

심인성 색전 요인이 없는 뇌경색 환자에서 경식도 심초음파와 Acoustic Quantification을 이용한 대동맥 탄성의 평가

가

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Assessment of Aortic Distensibility by Combined Transesophageal Echocardiography and Acoustic Quantification in Patients with Cerebral Infarction without Cardiac Origin of Emboli

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ABSTRACT

Background and Objectives : The atherosclerotic plaque in the thoracic aorta has been considered as potential source of cerebral embolization. The aim of this study was to evaluate the relation of atherosclerotic plaque burden and aortic distensibility by combined transesophageal echocardiography (TEE) and acoustic quantification (AQ) in patients with cerebral infarction without cardiac origin of emboli. **Methods :** The maximal intimal-medial thickness and distensibility of descending thoracic aorta using TEE (a 7.5 MHz multiplane transducer, Hewlett Packard Sonos 2500) and AQ were prospectively measured in 36 patients (mean age ; 61 ± 9 years) with cerebral infarction without cardiac origin of emboli and compared with 87 controls (mean age ; 56 ± 11 years) without history of cerebral infarction. After the quality of the short-axis images of the aorta was optimized, a software of AQ was activated and gain controls were adjusted. A region of interest was manually traced around the descending thoracic aorta and then integrated software was used to compute and instantaneously display aortic lumen area as a function of time. Maximal and minimal cross sectional area and fractional area change were calculated as an average from five consecutive cardiac cycles. **Results :** There were no statistically significant differences between two groups in gender, hyperlipidemia and smoking, but hypertension and diabetes were more common in the cerebral infarction group. The atherosclerotic intimal-medial thickness above grade 3 was found in 13 (36.1%) out of 36 patients with cerebral infarction and 15 (17.2%) out of 87 controls ($p < 0.05$). Aortic areas normalized for body surface area were not statistically different between patients and normal controls, but there were significant differences for elastic indices except compliance. Patients with cerebral infarction had a lower fractional area change ($5.7 \pm 3.2\%$ vs. $7.8 \pm 4.1\%$, $p < 0.05$) and higher stiffness index (12.2 ± 7.7 vs. 8.0 ± 5.1 , $p < 0.05$) compared with control group. There was an inverse relationship between the aortic intimal-medial thickness and the fractional

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area change of descending aorta ($r = -0.380$, $p < 0.01$). **Conclusion :** The data suggest that the aortic distensibility noninvasively measured by TEE and AQ predicts the atherosclerotic burden. Thus the aortic distensibility may be an additive risk factor for cerebral infarction. (**Korean Circulation J 2000;30(8):989-997**)

KEY WORDS : Aortic distensibility · TEE · Acoustic quantification · Cerebral infarction.

서론

36 (, : = 12 : 24, 61 ± 9)

87 (, : = 43 : 44, 56 ± 11)

¹⁾ 15~20% ²⁾³⁾ 45 23~36%

⁴⁾ 가 Hewlett Packard Model sonos 7.5 MHz

40% ⁵⁾⁶⁾ 2500

⁷⁻⁹⁾ 180

가 ¹⁰⁻¹²⁾ (inti - mal - medial thickness)

1 , 2 , 5 mm 3 , 5 mm 4 , 5 (Figs. 1A and 2A).¹³⁾ AQ 가

acoustic quantification (AQ) (aortic elastic properties) 가

(fractional area change, FAC) 5 가 (Figs. 1B and 2B).

재료 및 방법

1999 2 1999 8

$$FAC(\%) = \frac{A_{max} - A_{min}}{A_{max}} \times 100$$

3 (sphygmomometer) (mean blood pressure)

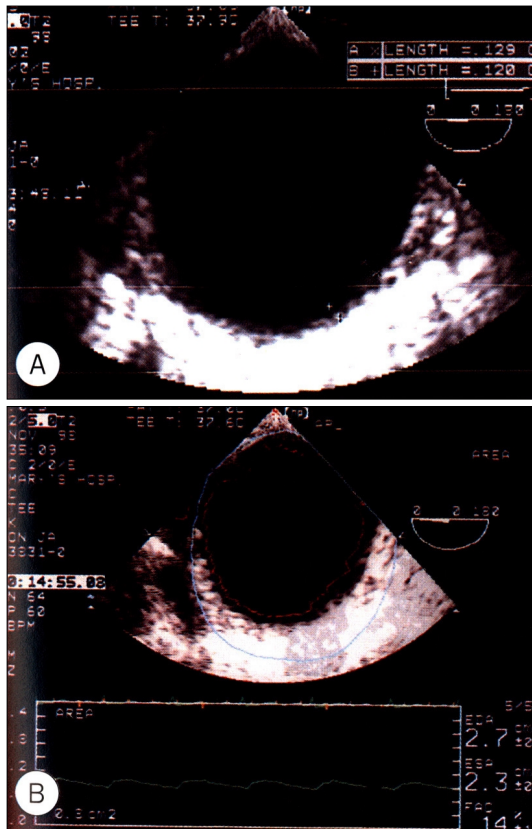


Fig. 1. Transesophageal echocardiographic findings of descending aorta in 58 year-old control woman. A : The intimal-medial thickness of descending thoracic aorta was about 1.2 mm. B : Fractional area change of this patient measured by acoustic quantification was 14%.

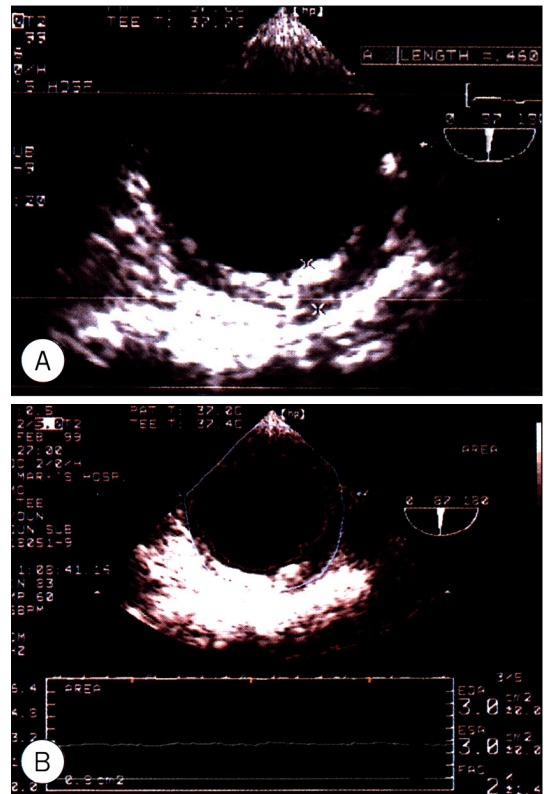


Fig. 2. Transesophageal echocardiographic findings of descending aorta in 50 year-old woman with cerebral infarction. A : The intimal-medial thickness of descending thoracic aorta was about 4.6 mm. B : Fractional area change of this patient measured by acoustic quantification was 2%.

(compliance),
(distensibility) (stiffness index)

$$Compliance(cm\ sup^2\ dyn^{-1}) = \frac{A_{max} - A_{min}}{BP_{mean}}$$

$$Distensibility(cm\ sup^2\ dyn^{-1}) = \frac{2(A_{max} - A_{min})/A_{max}}{BP_{sys} - BP_{dia}}$$

$$Stiffness\ index = \frac{\ln(BP_{sys}/BP_{dia})}{(A_{max} - A_{min})/A_{max}}$$

(Amax : , Amin : ,
BPsys : , BPdia : , Bpmean :
)

통계 분석

± SPSS
7.5

Student t - test, ² - test linear - by linear
association

(bivariate analysis)
(partial analysis)
. p<0.05

결 과

임상적 특성

(n=36) 61 ± 9
(n=87) 56 ± 11
가
가
88.7 ± 18.7 ,
82.9 ± 13.7
69.4%,
41.4%,
30.6%, 13.8%
가 (p<0.05)(Table 1).

이면성 경식도 심초음파 소견(죽상경화반 형태의 빈도 및 내막-중막 두께)

1
63.2%(n=55), 27.8%(n=10), 2
19.5%(n=17),
36.1%(n=13), 3 12.6%(n=11),
22.2%(n=8), 4
2.3%(n=2), 11.1%(n=4), 5
2.3%(n=2), 2.8%(n=1)
3
(17.2%, n=15) (36.1%, n=13)
linearly linear association
(p<0.02)(Fig. 3).

Table 1. Clinical characteristics

	Control (N = 87)	Cerebral infarction (N = 36)	p
Age (years)	56 ± 11	61 ± 9	<0.05
Male (%)	49.4	33.3	NS
Hypertension (%)	41.4	69 ± 4	<0.01
Heart Rate (BPM)	88.7 ± 18.7	82.9 ± 13.7	NS
Diabetes (%)	13.8	30.6	<0.05
Smoking (%)	21.8	22.2	NS
TC > 220 mg/dl (%)	19.8	20.6	NS

TC : Total cholesterol, BPM : beats per minute
NS : nonspecific

1.9 ± 1.1 mm,
2.6 ± 1.4 mm
(p<0.05)(Fig. 4).

AQ로 측정된 최대 대동맥 면적과 최소 대동맥 면적
(automated border detection
system) acoustic quantification

3.1 ± 0.9 cm²,
3.4 ± 0.8 cm²
2.8 ± 0.8 cm², 3.2 ± 0.8 cm²
가 (p<0.05).
1.8 ± 0.4 cm²/m²,
1.9 ± 0.4 cm²/m² 1.7 ±
0.4 cm²/m², 1.8 ± 0.4 cm²/m²
가 (Fig. 5).

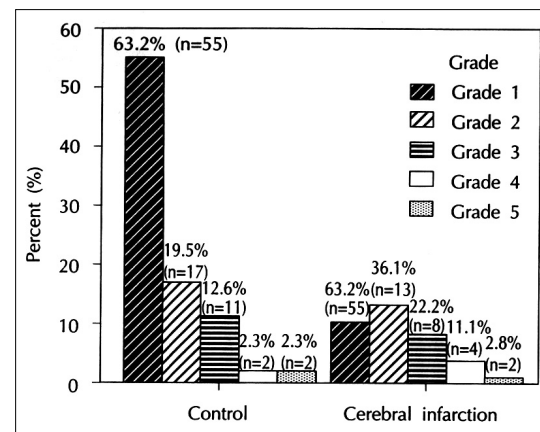


Fig. 3. The degree of atherosclerotic plaque of descending aorta in both group.

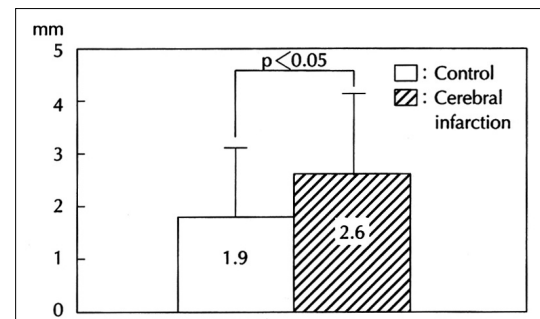


Fig. 4. Maximal intimal-medial thickness (mm) in both group.

분획 면적변화율, 순응도, 팽창력 및 경직도 지수
7.8±4.1%,

5.7±3.2%

(p<0.05)

(Fig. 6).

cm²dyn⁻¹,

2.6±1.5×10⁻³
2.1±1.6×10⁻³ cm²dyn⁻¹

23.9±17.2 cm²dyn⁻¹

8.0±5.1,

12.2±7.7

가

가

(p<0.05).

분획 면적변화율과 심혈관질환 위험인자와의 상관분석

37.9±27.9 cm²dyn⁻¹,

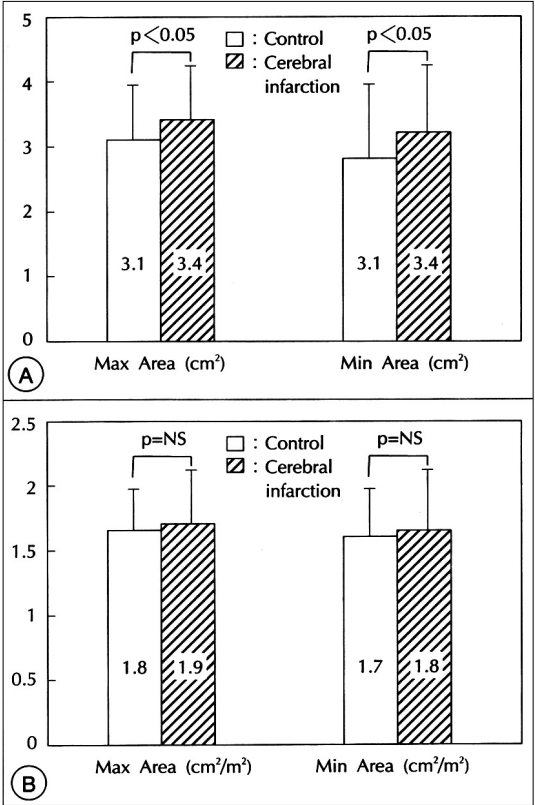


Fig. 5. A : Maximal and minimal transluminal areas of descending aorta by acoustic quantification. B : Maximal and minimal transluminal areas normalized by body surface area in both group.

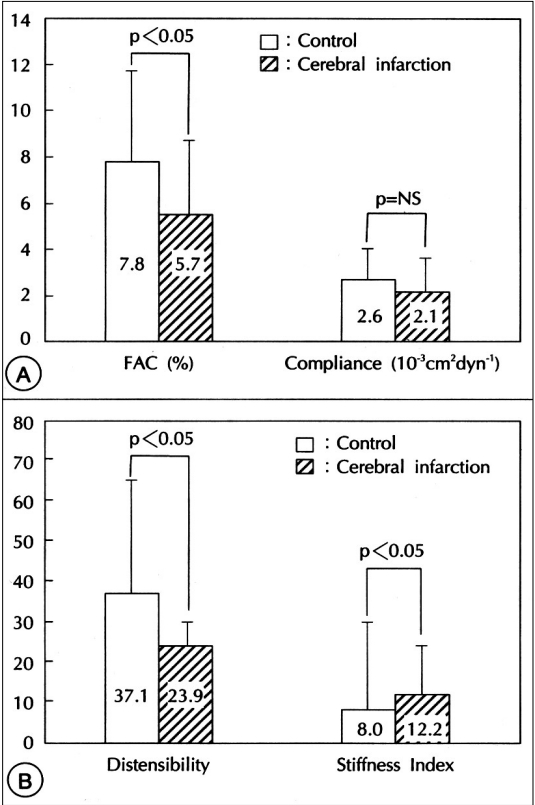


Fig. 6. A : Fractional area change (FAC) and compliance of descending thoracic aorta. B : distensibility and stiffness index of descending thoracic aorta in both group.

Table 2. Correlation between fractional area change and other clinical variables

Variables	Bivariate analysis		After adjustment		Adujst for
	Coefficient	p value	Coefficient	p value	
Age	- 0.375	<0.05	- 0.231	<0.05	Diabetes, Hypertension, Max IMT
Male	- 0.165	NS			
Diabetes	- 0.200	<0.05	0.017	NS	Age, Hypertension, Max IMT
Hypertension	- 0.206	<0.05	- 0.053	NS	Age, Diabetes, Max IMT
Smoking	- 0.135	NS			
Max IMT	- 0.380	<0.01	- 0.213	<0.05	Age, Diabetes, Hypertension

Maximal IMT ; Maximal intimal-medial thickness

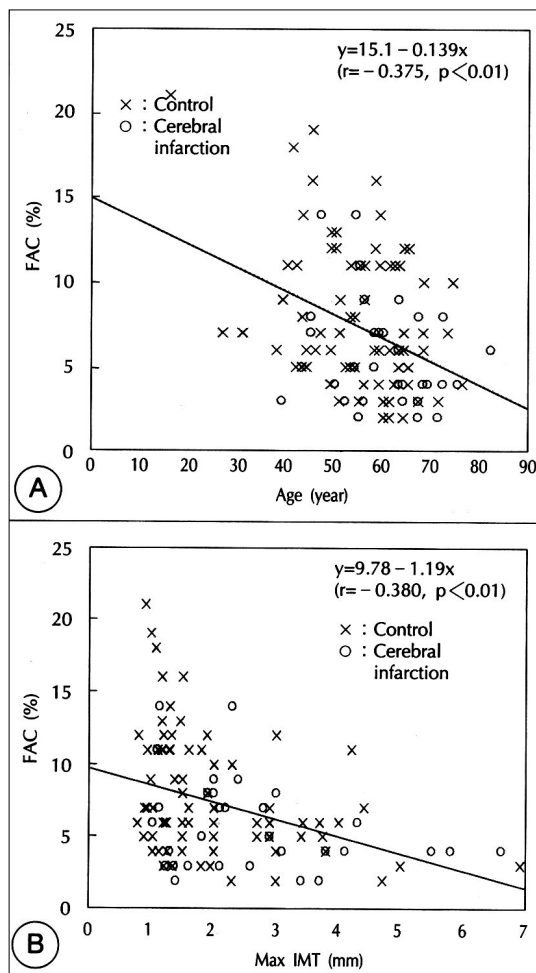


Fig. 7. A : Relation between age and fractional area change (FAC). B : relation between maximal intimal-medial thickness (Max IMT) and fractional area change.

가 가 . Lehmann ¹¹⁾
¹⁰⁻¹²⁾ , $\text{Ln}(\quad / \quad)$
²⁶⁾ 가
가 가 가
—
가 . St - , AQ
efanadis ¹⁴⁾
(disten - 가
sibility)
, 가
. Adams ²⁷⁾ Marfan 가 AQ
M
Hirata ¹³⁾ Marfan . M
가 가 . Pasie - 가 M
rski ²⁸⁾ M - mode
가 가 ³²⁾
, Perez ²⁹⁾³⁰⁾
backscatter 가
(automated border detection
system) 가
AQ
M AQ
가
M 가 가
가 가
AQ ³²⁾
Gerber ³¹⁾ AQ
가 요 약
(compliance)
(pulse pressure) 서 론 :
가

가 $1.7 \pm 0.4 \text{ cm}^2/\text{m}^2$, $1.8 \pm 0.4 \text{ cm}^2/\text{m}^2$ 가 : $7.8 \pm 4.1\%$, $5.7 \pm 3.2\%$ ($p < 0.05$). $2.6 \pm 1.5 \times 10^{-3} \text{ cm}^2\text{dyn}^{-1}$, $2.1 \pm 1.6 \times 10^{-3} \text{ cm}^2\text{dyn}^{-1}$

대상 및 방법 : 1999 2 1999 8 36 (: $37.9 \pm 27.9 \text{ cm}^2\text{dyn}^{-1}$, $23.9 \pm 17.2 \text{ cm}^2\text{dyn}^{-1}$ $= 12 : 24$, 61 ± 9) 87 (: ± 5.1 , 12.2 ± 7.7 가 $= 43 : 44$, 56 ± 11) 가 ($p < 0.05$).

acoustic quantification(AQ) (intimal - medial thickness) ($r = -0.375$, $p < 0.01$) 가 가 ($r = -0.380$, $p < 0.01$)

결 론 : AQ (fractional area change), (compliance), (distensibility) (stiffness index) 가

결 과 : 가 가 : 가 69.4%, 41.4% 30.6%, 13.8% 가 ($p < 0.05$). (가 3 (17.2%, $n = 15$) (36.1%, $n = 13$) (1.9 \pm 1.1 mm) (2.6 \pm 1.4 mm) ($p < 0.02$). AQ : $1.8 \pm 0.4 \text{ cm}^2/\text{m}^2$, $1.9 \pm 0.4 \text{ cm}^2/\text{m}^2$

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