Stunned Myocardium and Sympathetic Denervation

Clinical assessment using MIBG scintigraphy

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To evaluate the clinical relationship between stunned myocardium and the sympathetic nervous system, 6 patients who had stunned myocardium accompanied by T wave inversion underwent simultaneous ^{123}I -metaiodobenzyl guanidine (MIBG) scintigraphy and thallium scintigraphy. All patients showed abnormal filling defects on the MIBG scintigrams in the areas with stunned myocardium, but the thallium scintigrams were almost normal. The extent of the defects in these 6 patients was determined on the MIBG scintigrams using a Bull's eye display.

The defects were found to be larger than those in 4 patients with angina pectoris, and those in 4 patients who had previously shown T wave inversion but had a normal electrocardiogram at the time of examination. Thus, it is suggested that sympathetic denervation is one of the mechanisms causing stunned myocardium.

ANIMAL experiments suggest that sympathetic denervation is involved in the development of stunned myocardium¹⁻³ but the clinical detection of such denervation

has been very difficult. ^{123}I -metaiodobenzyl guanidine (MIBG) is a newly developed radionuclide that acts as an analogue of norepinephrine, and thus is concentrated in

TABLE I PROFILES OF STUNN GROUP PATIENTS

No.	Age	Sex	Coronary lesion	Location	Wall motion	Cardiac enzymes	Time after onset
1.	45	F	spasm	anterior	hypokinesis	(-)	12 days
2.	63	M	SVD	anterior	akinesis	(-)	12 days
3.	60	M	SVD	anterior	dyskinesis	(-)	12 days
4.	63	M	SVD	anterior	hypokinesis	(-)	23 days
5.	72	M	SVD	anterior	hypokinesis	(-)	35 days
6.	59	M	spasm	inferior	hypokinesis	CK 613	16 days
mean	60.3	yrs					18.3 days

M=male; F=female; SVD=single vessel disease; (-)=no elevation; CK=creatin kinase

Key words:

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Fig.1 Thallium and MIBG scintigrams of patient No.1 in Table 1. The apparent defect in the anterior and septal walls demonstrated by MIBG scintigraphy 12 day after the onset (A) had disappeared after 4 months (B). Both of the thallium scintigrams were normal.

adrenergic nerve terminals^{4,5} In this study we assessed the relationship between sympathetic denervation and stunned myocardium using MIBG scintigraphy.

SUBJECTS AND METHODS

Our investigation involved 24 patients who were divided into four group. The STUNN group consisted of 6 patients who had stun-

Fig. 2 Severity scores determined for MIBG (A) and thallium (B) scintigraphy using a Bull's eye display. Severity scores for MIBG scintigraphy were significantly higher in the STUNN group than in the AP and ONT groups, but severity scores for thallium scintigraphy were low in all three groups except for the OMI group.

ned myocardium after ischemic episodes. Their electrocardiograms showed inverted T waves without new Q waves at the time of examination, and all but one of them had no elevation of cardiac enzymes (Table I). The AP group consisted of 4 patients who had exertional angina with normal electrocardiograms. The ONT group consisted of 4 patients who had experienced ischemic episodes with T wave inversion, but had a normal electrocardiogram at the time of examination. Finally, the OMI group comprised 10 patients with transmural myocardial infarction.

In all these subjects and 8 normal controls, MIBG scintigraphy and thallium myocardial scintigraphy were performed by a simultaneous dual-isotope method. At peak exercise, 111 MBq of MIBG and 111 MBq of thallium were injected simultaneously and two sets of single-photon emission computed tomograms were obtained 4 hours later using simultaneous dual-isotope acquisition. We also utilized a Bull's eye display for quantitative analysis. Pixels that deviated by more

than 2 s.d. from normal were defined as abnormal, and a "severity score" was calculated by totaling the number of s.d.s below normal in the abnormal pixels.

RESULTS

In all 6 patients of the STUNN group, MIBG scintigrams showed apparent defects in the areas with stunned myocardium, but the thallium scintigrams were almost normal. A 45-year-old woman (case No.1 in Table I) presented with inversion of T wave in the precordial leads and anterior wall hypokinesia after an ischemic episode due to coronary spasm. MIBG scintigraphy obtained 12 days after the onset revealed defects in the anterior and septal walls, but the thallium scintigram was normal (Fig. 1A). After 4 months, when her electrocardiogram had returned to normal, MIBG scintigraphy showed no defects (Fig. 1B), and the ejection fraction measured using ^{99m}Tc radionuclide ventriculography had improved from 54% to 71%. In the AP and ONT

groups, both MIBG and thallium scintigrams were almost normal. In the OMI group, both types of scintigrams showed defects corresponding with the infarcted areas.

The severity scores in the STUNN group for MIBG scintigraphy were significantly higher than those in the AP and ONT groups (Fig. 2A). Concerning thallium scintigraphy, the STUNN group showed low severity scores, as did the AP and ONT groups, while in the OMI group the severity scores were significantly higher than in the STUNN group (Fig. 2B).

DISCUSSION

A relationship between stunned myocardium and the sympathetic nervous system had not yet been proven clinically. In our study, all 6 patients in the STUNN group showed regional disruption of the sympathetic nervous system (defects on MIBG scintigrams) in the areas with stunned myocardium. The extent of these defects was evaluated by severity scores obtained from the MIBG scintigrams, and scores were significantly higher in the STUNN group than in the AP and ONT groups. In one patient from the STUNN group, defects on the MIBG scintigram were observed 12 days after the onset of myocardial stunning and disappeared after 4 months. Four patients in the ONT group, who had previously shown the same electrocardiographic changes as the STUNN group but had normal electrocardiograms at the time of examination, demonstrated almost normal MIBG scintigrams. These findings indicate a close relationship between stunned myocardium and sympathetic denervation, and also emphasize the tran-

sient nature of this denervation. The almost normal thallium scintigrams in all subjects, and the lack of elevation of cardiac enzymes in all but one of the STUNN group, indicate that the damage to the myocardium was insignificant after these ischemic episodes.

Taken together with the results of animal experiments¹⁻³ our findings suggest that sympathetic denervation is one of the mechanisms causing stunned myocardium.

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