

The clinical value of coronary flow reserve measurement in ischemic heart disease

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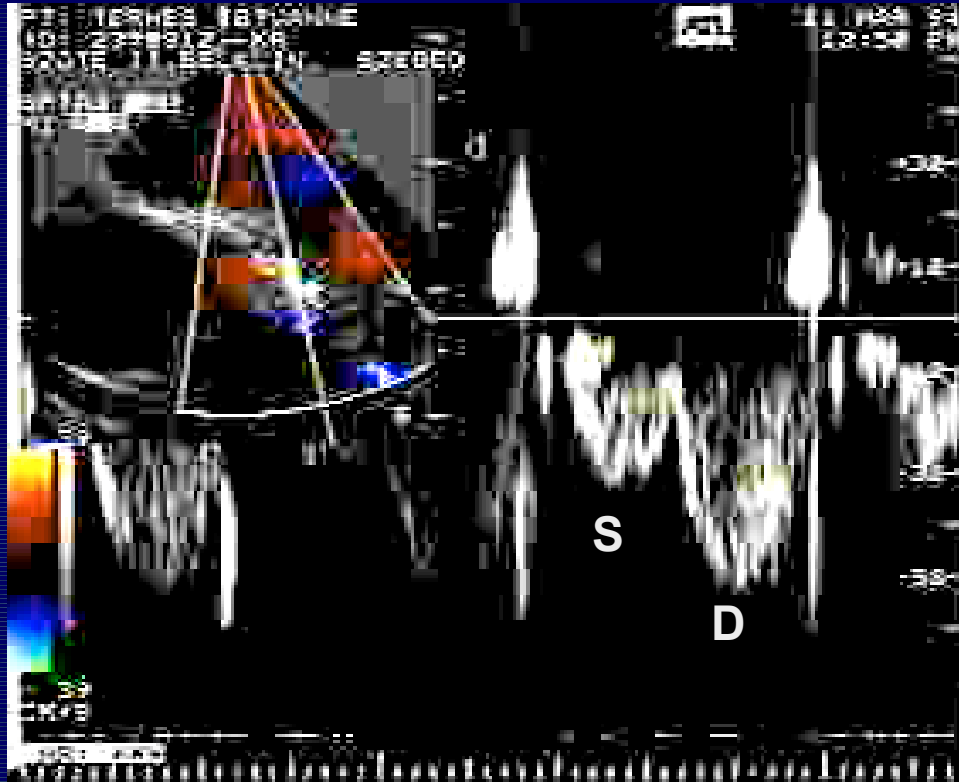
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Cardiology Center**

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CFR measurement

- **Non-invasive technique -
transoesophageal echocardiography
and vasodilator stimulus**
- ***S. Iliceto - Circulation 1991; 83: 61-69***
- **Vasodilator stimulus**
 - dipyridamole - 0.56 mg/kg - 4 min*
 - adenosin - 0.14 mg/kg/min - 4 min*

Flow in the LAD by TEE



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By Pulsed Doppler the flow in the LAD can be measured. A smaller systolic and a larger diastolic wave can be detected. Norm. diastolic flow velocity: < 60 cm/s.

Calculation of CFR

$$\text{CFR} = \frac{\text{Maximal velocity at peak vasodilation}}{\text{Flow velocity at baseline}}$$

Normal value: > 2.5

Results in ischemic heart disease

	n	CF
Negative	32	3.07±0.92 *
LAD	44	1.84±0.43 *
LAD/RC	19	1.85±0.52 *
LAD/CX	16	2.02±0.64
Cx or CD	26	2.41±0.58 *
Cx and CD	13	1.92±0.76 *
3-vessel dis.	11	1.89±0.41 *
X-syndrome	15	1.41±0.33 †
	172	

* $p < 0.01$ to normals
† $p < 0.05$ to LAD

Results in LAD disease

	n	CFR
non-significant LAD	13	1.96±0.65
distal LAD	14	1.86±0.51
proximal LAD	30	1.83±0.41

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There is a tendency for having lower CFR values with increasing severity of LAD disease (not significant).

Grades of aortic atherosclerosis

grade 0 - no atherosclerosis

grade 1 - intimal thickening

grade 2 - plaque < 5 mm

grade 3 - plaque > 5 mm

grade 4 - plaque with mobile component

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Grades of aortic atherosclerosis.

CFR and aorta atherosclerosis

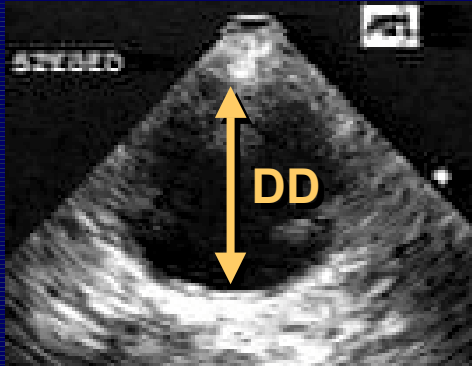
Aortic grades	CFR	mean CFR
Grade 0	2.51±0.79	2.32±0.77
Grade 1	1.96±0.62 *	1.91±0.67 *
Grade 2-3	2.03±0.81 *	1.90±0.78 *

*** p<0.05**

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In case of any atherosclerosis, CFR values decreased significantly.

Elastic properties of the aorta



Elastic modulus, $E(p) = (DBP/DD)DD$

Young's modulus, $E(s) = E(p)DD/2h$

A. Pearson, Am Heart J 1994; 128: 344-51

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The way to calculate elastic and Young's modulus.

BP - blood pressure

DD - diameter of the descending aorta

D - difference between diastolic and systolic diameters

h - thickness of the aortic wall

CFR and aortic distensibility

CFR

< 2.5

> 2.5

E(p)

0.87±0.56

0.59± 0.32*

E(s)

8.66±6.39

5.18±3.78*

* $p < 0.05$

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Elastic modulus and Young's modulus significantly increased in case of lower CFR values.

Factors influencing CFR

- **Vascular component**

 - stenosis of the epicardial coronary arteries*

 - microvascular coronary disease (X-syndrome)*

- **Extravascular component - hypertrophy**

- **Rheologic factors -viscosity**

Strauer, J Card Pharm, 1992

CFR and aortic stenosis

	Vrest	Vmax	CFR
Normal N=21	52.8±20	149.±26	3.21±1.1
AoS N=19	65.4±25*	121.6 ± 43*	1.92 ± 0.6*
LAD N=37	64.8±29*	109.5±41*	1.82±0.5*
p<	0.05	0.03	0.02

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In case of significant aortic stenosis and LAD disease, the CFR is markedly and similarly decreased.

LVM of patients

Normal:	264.6+79.4 g
AoS:	381.8+118 g*
LAD:	268.2+70.2 g

* $p < 0.005$

Hyperlipidemia and CFR

	Chol-level normal	Chol-level high
With Lipid-lowering	2.94±0.95 n=5	2.01±0.85* n=8
Without Lipid-lowering	2.53±1.06 n=17	2.17±0.72* n=8

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At normal cholesterol level with or without lipid-lowering therapy, the CFR is in the normal range. At increased cholesterol level (no matter to therapy), CFR is significantly lower.