of the obstructed kidneys which were distally obstructed was (0.69 ± 0.02) . However, this difference was statistically non-significant. Out of 100 study participants, 61 patients show obstruction of the right kidney and 39 patients had obstruction of the left kidney. Out of 61 obstructed

right kidneys, 27 patients had a proximal obstruction and 34 patients had a distal obstruction. Out of 39 obstructed left kidneys, 18 patients had proximal and 21 patients had a distal obstruction. (Table 2)

Table 1: Distribution of study participants according to the relationship of resistivity indices with the duration of obstruction.

| RI Values | 6-12 hours (n = 58%) | 13-18 hours (n = 24%) | 19-24 hours (n = 18%) | P value |
|---------------------|-------------------------|--------------------------|--------------------------|---------|
| Obstructed kidney | 0.71±0.01 | 0.70±0.01 | 0.72±0.01 | > 0.05 |
| Unobstructed kidney | 0.62±0.01 | 0.62±0.02 | 0.63±0.03 | > 0.05 |
| Delta RI | 0.09±0.01 | 0.08±0.02 | 0.09±0.02 | > 0.05 |

Table 2: Distribution study participants according to resistivity indices with the site of obstruction.

| RI Values | Mean RI of Proximal obstruction | Mean RI of Distal obstruction | P-value |
|--------------------------|---------------------------------|-------------------------------|---------|
| Obstructed kidney (RI) | 0.71±0.02 | 0.69±0.02 | NS |
| Unobstructed kidney (RI) | 0.64±0.01 | 0.63±0.01 | NS |
| Delta RI | 0.07±0.01 | 0.06±0.01 | NS |

In the present study, out of total patients, 68 patients had a complete obstruction, while 32 patients had a partial obstruction. The mean RI values in completely obstructed kidneys were 0.73 ±0.02 and mean RI values in partially obstructed kidneys were 0.70±0.01. This difference was statistically significant; p<0.05. (Table 3). In the present study,

we found the overall sensitivity of Doppler sonography was 94% and specificity reported to be 92%. In patients who had a complete renal obstruction, the sensitivity was 95% while specificity was 94%. In patients who had a partial renal obstruction, the sensitivity reduced to 93% specificity reduced to 90%.

Table 3: Distribution study participants according to resistivity indices with the degree of obstruction

| RI Values | Complete | Partial | P-value |
|--------------------------|-----------|-----------|---------|
| Obstructed kidney (RI) | 0.73±0.02 | 0.70±0.01 | < 0.05 |
| Unobstructed kidney (RI) | 0.64±0.02 | 0.62±0.02 | > 0.05 |
| Delta RI | 0.09±0.01 | 0.08±0.01 | > 0.05 |

DISCUSSION

The acute unilateral ureteric obstruction was responsible for complex sequelae of changes in ureteric pressure and renal blood flow and may exist with a complex sequence of morbidities (10). Ultrasonography provides indirect evidence of the proximal dilatation of renal obstruction; however, a more direct and 'functional' basis of diagnosis is required for treatment initiation. Hence, in the present study Doppler sonographic techniques have been assessed to obtain the basis of functional diagnosis in suspected acute renal obstruction with efficacy and its accuracy (11).

In the present study 100 patients were enrolled, out of the 71 were males and 29 were females. The mean age of males was 32.48±14.12 years which is nearly similar to the mean age of females 33.76±15.39 years. However, this difference in age groups was statistically non-significant. The mean resistivity index (RI) values were found to be higher in obstructed kidneys in all study participants. The delta RI values were ranged from 0.08±0.02 to 0.09±0.02 with a mean delta of 0.09. Most of the study participants (60%) were assessed between 6-12

hours after the onset of symptoms, 22% patients within 13-18 hours and 18% patients during 19-24 hours. The difference between RI values among these three groups was statistically non-significant.

A study conducted by Rodgers et al among patients of renal colic assessed by doppler sonography and reported that mean resistance index (RI) of the obstructed kidneys was significantly greater than the normal contralateral kidneys. The mean difference between the RIs of the obstructed kidneys and their contralateral normal kidneys was also significantly higher than the mean differences in RI values seen between pairs of normal kidneys (12). Similar results were reported in a study conducted by Platt et al among patients of acute unilateral renal obstruction and found that higher sensitivity of doppler USG and mean values of RI of the obstructed kidneys was significantly higher than the normal contralateral kidneys (13). Another study conducted by Tublin et al reported that the values of delta RI for the patients of acute unilateral renal obstruction were statistically significant. They also found that doppler alone was not found to be highly specific in diagnosing renal obstruction (14).

In the present study, the site of obstruction was proximal in 47% of patients and distal in 63% of patients. The mean RI of the obstructed kidneys which were proximally obstructed was (0.71 ± 0.02) and the mean RI of the obstructed kidneys which were distally obstructed was (0.69 ± 0.02) . However, this difference was statistically non-significant. Out of 100 study participants, 61 patients show obstruction of the right kidney and 39 patients had obstruction of the left kidney. Out of 61 obstructed right kidneys, 27 patients had a proximal obstruction and 34 patients had a distal obstruction. Out of 39 obstructed left kidneys, 18 patients had proximal and 21 patients had a distal obstruction. In the present study, out of total patients, 68 patients had a complete obstruction, while 32 patients had a partial obstruction.

The mean RI values in completely obstructed kidneys were 0.73 ± 0.02 and mean RI values in partially obstructed kidneys were 0.70 ± 0.01 . This difference was statistically significant; $p < 0.05$. In the present study, we found the overall sensitivity of

Doppler sonography was 94% and specificity reported to be 92%. Similar results to the present study were reported in a study conducted by Shokier et al, who reported that mean RI values of proximal obstruction were higher than mean RI values of the distal obstruction (15).

In the present study, we found the overall sensitivity of Doppler sonography was 94% and specificity reported to be 92%. In patients who had a complete renal obstruction, the sensitivity was 95% while specificity was 94%. In patients who had a partial renal obstruction, the sensitivity reduced to 93% specificity reduced to 90%. Similar results to the present study were reported in a study conducted by Toledo et al reported that the higher sensitivity of doppler sonography in acute renal obstruction i.e. 92% and specificity was 93% (16).

CONCLUSION

We concluded from the present study that Doppler sonography has high sensitivity and specificity in the detection of acute unilateral renal obstruction and better diagnostic tools than conventional USG. The resistivity index values are significantly higher in incomplete obstruction than partial obstruction. The resistivity index values were also higher in proximal obstruction than distal obstruction.

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