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NUTCRACKER PHENOMENON: A CASE WITH SURGICAL TREATMENT AND ITS DIAGNOSTIC CRITERIA

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A surgically treated case of the nutcracker phenomenon is reported. Severe left flank pain and gross hematuria were relieved by direct renocaval reimplantation. We proposed the diagnostic criteria of the nutcracker phenomenon causing severe flank pain and/or renal hematuria.

(Key words: Nutcracker phenomenon, Renocaval reimplantation, Pulsewave Doppler method)

INTRODUCTION

The nutcracker phenomenon, with the disturbance of the left renal venous circulation and the development of left renal collateral pathways, resulted from compression of the left renal vein (LRV) by the aorta and the superior mesenteric artery (SMA). It sometimes causes left flank pain and gross or occult hematuria. We report a surgically treated case and propose the diagnostic criteria of the nutcracker phenomenon.

CASE REPORT

A 38-year-old thin man was suffering from severe left flank pain and intermittent gross hematuria for more than 3 years without any treatment. Left flank pain and tenderness became rather worse in the standing position, so that he needed to have a continuous indwelling epidural anesthetic tube for 3 months. Left renal venography was performed. We made the diagnosis of the nutcracker phenomenon, because of the increasing pressure gradient between the left renal vein (LRV) and the inferior vena cava (IVC) by an other establishment, and the absence of any other reasons explaining his violent pain in the detailed examinations on the other abdominal organs. Left renal venography simultaneously with arteriography of the superior mesenteric artery (SMA) (Fig. 1) demonstrated compression at the cross point of the SMA and pooling of contrast medium. The pressure gradient between the LRV and the IVC was 6 cm of water by supine, 24 cm of water by standing. Maximum velocity of the left renal venous flow decreased to 8.7 cm/sec measured by the pulsewave Doppler method (Fig. 2). On October 30, 1990 direct left renocaval reimplantation was performed with excision of gonadal and adrenal veins. The LRV was reanastomosed into the IVC 4 cm caudally to the original site. Ptosis of pancreas body over the LRV was also
Fig. 2. Pulsewave Doppler method shows the decreased maximum velocity of the left renal venous flow, especially in standing position (below).

observed. After the operation his symptoms improved and he was released from continuous epidural anesthesia. He had left renal venography again 30 months after the operation. In spite of the marked improvement of the left renal venous circulation, the pressure gradient between the LRV and the IVC was still 6 cm of water in supine position (that in standing position was not measured). He is now almost free from pain and hematuria (one to four red cells per high-power field were present in the sediment).

**DISCUSSION**

It is well known that compression of the LRV by the aorta and the SMA causes left renal venous hypertension and sometimes leads to left flank pain, gross or microhematuria, and development of collateral renal varices including varicocele. DeSchepper etc named such a syndrome the "nutcracker phenomenon" in 1972. Recently, with the spread of the concept of this phenomenon, it is considered to be a cause of unknown origin renal hematuria.

Table 1. Pressure gradient between the LRV and the IVC

<table>
<thead>
<tr>
<th>Reference</th>
<th>Age-Sex</th>
<th>Pressure gradient</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dever and associates</td>
<td>40-F</td>
<td>3 mmHg (=4 cmH2O)</td>
<td>Observation</td>
</tr>
<tr>
<td>Wendel and associates</td>
<td>45-F</td>
<td>7 cmH2O</td>
<td>Medial fixation of the left kidney</td>
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<tr>
<td>Stewart and Reiman</td>
<td>19, 24-F</td>
<td>5.5–6.3 cmH2O</td>
<td>Direct left renocaval reimplantation</td>
</tr>
<tr>
<td>Stewart and Reiman</td>
<td>31-M</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Choi and Anlo</td>
<td>19-F</td>
<td>6 cmH2O</td>
<td>Direct left renocaval reimplantation resection of a paraaortic fibrous tissue</td>
</tr>
<tr>
<td>Ariyoshi and Nagase</td>
<td>20-M</td>
<td>8.2 cmH2O</td>
<td>Direct left renocaval reimplantation</td>
</tr>
<tr>
<td>Sachs and associates</td>
<td>30-F</td>
<td>8 cmH2O</td>
<td>Direct left renocaval reimplantation</td>
</tr>
<tr>
<td>Present case</td>
<td>38-M</td>
<td>6 cmH2O</td>
<td>Direct left renocaval reimplantation</td>
</tr>
</tbody>
</table>
Table 2. The Diagnostic Criteria of the Nutcracker Phenomenon

| No specific findings are obtained by ordinarily performed medical and urological examination against hematuria or left flank pain |
| Nutcracker Distance* < 5 mm |
| Maximum velocity of the left renal venous flow** < 15 cm/sec |
| Compression of the LRV by the SMA on selective renal venography |
| The pressure gradient between the LRV and the IVC > 4 cmH₂O |

* Nutcracker Distance is the distance between the SMA and the aorta on abdominal CT.
** The velocity is measured by the pulsewave Doppler method and its average of control cases is more than 20 cm/sec.

Dever and associates\(^2\) discussed the diagnostic options. They advocated that the diagnosis should be established by demonstrating compression of the LRV on selective renal venography and existence of a significant pressure gradient increase. However, he did not refer to the definitive value of the pressure gradient. Judging from the values of the pressure gradient in 2 patients with the disease and 6 normal controls we previously reported\(^3\), and review of the literature (Table 1)\(^2,4-8\), we decided the gradient of 4 cm of water to be adequate as the border value. Choi\(^6\) mentioned the significance of the decrease in the angle of the SMA from the aorta. We express it by means of the distance between the SMA and the aorta measured in computerized tomography (CT), and call it nutcracker distance (Fig. 3)\(^9\). The uniform criteria of the nutcracker phenomenon has not yet been defined in the literature, and we propose our ideal criteria (Table 2). The left renal venous flow velocity measured by the pulsewave Doppler method is useful for estimating the effect of the surgical treatment\(^2\).

Stewart\(^5\) performed direct renocaval reimplantation for 3 patients with the nutcracker phenomenon and received satisfying results. Wendel\(^4\) thought venous compressions was caused by surrounding structures and positional factors, and performed medial fixation of the left kidney and excision of extensive renal varicosities. Dever and associates\(^2\) noted the former approach was logical for the patients with the significant pressure gradient increase, and we also recommend it as the best method for the relief from severe pain by recovery of the renal venous circulation. Observation is first and fundamental, but when severe flank pain has continued for a long term we should take a plunge to surgical treatment, and it is of course necessary to rule out any probabilities of other painful diseases before the decision of the surgery.

REFERENCES

8) Sacks BA, Gomori J, Lerner M, et al.: Left renal hypertension in association with the
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