The Effect of Acupuncture at Nèiguān Point on the Circulatory System (Ⅱ) : Improving Diastolic Abnormalities in Diabetic Patients

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Summary: Acupuncture at Nèiguān point (P6) has been employed against for various circulatory diseases. In 1988, we examined the effect of acupuncture at Nèiguān point on the circulatory system using a pulse Doppler method in healthy adult males and such acupuncture was found to increase left ventricular contractility.

In this study, we investigated the effect of acupuncture at Nèiguān point on left ventricular diastolic abnormalities in diabetic patients. The peak blood flow velocity in the rapid filling phase (R) and during atrial contraction (A) of the left ventricular inflow tract were measured. The A/R ratio and deceleration half time of the rapid filling velocity (DHT) were calculated in evaluating left ventricular diastolic function. The acceleration time (ACT) and ejection time (ET) of the left ventricular outflow tract were measured and the ACT/ET ratio calculated in evaluating left ventricular contractility. In diabetic patients, significant decreases of DHTs were observed in comparison with control values and A/R ratios tended to decreases. These results suggest that the acupuncture at Nèiguān point may improve and increase contractility in left ventricular function. This suggests that acupuncture at Nèiguān point is also useful in treating organic cardiac changes in diabetic patients.

Key Words : Acupuncture, Nèiguān(P6), Pulse Doppler echocardiography, Diastolic abnormalities, Diabetes mellitus

1. Introduction

Diastolic abnormalities of the left ventricle are induced by insulin deficiency[1,2,3,4,5,6] and it is known that such abnormalities are one of the complications of early stage diabetes, these abnormalities being detectable by pulse Doppler echocardiography[2,7]. The Nèiguān point is often used as an acupuncture point in treatment of circulatory disease[8,9,10,11,12,13] as there are indications that acupuncture at Nèiguān point influences cardiovascular function[13,14,15]. In this study, acupuncture at Nèiguān point was performed on diabetic patients with diastolic abnormalities of left ventricle and the effects of such acupuncture on left ventricular function were investigated.

2. Materials and Methods

Eight patients (2 male and 6 female), aged between 54 and 79 years (mean: 68.4 years),

with histories of diabetes ranging in length from 12 to 180 months (mean:85.3 months) were examined(Table 1). The Nèiguān point was located in each subject at 2 cun (1 cun= 3.03 cm : a Japanese measure) above the transverse line of the wrist between the tendons of the m. flexor carpi radialis and m.palmalis longus. A stainless acupuncture needle (Seirin Kasei Co. Ltd., Japan), 40 mm in length and 0.20 mm thick was used.

The left ventricular diastole and systole activities were studied by pulse Doppler echocardiography with an electoronic sector scanner and 2.5 MHz transducer (model SSH α-160A, Toshiba Corporation). Parameters determining left ventricular function were determined as follow. Fig. 1 shows the points of the measurement of the left ventricular blood flow tract at which diastolic and systolic flow velocity signals were obtained. The diastolic flow velocity signal is shown in Fig.2. The peak velocities in the rapid filling (R) and in atrial contraction (A) phases comprised the first and second peaks of the diastolic flow signal, respectively. The deceleration half time of the rapid filling velocity (DHT) was the time necessary for the maximum rapid inflow velocity to reduse by half. The A/R ratio and DHT were calculated as indices of left ventricular diastolic function. The systolic flow velocity signal is shown in Fig.3. The ejection time (ET) was measured as time from the beginning to the end of the systolic flow velocity signal. The acceleration

Table 1. Diabetic patients with left ventricular diastolic abnormalities.

PATIENT No.	AGE/SEX (yr)	LENGTH OF DIABETIC HISTORY (month)	A/R * ratio	DHT ** (sec)	ACT/ET*** ratio	ECG finding	Diabetic complication	Relavent Disease
1	77/M	120	1.11	0.14	0.26	A-Vblock	(−)	(−)
2	54/F	96	1.38	0.13	0.33	normal	(−)	(−)
3	62/F	16	1.56	-	0.35	normal	nephropathy retinopathy	(−)
4	61/M	12	1.58	0.15	0.62	longQT	retinopathy	hypertension
5	79/F	180	1.64	0.15	0.19	normal	(−)	(−)
6	65/F	190	1.65	0.14	0.16	abnormalT	neuropathy	hypertension
7	74/F	24	1.83	0.13	0.26	abnormalT	(−)	(−)
8	75/F	44	2.22	0.16	-	normal	(−)	(−)

*A/R ratio: Peak velocity in the atrial contraction phase / the peak velocity in rapid filling phase ratio.
**DHT: Deceleration half time of the rapid filling velocity.
***ACT/ET ratio: Acceleration time / ejection time.
A/R and DHT were calculated as indices of left ventricular diastoric function.
The ACT/ET ratio was calculated as an index of left ventricular systolic function.
Normal A/R ratio levels are <1.0
Patients were selected with negative histories for arrythmia, stenosis, or valvular insufficiency.

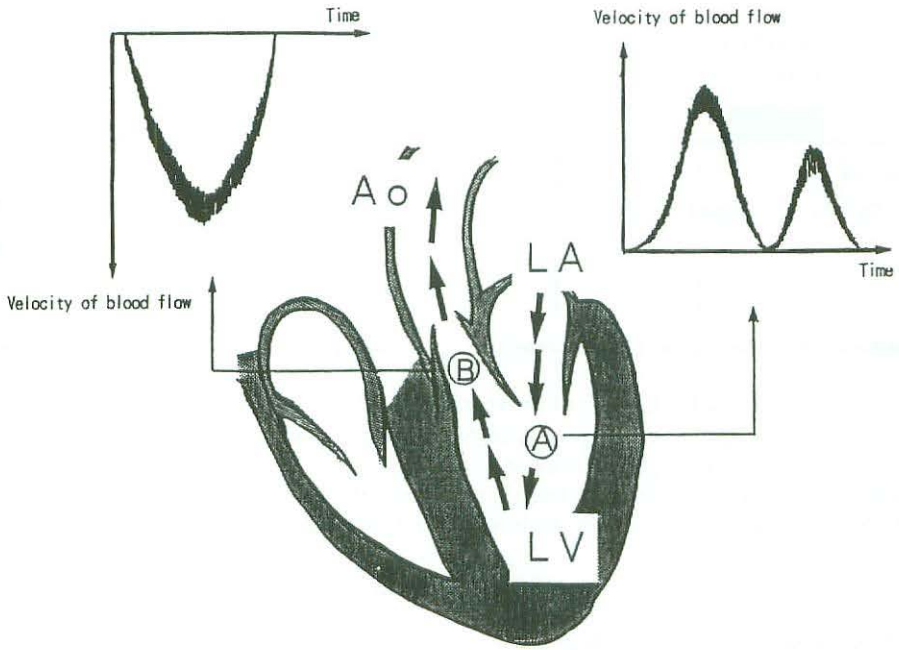

Fig.1. A shema of longitudial section of the heart and aorta.
A shows the measurement point at left ventricular inflow tract.
B shows the measurement point at left ventricular outflow tract.
Arrows indicate intra ventricular blood flow.
L A : left atrium, L V : left ventricle, A o : aorta.

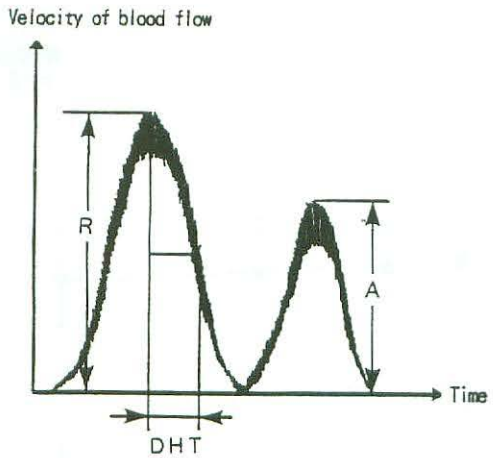

Fig.2. Blood flow pattern at the left ventricular inflow tract.
R : Peak velocity in the rapid filling phase.
A : Peak velocity in the atrial contraction phase.
DHT : Deceleration half time of the rapid filling phase.

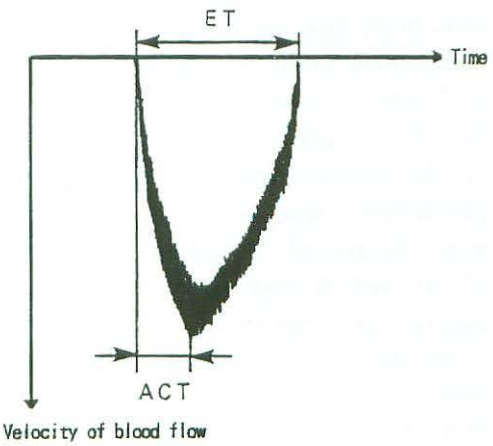

Fig.3. Blood flow pattern at the left ventricular outflow tract.
E T : Ejection time.
A C T : Acceleration time.

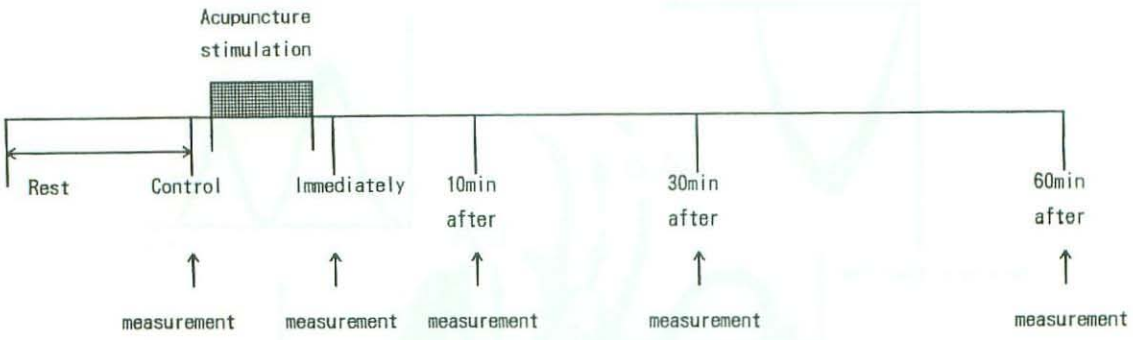

Fig.4. Examination process

Subject: Eight diabetic patients with left ventricular diastolic abnormalities.
Acupuncture point: Bilateral Neiguan point(p6)
Needle: Stainless steel needle of 40mm in length, of 0.20mm thickness. (Seirin Kasei Co, Ltd., Japan)
Stimulation: Needle in place for 10 min, following the needle sensation.

time (ACT) was measured from the beginning of ejection to the point of peak flow velocity. The ACT/ET ratio was calculated as an index of left ventricular systolic function.

After bed rest in a left lateral position for 30 min, blood pressure, heart rate, and echocardiograms were taken. Acupuncture to Nèiguān point was applied for 10 min after confirmation of the needling sensation. The parameters mentioned above were determined immediately, 10, 30, and 60 min after acupuncture as shown in Fig.4.

All data were expressed as mean ± standard deviations. Statisitcal significance was examined by paired t-tests of values at each point in time in comparison with controls. P-values less than 0.05 were considered significant.

1. Results

Blood pressure and heart rate: Mean systolic and diastolic blood pressures, and heart rates before and after acupuncture are shown

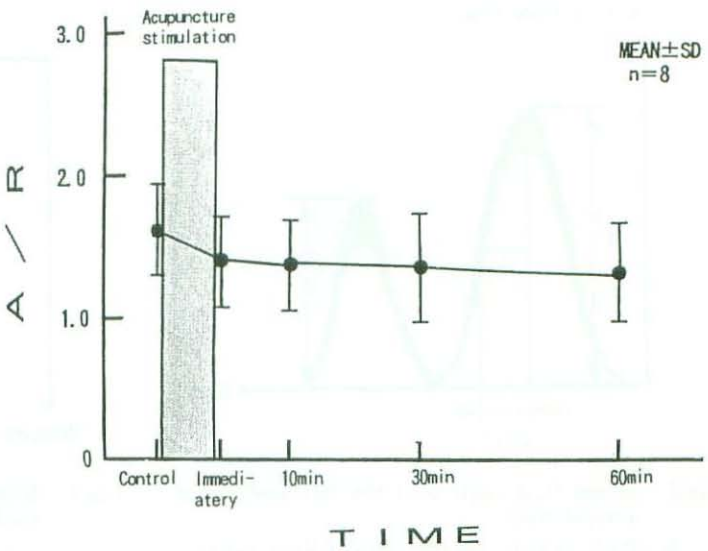

Fig.5. A/R ratio.
The mean A/R ratio decreased gradually after acupuncture.

Table 2. Changes of indices before and after acupuncuture.

		Control	Immediately after	10min after	30min after	60min after
A/R	Mean	1. 621	1. 390	1. 373	1. 351	1. 308
	S. D.	0. 323	0. 314	0. 309	0. 388	0. 342
DHT (sec)	Mean	0. 143	0. 111 *	0. 114 *	0. 111 *	0. 107 **
	S. D.	0. 011	0. 022	0. 014	0. 023	0. 016
ACT/ET	Mean	0. 310	0. 203	0. 227	0. 246	0. 272
	S. D.	0. 153	0. 085	0. 103	0. 109	0. 115
SBP (mmHg)	Mean	132. 571	133. 143	128. 857	122. 857	124. 000
	S. D.	15. 306	16. 688	12. 746	17. 199	15. 319
DBP (mmHg)	Mean	72. 750	71. 250	70. 000	68. 250	70. 250
	S. D.	5. 651	7. 630	9. 134	9. 468	7. 741
HR (beat/min)	Mean	69. 500	68. 000	65. 750	67. 500	67. 500
	S. D.	12. 827	13. 856	11. 973	12. 271	13. 596

Significance compared to value before acupuncture. (*p <0.01, **p<0.001)
SBP: Systolic blood pressure. DBP: Diastolic blood pressure.
HR: Heart rate.

in Table 1. There were no significant differences between these values before and after acupuncture.

Significant data: Doppler cardiographic data are also in Table 1. Mean A/R ratios decreased gradually after acupuncture as shown in Fig.5. Mean DHTs before and after acupuncture are shown in Fig.6 with these values being reduced significantly to 0.111 sec immediately after ($p<0.01$), 0.114 sec 10 min after ($p<0.01$), 0.111 sec 30 min after ($p<$

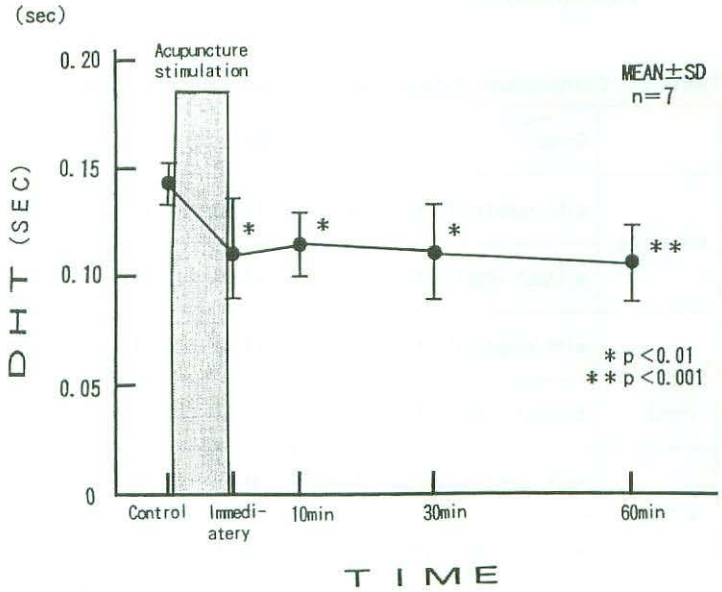

Fig.6. Deceleration half time. (DHT)
The mean DHT decreased significantly after acupuncture. (*p <0.01, **p<0.001)

0.01), and 0.107 sec 60 min after acupuncture ($p<0.001$) from a control value of 0.143 sec. Mean ACT/ET ratios decreased during the period from immediately to 60 min after acupuncture are shown in Fig.7.

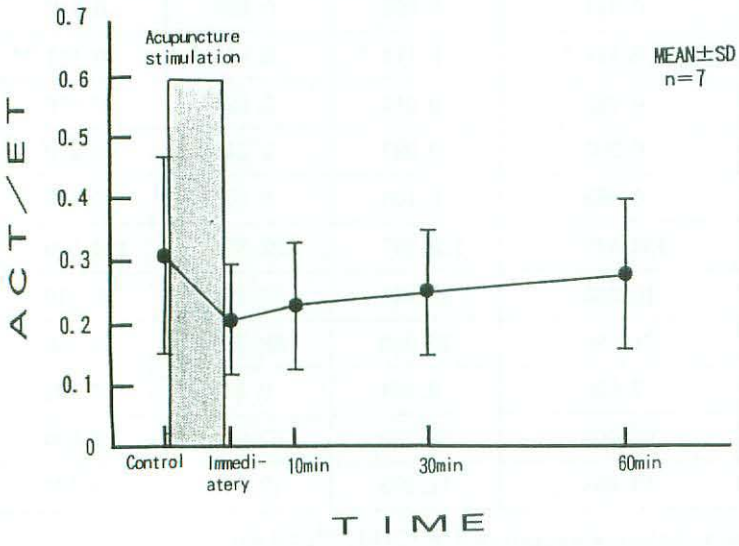

Fig.7. ACT/ET ratio.
The mean ACT/ET ratio decreased during the period from immediately to 60 min after Acupuncture.

All subjects were divided into 2 groups, the first consisting of patients with diabetic complication such as nephropathy, retinopathy, and/or neuropathy, and the second being patients without diabetic complications. We compared the 2 groups with respect to the improvement rates of indices(Table 3). There were no significant differences between them.

2. Discussion

Figure 8 is a schematic diagram of cvardiovascular complications of diabetes[6]. In diabetic patients, ischemic heart disease, diabetic myocardosis,

Table 3. Comparison between patients with and without complications.

	Group \ Time	Immediately after	10min after	30min after	60min after
A/R ratio	with complications (n=4)	15.03 ±16.46	14.82 ±11.73	18.40 ±13.19	18.53 ±15.36
	without complications (n=4)	13.00 ±12.18	15.78 ± 9.05	16.82 ± 9.17	21.15 ± 7.27
DHT (sec)	with complications (n=4)	14.00 ±12.64	32.05 ±32.06	32.06 ±13.19	25.07 ±10.46
	without complications (n=4)	28.65 ± 5.73	22.87 ± 9.68	20.23 ± 8.96	24.80 ±12.21
ACT/ET	with complications (n=4)	34.65 ±27.08	19.55 ±13.27	11.10 ±24.44	8.75 ±29.13
	without complications (n=4)	26.00 ±25.56	31.60 ± 4.12	25.47 ± 5.69	18.70 ± 0.71

Complications including nephropathy, retinopathy, and neuropathy.
Comparison on improvement rates of indices between patients with and without complications. There are no significant difference between two groups.

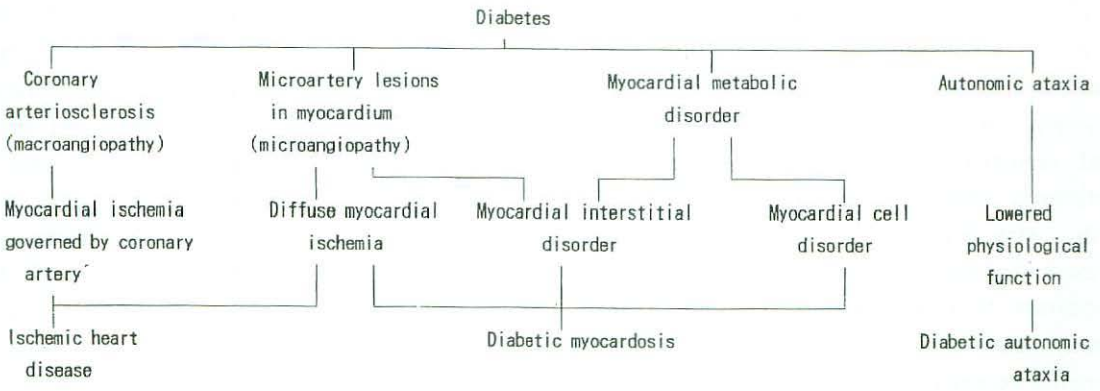

Fig.8. A general schema of cardioavascular complications of diabetes.
In diabetic patients, ischemic heart disease, diabetic myocardosis and diabetic autonomic ataxia are caused as a result of secretional or/and functional deficiency.

and diabetic autonomic ataxia are results of insulin deficiency. Left ventricular diastolic filling abnormalities in diabetic patients have been precisely evaluated by pulse Doppler echocardiography[7]. A/R ratios and DHTs measured in the left ventricular inflow tract and ACT /ET ratios measured in the left ventricular outflow tract are useful indices of left ventricular function[16,17]. In this study, a significant decrease of DHT as well as tendencies for A/R and ACT/ET ratios to decrease were observed after acupuncture. These results suggest that left ventricular function may be improved by acupuncture at Nèiguān point in diabetic patients. There are some indications that acupuncture is effective in various circulatory diseases[18,19,20,21,22,23] and Nèiguān point is often the acupuncture treatment point of choice heart diseases including hypertension[8], hypertensive heart disease[9], myocarditis[10], tachycardia[12,24], coronary heart disease[10,15,25], and angina pectoris[11], among others. A few reports have shown that acupuncture at Nèiguān point can improve left ventricular relaxation[10,13,26]. We reported previously on the effects of Nèiguān point acupuncture on the circulatory system using pulse Doppler echocardiography[27] acupuncture at Nèiguān point increased the contractility of the left ventricle in healthy adult males. This result was supported by the findings of Huang et al. that acupuncture at Nèiguān point effectively enlarged the left ventricular end-systolic diameter and increased stroke volume[28]. Moreover Tayama et al. reported that Nèiguān-Ximen(P4) electro-acupuncture effectively increased stroke volume and cardiac output[26]. On the other hand, a recent study has demonstrated that acupuncture alleviates ischemic heart disease. Radzievsky et al. reported that acupuncture treatment of patients with ischemic heart disease caused improvement of left ventricular systolic function and myocardial relaxation[29] and Oka et al. reported that acupuncture at Nèiguān point effectively enlarged the coronary arteries[30]. These facts

indicate that left ventricular contractility and enlargement of coronary arteries are influenced by acupuncture at Nèiguān point. Some authors have assumed a direct influence of acupuncture on autonomic systems. Qian et al. reported on the effects of acupuncture in diabetic cardiovascular autonomic neuropathy, with improvements of cardiovascular autonomic functions observed[31]. These reports indicate that acupuncture at Nèiguān point may improve myocardial ischemia and autonomic neuropathy in diabetic patients.

There are some reports that acupuncture may be useful in treating diabetes itself. Hasegawa reported that acupuncture treatment improved blood sugar levels and increased insulin responses to administered glucose in diabetic patients[32] and Kiyofuji et al. found that acupuncture at Quchi point increased insulin secretion in rats[33]. Thus, left ventricular diastolic abnormalities in diabetic patients may be better treated by combined acupuncture to Quchi and Nèiguān points.

We assumed that acupuncture stimulation would be more effective in mild cases without diabetic complications than in more serious cases. However, the presence or absence of diabetic complications did not seem to be significantly related to the effectiveness of the acupuncture. This may be because all patients have differing underlying physical factors such as age, hypertension, and arteriosclerosis, with aged and arteriosclerotic patients having possible fibrosis in the myocardium. Patients with long term hypertension may have myocardial hypertrophy and also diastolic dysfunction and these physical factors may have influenced on left ventricular function in addition to diabetic cardiac abnormalities. Such secondary myocardial lesions may indeed have an influence on the action of acupuncture. Thus, the 8 cases in this study seem insufficient to analyse the effects of diabetic complications or to find may significant correlations between acupuncture effects and such complications. Acupuncture at Nèiguān point that impacts left ventricular function not only in normal subjects but also in diabetic patients with organic cardiac changes may be useful in the treatment of other organic heart diseases.

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内関刺激の循環系に及ぼす影響（第2報）
左室拡張能障害を有する糖尿病患者での検討

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行待 寿紀* 中川 修史** 本郷 仁志** 松本 圭**
苗村 健治** 山村 義治** 梶山 靜夫**

要旨：糖尿病における左室拡張能障害は同病の早期心臓合併症のひとつであり，心エコードップラー法にて鋭敏に評価される．我々は，前回，健常者を対象にした場合，内関刺激が左室の収縮能を亢進させることを心エコードップラー法を用いて明らかにし，報告した．本実験では，同刺激の臨床的影響を検討するために，対象を左室拡張能障害を有する糖尿病患者8例とし，刺激前および刺激後60分間の血圧，脈拍の測定と心エコードップラー法による左室機能の評価を行った．その結果，内関刺激によりA／R，DHT の改善を認め，左室急速流入の増大及び左房負荷の軽減が示され，すなわち左室拡張能の改善が示唆された．左室収縮能ではACT／ETが減少する傾向が認められ，すなわち左室収縮能の改善が示唆された．内関刺激の効果が健常人だけでなく臨床的にも認められたことより同刺激の治療法としての有用性が示された．

Key Words：鍼刺激，内関穴，心エコードップラー法，左室拡張能障害，糖尿病