Journal of Korean Medical Science
Vol 4, No. 4, P 163-169, December 1989

Clinical and Morphological Features of Hypertrophic Cardiomyopathy in Korean Patients

Young-Bae Park, M.D., Woo Seung Lee, M.D., Duk-Kyung Kim, M.D.,
Yun Shik Choi, M.D., Jung Don Seo, M.D. and Young Woo Lee, M.D.

*Department of Internal Medicine, College of Medicine,
Seoul National University*

Thirty three cases of hypertrophic cardiomyopathy (HCMP) were reviewed to estimate the relative frequencies of the subtypes of HCMP and to clarify whether there is any racial difference in clinical and morphological features of HCMP. The diagnosis was made by echocardiography, cardiac catheterization and left ventriculography. Twenty four patients underwent coronary angiogram. Numbers of cases by the types of HCMP were 20 (61%) with asymmetrical septal hypertrophy (ASH), 11 (33%) with apical hypertrophy (APH) and 2 (6%) with midventricular hypertrophy (MVH). Mean ages of the patients with APH, ASH and MVH were 54, 46 and 31 years respectively, and the differences were statistically significant ($p<0.05$). The giant negative T wave on electrocardiogram was seen in 4 patients (20%) of ASH and 5 patients (45%) of APH. On echocardiogram mean ratio of interventricular septal to left ventricular posterior wall thickness was 1.9 in ASH, 1.2 in APH and 1.6 in MVH, and the differences were statistically significant ($p<0.05$). All patients with APH showed "spade of ace" deformity in left ventriculography. Coronary angiograms were normal in all patients who had the procedure. Our study showed high frequency of APH of which characteristics were similar to those of the Japanese type APH.

Key Words: *Hypertrophic Cardiomyopathy, Asymmetrical Septal Hypertrophy, Apical Hypertrophy, Midventricular Hypertrophy.*

INTRODUCTION

Hypertrophic cardiomyopathy is defined as a heart muscle disorder of unknown origin that is characterized by hypertrophy of a nondilated left ventricle (Goodwin 1982). The hypertrophy may be obstructive or nonobstructive and its distribution may exhibit marked variation (Wigle et al., 1985; Maron et al., 1987).

Since 1976, studies from Japan (Yamaguchi et al., 1976; Sakamoto et al., 1976; Yamaguchi et al., 1979) have identified a morphologic variant of the disease in which wall thickening is confined to the most apical portion of the left ventricle and is associated with a striking electrocardiographic pattern of "giant" negative T waves and a "spade of ace" deformity of the left ventricle, as detected by contrast angiography. Several recent reports from outside Japan (Maron et al., 1982; Keren et al., 1985; Louie et al., 1987) have described apical hypertrophic cardiomyopathy in nonorientals, but some of the features of the disease in these patients often clearly differ from those seen in Japanese patients.

There are many reports on clinical and morphologic features of this disease by noninvasive and invasive techniques in Korea, but only 3 patients with apical hypertrophy were reported in the past (Lee et al., 1977; Kim et al., 1979; Kim et al., 1982: Joo et al., 1982; Kim et al., 1983; Kim et al., 1988).

We conducted this study to estimate the relative frequencies of the subtypes of hypertrophic cardi-

Address for correspondence: *Young-Bae Park, M.D. Department of Internal medicine, College of Medicine, Seoul National University #28 Yeongun-Dong, Chongno-Ku, Seoul 110-744, Korea (Tel. (02) 7601-3379)*
This study was supported in part by the 1989 Clinical Research Grant from Seoul National University Hospital

omyopathy and clarify whether there is any racial difference in clinical and morphological features of the disease, particularly with respect to those features of apical hypertrophic cardiomyopathy described in the reports from Japan and other parts of the world.

MATERIALS AND METHODS

We reviewed the case records of 33 patients with hypertrophic cardiomyopathy who were admitted to the Division of Cardiology of Seoul National University Hospital between September, 1979 and January, 1989. All patients underwent electrocardiographic and M-mode and two-dimensional echocardiographic studies. Cardiac catheterization and left ventriculography were performed in 33 patients, and 24 patients underwent coronary angiogram. The diagnostic criteria of septal hypertrophy were the thickness of interventricular septum of 15mm or more, and its ratio to the posterior wall thickness of the left ventricle of 1.3 or more on the echocardiography. The diagnosis of apical hypertrophy was made by ventricular hypertrophy virtually confined to the apical part on the left ventriculography. Midventricular hypertrophy was diagnosed by the maximal hypertrophy of the mid-portion of the left ventricle with was nearly obstructing ventricular cavity on the left ventriculography. Systolic anterior motion of anterior mitral leaflet on the echocardiography was semiquantitated according to the method described by Wigle et al. (1985). In the case of septal hypertrophy resting obstruction was defined by a persistent pressure gradient across the left ventricular outflow tract in the control state, and latent obstruction was considered to be present if there was no pressure gradient at rest but a pressure gradient appeared with provocation tests such as isoproterenol infusion or postextrasystolic potentiation.

RESULTS

Types of hypertrophic cardiomyopathy

According to echocardiographic and left ventriculographic findings, 33 patients were divided into 20 (61%) with septal hypertrophy, 11 (33%) with apical hypertrophy and 2 (6%) with midventricular hypertrophy. Twenty patients with septal hypertrophy were subdivided into non-obstructive in 10 (30%), latent obstructive in 3 (10%) and resting obstructive type in 7 (21%).

Clinical features

The age of the patients with HCMP ranged from 27 to 66 years and mean age were 48. Twenty-one patients were male. Male to femal ratio in patients with septal hypertrophy, apical hypertrophy and midventricular hypertrophy were 12:8, 7:4, and 2:0, respectively (Fig. 1). Patients with apical hypertrophy (mean age, 54) were older than patients with septal hypertrophy (mean age, 46) and midventricular hypertrophy (mean age, 31) and the differences of age were statistically significant ($p<0.05$).

Common clinical symptoms were chest pain, dyspnea and palpitation. Clinical symptoms of 15 patients with septal hypertrophy were dyspnea in 13 (87%), chest pain in 11 (73%) and palpitation in 6 (40%). In apical hypertrophy the commonest symptom was chest pain in 9 (82%) out of 11 patients. Other clinical symptoms in patients with apical hypertrophy were dyspnea in 3 (27%) and palpitation in 1 (9%). All of the two patients with midventricular hypertrophy com-

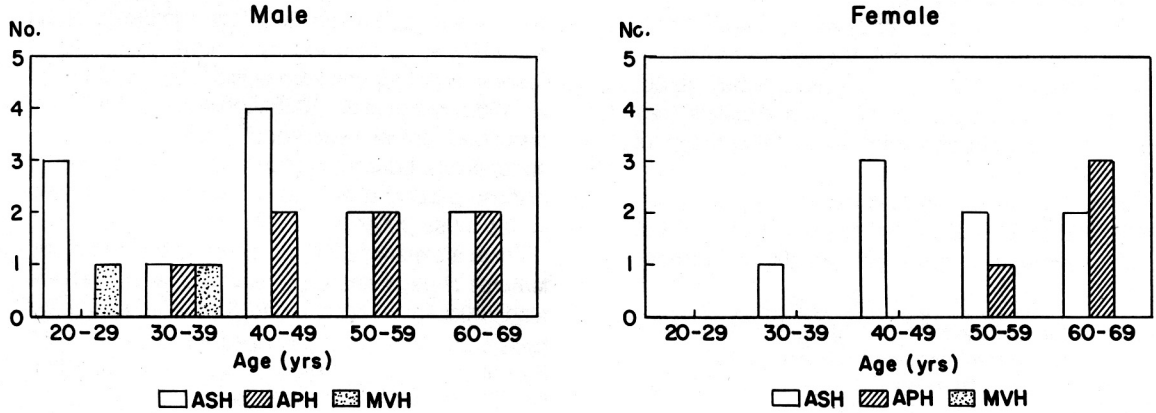

Fig. 1. Age and sex distribution of patients with hypertrophic cardiomyopathy (ASH: asymmetrical septal hypertrophy, APH: apical hypertrophy, MVH: midventricular hypertrophy).

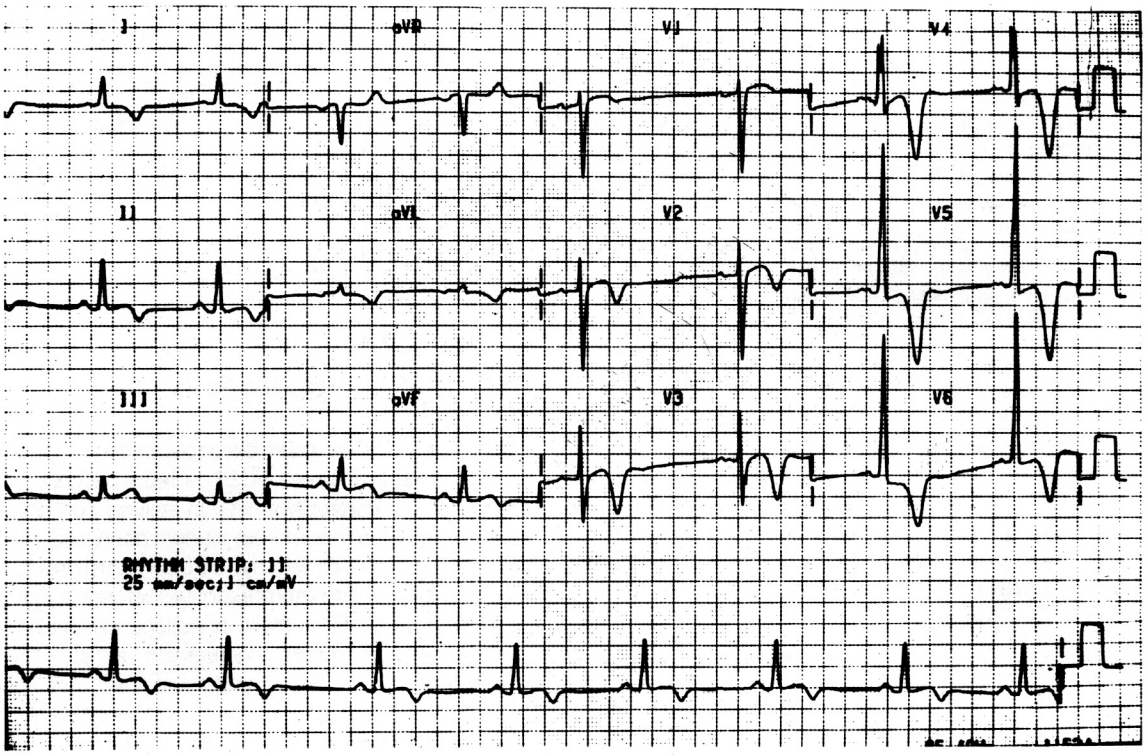

Fig. 2. Twelve-lead electrocardiogram in a patient with apical hypertrophy showed left ventricular hypertrophy and giant negative T wave (15 mm) in the precordial leads.

plained of dyspnea, and chest pain was present in one patient. Six patients with apical hypertrophy and 1 patient with septal hypertrophy showed relatively mild systemic hypertension (diastolc pressure:90 to 104 mmHg) which was not considered to be sufficient severity to produce the magnitude of left ventricular hypertrophy that was seen in our patients. No one had a history of myocardial infarction. We did not study all family members of patients with hypertrophic cardiomyopathy with invasive or non-invasive method, but 4 patients with septal hypertrophy had family history of documented hypertrophic cardiomyopathy. No family members of patients with apical hypertrophy and midventricular hypertrophy were affected.

Electrocardiographic findings

In 15 patients with septal hypertrophy, common electrocardiographic findings were notched P-wave (40%), left ventricular hypertrophy (47%), abnormal Q-wave (33%) and giant negative T wave more than 10mm in depth (27%). Among the 11 patients with apical hypertrophy, left ventricular hypertrophy was the commonest (73%) and giant negative T wave inversion was present in 45% (Figure 2). Notched P-wave (50%) and abnormal Q-wave (100%) were noted in 2 patients with midventricular hypertrophy.

Echocardiographic findings

Mean ratio of interventricular septal to left ventricular posterior wall thickness was 1.9 in septal hypertrophy, 1.2 in apical hypertrophy and 1.6 in midventricular hypertrophy, and the differences were statistically significant ($p < 0.05$). Systolic anterior motion (SAM) was noted in 4 of 8 non-obstructive septal hypertrophy, but it was present in all the patients with latent obstructive and resting obstructive septal hypertrophy (Table 1).

Systolic anterior motion of anterior mitral valve was quantitated according to its severity, and mild SAM was seen in 4 patients with non-obstructive septal hypertrophy, but 6 out 7 patients with resting obstructive type showed severe SAM (Table 2).

Cardiac catheterization and angiographic findings

Table 1. Echocardiographic Characteristics.

Type	No. of Cases	Mean thickness IVS/LVPW (mm)	Mean ratio of IVS/LVPW	SAM +	SAM −	Mean LA Dimension (mm)	EF (%)
Septal hypertrophy							
non-obstructive	8	19.6/9.3	2.2	4	4	38.5	75
latent obstructive	3	17.7/10.7	1.7	3	0	35.0	74
resting obstructive	7	15.8/9.8	1.7	7	0	38.0	73
Apical hypertrophy	7	14.8/12.2	1.2	1	6	39.3	76
Midventricular hypertrophy	2	20.5/13	1.6	2	0	38.5	69

IVS Intreventricular septum
LVPW : Left ventricular posterior wall
SAM : Systolic anterior motion

Table 2. Degree of SAM in the hemodynamic subgroups of septal hypertrophy.

Subgroups	No. of Cases	SAM absent	mild	moderate	severe
Non-obstructive	8	4	4	0	0
latent obstructive	3	0	1	1	1
Resting obstructive	7	0	0	1	6

Table 3. Cardiac catheterization and angiographic findings.

	No. of Cases	LVEDP (mmHg) ≤12	>12	CI (l/min/m²)	MR +	MR −	CAG N	CAG A
Septal hypertrophy	17	9	8	3.2	11	6	11	0
Apical hypertrophy	11	6	5	3.3	1	10	11	0
Midventricular hypertrophy	2	2	0	3.6	0	2	2	0

LVEDP: Left ventricular end-diastolic pressure
CI :Cardiac index
MR :Mitral regurgitation
CAG :Coronary arteriogram (N: Normal, A: Abnormal)

Cardiac index was normal in all patients, but left ventricular end-diastolic pressure (LVEDP) was elevated more than 12 mmHg in 8 (47%) and mitral regurgitation was seen in 11 (65%) of 17 patients with septal hypertrophy. Of the 11 patients with apical hypertrophy, 5 patients (45%) had elevated LVEDP. Mitral regurgitation was noted in only one case (9%). All patients with apical hypertrophy showed "spade of ace" deformity on left ventriculography (Figure 3). There was no elevated LVEDP or mitral regurgitation in two patients with midventricular hypertrophy. Left ventricular wall motion was normal in all patients. Coronary angiographic findings were normal in 24 patients who had the procedures (Table 3).

DISCUSSION

In this study we have described the clinical and morphological features of 33 Korean patients with hypertrophic cardiomyopathy. In striking contrast to the results of the reports from western countries, about 33% of the patients with hypertrophic cardiomyopathy had clinical and morphological features of apical hypertrophy similar to those of patients described in the Japanese studies (Yamaguchi et al., 1976: Sakamoto et al., 1976; Yamaguchi et al., 1979). In the past studies of hypertrophic cardiomyopathy in Korea only 3 patients with apical hypertrophy were reported (Kim et al., 1982).

About 25% of those patients with hypertrophic cardiomyopathy who have been described in reports from Japan had angiographic evidence of apical hypertrophy, which was confined to the true left ventricular apex. This distribution of hypertrophy created a spade deformity of the left ventricular cavity on the contrast angiogram in diastole and also was associated with a distinctive electrocardiographic pattern of deep ("giant") T-wave inversion greater than 10mm in the precordial leads (Sakamoto et al., 1976; Yamaguchi et al., 1979). Patients with apical hypertrophy have been relatively uncommon in reports from outside Japan, comprising only about 2 to 3% of the patients with hypertrophic cardiomyopathy (Wigle et al., 1985; Louie et al., 1987), and even those patients showed morphologic and clinical features that were not similar to those found previously in Japanese patients with apical hypertrophy (Keren et al., 1985; Louie et al., 1987). Among 23 patients with apical hypertrophy described by Keren et al. (1985), 5 (22%) and 1 (4%) patient showed giant T-wave inversion and spade deformity, respectively. The patients in the report of Louie et al. (1987) demostrated giant T-wave inversion in 4 (17%) and spade deformity in 3 (13%) of

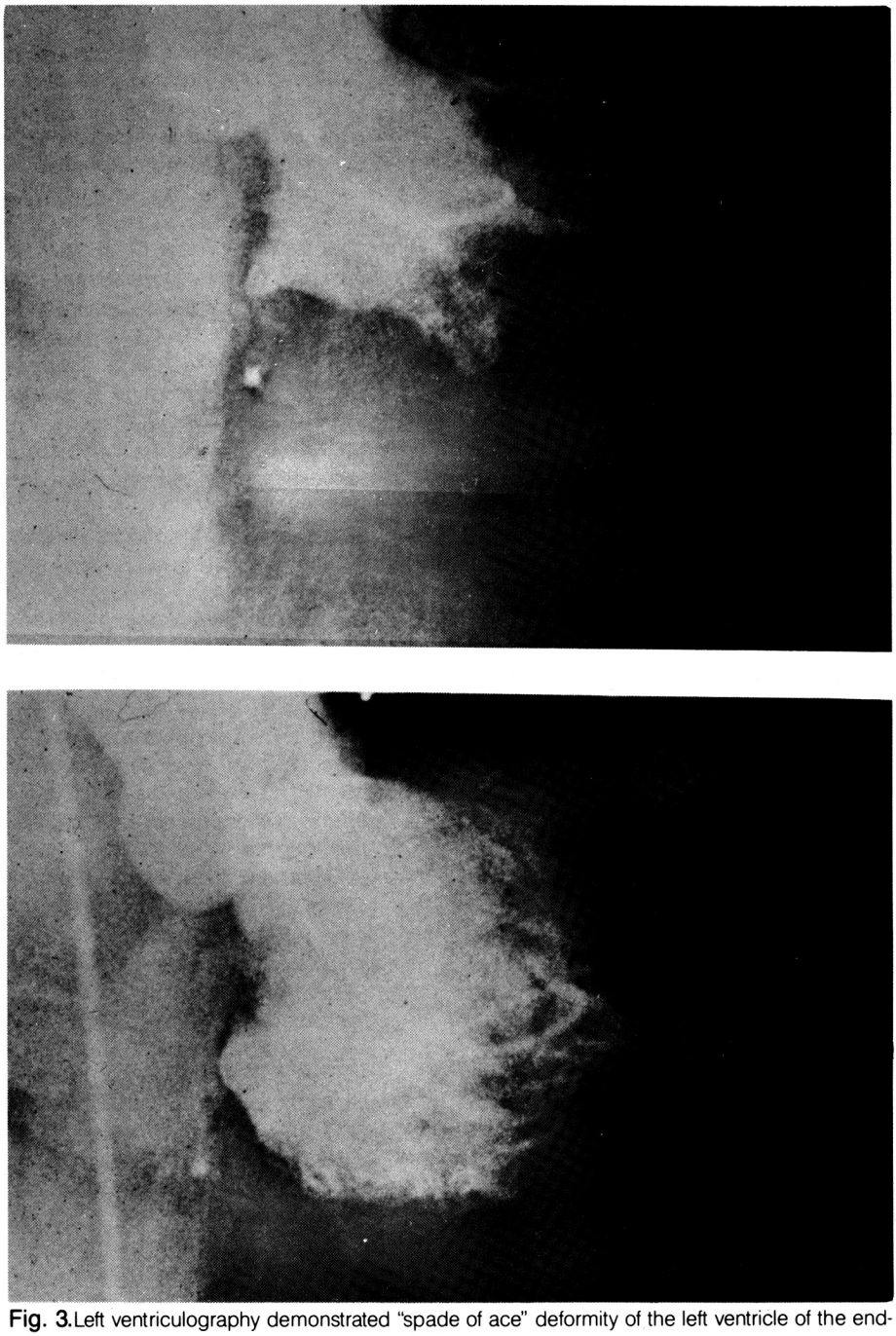

Fig. 3. Left ventriculography demonstrated "spade of ace" deformity of the left ventricle of the end-diastolic phase (lower panei) in a patient with apical hypertrophy.

23 patients with apical hypertrophy. In our experience 5 (45%) of 11 patients showed giant negative T wave and spade shape of the left ventricle on left ventriculoraphy was noted in all patients with apical hypertrophy.

Apical hypertrophy in Japanese patients generally appears to be clinically benign disease with a low rate of familial involvement that occurs predominantly in

older men, and is frequently associated with systemic hypertension (Sakamoto et al., 1976; Yamaguchi et al., 1979; Koga et al., 1984; Koga et al., 1985). In the study by Koga et al. (1985), family surveys showed that 13% of siblings of apical hypertrophy were affected, significantly less than in obstructive (31%) or non-obstructive (29%) types of asymmetrical septal hypertrophy. Louie et al. (1987) reported 39% of patients with apical hypertrophy had histories of familial occurence identified by clinical or autopsy findings of hypertrophic cardiomyopathy or premature sudden death. Even though family members of our patients were not fully studied by invasive or non-invasive method,no family members of our patients with apical hypertrophy were affected. Patients reported from Japan by Yamaguchi et al. (1979) (mean age, 49) and Sakamoto et al. (1976) (mean age, 43) were older than patients reported by Louie et al. (1987) (mean age, 37). In our experience patients with apical hypertrophy were older than those with asymmetrical septal or midventricular hypertrophy. Indeed our patients (mean age, 54) were older than the patients described in Japan. Striking male preponderence over 90% was noted in the Japanese studies. We also noted such male preponderence, although 4 (36%) of 11 patients were female. Koga et al. (1985) reported that relative risk (odd ratio) of apical hypertrophy was 3.5 in those with histories of hypertension, and increased further to 8.1 in those who were often hypertensive according to their physician's evaluations. No hypertension was noted in patients with apical hypertrophy described by Keren et al. (1985), and 5 (22%) out of 23 patients with apical hypertrophy reported by Louie et al. (1987) showed systemic hypertension. Our study showed high association rate (55%) of hypertension in patients with apical hypertrophy in contrast to the association of hypertension in only 1 patient with septal hypertrophy or midventricular hypertrophy.

The reason for the frequent occurrence of apical hypertrophy in this part of the world, namely Japan and Korea, and differences in the phenotypic expression of apical hypertophy between many Japanese and Korean patients and most patients described in studies from other parts of the world is not known. We could not point out any reason for such difference. Louie et al. (1987) suggested that genetic, racial, or even environmental factors (such as diet) could account for such variation. Further researches are needed to clarify these problems.

REFERENCES

Goodwin JF: *The frontiers of cardiomyopathy. Br Hear J 48:1-18, 1982.*

Joo WS, Kim JS: *The echocardiographic study on the 13 patients with the hypertrophic cardiomyopathy. Korean Circ J 12:117-127, 1982.*

Keren G, Belhassen B, Sherez J, Miller H, Megidish R, Berenfeld D, Laniado S: *Apical hypertrophic cardiomyopathy: evaluation by noninvasive and invasive techniques in 23 patients. Circulation 71:45-56, 1985.*

Kim DK, Jang HC, Kim CH, Oh BH, Park YB, Choi YS, Seo JD, Lee YW: *A case of progression from hypertrophic cardiomyopathy to dilated cardiomyopathy-like features. Korean J Intern Med 35:714-721, 1988.*

Kim JS, Kim DK, Kim YK, Choi KO: *Echocardiography of idiopathic hypertrophic subaortic stenosis. Korean J Intern Med 22:479-486, 1979.*

Kim JY, Bahk SJ, Kim JM, Kim JM, Cho SY, Lee WK: *Three cases of apical hypertrophy. Korean J Intern Med 25:851-857, 1982.*

Kim MH, Lee JC, Kim JH, Kim JS, Hong SJ, Kim SS, Kim HJ: *Primary hypertrophic cardiomyopathy: ventriculographic and coronary arteriographic findings in 11 patients. Korean J Intern Med 26:367-377, 1983.*

Koga Y, Itaya M, Takahashi H, Koga M, Ikeda H, Itaya K, *omyopathy. Am Heart J 108:351-359, 1984.*

Koga Y, Itaya M, Takahashi H, Koga M, Ikeda H, Itaya K, Toshima H: *Apical hypertrophy and its genetic and acquired factors. J Cardiogr 15 (suppl 6): 65-74, 1985.*

Lee SI, Kim SS, Ro WS, Cha HD: *A clinical study of idiopathic hypertrophic subaortic stenosis. Korean J Intern Med 20:681-692, 1977.*

Louie EK, Maron BJ: *Apical hypertrophic cardiomyopathy: Clinical and two dimensional echocardiographic assessment. Ann Intern Med 106:663-670, 1987.*

Maron BJ, Bonow RO, Seshagiri TNR, Roberts WC, Epstein SE: *Hypertrophic cardiomyopathy with ventricular septal hypertrophy localized to the apical region of the left ventricle (apical hypertrophic cardiomyopathy). Am J Cardiol 49:1838-1948, 1982.*

Maron BJ, Bonow RO, Cannon RO III, Leon MB, Epstein SE: *Hypertrophic cardiomyopathy:interrelations of clinical manifestations, pathophysiology and therapy. New Engl J Med 316:780-789, 844-852, 1987.*

Sakamoto T, Tei C, Murayama M, Ichiyasu H, Hada Y, Hayashi T, Amano K: *Giant T wave inversion as a manifestation of asymmetrical apical hypertrophy of the left ventricle. Echocardiographic and ultrasonocardiographic study. Jpn Heart J 17:611-629, 1976.*

Wigle ED, Sasson Z, Henderson MA, Ruddy TD, Fulop J, Rakowski H, Williams WG: *Hypertrophic cardiomyopathy: the importance of the site and the extent of hypertrophy:a review. Prog Cardiovasc Dis 28:1-83, 1985.*

Yamaguchi H, Nakanishi S, Nishijo T, Nagasaki F, Matsumoto S, Ishimura T: *Hypertrophic cardiomyopathy with gi-*

ant negative T waves. Jpn Circ J 40 (suppl): 110-111, 1976.

Yamaguchi H, Ishimura T, Nishiyama S, Nagasaki F, Takatsu F, Nishijo T, Umeda T, Machii K: *Hypertrophic nonobstructive cardiomyopathy with giant negative T waves (apical hypertrophy): ventriculographic and echocardiographic features in 30 patients. Am J Cardiol 44:401-412, 1979.*