Asymmetric Hypertrophy of Renal Graft after Transplantation

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Since the cortical thickness of the graft is thinner at contact with the psoas muscle [1], it is suggested that the local mechanical effect of the recipient affects the graft hypertrophy, i.e. the upper part of the graft facing the upper abdomen hypertrophies more than the lower part facing the minor pelvis where there is no space to move. In order to prove this hypothesis, renal volume was measured using CT scan in its upper, hilar and lower parts.

Six recipients (25.3 ± 7.9 years of age, mean $\pm$ SD) received grafts from their parents (53.2 ± 5.6 years of age). CT scans were performed from the upper pole to lower pole of the kidney sequentially with a constant slice width (8 mm), 77 ± 43 days before transplantation and 75 ± 28 days after transplantation for grafts and 42 ± 36 days after transplantation for donor's remaining kidneys. The donor's left kidney was transplanted in the right iliac fossa of the recipient inside out. The serum creatinine levels in 6 recipients were 1.0–1.5 mg/dl at the time of CT examination after transplantation.

The upper or lower parts of the kidney were defined as kidney part above the uppermost scan level or below the lowest scan level where the hilus is included. The hilar part was defined as the renal part with scan slices including the renal hilus. The volumes of the upper, hilar and lower parts were measured in 35 recipients who received the donor's left kidney in their right iliac fossa besides 6 donor and recipient pairs.

The angle of the axis of the graft to the median line in 6 recipients ($1.2 \pm 5.7^\circ$) is significantly more upright than the axis of the left kidney in the donor ($-12.4 \pm 7.6^\circ$) ($p < 0.05$). Therefore, the volume of the upper part of the graft is underestimated and the volume of the lower part is overestimated because the axis of the graft is more upright.

The volumes of the upper, hilar, lower parts, and total in the right kidney (n = 6) were 32.9 ± 5.7 , 60.3 ± 16.4 , 28.5 ± 10.0 , and 121.7 ± 14.2 ml/1.48 m², respectively. The volumes in the upper, hilar, lower parts, and total of the left kidney were 39.3 ± 7.4 , 61.1 ± 17.3 , 31.4 ± 9.9 , and 131.8 ± 18.0 ml. No significant volume differences were observed in the upper and lower parts in either kidney. The volumes in the upper, hilar, lower parts, and total of the graft were 94.2 ± 29.4 , 94.2 ± 29.3 , 51.9 ± 19.9 , and 240.4 ± 74.3 ml. On the other hand, the volumes in the upper, hilar, lower parts, and total of the donor's remaining kidney were 43.2 ± 19.0 , 75.9 ± 21.5 , 39.7 ± 11.4 , and 158.8 ± 37.7 ml. The volume of the upper part was larger than that of the lower part in the graft ($p < 0.01$). The volume of the upper part of the graft was significantly larger than that of the upper part of the donor's remaining kidney ($p < 0.001$). The volume of the upper part in 35 recipients with good renal function (serum creatinine < 2.0 mg/dl) was significantly larger than that of the lower part ($p < 0.01$) (fig. 1). These data were in accord with those of the previous 6 pairs.

In 1 of 6 paired data, the reconstruction of the kidney from CT scan was made. The graft and remaining right kidney hypertrophied; however, the upper part of the graft was larger than the lower part. This effect was more predominant when the graft was observed from the hilus side (fig. 2).

From early experiences, hypertrophy of the kidney was observed in vivo by intravenous urography using indices such as total renal area [2], long axis [3], and long axis times short axis of the graft [4]. However, our method for organ volume measurement using CT scan is the most accurate one [5, 6].

Uniform overall renal compensatory hypertrophy was not observed in this study. The volume of the upper part of the graft is significantly larger than that of the lower part after correction of the renal axis deviation. The observation of the graft nephrogram after angiography or

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$P < Q.001$

$P < 0.02$

$p < 0.001$

Upper

Hilar

Lower

Fig. 1. The graft volumes in its upper, hilar and lower parts in 35 renal recipients. The volume of the upper part is significantly larger than that of the lower part.

Fig. 2. The graft volume of the upper part is larger than that of the lower part. This is obvious when the graft is observed from its hilus side. Right panel shows donor's left kidney before transplantation.

urography supports this hypothesis retrospectively. However, this hypothesis was only conclusive using CT evaluation, because it is difficult to see the renal hilus on angiography or urography. This phenomenon was also observed in the graft with acute rejection episode and chronic rejection episode, though data are not shown in this study.

The extent of hypertrophy of the renal graft is related to the age of the donor kidney [7] and a circulating renal growth regulator of the recipient [8–10]. This study, in addition to our previous study [1], suggests that compensatory renal growth is also affected by the local environment. In conclusion, the upper part of the graft facing the upper abdomen, where there is room to move, reveals more hypertrophy than the lower part facing the minor pelvis where space is limited.

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