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Ultrasonographically Demonstrated Nutcracker Phenomenon: Alternative to Angiography

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We report on a child with nutcracker phenomenon, which is a possible cause of intermittent gross haematuria of unknown origin. Early serial ultrasound examinations can demonstrate the lesions.

The merits and demerits of conventional angiographic imaging are also discussed.

The nutcracker phenomenon has been recognized as a cause of haematuria of unknown origin. All previously reported cases were diagnosed by means of renal angiography and renal venography, and recently by pressure study of the left renal vein [1–4]. Thanks to the progress in ultrasound examination, morphological evaluation using this technique has been easily made in all fields of medicine.

We experienced an ultrasonographically confirmed case of a child with nutcracker phenomenon complaining of intermittent gross haematuria. The role of this imaging modality is also discussed.

Case report

An 11-year-old girl complained of intermittent asymptomatic gross haematuria after exercise. All laboratory examinations at the paediatric service were normal. Results of excretory urography were within normal limits. She was referred to our department for further evaluation and cystoscopic study revealed bleeding from the left ureteral orifice. After this, ultrasonic studies were performed with a sector scanning system (Yokogawa Medical Systems, RT 3600, 3.5 MHz and 5 MHz) in the supine position. Parenchyme and collecting system of the bilateral kidneys were normal in both shape and size. However, the left renal vein was dilated prior to the portion where it passed between the superior mesenteric artery and the aorta (Fig. 1A). Also, the course of the left renal vein was interrupted at this area. The dilated left renal vein looks like an aneurysm arising from the aorta. The interface between the left renal vein and the aorta may be very difficult to see. After passing the aorta, the left renal vein smoothly drains into the inferior vena cava. The space between the superior mesenteric artery and the aorta during haematuria, as shown

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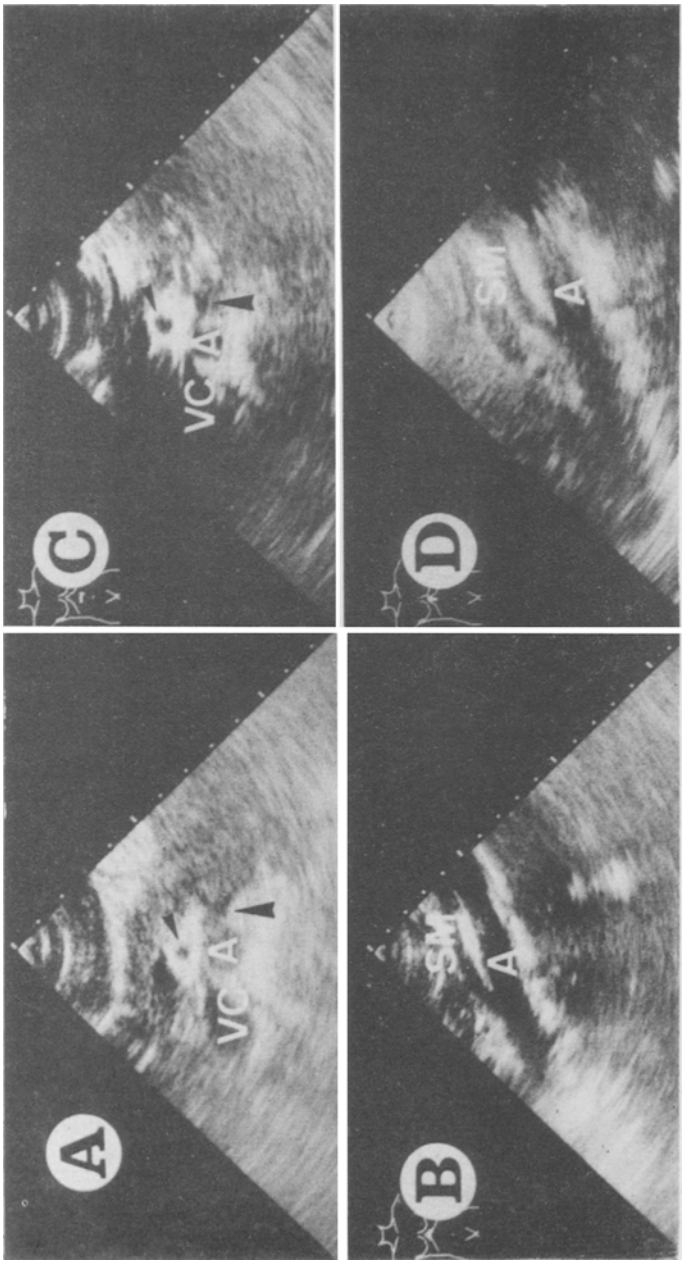

Fig. 1. A and B are ultrasound images of the abdomen during haematuria, C and D at normal urination. A and C: Transverse supine view. B and D: Longitudinal section. Comparing A with C, and B with D, respectively, the space between the superior mesenteric artery and the aorta during haematuria is smaller than that at normal urine. VC: inferior vena cava, A: aorta, SM: superior mesenteric artery, large arrowhead: left renal vein; small arrowhead: superior mesenteric artery

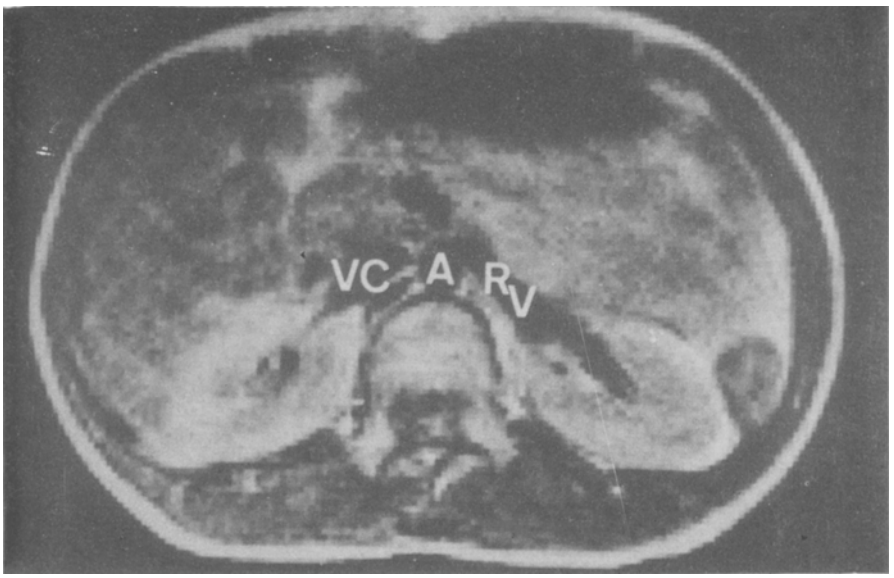

Fig. 2. Transverse MRI image of the abdomen during haematuria. T_1 weighted, R_V: renal vein

in Fig. 1A, is smaller than that at the normal urination period, as demonstrated in Fig. 1C. Supine longitudinal view during haematuria shows that the narrow angle between the superior mesenteric artery and the aorta can act as a "nutcracker" (Fig. 1B).

At normal urination, the dilated left renal vein is normalized (Fig. 1C) and supine longitudinal view demonstrates the wide angle between the two arteries (Fig. 1D).

T_1 weighted transverse image during haematuria demonstrates the dilated left renal vein whose size is almost the same as that of the inferior vena cava (Fig. 2).

Discussion

When we see a patient with gross haematuria it is important to localize the source of red blood cells in the urinary tract. Less invasive imaging modalities including ultrasonography, radionuclide study, computed tomography and magnetic resonance imaging are preferred, especially in children.

When the bleeding is unilateral, especially from the left side, the "nutcracker phenomenon" may be considered as one of the possible causes of vascular lesion. Renal angiography along with selective renal venography is required as the last definitive examination method in patients with haematuria of unknown origin. Recently, the pullback pressure study has been also carried out during these proce-

dures [3, 4]. According to the pullback pressure study of the left renal vein, 12% of patients with left renal bleeding of unknown origin had normal pressure gradients. In a case of intermittent gross haematuria, the pathophysiologic condition probably alternates momentarily between normal and abnormal. Early examination is essential to achieve a precise diagnosis. Ultrasound examination, having many advantages such as noninvasiveness, repeatability, real-time operation and cost effectiveness, is suitable in these situations and preferred as a first choice procedure to assess not only renal parenchymal abnormalities but also the vascular architecture in patients with haematuria.

The pathophysiologic characteristics of this disorder relate to the vascular angle the superior mesenteric artery forms as it originates from the abdominal aorta. The mean angle made by the two arteries has been reported as 38, 41.5 and 56 degrees, respectively [5–7]. In this case, the angle at normal urination was 47 degrees, on the other hand, during gross haematuria it was markedly reduced to 12 degrees. These results correspond to the data of the superior mesenteric artery syndrome in which the aortomesenteric angle is diminished to approximately 6–16 degrees [7, 8].

No case until now has been reported on using this technique. Hereafter, the above described two findings of a dilated left renal vein along with a decreased aortomesenteric angle will become one of the important criteria in order to make the diagnosis of the nutcracker phenomenon by ultrasound. Furthermore, we are convinced that ultrasound may be an alternative to angiographic examination in this field.

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