

폐정맥 혈류와 승모판 혈류를 이용한 비침습적 좌심실 확장기압 측정

김동수 · 정남식 · 임세중 · 권 준 · 권혁문 · 김현승 · 박현영
김지영 · 하종원 · 장양수 · 심원흠 · 조승연 · 김성순

= Abstract =

Assessment of Left Ventricular Diastolic Pressures with Pulmonary Venous Flow and Transmural Inflow by Doppler Echocardiography

Dong Soo Kim, M.D., Nam Sik Chung, M.D., Se Joong Rim, M.D.,
June Kwan, M.D., Hyuck-Moon Kwon, M.D., Hyun-Seung Kim, M.D.,
Hyun Young Park, M.D., Ji Young Kim, B.S., Jong-Won Ha, M.D.,
Yang Soo Jang, M.D., Won Heum Shim, M.D.,
Seung Yun Cho, M.D., Sung Soon Kim, M.D.

*Department of Internal Medicine, Cardiology Division Yonsei Cardiovascular Center,
College of Medicine, Yonsei University, Seoul, Korea*

Background : Doppler variables of mitral inflow have been used to assess left ventricular diastolic function indirectly. Pulmonary venous flow(PVF) variables could supplement mitral inflow in the estimation of left ventricular diastolic function. The purposes of this study are to assess the feasibility of PVF measurement by using transthoracic pulsed wave Doppler echocardiogram and to estimate the LV end-diastolic pressure with PVF parameters.

Methods : Fifty six patients underwent transthoracic pulsed wave Doppler echocardiography(HP Sonos 1500) with in 2 hours before left heart catheterization for the measurement of left ventricular pressure.

Results :

- 1) Measurement of transthoracic PVF was feasible in 50 patients(89.3%).
- 2) The difference between the duration of pulmonary venous reversal flow and mitral A wave(D difference, D) was strongly correlated with left ventricular end diastolic pressure($r = 0.73$, $p < 0.01$). PVF reversal duration exceeding that of mitral A wave predicted left ventricular end diastolic pressure 12mmHg(sensitivity 90.6%, specificity 50.0%).

Conclusion : PVF could be assessed with transthoracic Doppler ultrasound with good feasibility. PVF may be an important parameter in the evaluation of left ventricular diastolic function. PVF reversal duration exceeding that of mitral A wave would be a marker of elevated left ventricular end

diastolic pressure (12mmHg).

KEY WORDS : Pulmonary venous flow · Transmural inflow · Left ventricular end diastolic pressure · Transthoracic doppler echocardiography.

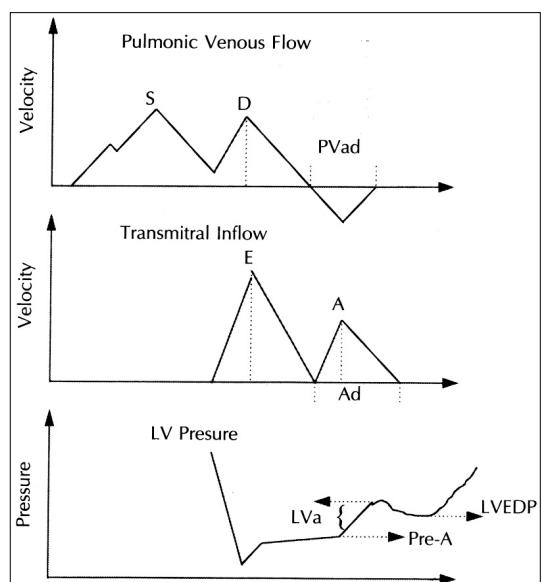


Fig. 1. Parameters of pulmonary venous(upper), mitral (middle) flow and left ventricular pressure (bottom) curves.

- A : peak velocity of late mitral flow
- Ad : duration of late mitral flow
- E : peak velocity of early mitral flow
- PVad : duration of reverse flow
- S : peak systolic velocity of pulmonary venous flow
- D : peak diastolic velocity of pulmonary venous flow
- SVti : systolic velocity integral
- DVti : diastolic velocity integral
- LVa : increase in ventricular pressure due to atrial systole
- Pre-A : pressure before atrial contraction
- LVEDP : left ventricular end diastolic pressure

eter

(pre - A),
가(LVa)
(left ventricular end diastolic pressure,
EDP) (Fig. 1).

4. 자료분석 방법

Doppler
SPSSW package
fficients multiple regression
value 0.05

correlation coe -
p

결 과

1. 측정가능 정도

56 50 (89.3%)
가 2 , 1

2. 승모판 혈류 Doppler지표와 폐정맥 혈류 Doppler지표 사이의 상관관계

E (E)
(D), A (A)
(PVa)
0.40, 0.31($p<0.05$)

3. 승모판 혈류 및 폐정맥 혈류 Doppler지표 와 좌심실 이완기압과의 상관관계

Doppler

Table 1. Relations between PVF variables and LV pressure

	Pre-A	LVa	LVEDP
PVad	0.51*	0.46*	0.59*
Ad	- 0.35**	- 0.37*	- 0.45*
Differnce	0.61*	0.58*	0.73*
LVEF	- 0.51*	- 0.10	- 0.40*
A(DT)	- 0.43*	- 0.20	- 0.48*

PVad : duration of pulmonary reverse flow * $p<0.01$

Ad : duration of mitral A wave ** $p<0.05$

Difference : PVad-Ad

A(DT) : deceleration time of A wave

Table 1

E	A	(E/A ratio)	E	A
가	LV -		가	(r = 0.16, - 0.17, - 0.04 p =
NS)	A		(Ad)	(A - DT)
				(r = - 0.45, - 0.48 p < 0.01
				Fig. 2).
				가
				(LV ejection fraction)
				systolic time velocity integral(Stvi)
				0.50(p < 0.01)
				Doppler
				(S),

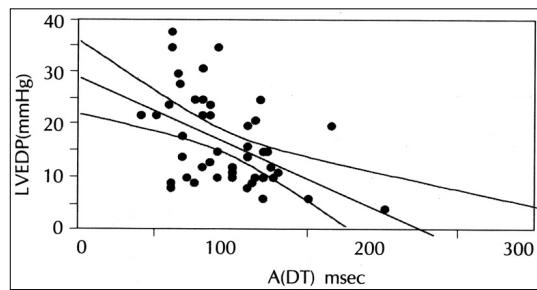


Fig. 2. Correlation between deceleration time of A wave and LVEDP.

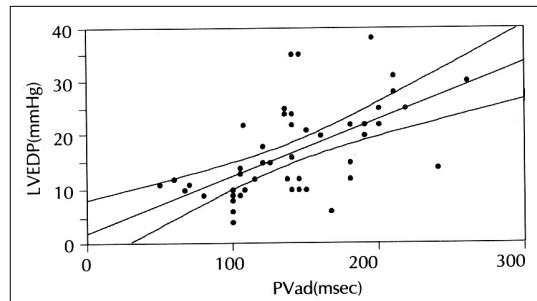


Fig. 3. Correlation between PV ad and LVEDP.

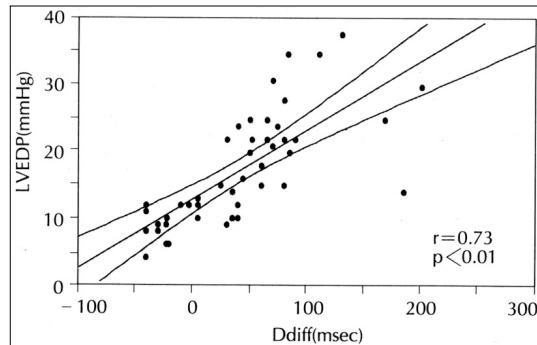


Fig. 4. Correlation between Ddiff and LVEDP.

(D) (LVEDP) Doppler
 $(r = -0.19, 0.31 p =$ 가
NS) (PVad) 3). Rossvoll (4) 가 가
0.59 (p<0.01, Fig. 3).
A (PVad - Ad, D)
 $(r = 0.73 p<0.01)$ 가
(Fig. 4) D가 0 A
12mmHg 50 29
(Sensitivity 90.6% Specificity 50.0% Table 2).

고 안

가 78
96% 4,6,7) 89.3%

Table 2. Sensitivity of specificity

	DD 0(msec)	DD<0(msec)
LVEDP 12(mmHg)	29(pts)	3(pts)
LVEDP 12(mmHg)	9(pts)	9(pts)

sensitivity 90.6% specificity 50.0%

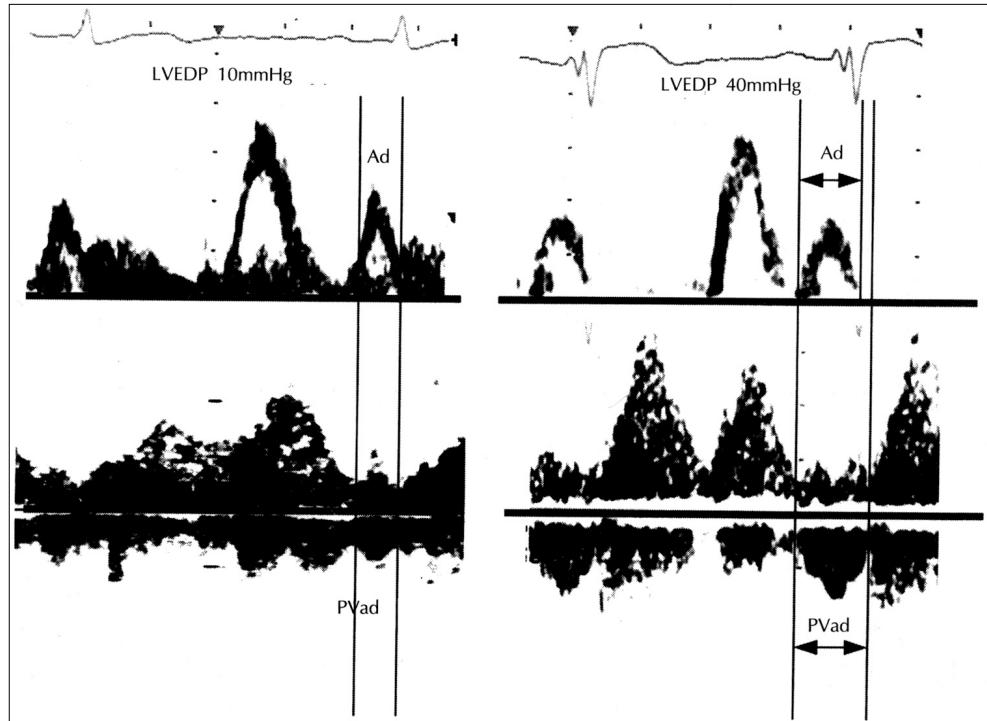


Fig. 5. Tracings from patients with normal and elevated LVEDP.

0부

2	0.5	1.0cm	56
Doppler		3	
			5
7 Fr pigtail catheter			
	(pre A),		
	가(LVa)		
(LVEDP)			
결과:			
1)	56	37	19
52.7	.	52	
3			
	1	.	
2)			가
56	50 (89.3%)		가
	3 ,		2 ,
	1	6	
3)	E	A	
E	A	(E/A ratio)	
			(r=0.16, -0.17,
-0.04 p=NS) A			(A - DT)
			(r = - 0.45, - 0.48 p<0.01).
	(PVad)		
	(r=0.59, p<0.01).		
	A		(D)
			(r = 0.73,
p<0.01)	D가 0		
	A		
50	29		12mmHg
			(sensitivity 90.6%, specificity 50.0%).

결 론 :

가

References

- 1) Kitabatake A, Inoue M, Asao M : *Transmitral blood flow reflectio diastolic behavior of the left ventricle in health and disease. A study by pulsed Doppler technique* Jpn. Circ J 46 : 92-102, 1982
 - 2) Kuecherer HF, Muhuideen IA, Kusumoto FM, Lee E, Moulinier LE, Cahalan MK, Schiller NB : *Estimation of mean left atrial pressure from transesophageal pulsed Doppler echocardiography of pulmonary venous flow*. Circulation 82 : 1127-1139, 1990
 - 3) Castello R, Vaughn V, Dressler FA, McBride LR, Willman VL, Kaiser GC, Schweiss JF, Ofili EO, Labovitz AJ : *Relation between pulmonary venous flow and pulmonary wedge pressure : Influence of cardiac output*. Am Heart J 130 : 127-134, 1995
 - 4) Rossvoll O, Hatle LK : *Pulmonary venous flow velocities recorded by transthoracic Doppler ultrasound : Relation to left ventricular diastolic pressures* J Am Coll Cardiol 21 : 1687-1696, 1993
 - 5) Basnight MA, Gonzalez MS, Kershenovich SC, Appleton CP : *Pulmonary venous flow velocity : relation to hemodynamics, mitral flow velocity and left atrial volume and ejection fraction*. J Am Soc Echocardiogr 4 : 547-558, 1991
 - 6) Brunazzi MC, Chirillo F, Pasqualini M, Gemelli M, Grisolia EF, Longhini C, Giommi L, Barbaresi F, Stritoni P : *Estimation of left ventricular diastolic pressures from precordial pulsed Doppler analysis of pulmonary venous and mitral flow*. Am Heart J 112 : 293-300, 1994
 - 7) Masuyama T, Lee JM, Nagano R, Nariyama K, Yamamoto K, Naito J, Mano T, Kondo H, Hori M, Kamada T : *Doppler echocardiographic pulmonary venous flow-velocity pattern for assessment of the hemodynamic profile in acute congestive heart failure*. Am Heart J 129 : 107-113, 1995
 - 8) Appleton CP : *Doppler assessment of left ventricular diastolic function : The refinements continue*. JACC 21 (7) : 1697-1700, 1993
 - 9) Appleton CP, Gonzalez MS, Basnight MA : *Relationship of left atrial pressure and pulmonary venous flow velocities : Importance of baseline mitral and pulmonary venous flow velocity patterns studied in lightly sedated dogs*. J Am Soc Echocardiogr 7 : 264-275, 1994
 - 10) Kuecherer HF, Kusumoto F, Muhuideen IA, Cahalan MK, Schiller NB : *Pulmonary venous flow patterns by transesophageal pulsed Doppler echocardiography : Relation to parameters of left ventricular systolic and diastolic function*. Am Heart J 122 : 1683-1693, 1991
 - 11) Nishimura RA, Abel MD, Hatle LK, Jajik AJ : *Relation of pulmonary vein to mitral flow velocities by transesophageal echocardiography. Effect of different loading conditions*. Circulation 81 : 1488-1497, 1990