Changes in renal doppler ultrasonographic parameters in patients managed with rigid ureteroscopy

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Purpose

Our primary aim in this prospective clinical study was to determine preoperative and postoperative intrarenal vascular parameters such as resistive index (RI), pulsatility index (PI), peak systolic velocity (PSV), end-diastolic velocity (EDV); measure changes on those values (#RI, #PI, #PSV and #EDV) in patients treated with URS and, compare the outcomes with the results of normal contralateral kidneys which served as controls. In addition, we aimed to determine possible parameters that could affect renal vascular resistance changes.
Methods and Materials

We prospectively studied 47 patients who underwent rigid URS. Preoperative gray-scale and doppler ultrasonography (CDUS) measurements were obtained 24 hours before URS. Similarly, postoperative CDUS measurements were done 24 hours after the operation. The degree of hydronephrosis and location of stones in the obstructed kidneys, diameters of both kidneys and thickness of renal parenchyma were evaluated with gray-scale US followed by CDUS with calculation of the intrarenal RI, PI, PSV and EDV values for each kidneys.

For statistical analyses, a commercially available software package (Statistical Package for Social Sciences, version 18.0, SPSS Inc., Chicago, Illinois, USA) was used. Categorical variables were summarized as numbers and percentages; continuous variables were given as the means and standard deviations (median, minimum and maximum, if required). Variables were compared using Student’s T and Mann-Whitney U tests depending on the data type. For the comparison of postoperative and preoperative CDUS parameters (RI, PI, PSV, EDV, #RI, #PI, #PSV and #EDV), paired samples T and Wilcoxon Signed Rank tests were used. Spearman correlation coefficient was obtained to investigate the correlation between continuous variables. Two-tailed $p$ value of $< 0.05$ was accepted as statistically significant.
Results

Mean renal parenchymal thickness, renal length and width values for operated kidneys were comparable with the values for normal contralateral kidneys of which served as controls (p>0.05, student’s t test).

In Table 1, CDUS findings for each kidneys and relevant p values for each comparisons were given. Although, the p value was <0.05, the mean RI increase on normal contralateral kidneys after ureteroscopies was only 0.01 (2.25% increase after the operation). However, for the operated kidneys, very significant statistical significancies were noticed when RI (8.6% increase after the operation) and PI (21.8% increase after the operation) values were considered (p<0.001). The changes in mean RI (#RI) and PI (#PI) of the operated kidneys were also significantly greater than the changes of non-operated kidneys (p<0.001). The differences in the mean #PSV and #EDV between the operated and non-operated kidneys were not statistically significant (Table 1). The mean RI and PI values for the groups categorized according to the operation status were illustrated in Figures 1 and 2, respectively.

Table 1: Spectral doppler analysis findings for each kidneys

<table>
<thead>
<tr>
<th></th>
<th>Normal contralateral kidney</th>
<th>Operated kidney</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Preoperative</td>
<td>Postoperative</td>
</tr>
<tr>
<td>Mean±SD</td>
<td>Med (range)</td>
<td>Mean±SD Med (range)</td>
</tr>
<tr>
<td>RI</td>
<td>0,59±0,05</td>
<td>0,6±0,05 0,6 (0,53-0,74)</td>
</tr>
<tr>
<td>#RI</td>
<td>0,01±0,03</td>
<td>0,05±0,05</td>
</tr>
<tr>
<td>PI</td>
<td>1,02±0,32</td>
<td>1,01±0,18 0,96 (0,63-1,6)</td>
</tr>
<tr>
<td>#PI</td>
<td>-0,02±0,31</td>
<td>0,2±0,25</td>
</tr>
<tr>
<td>PSV (cm/sec)</td>
<td>30,04±8,63</td>
<td>29,63±9,32 28 (10,7-50)</td>
</tr>
<tr>
<td>#PSV</td>
<td>-0,42±10,91</td>
<td>3,2±12,25</td>
</tr>
<tr>
<td></td>
<td>12,23±3,77</td>
<td>11,54±3,79</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
<td>-------------</td>
</tr>
<tr>
<td>EDV (cm/ sec)</td>
<td>11,7</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>(5-23,1)</td>
<td>(4,4-21)</td>
</tr>
<tr>
<td>#EDV</td>
<td>-0,69±4,31</td>
<td>-0,8±4,32</td>
</tr>
</tbody>
</table>

The change in mean RI, which was represented in current study as #RI, was only correlated with the parameters; "operative time" and "irrigation fluid volume". No significant relationship was documented between #RI and the other parameters; age, gender, side of ureteroscopy, stone location and degree of hydronephrosis. On the other hand, none of the above parameters including operative time and irrigation fluid volume were not correlated with #PI, #PSV and #EDV values.
**Fig. 1:** Renal resistive index (RI) values

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**Fig. 2:** Renal pulsatility index (PI) values

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Fig. 3: Mean renal parenchymal thickness (RPT) values in operated and non-operated kidneys

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Conclusion

We already know that baseline RI and changes in RI values can demonstrate altered renal perfusion before pelvicalyceal system dilation exists [1-5]. So, significant changes in RI and PI values in patients treated with URS reveal that URS operation itself is a functionally obstructing event and can cause significant increase in renal vascular resistance that may eventually lead to a decrease in renal blood flow. With the increase in operative time and irrigation fluid volume used during the operation, renal vascular resistance (RI) seems to be significantly increased. Thus, we think that it would be better for an endourologist to manage URS operations with minimum operative time available and, volume of irrigation fluid infused must be as low as possible.
References

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