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Cardiac involvement of progressive muscular dystrophy (Becker type, Limb-girdle type and Fukuyama type) evaluated by radionuclide method

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Tl-201 SPECT and Tc-99m-Human serum albumin (HSA) multigated radionuclide ventriculography were performed on 11 patients with progressive muscular dystrophy (Becker type 2, Fukuyama type 2, Limb-girdle type 7) to evaluate myocardial involvement. Hypoperfusion was detected in 8 patients on Tl-201 SPECT. Decreases in both systolic function (left ventricular ejection fraction; LVEF) and diastolic function (peak filling rate; PFR) were also seen in these patients. A high incidence of myocardial involvement of these kinds of progressive muscular dystrophy was suggested.

Key words: Tl-201 myocardial SPECT, progressive muscular dystrophy, Tc-99m-HSA multigated ventriculography, LVEF, PFR

INTRODUCTION

CARDIAC INVOLVEMENT is common in progressive muscular dystrophy of Duchenne's type (DMD).[1–5] Although they have come to be evaluated by the radionuclide method recently,[6–12] myocardial disorder is uncommon in other types[2–4] and there have been few reports on the radionuclide method.[7,8]

In this paper, we evaluate cardiac involvement of patients with the Becker type, Fukuyama type and Limb-girdle type, by means of Tl-201 myocardial SPECT and multigated radionuclide ventriculography.

MATERIALS AND METHODS

Eleven patients with Progressive muscular dystrophy (PMD) (Becker type 2, Limb-girdle type 7, Fukuyama type 2) ranging in age from 7 to 62 years (average, 28.9 years) underwent Tl-201 SPECT and multigated radionuclide ventriculography.

The patients were given 111 MBq of Tl-201 intravenously. SPECT imaging, with a Siemens rotating gamma camera (ZLC7500) with a low-energy collimator, was started 10 minutes after injection. Data acquisition was done from 32 projections in a 64 square matrix. Acquisition time was set to 30 seconds per projection. The data were reconstructed by filtered back projection with a Shepp-Logan filter. Slice thickness was 6 mm. Hypoperfusion areas were evaluated on the reconstructed images (long axis and short axis). Areas were divided into six sections and the severity of lesions was classified into three degrees on visual analysis (mild, one-third of muscle revealed hypoperfusion; moderate, two-thirds of muscle revealed hypoperfusion; severe, complete perfusion defect).

After intravenous injection of 740 MBq of Tc-99m-HSA, multigated radionuclide ventriculography was done. Data were acquired in the left anterior oblique projection and formated in the 64 square matrix. The left ventricular ejection fraction (LVEF) was calculated from the left ventricular time-activity curve (LV-TAC) from the 24 sequential equilibrium cardiac pool images. The peak filling rate (PFR) was also calculated from the derivative curve of LV-TAC and was normalized to the end-diastolic count ratio (end-diastolic volume/second; EDV/sec).

RESULTS

The results are summarized in Table 1. Eight of eleven patients revealed hypoperfusion. Abnormal findings were seen in each type of PMD. With increasing age, the low

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Table 1 Summary of results

case	sex	age	type	hypoperfusion area						LVEF (%)	PFR (EDV/sec)
				ant	sep	apex	lat	inf	pos		
1.	F	19	LG	+						68	4.0
2.	F	27	LG	++	+		+			48	2.2
3.	M	20	LG							49	2.7
4.	F	32	LG		+					58	3.4
5.	M	36	LG					+		53	3.2
6.	M	51	LG		++			++	++	34	1.5
7.	F	62	LG		+			+		37	1.5
8.	M	7	Bec							39	1.9
9.	M	30	Bec	+++	++		++	++	++	18	1.5
10.	F	15	Fuk							49	2.6
11.	F	19	Fuk	+						37	2.5
control (n = 8)										50	2.5

LG: Limb-girdle, Bec: Becker, Fuk: Fukuyama, ant: anterior wall, sep: septum, lat: lateral wall, inf: inferior wall, pos: posterior wall, LVEF: left ventricular ejection fraction, PFR: peak filling rate, EDV: end diastolic volume, +: mild, ++: moderate, +++: severe

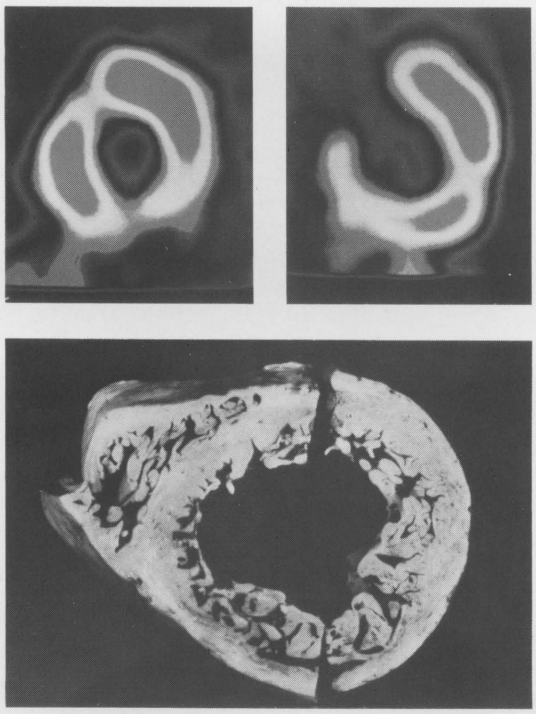

Fig. 1a Hypoperfusion areas are seen in posterior-inferior wall, a part of anterior wall and lateral wall on Tl-201 SPECT (lt upper row: short axis. rt upper row: long axis). On macroscopic findings, left ventricle dilated markedly and fibrosis existed in outer layer of the myocardium mainly in posterior wall (lower row).

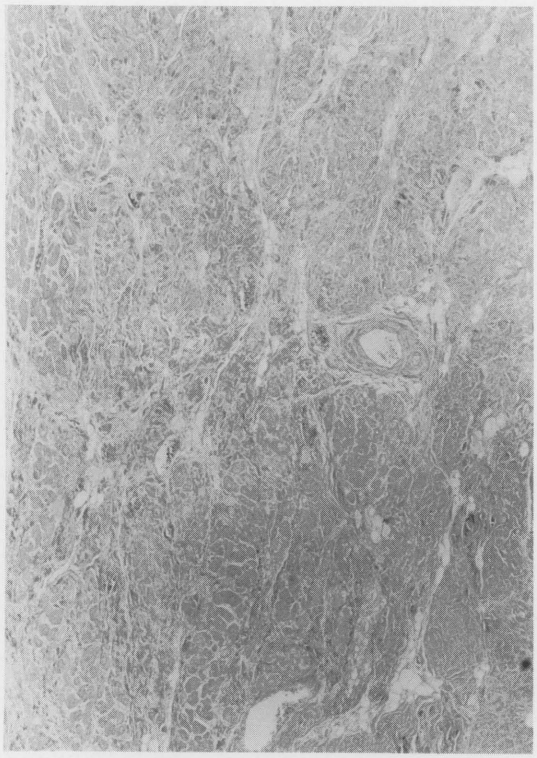

Fig. 1b Marked fibrosis in Azan-Maroly stain was shown by microscopic study.

perfusion area enlarged in the Limb-girdle type. Both LVEF and PFR of the patients with severe perfusion defects on Tl-201 SPECT were very low.

CASE REPORT

Case 1: No 9, 30 year old male, Becker type

Tl-201 SPECT revealed severe hypoperfusion of posterior-inferior wall, anterior wall and moderate hypoperfusion of septum and lateral wall (Fig. 1a). Both LVEF (18%) and PFR (1.52 EDV/sec) decreased. Six months later, the patient died of heart failure and myocardial fibrosis was confirmed on necropsy. There was severe posterior-inferior wall involvement corresponding with the area of hypoperfusion on Tl-201 SPECT (Fig. 1a). Microscopic studies by the Azan-Malory method showed diffuse fibrotic tissue (Fig. 1b).

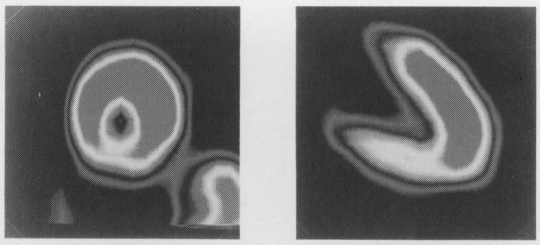

Fig. 2 Hypoperfusion areas are seen in posterior-inferior wall on Tl-201 SPECT (left: short axis, right: long axis).

Case 2: No 6. 51 year old male, Limb-girdle type
Tl-201 SPECT showed hypoperfusion in posterior-inferior wall (Fig. 2). Both LVEF (34%) and PFR (1.48 EDV/sec) were low.

DISCUSSION

Tl-201 SPECT is a useful method of assessing Duchenne's cardiomyopathy and it has come to be used commonly.[7–12] However, there had been few reports on the cardiac involvement of other types of PMD (Becker type, Fukuyama type and Limb-girdle type) evaluated by the radionuclide technique.[7,8] Our study showed the presence of cardiac disorder in these three kinds of PMD.

Becker's muscular dystrophy is benign X-linked recessive and is allelic disease of DMD.[13,14] So the possibility existed that Becker's dystrophy has a high incidence of cardiac involvement. This time we could confirm myocardial fibrosis from the necroscopic findings. Compared with the SPECT study, the distribution of severe fibrosis of the left ventricular wall corresponded with the areas of perfusion defect. There were no ischemic changes or necrosis in microscopic findings. Reduced uptake of Tl-201 is therefore considered to reflect a decrease in normal muscle fibers per unit mass.

Furthermore, abnormalities in Na, K and ATPase are reported in PMD.[3] Because Tl-201 kinetics is closely related with its concentration, such a biochemical fault may cause low uptake of Tl-201.

Fukuyama's disease is congenital muscular dystrophy with central nervous system malformations that occurs commonly in Japan.[15] Although myocardial fibrosis had been reported in necroscopic studies,[15] not much attention has been paid so far to cardiac involvement clinically. We should observe morphologic changes in the myocardium in patients with Fukuyama's dystrophy by Tl-201 SPECT.

Although cardiac involvement in the Limb-girdle type is uncommon, there is a remarkable variation in the course of the disease and the clinical expression in some patients is similar to DMD.[3,4] Yamamoto reported hypoperfusion on Tl-201 SPECT in 3 (60%) of 5 patients.[7] In 6 (86%) of 7 our cases, there were also hypoperfusion areas. These results suggest a high incidence of myocardial involvement in the Limb-girdle type. As the population is too small, more data will be needed before the clinical implications of these findings become clear.

The LVEFs in cases 6,7,9 and 11 were relatively lower than in other patients without a hypoperfusion area on Tl-201 SPECT. It was considered that adequate systolic force could not be obtained due to fibrosis in these patients. Particularly the Becker type patient (case 9) showed marked reduction (18%) and he died of heart failure 6 months after the examination. LVEF would be useful index for prognosis.

PFR is a parameter of diastolic function calculated by the derivative method.[16,17] Although myocardial relaxation represents a complex interaction of both active and passive processes during early isovolumic diastole, the cellular events and the mechanical factors that govern the period of early relaxation remain incompletely understood.[17] However, it is probable that many fibers begin to relax while others are still in their shortening period.[17] Such a nonuniformity of contraction and relaxation exists in the normal state and probably affects measures of the overall rate of ventricular relaxation. In patients with PMD, nonuniformity of contraction and relaxation is considered to be increased due to fibrotic changes. A decrease in PFR could reflect severe myocardial fibrosis.

Although diastolic dysfunction is said to precede systolic dysfunction in many cardiac disorders,[17] most patients with low LVEF revealed lowering of PFR. As dilated cardiomyopathy due to fibrosis is considered to be an essential feature of cardiac involvement of PMD, diastolic dysfunction may be a concomitant phenomenon secondary to systolic dysfunction. This speculation is quite groundless in the case of Fukuyama type and Limb-girdle type. Further study of a large number of patients is required. If attention to and interest in these types of PMD increase, the elucidation of cardiac involvement in these disorder will be facilitated.

We performed Tl-201 SPECT and Tc-99m-HSA gated pool studies on patients with PMD (Becker type, Limb-girdle type, and Fukuyama type) and several patients had abnormal findings. Although the clinical course of these PMD is longer than that of DMD, some patients have latent cardiac failure affecting prognosis. So we should monitor pathological changes in the myocardium by following up with periodic studies by means of radionuclide method.

CONCLUSION

Tl-201 myocardial SPECT and Tc-99m-HSA multigated radionuclide ventriculography showed high incidence of myocardial involvement in patients with PMD (Becker type, Fukuyama type and Limb-girdle type).

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