

좌심실 전부하, 후부하 및 심박수의 변화가 관동맥 혈류 예비력에 미치는 영향에 관한 연구

가

이현승 · 윤호중 · 유기동 · 정옥성 · 채장성 · 김재형 · 최규보 · 홍순조

Change of Coronary Flow Reserve in the Dogs : Influence of Atrial and Ventricular Pacing, Ventricular Preload and Afterload

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ABSTRACT

Background and Objectives : The aim of this study was to analyze the influence of changes in ventricular preload and afterload, atrial and ventricular pacing on the coronary flow reserve (CFR). **Method :** Five open chest anesthetized dogs were studied in five sequential stages : baseline, saline solution volume loading (293.8 ± 29.2 ml for 10 min), atrial and ventricular pacing (120, 140, and 160 bpm), and aortic clamp. Coronary blood flow (CBF) was measured with electro-magnetic flowmeter. CFR was defined as the ratio of hyperemic CBF (hCBF) to resting CBF (rCBF). Hyperemia was induced by IV adenosine infusion (1 mg/kg/min). **Results :** 1) After volume loading with saline solution, CFR significantly decreased ($p < 0.05$) because rCBF was increased while hCBF remained unchanged. 2) Atrial pacing produced increase in rCBF but did not change hCBF. Consequently CFR significantly reduced when heart rate (HR) increased from sinus rhythm to 120, 140, and 160 bpm ($p < 0.01$). 3) Ventricular pacing produced decrease in hCBF but did not change rCBF. Consequently CFR significantly reduced as HR increased from sinus rhythm to 120 ($p < 0.05$), 140 ($p < 0.01$), and 160 ($p < 0.01$) bpm. 4) After aortic clamp, CFR significantly decreased ($p < 0.01$) because rCBF increased while hCBF remained unchanged. **Conclusion :** We found that CFR is dependent on the changes in volume loading, HR, and ventricular afterload that may commonly occur in clinical situations. (**Korean Circulation J 1999;29(3):251-258**)

KEY WORDS : Coronary flow reserve · Ventricular preload and afterload · Atrial and ventricular pacing.

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1)
2)3)
, dipyrindamole

,

가

가

가

4) 1960 Coffman Gregg⁵⁾

(coronary flow reserve)

, Mosher⁶⁾

(70-130 mmHg)

가 ,

4)7)

intracoronary

Doppler catheter, coronary sinus thermodilution

diffusible indication technique, distal subtraction

angiographic methods, positron emission tomography

4)8) - 10)

, X ,

가 11) - 18)

. Cleary¹⁹⁾

가 , 가

(autonomic tone)

, McGinn²⁰⁾

가

가

19)20)가

가

재료 및 방법

실험 동물

15.6 ± 1.6 kg (14-18 kg)

5 (ketamine

HCL,) 1-2 mg/kg

(ventilator, animal, 683, Harvard,

USA) 35-40, 1-15

20 ml

(thiopental sodium 0.5 g, sodium car-

bonate 0.03 g,) 50-75 mg (2.5%

2-3 ml) 5

2-3 cm

(blood flow transducer)

(Cliniflow II, Model FM 701D, Carolina

Medical Electronic inc, North Carolina, USA)

5F

(NEC Sanei 366, Japan)

실험 계획

가

(preload) , (atrial pacing)

(ventricular pacing)

가(afterload)

5

Table 1. Overview of the experimental protocol

	Baseline	Preload	Pacing	Afterload
Volume loading	R / H	R / H		
Atrial pacing	R / H		R / H	
Ventricular pacing	R / H		R / H	
Aortic clamp	R / H			R / H

R ; resting coronary flow, H ; hyperemic coronary flow

adenosine(9 - - D - ribofuranosyladenine, Sa -
nofi Winthrobe Ltd) 1 mg/kg/min

(Table 1).

15 가

가

가

±29 ml

가

digital programmable cardiac stimulator
(DTU - 101, Bloom associates, U.S.A)

120 / , 140 / 160 / 3

160 /

가

5 cm

40 50%

가

결과 분석 및 배제

(ml/min) .(
/)

20

3
, 3

10% , 2
가 50 /

5 ml/min , 3
80 mmHg

1 , 2 ,
1 5

통계 분석

±
paired Students
t - test p<0.05

결 과

관동맥 혈류 예비력에 대한 전부하 증가 효과

(293.8 ± 29.2 ml)

가 , 87.4 ± 9.6 mmHg
101.2 ± 17.9 mmHg (p<0.01) 가

가

12.8 ± 0.3 ml/min 15.9 ± 0.4 ml/min 24.2%
가 가 , 22.4 ± 0.8
ml/min 23.9 ± 2.6 ml/min 가

가

가 ,

1.75 ± 0.07

가 1.51 ± 0.17

(p<0.05)(Table 2).

관동맥 혈류 예비력에 대한 심박동수 증가 효과

, 120, 160 /min

, 140 /min

105.4 ±

17.9 mm/Hg

94.9 ± 20.0

mm/Hg (p<0.01). 120 / 140
 , 140 / 160 / 가 / 160 / 87.4±9.6 mmHg
 12.8±0.3 ml/ 78.3±15.3 mmHg, 71.0±6.3 mmHg
 min 14.6±1.2 ml/min(p<0.05), 16.3±0.8
 ml/min(p<0.01), 16.1±0.5 ml/min(p<0.01)
 가 가 가
 22.4±0.8 12.8±0.3 ml/min
 21.4±0.7, 22.2± 12.2±0.6 ml/min, 12.5±0.7 ml/min, 12.9±
 1.3, 22.7 ±0.9 가 0.6 ml/min 가
 , 1.75± 22.4±0.8 ml/min
 0.07 , 1.47±0.11, 1.36±0.52, 1.41± 20.2±0.5 ml/min, 20.6±1.1 ml/min,
 0.05 20.7±0.7 ml/min (p<0.05).
 (p<0.01) (Table 3). 가
 , 1.66±0.08, 1.65±
 0.06, 1.60±0.08 1.75±0.07
 120 / , 140 / 160 / (p<0.05) (Table 4).
 가

Table 2. Effect of ventricular preload on coronary flow reserve

	HR (beat / min)		MAP (mmHg)		CBF (ml / min)		CFR
	R	H	R	H	R	H	
Baseline	68.3±3.4	76.9±6.7	87.4± 9.6	86.7±13.2	12.8±0.3	22.4±0.8	1.75±0.07
Volume loading	71.5±1.3	67.1±3.3*	101.2±17.9**	78.7± 5.4*	15.9±0.4**	23.9±2.6	1.51±0.17*

HR ; heart rate, MAP ; mean arterial pressure, CBF ; coronary blood flow, CFR ; coronary flow reserve, R ; resting coronary flow, H ; hyperemic coronary flow

Table 3. Effect of atrial pacing on coronary flow reserve

	HR (beat / min)		MAP (mmHg)		CBF (ml / min)		CFR
	R	H	R	H	R	H	
Baseline	68.3±3.4	76.9±6.7	87.4 ± 9.6	86.7±13.2	12.8±0.3	22.4±0.8	1.75±0.07
Atrial pacing	120	120	100.8±29.6	100.5±29.5	14.6±1.2*	21.4±0.7	1.47±0.11**
	140	140	105.4 ±17.9**	94.9±20.0	16.3±0.8**	22.2±1.3	1.36±0.52**
	160	160	95.9 ±23.8	85.2±17.4	16.1±0.5**	22.7±0.9	1.41±0.05**

HR ; heart rate, MAP ; mean arterial pressure, CBF ; coronary blood flow, CFR ; coronary flow reserve, R ; resting coronary flow, H ; hyperemic coronary flow, *p<0.05 vs baseline, **p<0.01 vs baseline

Table 4. Effect of ventricular pacing on coronary flow reserve

	HR (beat / min)		MAP (mmHg)		CBF (ml / min)		CFR
	R	H	R	H	R	H	
Baseline	68.3±3.4	76.9±6.7	87.4± 9.6	86.7±13.2	12.8±0.3	22.4±0.8	1.75±0.07
Ventricular pacing	120	120	78.3±24.5	78.0±19.6*	12.2±0.6	20.2±0.5**	1.66±0.08*
	140	140	78.3±15.3**	76.8± 8.8**	12.5±0.7	20.6±1.1*	1.65±0.06**
	160	160	71.0± 6.3**	64.1± 4.8**	12.9±0.6	20.7±0.7*	1.60±0.08**

HR ; heart rate, MAP ; mean arterial pressure, CBF ; coronary blood flow, CFR ; coronary flow reserve, R ; resting coronary flow, H ; hyperemic coronary flow, *p<0.05 vs baseline, **p<0.01 vs baseline

	HR (beat / min)		MAP (mmHg)		CBF (ml / min)		CFR
	R	H	R	H	R	H	
Baseline	68.3 ± 3.4	76.9 ± 6.7	87.4 ± 9.6	86.7 ± 13.2	12.8 ± 0.3	22.4 ± 0.8	1.75 ± 0.07
Aortic clamp	84.6 ± 5.1**	86.4 ± 4.4*	50.0 ± 13.2**	42.5 ± 16.0**	19.2 ± 1.3**	22.5 ± 1.1	1.17 ± 0.08**

HR ; heart rate, MAP ; mean arterial pressure, CBF ; coronary blood flow, CFR ; coronary flow reserve, R ; resting coronary flow, H ; hyperemic coronary flow. *p<0.05 vs baseline, **p<0.01 vs baseline

255

, Ellis ²⁵⁾ Aversano ²⁶⁾ 가 가 ,
 가가
 , 가 , 가가
 가 가
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요 약

연구배경 :

가
 가
 (MVO₂) 가
 가
 가
 방 법 :
 5 5
 Blalock clamp
 2 3 cm
 3
 가 ,
 가 가
 가 McGinn ²⁰⁾ 가
 가 (10 293.8±29 ml)
 가 ,
 가 (120 / , 140 / , 160 /
 5 cm

가 5

(ml/min) adenosine (1

mg/kg/min) (ml/min)

실험 결과 :

1) 가 가

가 ,

가

($p < 0.05$).

2) 120 / , 140 / , 160 /

가 ,

가

($p < 0.01$).

3) 120 / , 140 / , 160 /

가 ,

120 /

($p < 0.05$), 140 / ($p < 0.01$), 160 / ($p < 0.01$)

4) 가

가 ,

가

($p < 0.01$).

결 론 :

,

,

중심 단어 :

1997

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