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# Left Atrial Spontaneous Echo Contrast in Hypertrophic Cardiomyopathy with Atrial Fibrillation

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**Transesophageal echocardiography was performed to assess the incidence of left atrial spontaneous echo contrast in patients with hypertrophic cardiomyopathy, who were divided into two groups according to the presence (group 1-A; 10 patients) or absence (group 1-B; 5 patients) of persistent atrial fibrillation. Twelve patients with atrial fibrillation (group 2) served as control. Among these, 5 patients had mitral regurgitation and 8 patients lone atrial fibrillation. Left atrial spontaneous echo contrast was detected in 8 patients (80%) in group 1-A, none in group 1-B, and 3 patients (25%) in group 2. The incidence of echo contrast in group 1-A was significantly higher than that in the other 2 groups. The size of the left atrium was not statistically different among the 3 groups. Accordingly, hypertrophic cardiomyopathy with atrial fibrillation seemed to be a specific diseased state to favor the development of the left atrial spontaneous echo contrast. Previous reports suggested that the presence of left atrial spontaneous contrast was considered as a warning sign of left atrial thrombus and would be an indicator of increased risk of embolism.[1)2)3)] Three of the 8 patients who had spontaneous echo contrast in group 1-A had a history of systemic embolization. We proposed that patients with hypertrophic cardiomyopathy with atrial fibrillation were in a high risk state of thromboembolism.**

**Key Words:** left atrial spontaneous echo contrast, hypertrophic cardiomyopathy, atrial fibrillation, systemic embolization.

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## Introduction

Transesophageal echocardiography provides superior imaging of the left atrium and has been clinically applied as a diagnostic method for detection of the source of embolism.[3)4)5)]

Recently, left atrial spontaneous echo contrast (LASEC) which represents the status of left atrial blood flow has been recognized as a risk factor for thrombus and embolization.[1)2)] Many investigators suggest that mitral stenosis, atrial fibrillation and large left atrium are considered major factors to develop LASEC. In addition, remarkable LASEC in hypertrophic cardiomyopathy (HCM) has sometimes drawn our attention (Fig 1). However, to the best of our knowledge, no previous reports have presented the relation between HCM and LASEC. Therefore, this study was prospectively designed to assess the incidence and severity of LASEC in patients with HCM. The history of systemic embolism was also elaborately inquired.

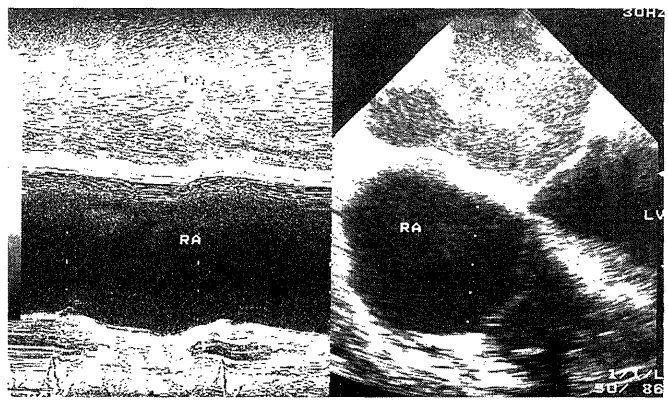



**Fig. 1.** Transesophageal echocardiogram. Left atrial spontaneous echo contrast is shown in transverse 4 chamber view in a case of hypertrophic cardiomyopathy with atrial fibrillation.

## Methods

Patient population: The study included 15 HCM patients, who were divided into two groups according to the presence (group 1-A) or absence (group 1-B) of persistent atrial fibrillation. The diagnosis of HCM was made in terms of asymmetrical septal hypertrophy, apical hypertrophy and/or diffuse increased LV wall thickness (15mm) associated with ECG changes compatible to HCM. Twelve atrial fibrillation patients without HCM served as control (group 2).

Group 1-A (HCM with atrial fibrillation) consisted of 10 patients, 4 women and 6 men, with the mean age of 61 year (range 54 to 70 years) (table 1). Group 1-B (HCM with sinus rhythm) consisted of 5 patients, 1 women and 4 men, with the mean age of 63 years (range 45 to 70 years) (table 1). Group 2 (control) consisted of 12 atrial fibrillation patients without HCM. In this group, transesophageal echocardiography was used to evaluate the severity of mitral regurgitation in 5 patients and to rule out the cardiac source of embolism in 7 patients (three of them had a history of stroke or other systemic embolism). No patients with mitral stenosis were included. The age ranged from 48 to 81 years with the mean of 71 years (table 2). The history of patients in the 3 groups was carefully inquired for unequivocally documented event of systemic embolization. At the time of study, 3 patients in group 1-A and 3 patients in group 2 were receiving anticoagulant. Informed consent was obtained from each patient prior to entering this study.

**Table 1.**

HCM with Chronic Af No. : 10

| Name | Age · Sex | SEC* | LAd (mm) | LVd (mm) | EF (%) | IVS (mm) | LVPW (mm) | MR** | Stroke or Systemic embolism |
|---|---|---|---|---|---|---|---|---|---|
| T H | 54 M | 3 | 58 | 23/54 | 90 | 16 | 15 | — | Renal infarction |
| K I | 70 M | 3 | 49 | 32/49 | 73 | 16 | 12 | — | — |
| K O | 65 M | 3 | 52 | 30/49 | 77 | 13 (Apical type) | 11 | + | — |
| M T | 61 F | 3 | 50 | 22/42 | 86 | 20 | 12 | + | — |
| M Y | 56 F | 3 | 40 | 23/44 | 86 | 18 | 13 | — | — |
| T K | 62 M | 2 | 39 | 26/42 | 76 | 14 | 15 | — | CVA |
| S S | 57 F | — | 43 | 24/38 | 75 | 25 | 12 | + | — |
| K M | 68 F | 3 | 46 | 23/34 | 70 | 17 | 13 | — | — |
| T K | 64 M | 3 | 45 | 31/49 | 75 | 15 | 12 | — | CVA |
| M Y | 57 M | — | 46 | 35/51 | 58 | 14 | 15 | — | — |
| mean | | | 47±5 | 27±4 / 45±6 | 77±9 | 17±3 | 13±1 | | |

* grade of LASEC
** mosaic area ≧5.0cm²

HCM with Sinus rhythm No. : 5

| Name | Age · Sex | SEC* | LAd (mm) | LVd (mm) | EF (%) | IVS (mm) | LVPW (mm) | MR** | Stroke or Systemic embolism |
|---|---|---|---|---|---|---|---|---|---|
| M N | 66 F | — | 35 | 28/51 | 76 | 19 | 10 | + | — |
| K I | 67 M | — | 47 | 22/48 | 90 | 18 | 15 | — | — |
| N K | 45 M | — | 41 | 24/48 | 87 | 20 | 13 | — | — |
| I U | 70 M | — | 44 | 25/49 | 86 | 18 | 13 | — | — |
| H I | 67 M | — | 42 | 37/44 | 41 | 17 | 14 | — | — |
| mean | | | 42±4 | 27±5 / 48±2 | 76±18 | 18±1 | 13±2 | | |

* grade of LASEC
** mosaic area ≧5.0cm²

**Table 2.**

Chronic Af No. : 12

| Name | Age · Sex | SEC | LAd (mm) | LVd (mm) | EF (%) | IVS (mm) | LVPW (mm) | Heart * Disease | Stroke or Systemic embolism |
|---|---|---|---|---|---|---|---|---|---|
| T O | 73 M | — | 51 | 27/48 | 81 | 14 | 14 | MR, TR Pacemaker | — |
| K S | 75 M | — | 55 | 34/58 | 72 | 9 | 11 | MR | — |
| S I | 80 F | — | 35 | 20/43 | 85 | 8 | 8 | MR, AR | — |
| K S | 73 F | — | 42 | 30/49 | 76 | 11 | 12 | HHD | — |
| T I | 58 M | — | 43 | 43/54 | 52 | 8 | 10 | — | CVA |
| M K | 71 M | — | 48 | 30/45 | 61 | 9 | 10 | MR, TR | — |
| A U | 71 M | — | 58 | 32/60 | 78 | 12 | 12 | MR, TR | — |
| T M | 81 M | 3 | 45 | 35/53 | 71 | 11 | 10 | — | Femoral and Brachial |
| S H | 48 M | — | 40 | 35/51 | 66 | 11 | 12 | — | — |
| M M | 64 M | — | 43 | 30/53 | 75 | 11 | 9 | — | — |
| T D | 85 M | 2 | 41 | 34/46 | 60 | 10 | 10 | — | — |
| T J | 69 M | 1 | 32 | 30/48 | 76 | 10 | 11 | — | + |
| mean | | | 44±7 | 32±5 / 51±5 | 71±9 | 10±2 | 11±1 | | |

* No MS included

Echocardiography: Transthoracic echocardiography was performed in a standardized fashion by using a 3.75 MHz probe. Left atrial diameter was obtained in the M-mode echocardiogram from the parasternal long axis view by the American Society of Echocardiography.[8] Transesophageal echocardiography was performed with a biplane (model PEF-507SB, Toshiba) 5 MHz probe in conjunction with Toshiba SSH-160A. Following local pharyngeal anesthesia with a topical lidocaine spray, the esophageal probe was introduced. There were no complications attributable to the procedure.

Left atrial spontaneous echo contrast (LASEC) was defined as dynamic clouds of echoes curing slowly in a circular or spiral shape within the left atrial cavity. The characteristic swiring motion pattern was useful in differentiating white nose artifact usually located throughout the ultrasound field at a high gain setting. When the presence of LASEC was suspected, the gain setting was decreased in a stepwise fashion to exclude white nose artifact. On the basis of its appearance, LASEC was graded into 3 groups: grade 3 was defined as an intensive echo contrast easily recognized at a normal gain setting throughout the entire left atrium;

grade 2 as echo contrast clearly visible in some part of the left atrium in an ordinary gain setting; and grade 1 as faint echo contrast in small part of the left atrium in a relatively high gain setting. Mitral regurgitation was defined as moderate to severe when the mosaic area in transesophageal echocardiography was above 5.0cm$^2$, and mosaic area below 5.0cm$^2$ was estimated as mild or insignificant according to the previous reports.[9][10][11] All echocardiograms were carefully evaluated by two independent observers.

## Results

Left atrial spontaneous echo contrast (LASEC) was observed in 8 (80%) of the 10 patients in group 1-A, 7 being classified as grade 3 and 1 patient as grade 2. Independent evaluation by the 2 observers resulted in only small discrepancies concerning the classification of LASEC. Three of these 10 patients (30%) had a history of documented arterial embolization to the brain and kidney, and LASEC was observed in all of them. No LASEC nor a history of arterial embolization was detected in any of the 5 patients in group 1-B (table 1). Three (25%) of the 12 patients in group 2 had SEC (grade 1, grade 2 and grade 3 in 1 patient each) (table 2). Although 3 patients in group 2 had a history of arterial embolization, it was not referred to the incidence, because transesophageal echocardiography was to exclude the source of embolism in those 3 patients. The incidence of LASEC in group 1-A was significantly higher than that in group 1-B and group 2 (fig 2). Left atrial thrombus was not observed in any patients in the 3 groups. Moderate to severe mitral regurgitation in transesophageal echocardiography was detected in 3, 1 and 5 patients in groups 1-A, 1-B and 2, respectively. There were no significant differences in the incidence of mitral regurgitation among the 3 groups.

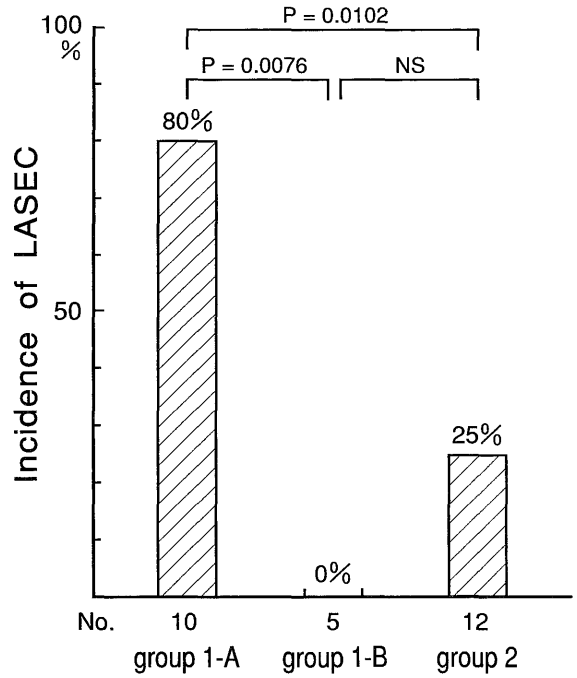
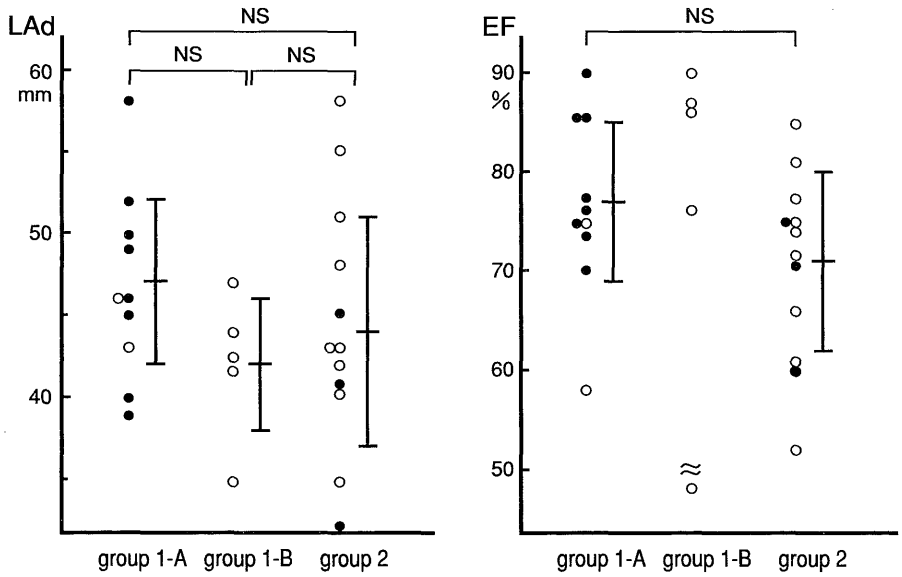



**Fig. 2.** Incidence of left atrial spontaneous echo contrast in group 1-A, group 1-B and group2.
LASEC = Left atrial spontaneous echo contrast




[LASEC (+) : ● (−) : ○ ]

**Fig. 3.** Individual values for left atrial dimension and left ventricular ejection fraction in patients in group 1-A, group 1-B and group 2.
LAd = Left atrial dimension LVEF = Left ventricular ejection fraction LASEC = Left atrial spontaneous echo contrast
Closed circle indicates a patient with LASEC and open circle indicates a patient without LASEC.

Transthoracic echocardiography revealed LASEC in none of the patients studied. Echocardiographic characteristics are shown in table 1 and table 2. Left atrial dimension and left ventricular ejection fraction are also demonstrated in figure 3. Left atrial dimension was 47±5mm, 42±4mm and 44±7mm in group 1-A, group 1-B and group 2, respectively. The differences were not statistically significant among the 3 groups. Left ventricular ejection fraction was 77±8%, 76±18 % and 71±9% in groups 1-A, 1-B and 2, respectively. There were no significant differences among the 3 groups.

## Discussion

Left atrial spontaneous echo contrast (LASEC) is the smoke-like refractances of swiring blood in the left atrium seen in a low blood flow state and may predispose to thrombus formation and systemic emboly.[1)6)] It is well known that LASEC is not a common finding by transthoracic echocardiography. Recently, the advent of transesophageal echocardiography made it possible explore the left atrium more precisely with a proximity of the probe to the left atrium and with the use of the higher frequency probe.

Hence, LASEC became a more frequent finding, especially in patients with mitral stenosis and atrial fibrillation.[1)2)12)] Many previous reports concerning LASEC have only studied patients with mitral valvular disease.[1)2)] Little interest seems to have turned to hypertrophic cardiomyopathy (HCM) for its association with LASEC. Therefore, we evaluated the incidence of LASEC in patients with HCM prospectively. First, LASEC was found in 8 (80%) of 10 HCM patients with Af. On the other hand, LASEC was not detected in any HCM patients with sinus rhythm. Secondly, LASEC was identified in only 3 (25%) of the 12 atrial fibrillation patients without HCM. The incidence was significantly lower than that in HCM patients with atrial fibrillation. Previous reports have also shown only 16% of the patients with lone atrial fibrillation had LASEC.[12)] Accordingly, it seems that HCM might be an independent diseased state to favor the development of LASEC. The limitation of this study was the clinical characteristics of the patients in group 2 used as control. Transesophageal echocardiogram was useful for evaluation of the severity of mitral regurgitation, moderate to severe in 5 (42%) of the 12 patients. Previous reports suggested that the presence of significant mitral regurgitation would preclude the development of LASEC as well as left atrial thrombus because the static blood stirred by regurgitant flow increases the flow velocity in the left atrium and eliminate blood stasis.[12)13)14)] In fact, 3 (43%) of 7 patients without mitral regurgitation in group 2 had LASEC. However, 3 patients (30%) in group 1-A also had significant mitral regurgitation and LASEC was discovered in 2 of those 3 patients. The mechanism of the formation of LASEC still remains unknown. The lack of effective atrial contraction in patients with atrial fibrillation, disturbance of diastolic flow into the left ventricle in patients with mitral stenosis and large left atrial cavity have been recognized as the factors favoring stasis of left atrial blood.[1)13)] Although it was not the objective of the present study to clarify the pathogenesis of LASEC in patients with HCM, some contributing factors were speculated. The fundamental pathophysiological abnormalities in HCM are increased stiffness of the left ventricle with resultant impaired ventricular filling.[15)] Left ventricular diastolic dysfunction causes elevation of left ventricular diastolic pressure and left atrial pressure. Accordingly, in addition to the alteration of flow pattern into the left ventricle in distole, pulmonary vein flow and left atrial appendage flow may also be altered, especially under the condition of atrial fibrillation. Previous reports indicate the pulmonary vein flow pattern in patients with atrial fibrillation differed from normal in that systolic flow velocity was blunt.[16)] On the other hand, diastolic pulmonary vein flow was reported to decrease in HCM patients with sinus rhythm .[17)] Consequently, the left atrial flow pattern in HCM patient with atrial fibrillation may become indolent throughout the cardiac cycle, which may contribute to the formation of LASEC.

Spontaneous echo contrast and thromboembolism - clinical implication

Previous reports suggested that the presence of LASEC was considered as a warning sign of left atrial thrombus and would be an indicator of increased risk of embolism.[1)2)] This hypothesis is based on the relatively high incidence of left atrial thrombus and arterial embolization in those patients. Erbel et al reported that cerebral and other peripheral embolism were found in 8 of 9 patients with spontaneous contrast.[18)] In the series of Daniel et al, atrial thrombus or arterial embolization was found in 29 (48%) of 61 patients with spontaneous contrast in mitral valvular disease.[1)]

Our results indicated 8 (80%) of the 10 HCM patients in group 1 had LASEC, with a history of embolization in 3 (38%). The incidence of LASEC and the history of embolism were apparently high. Although the prognostic value may require further studies in large prospective trials, HCM patients with atrial fibrillation were strongly suggested to be in a high risk state of thromboembolism from our results. Identification

of high risk subpopulations in atrial fibrillation patients might be important to determine the indication of prophylactic anticoagulant therapy.

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