

## 다면성 경식도 심초음파도를 이용한 좌심방이에 관한 연구

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### Multiplane Transesophageal Echocardiographic Assessment of Left Atrial Appendage

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#### ABSTRACT

**Background and Objectives :** Transesophageal echocardiography (TEE) allows a detailed evaluation of the structure and function of the left atrial appendage (LAA) by two-dimensional imaging and Doppler interrogation of appendage flow. LAA dysfunction has been associated with spontaneous echo contrast (SEC), thrombus formation and thromboembolism. The purpose of this study was to define normal heart reference values of LAA maximal forward velocity (LAAV), and to correlate LAAV with cardiac rhythm, mitral valve disease severity, SEC grade and left atrial thrombi development. **Subjects and Methods :** LAA volume measurement and pulse Doppler evaluation of LA appendage flow during TEE were undertaken in 95 subjects ; 32 patients with normal heart and 63 patients with various cardiac diseases. **Results :** Mean LAAV was  $87.1 \pm 26.7$  cm/s, mean LAA maximal backward velocity  $66.0 \pm 15.0$  cm/s and mean LAA volume  $2.2 \pm 1.2$  mL in those patients with normal heart (n = 32). There was a negative correlation between LAAV and SEC grade, mitral stenosis severity, LA size and LAA volume. Among those patients with atrial fibrillation, LAAV was lower in the subgroup with LA thrombi than in the subgroup without thrombi ( $14.9 \pm 8.1$  cm/s (n = 16), vs.  $29.7 \pm 21.2$  cm/s (n = 33), p<0.01). **Conclusion :** Reduced LAAV, SEC and mitral stenosis are all associated with LAA thrombus formation in patients with atrial fibrillation. **(Korean Circulation J 2002;32(2):137-145)**

**KEY WORDS :** Echocardiography, transesophageal ; Atrial appendage ; Atrial fibrillation ; Thromboembolism.

#### 서 론

가<sup>3)</sup>  
가  
가<sup>1)2)</sup> 가  
가 가 가  
가  
: 2001 11 20 . 80  
: 2001 12 29  
: , 158 - 710 911 - 1 가  
: (02) 650 - 5018 . : (02) 650 - 5424 ,  
E - mail : pseongh@mm.ewha.ac.kr

가 , 가

(multiplane transducer) HP SON-OS 1,000 (Hewlett - Packard, Andover, Massachusetts)

. 10% lidocaine spray

superVHS videotape

midesophageal level 90°

45°

limbus

가

가

가

p , (Fig. 1).

planimetry

3

### 대상 및 방법

대 상

1997 3 2000 7

가 가

sample volume 0.5 cm  
1 cm

54

(Fig. 2).

P

41

가

95 가 40 , 가 55

1 cm sa-

54 , 19 (

sample volume

12 , 4 ,

2 , 1 ),

10 , 4 , 3 ,

(spontaneous echo contrast) Fatkin

2 , 1 ,

1 , 1

32

방 법

2.5 MHz

. 4

5.0 MHz

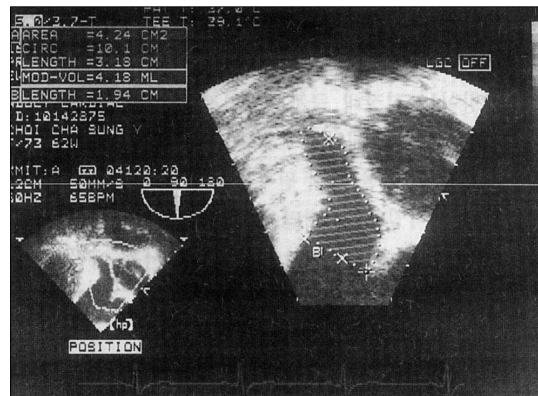


Fig. 1. Measurement of left atrial appendage area and volume.

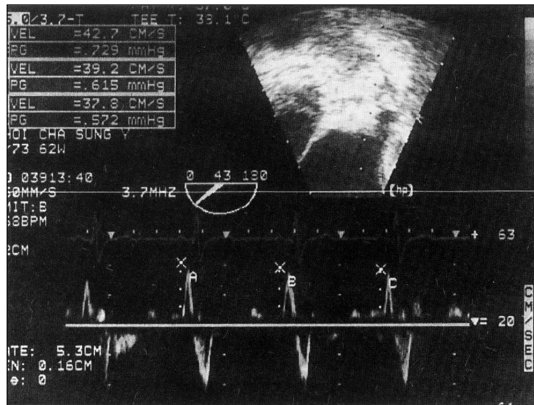


Fig. 2. Measurement of maximal forward and backward flow velocity of left atrial appendage in sinus rhythm.

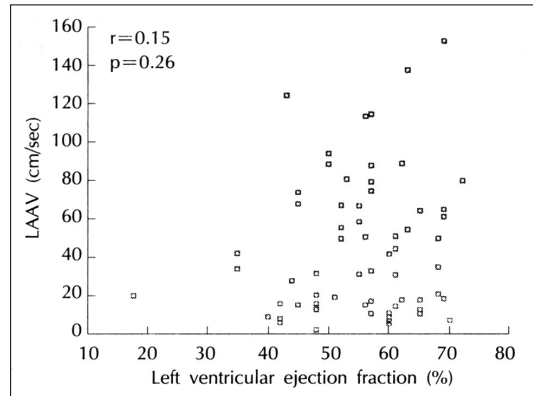


Fig. 3. The maximal forward flow velocity of left atrial appendage (LAAV) was not correlated with left ventricular ejection fraction.

4) grade 0 grade 4

통계분석

SPSS for windows 10.0

45° 90°

paired t - test

90°

Pe -

erson correlation coefficient

(Bivariate correlation analysis) , LA -

AV가 ,

가

(oneway ANOVA analysis) Kruskal - Wallis te -

st

Student t - test

linear by li -

near association . p 0.05

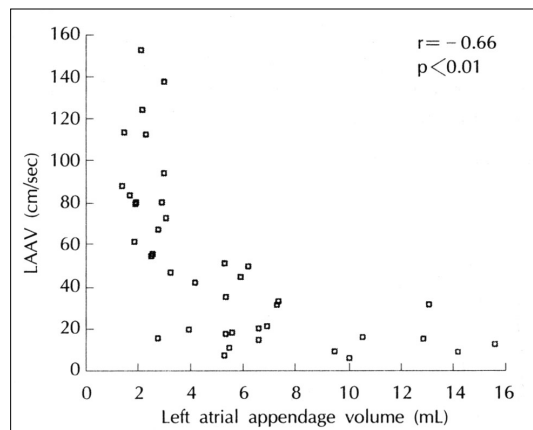


Fig. 4. The maximal forward flow velocity of left atrial appendage (LAAV) was inversely correlated with left atrial appendage volume.

45°

87.1 ± 26.7 cm/s, 90° 78.8 ± 31.7 cm/s ,

45° 66.0 ± 15.0 cm/s, 90°

62.2 ± 18.7 cm/s . 45°

2.8 ± 1.0 cm<sup>2</sup>, 90° 3.0 ± 0.8 cm<sup>2</sup> ,

45° 2.2 ± 1.2 mL, 90° 2.3 ± 0.8 mL

45° 90°

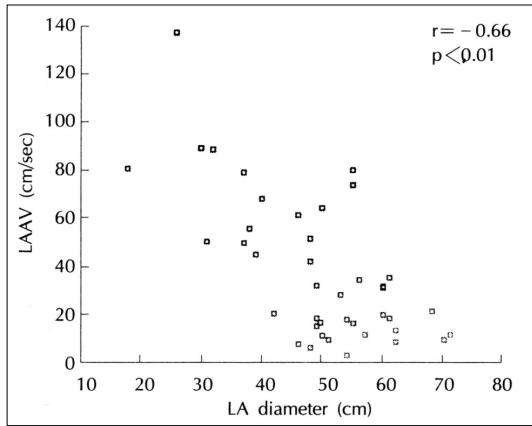
## 결 과

정상 좌심방이의 용적 및 혈류속도

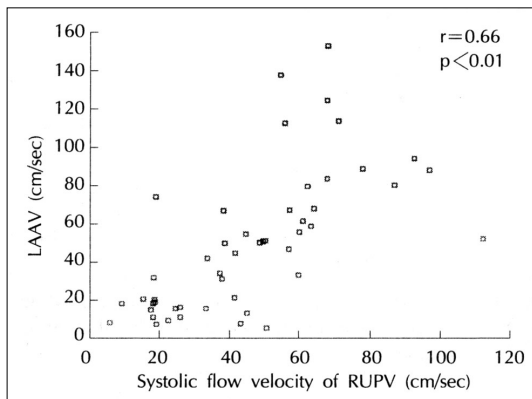
56 ± 16 , 24 ,

좌심방이 최대 전방 혈류속도와 좌심방이 용적, 좌심방 전 후직경, 폐정맥 수축기 혈류속도, 좌심실 구혈률과의 상관성

3), (Fig. 4), (Fig. 5), (Fig. 6).  
 , 50%



**Fig. 5.** The maximal forward flow velocity of left atrial appendage (LAAV) was inversely correlated with the anteroposterior diameter of left atrium.



**Fig. 6.** The maximal forward flow velocity of left atrial appendage (LAAV) was positively correlated with systolic flow velocity of right upper pulmonary vein (RUPV).

전체 환자에서 자발에코영상, 승모판 협착증 및 승모판 폐쇄부전증의 중증도 및 심방세동유무에 따른 좌심방이 최대 전방 혈류속도의 차이

가 (Table 1), 가 (Table 2),

(Table 3).

26.7 ± 20.7 cm/s

73.4 ± 32.7 cm/s

가 (p < 0.01).

가 (Table 4).

좌심방이 최대 전방 혈류속도와 좌심방혈전과의 관계

(46 )

(49 )

16 (32.7%)

가 12 ,

가 3 ,

가 1

I (16 ) ,

II (33 ) , I

63 II

65

I 14.9 ± 8.1 cm/s, II 29.7

**Table 1.** Comparison of mean LAAV by SEC grade

	SEC grade					p
	0 (n=39)	1 (n=5)	2 (n=4)	3 (n=17)	4 (n=5)	
LAAV (cm/sec)	70 ± 32	33 ± 16	22 ± 18	18 ± 11	14 ± 4	<0.01

LAAV : the maximal forward flow velocity of left atrial appendage, SEC : spontaneous echo contrast

**Table 2.** Comparison of mean LAAV by MS grade

	MS grade				p
	0 (n=54)	Mild (n=2)	Moderate (n=1)	Severe (n=10)	
LAAV (cm/sec)	55 ± 36	10 ± 1	22	18 ± 14	<0.01

LAAV : the maximal forward flow velocity of left atrial appendage, MS : mitral stenosis

**Table 3.** Comparison of mean LAAV by MR grade

	MR grade					p
	0 (n=29)	± (n=25)	1 (n=8)	2 (n=1)	3 (n=5)	
LAAV (cm/sec)	65 ± 41	39 ± 28	26 ± 24	21	36 ± 19	NS

LAAV : the maximal forward flow velocity of left atrial appendage, MR : mitral regurgitation, NS : not significant

**Table 4.** Comparison of mean LAAV, LAA area and LAA volume by rhythm

	Sinus rhythm	Atrial fibrillation	p
LAAV (cm/sec)	73.4 ± 32.7 (n=32)	26.7 ± 20.7 (n=38)	<0.01
LAA area (cm <sup>2</sup> )	3.3 ± 1.3 (n=29)	5.8 ± 1.4 (n=31)	<0.01
LAA volume (mL)	2.9 ± 1.8 (n=28)	8.4 ± 3.5 (n=27)	<0.01

LAAV : the maximal forward flow velocity of left atrial appendage, LAA : left atrial appendage

**Table 5.** The incidence of thrombi by SEC grade in patients with atrial fibrillation

Thrombi \ SEC	0	1	2	3	4
No	13 (87)	5 (83)	1 (33)	11 (58)	3 (50)
Yes	2 (13)	1 (17)	2 (67)	8 (42)	3 (50)

p<0.05, ( ) : % within SEC, LAAV : the maximal forward flow velocity of left atrial appendage, SEC : spontaneous echo contrast

**Table 6.** The incidence of thrombi by MS grade in patients with atrial fibrillation

Thrombi \ MS	0	Mild	Moderate	Severe
No	28 (85)	1 (33)	0	3 (30)
Yes	5 (15)	2 (67)	2 (100)	7 (70)

p<0.01, ( ) : % within MS, MS : mitral stenosis

± 21.2 cm/s (p<0.01).  
 I 7.0 ± 1.4 cm<sup>2</sup>,  
 9.8 ± 4.4 mL, II 5.8 ± 1.5 cm<sup>2</sup>,  
 7.4 ± 3.1 mL

**Table 7.** The incidence of thrombi by MR grade in patients with atrial fibrillation

Thrombi \ MR	0	Trace	1	2	3	4
No	7 (54)	14 (70)	6 (67)	1 (100)	5 (100)	0
Yes	6 (46)	6 (30)	3 (33)	0	0	0

p=0.06, ( ) : % within MR, MR : mitral regurgitation

(p=0.06,

Table 7).

**고찰**

가

Suetsugu<sup>5)</sup> 1988

가

가

정상 심장의 좌심방이 최대전방혈류속도 및 용적

45°

87.1 ± 26.7 cm/s,

66.0 ± 15.0 cm/s,

2.8 ± 1.0 cm<sup>2</sup>,

2.2 ± 1.2 mL, 45° 90°

심방세동 환자군에서 자발에코영상(SEC), 승모판협착증 및 승모판폐쇄부전증의 중증도(severity)와 좌심방혈전과의 관계

가 (Table 5),

가

가 (Table 6).

가

가  
<sup>8)9)</sup> selection bias가  
가  
(biplane tranducer)  
가  
<sup>10)11)</sup> Agmon <sup>9)</sup> 310  
55 64 가  $82 \pm 23$  cm/s  
1993 <sup>12)</sup> 12 가  
 $54 \pm 21$  cm/s  
(biplane trans-  
ducer)  
가 가 Doppler 가 <sup>17)18)</sup>  
가  
3  
data aquisition off - line analysis in -  
terobserver variability가 <sup>13)14)</sup> 가 <sup>12)</sup>  
가  
가  $14.9 \pm 8.1$  cm/s , 29.  
가  $7 \pm 21.2$  cm/s  
가  
가 20 cm/s 가 2.6  
작심방 혈전생성의 예측 가 <sup>19)</sup>  
32.7%  
(cardioversion) 가 <sup>20)</sup>  
5 15% 가  
<sup>15)16)</sup>

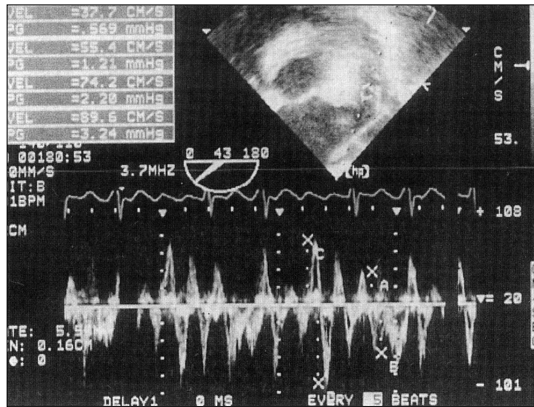


Fig. 7. An example of left atrial appendage flow recording in patients with atrial fibrillation and preserved left atrial appendage function.

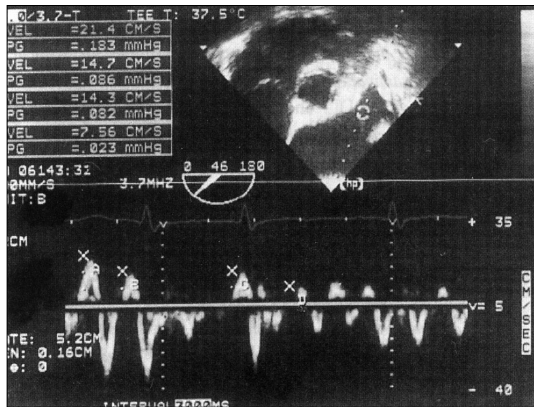


Fig. 8. An example of left atrial appendage flow recording in patients with atrial fibrillation and left atrial appendage dysfunction.

경식도 심초음파시 좌심방이 최대 전방 혈류속도 측정의 의의

(17)21)22)

가  
(Fig. 7) 가  
(Fig. 8).

제한점

가 95  
, 45 90  
가  
45  
가 70 , 90  
가 46 mi -  
ssing value  
(cross - sectional study)  
가  
가  
(prospective study)  
가

요 약

배경 및 목적 :

방 법 :

54  
41

32

결 과 :

8  
(LAAV) 45° 87.1 ± 26.7 cm/s, 90° 78.  
8 ± 31.7 cm/s, 45° 66.  
0 ± 15.0 cm/s, 90° 62.2 ± 18.7 cm/s  
45° 2.2 ± 1.2 mL, 90° 2.3  
± 0.8 mL, 45° 90°

LAAV  
( = 0.15, p = 0.26),

가 , 가  
LAAV  
LAAV  
26.7 ± 20.7 cm/s  
73.4 ± 32.7 cm/s  
가

I (16 ),  
II (33 )  
LAAV I 14.9 ± 8.1 cm/s, II  
29.7 ± 21.2 cm/s (p < 0.01).

결 론 :

중심 단어 : ; ; ; ;

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