FFR and Valvular Heart Disease

Morton J. Kern, MD
Chief of Medicine, VA Long Beach HCS
Professor of Medicine
University California Irvine
Orange, California

UNIVERSITY of CALIFORNIA · IRVINE

Disclosure:

Morton J. Kern, MD

Within the past 12 months, the presenter or their spouse/partner have had a financial interest/arrangement or affiliation with the organization listed below.

Company Name	Relationship
St. Jude Medical Inc.	Speakers' Bureau
Volcano Therapeutics	Speakers' Bureau
Merit Medical Inc.	Consultant
Acist Medical Inc.	Consultant
Opsens	Consultant

FFR in Valvular Heart Disease

Factors confounding interpretation of FFR

- Coronary Blood flow and Reserve
- Left Ventricular Hypertrophy and Strain
- Microvascular dysfunction

Theoretical considerations for FFR in TAVR

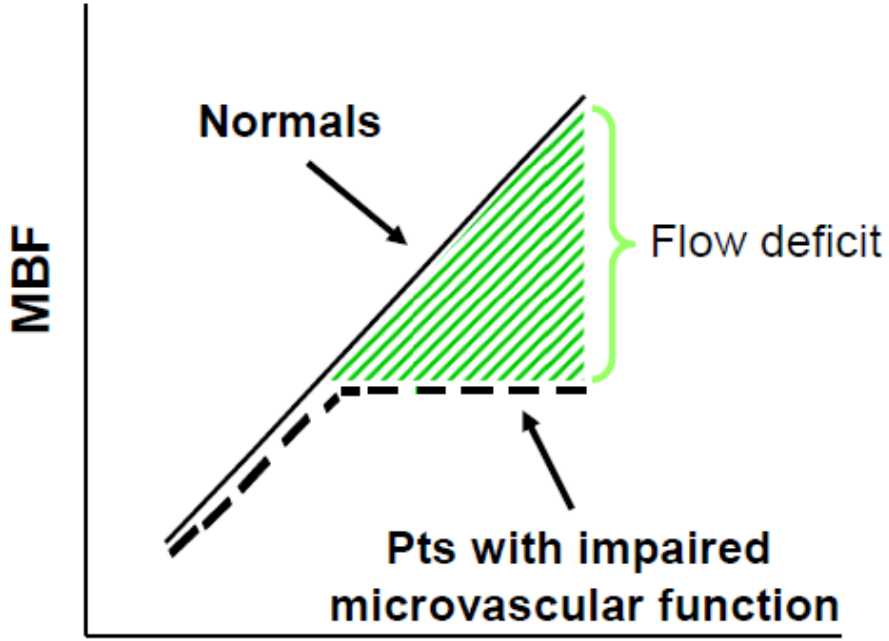
Editorial

Why Angina in Aortic Stenosis With Normal Coronary Arteriograms?

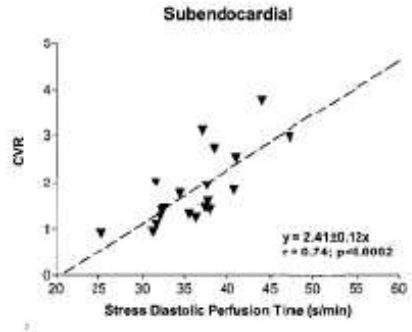
K. Lance Gould, MD; Blase A. Carabello, MD

Circulation 2003;107:3121-3123

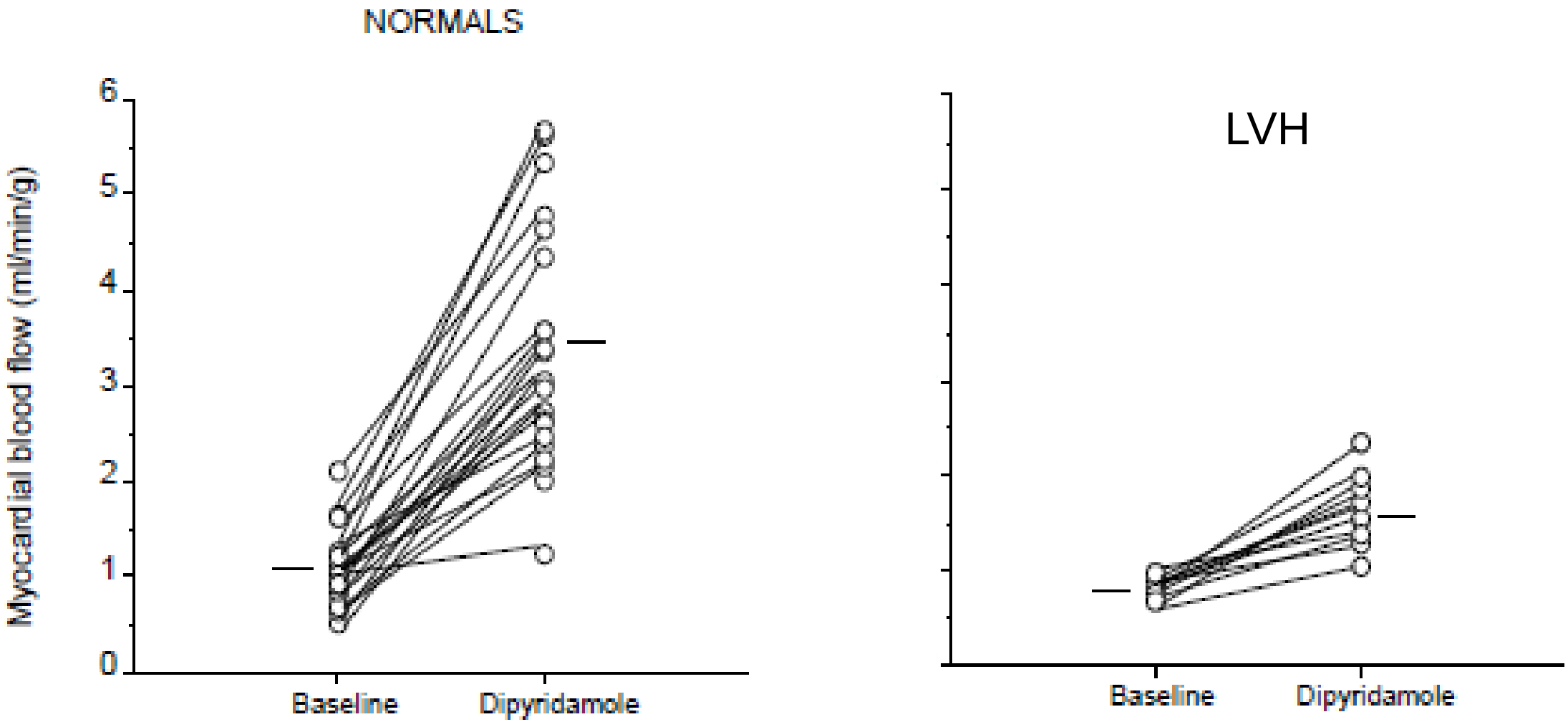
CFR vs. LVH



CFR vs. Diastolic Perfusion Time

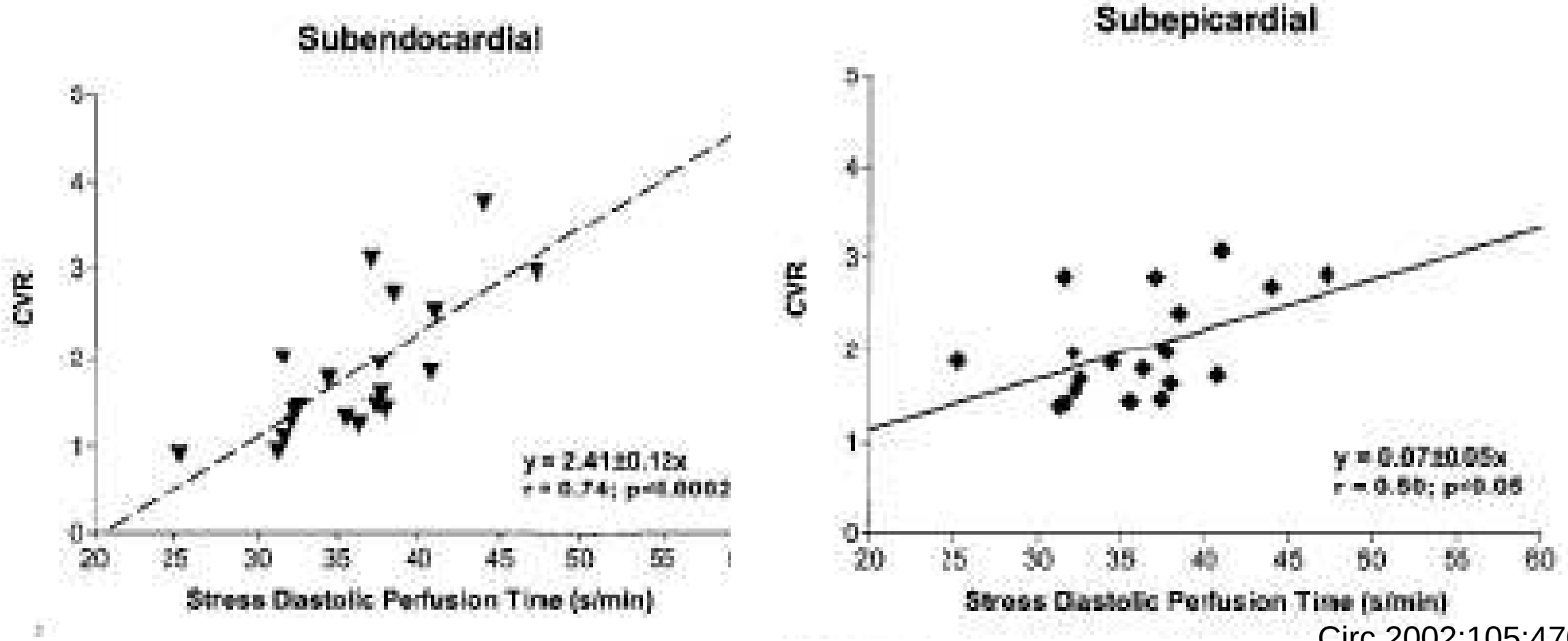


Microvascular disease and CBF



Camici et al. Eur Heart J 1997; 18: 108-116

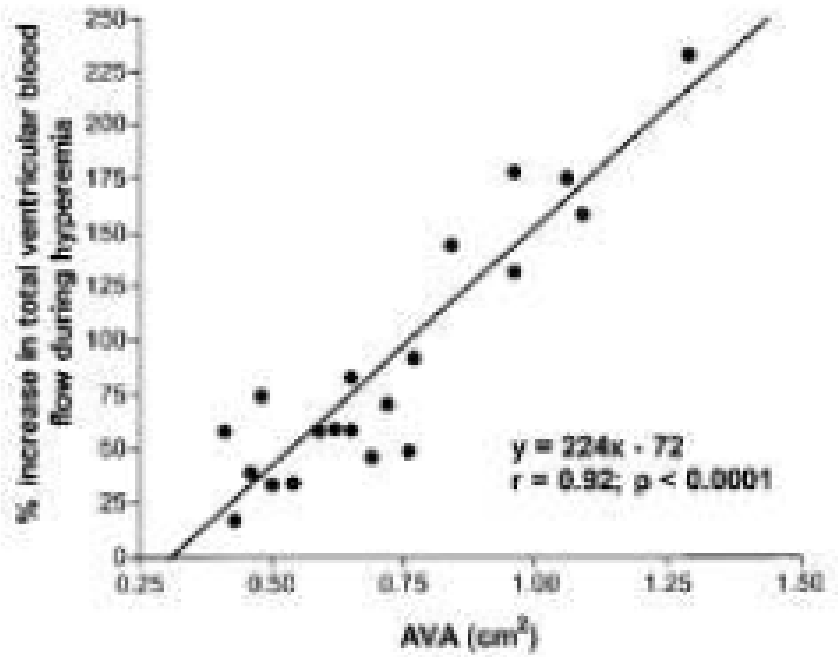
CVR vs Diastolic Perfusion Time



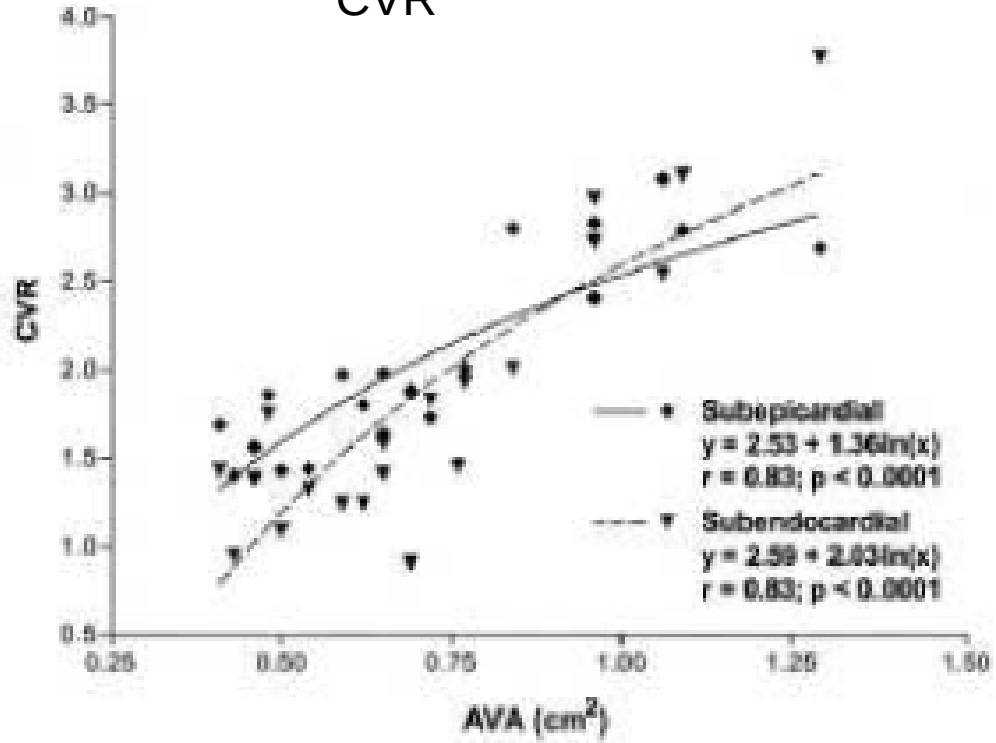
Circ 2002;105:470-476

Total and transmural MBF in Ao stenosis: relation to AVA

Ventricular blood flow during hyperemia



CVR



Myocardial Blood Flow and Oxygen Consumption in Man Early After Valve Replacement

By JAMES D. WISHEART, M.B., B.SC., F.R.C.S. (ED), JOSEPH P. ARCHIE, PH.D., M.D., JOHN W. KIRKLIN, M.D., AND WILLIAM G. TRACY, B.S.

Differences Between Patients in Group A According to the Valve Replaced

	Mean LAP	LV CBF		$M_{VO_2} \div TTI$	
	(Period 1)	(Period 2)	(Period 3)	(Period 2)	(Period 3)
Aortic valve replacement (N = 10)	9 ± 1.0	98.0 ± 5.4	96.3 ± 5.8	4.6 ± 0.27	5.0 ± 0.38
Mitral valve replacement (N = 4)	15 ± 2.3	123.1 ± 6.3	127.2 ± 8.7	6.7 ± 0.42	7.5 ± 0.59
P	< 0.025	< 0.05	< 0.025	< 0.001	< 0.005

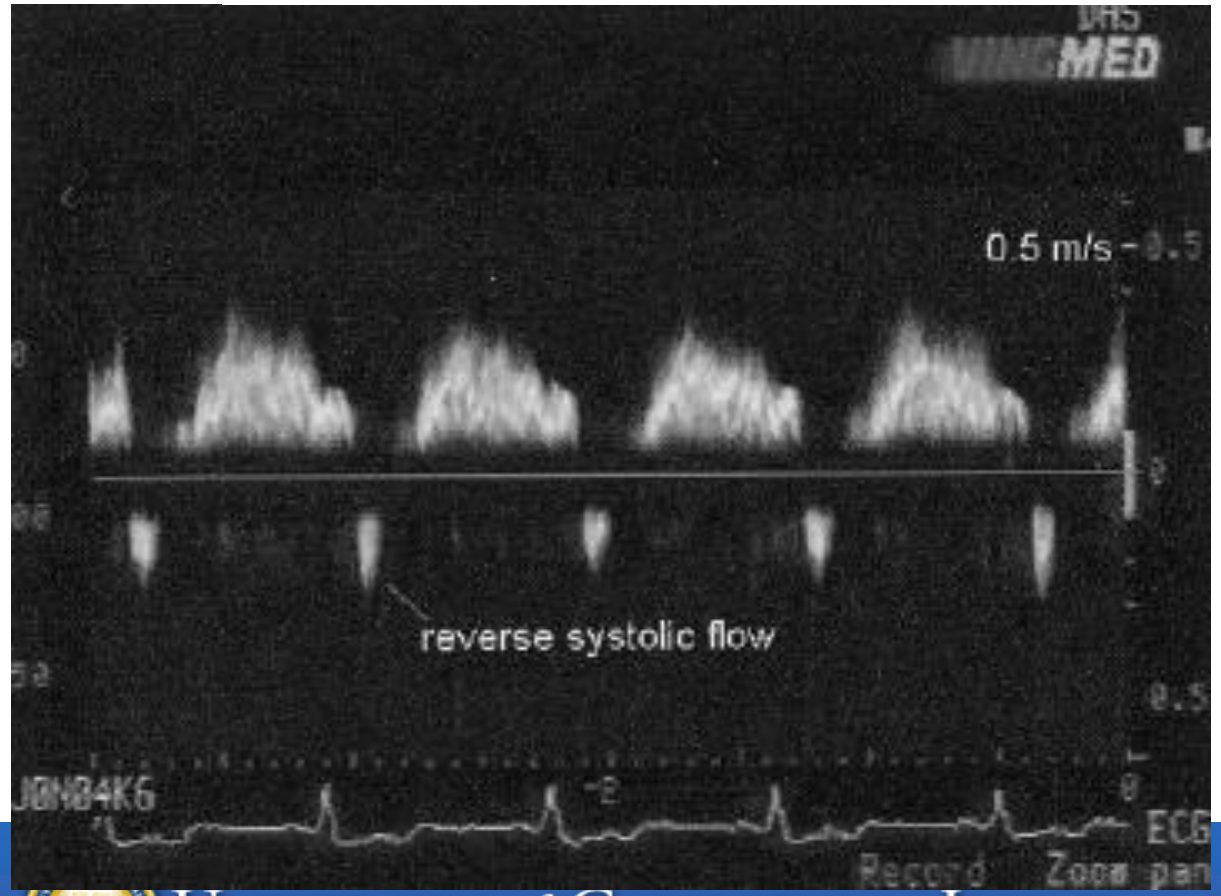
Circulation, Volume XLIX, May 1974

Period 1 = pre, period 2= 2-4h post, period 3= 1 day post

Coronary Flow Reserve Improves After Aortic Valve Replacement for Aortic Stenosis: An Adenosine Transthoracic Echocardiography Study

JACC 2000

David J. R. Hildick-Smith, MA, MRCP, Leonard M. Shapiro, MD, FRCP, FACC
Cambridge, United Kingdom



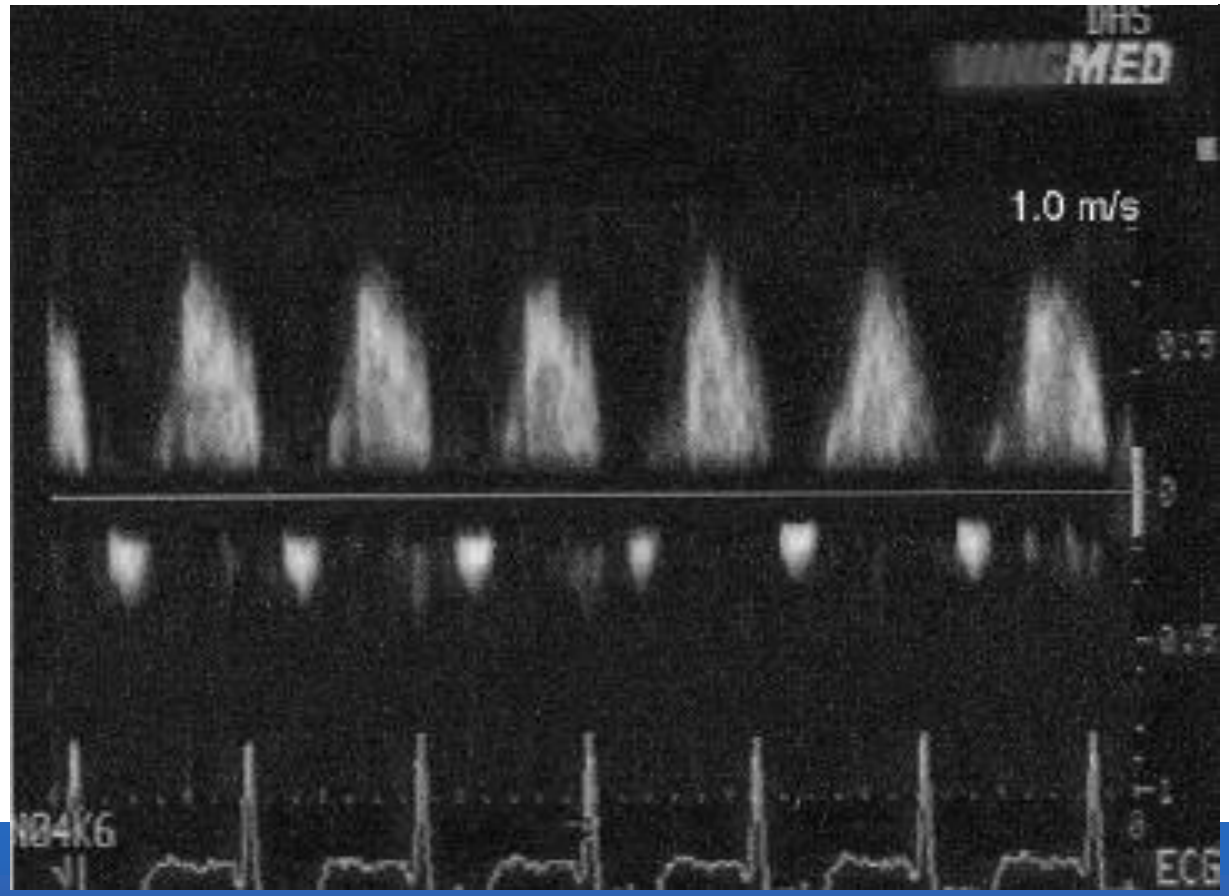
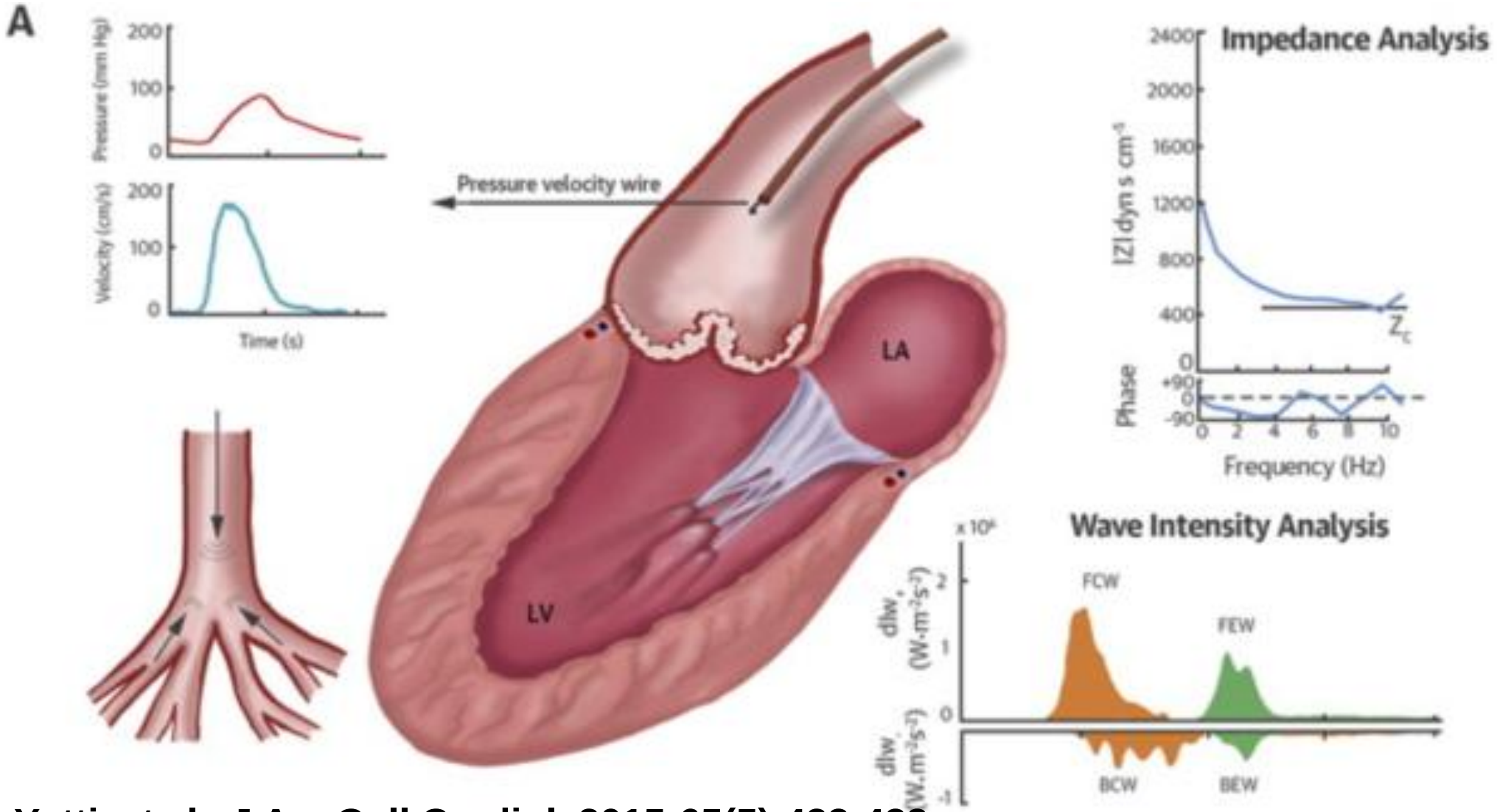


Table 3. Distal Left Anterior Descending Coronary Artery Flow Velocities and Flow Reserve Before and After AVR

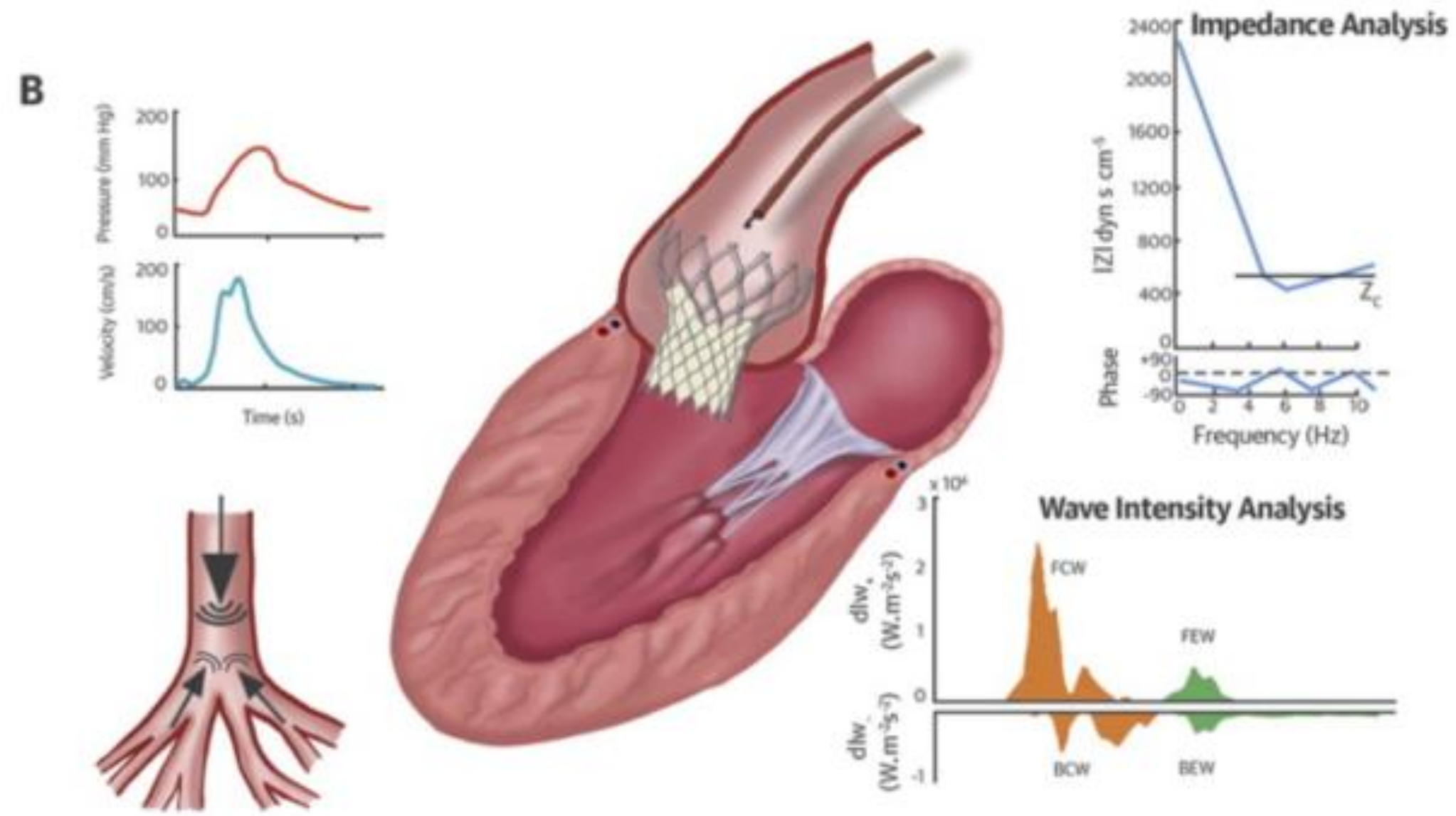
Variable	Resting			Hyperemia		
	Pre-AVR	Post-AVR	p Value	Pre-AVR	Post-AVR	p Value
PSV (m/s)	0.05 (0.11)	0.16 (0.08)	< 0.01	0.02 (0.26)	0.25 (0.21)	< 0.01
PDV (m/s)	0.43 (0.16)	0.41 (0.11)	NS	0.71 (0.26)	1.08 (0.24)	< 0.01
VTI (mm)	15.4 (6.7)	13.4 (3.4)	NS	22.5 (5.2)	30.2 (5.2)	< 0.01
Heart rate (beats/min)	70 (11)	73 (9)	NS	78 (11)	81 (7)	NS
Flow (ml/min)	23.3 (10.1)	20.9 (5.2)	NS	37.8 (11.3)	53.5 (16.1)	< 0.01
Flow (ml/min/100 g LV mass)	8.7 (3.8)	9.0 (2.5)	NS	14.3 (5.0)	23.3 (8.5)	< 0.01
Coronary Flow Reserve				**1.76 (0.5)**	**2.61 (0.7)**	**< 0.01**

Systemic Vascular Load in Calcific Degenerative Aortic Valve Stenosis: Insight From Percutaneous Valve Replacement



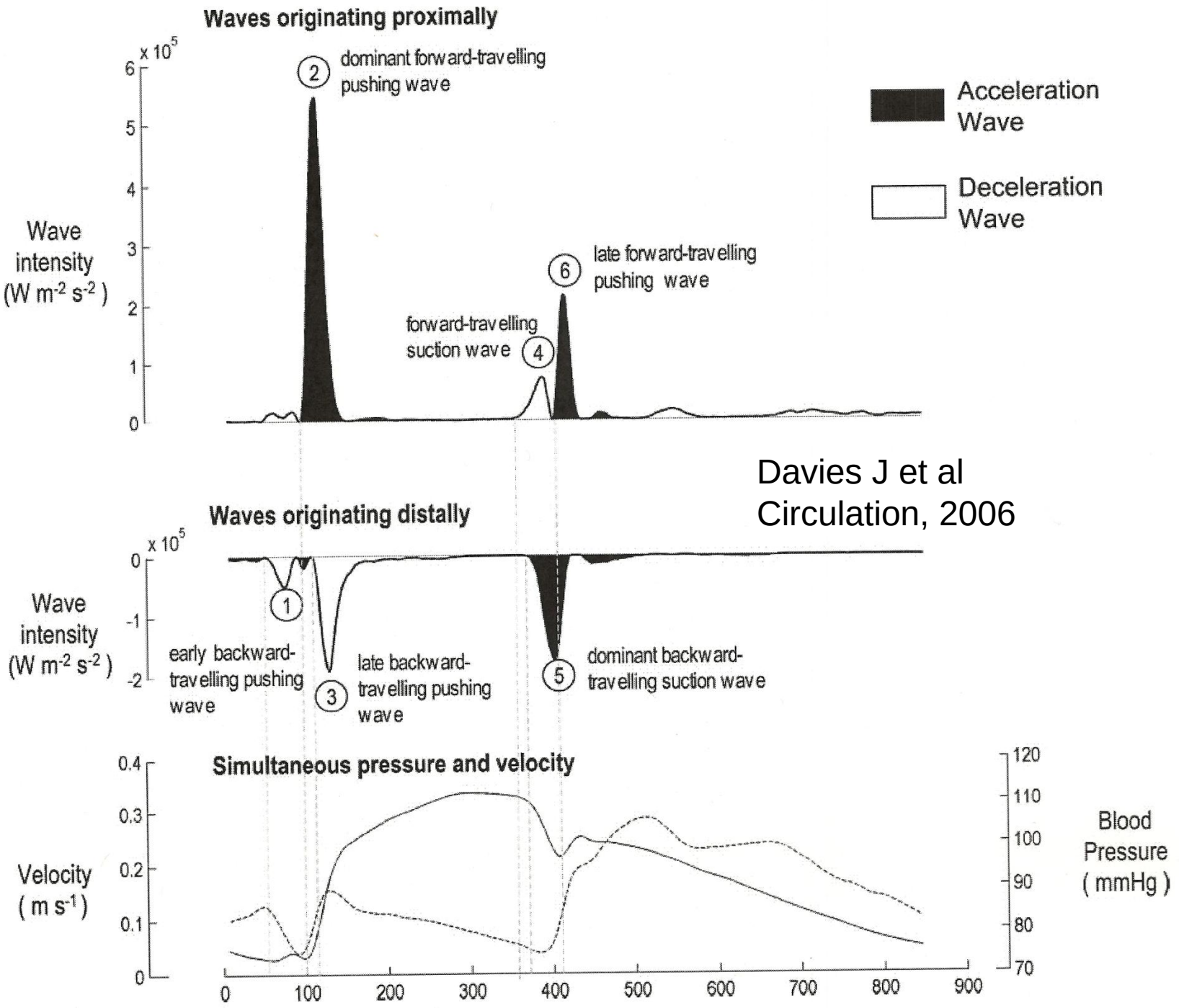
Yotti, et al. J Am Coll Cardiol. 2015;65(5):423-433.

Systemic Vascular Load in Calcific Degenerative Aortic Valve Stenosis: Insight From TAVR

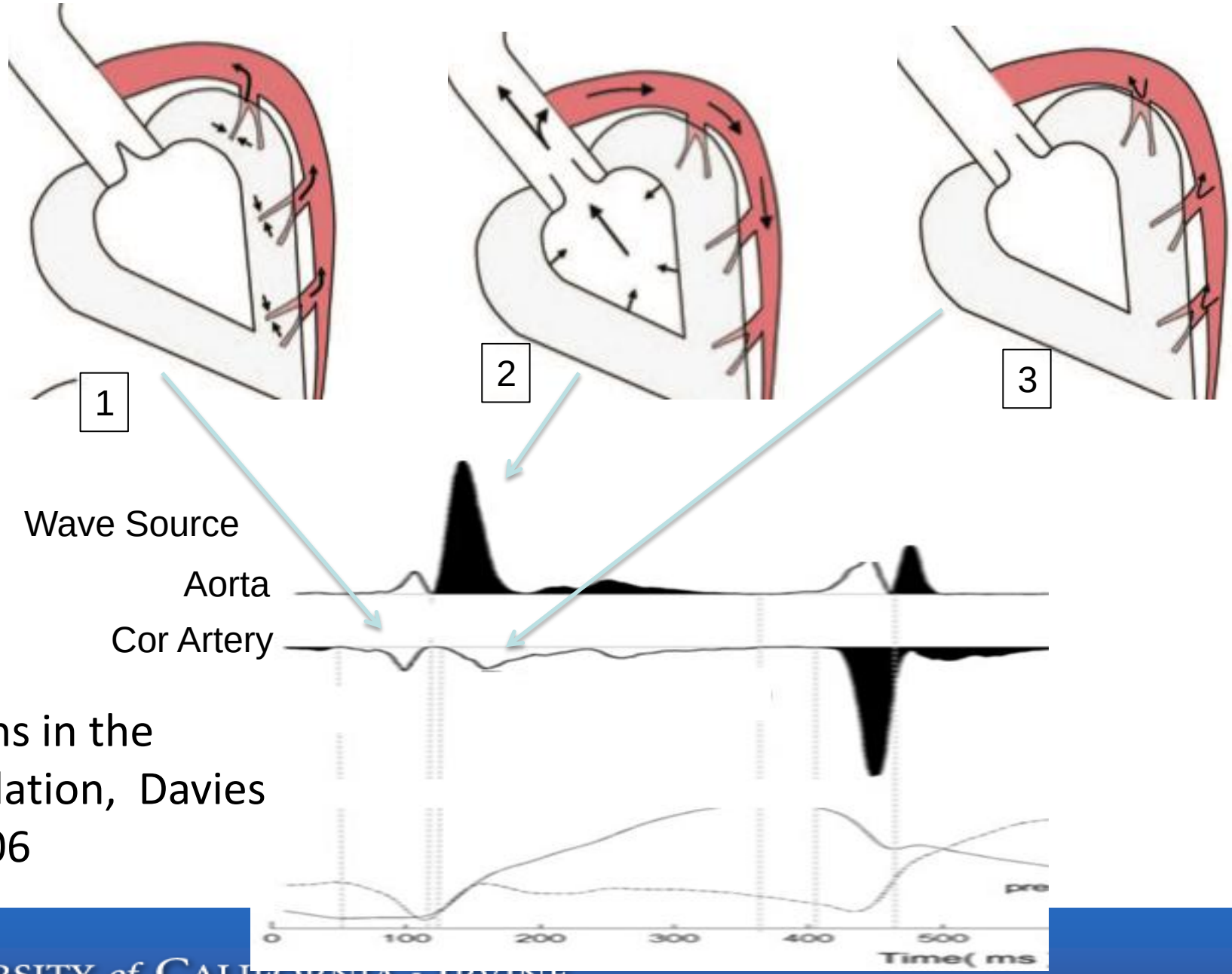


Yotti, et al. J Am Coll Cardiol. 2015;65(5):423-433.

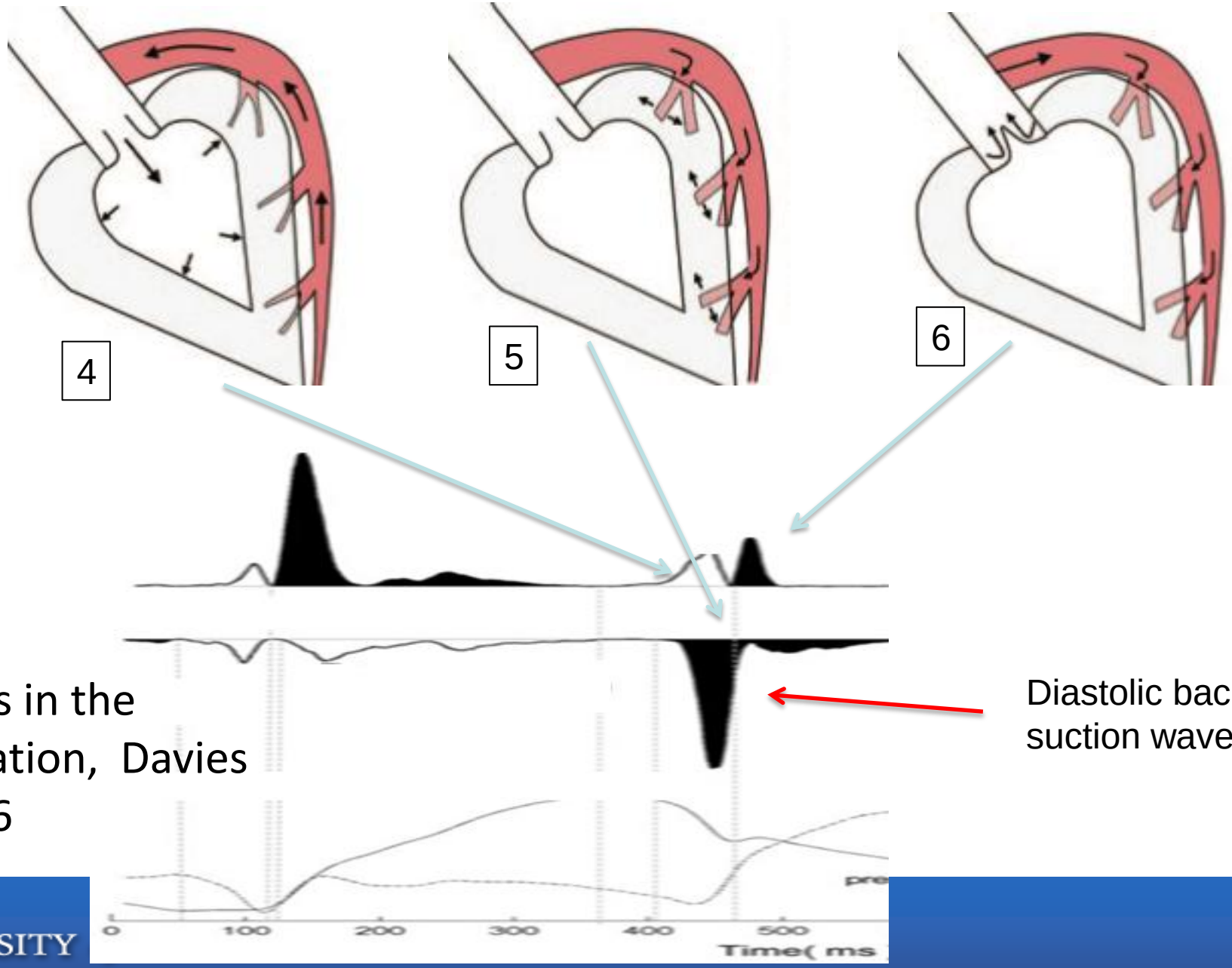
Wave reflections in the coronary circulation, Davies J et al 2006



Davies J et al
Circulation, 2006



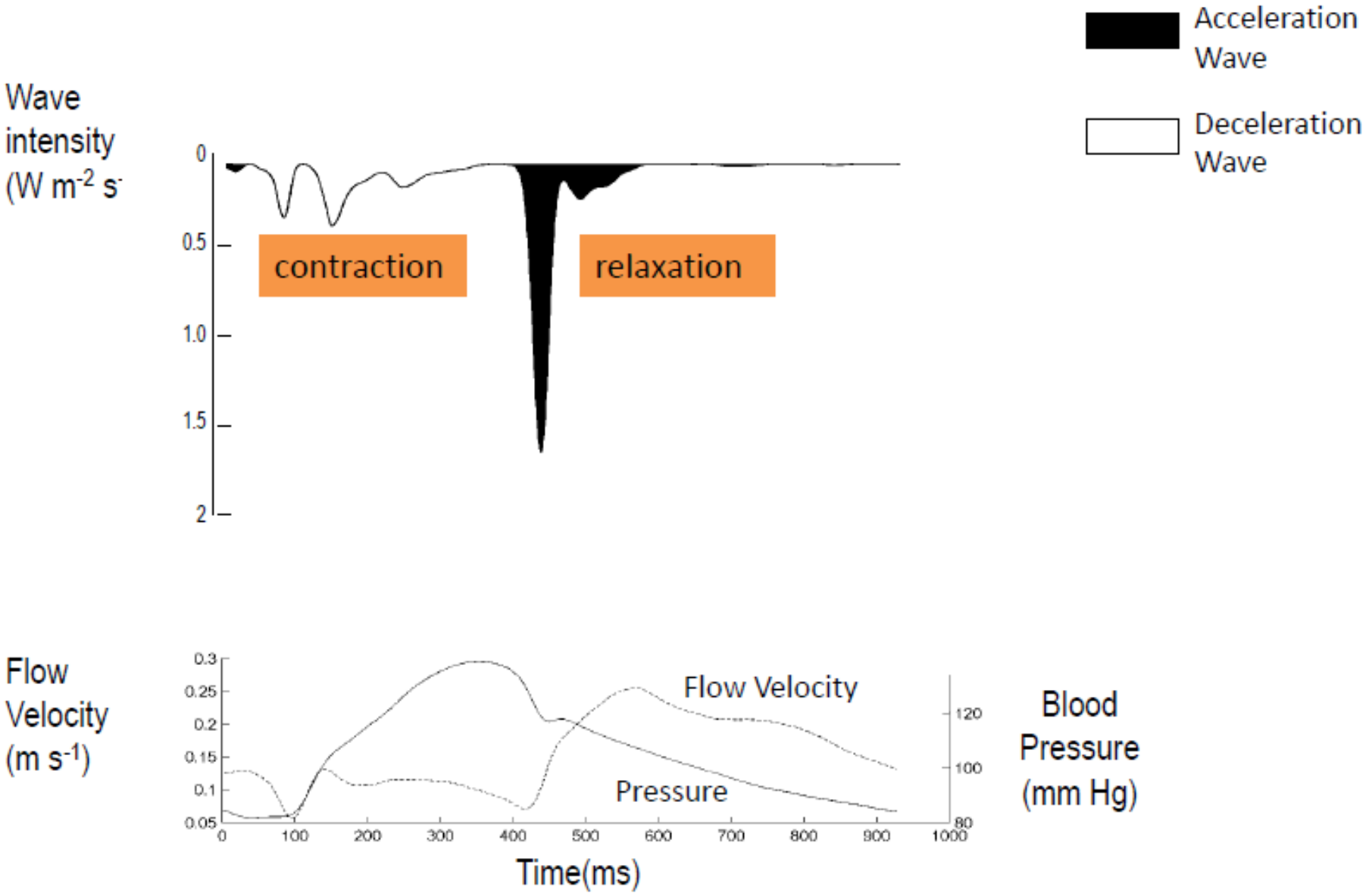
Wave reflections in the Coronary Circulation, Davies J et al, Circ. 2006



Wave reflections in the Coronary Circulation, Davies J et al, Circ. 2006

Diastolic backward suction wave

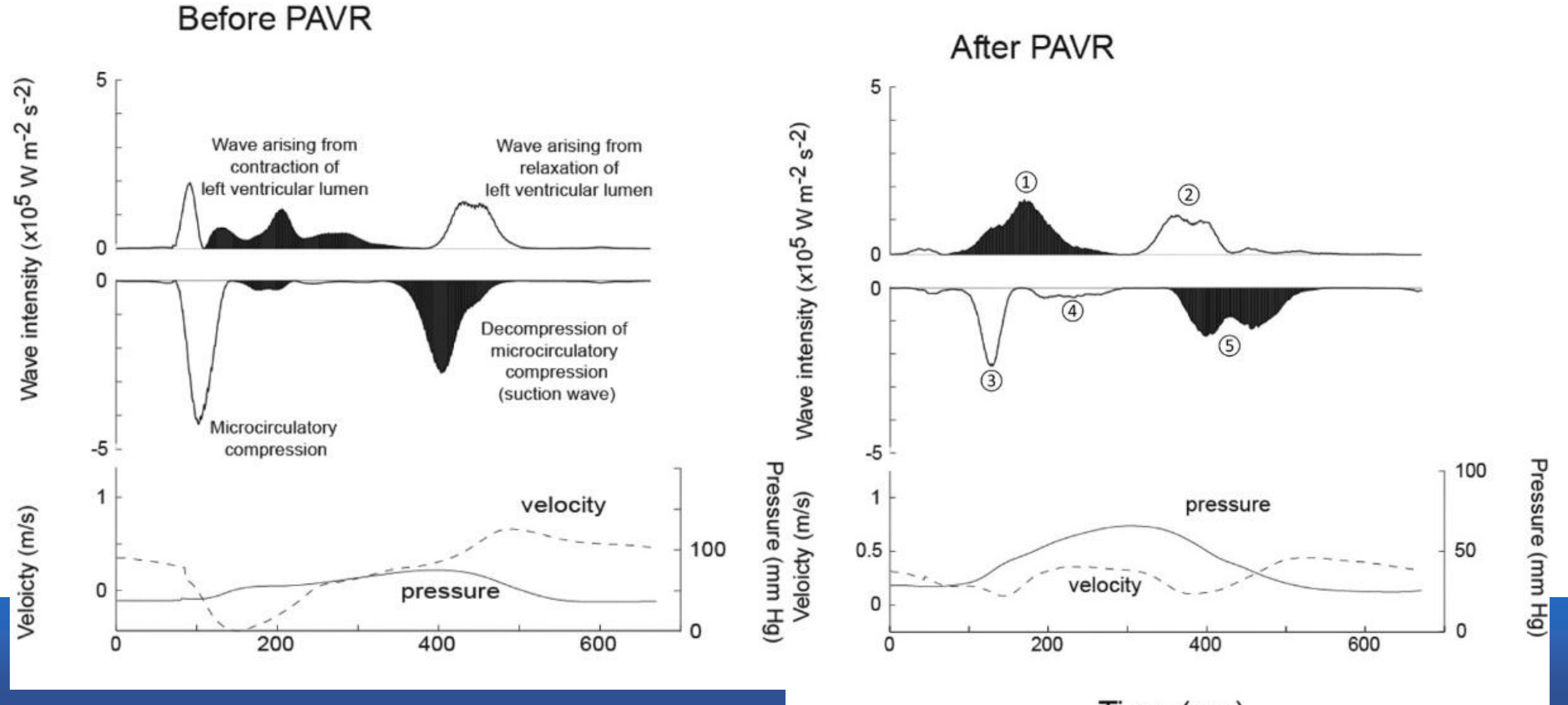
Microcirculatory originating wave intensity



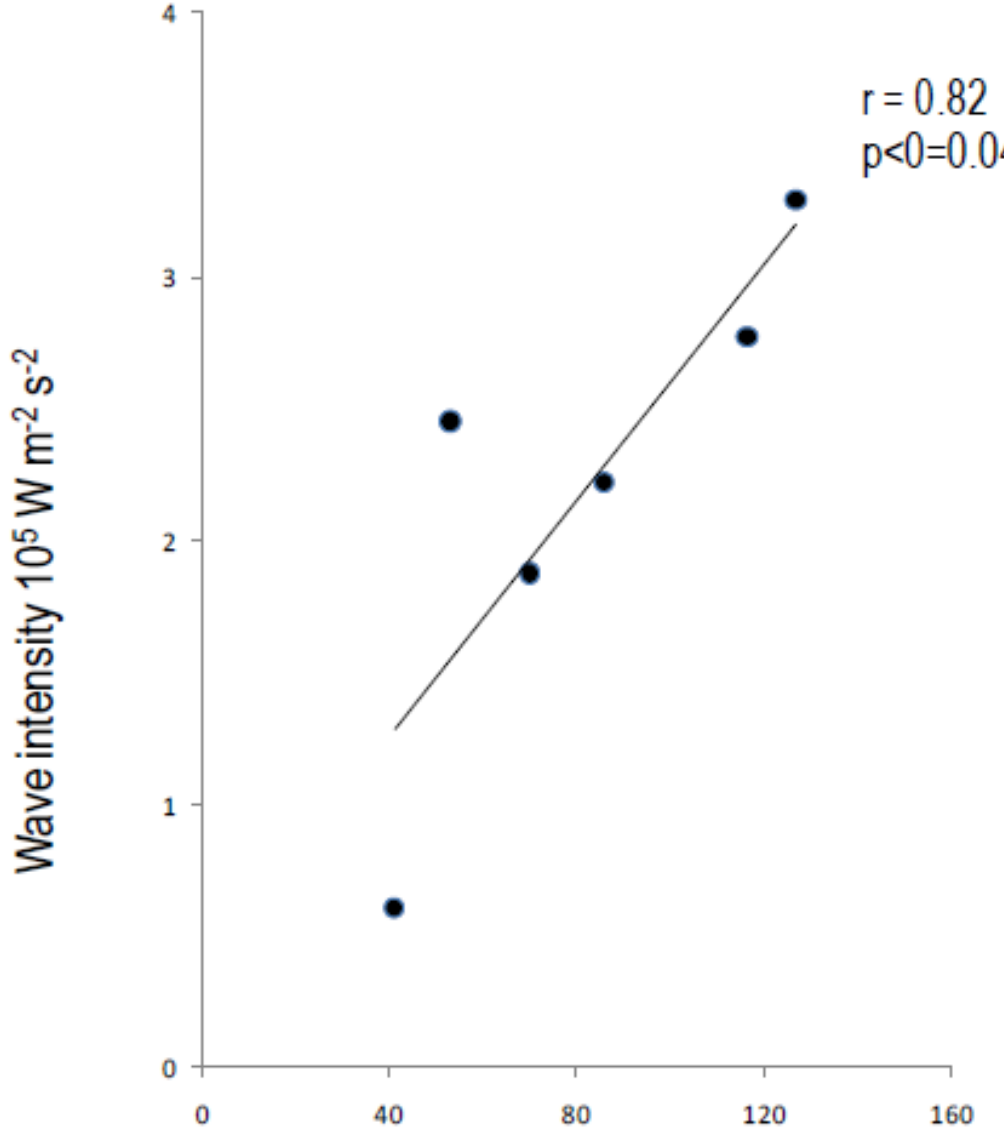
Davies JE, Mayet J *et al.* Circulation 2006;113:1767-1778

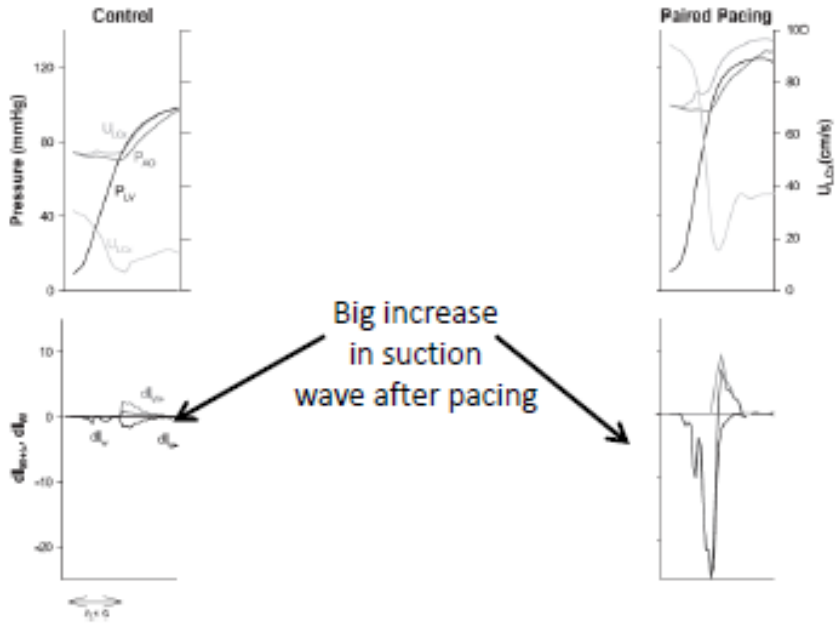
Changes in coronary wave intensity analysis in a subject with severe aortic stenosis before and after TAVR

Justin E. Davies et al. Circulation. 2011;124:1565-1572

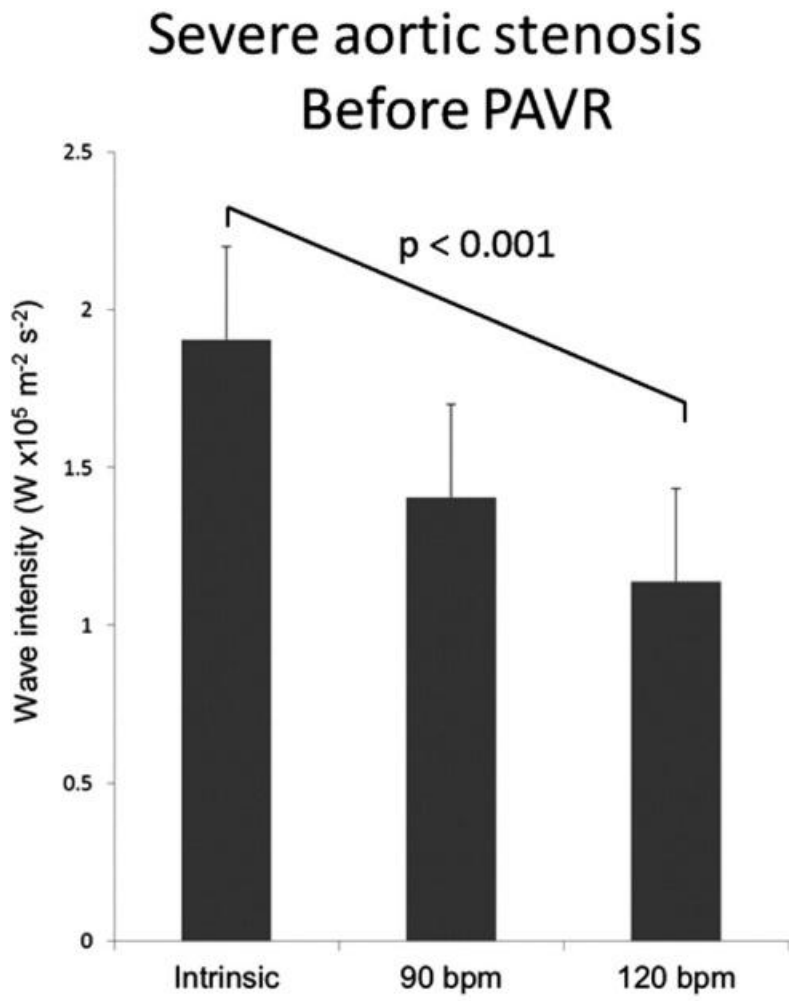


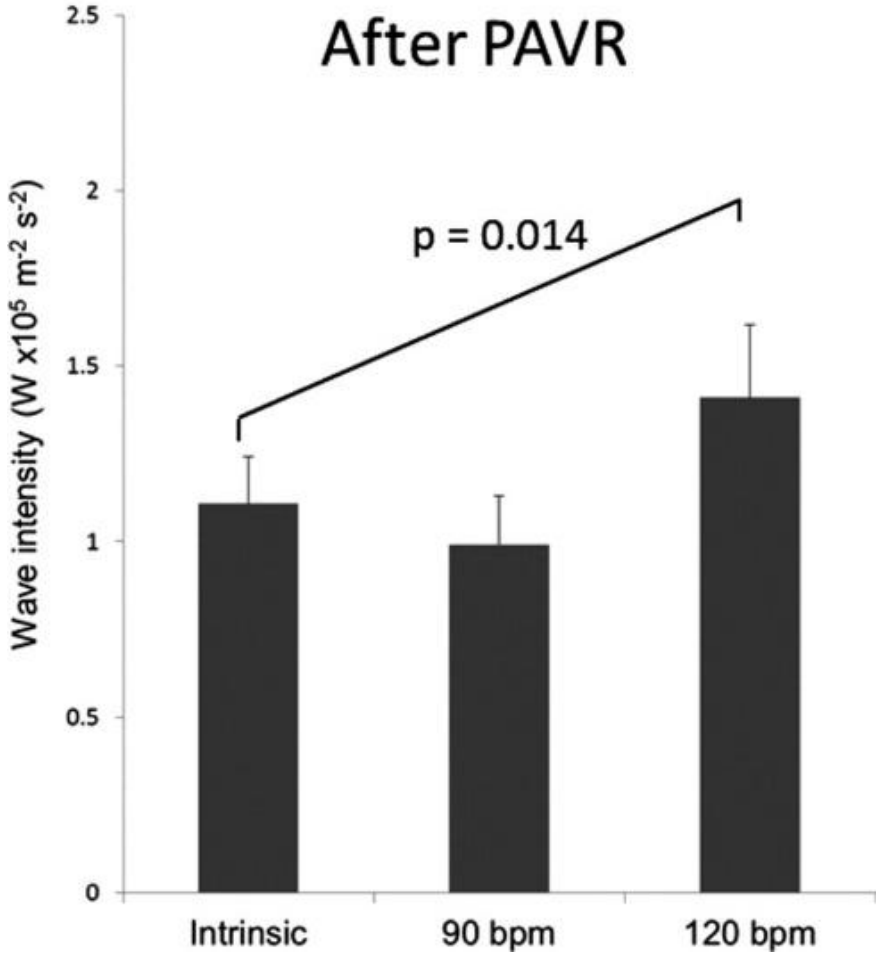
Increase in suction wave with increasing severity of aortic stenosis





Improvement in physiological reserve in subjects with aortic stenosis after percutaneous aortic valve replacement (PAVR).





Justin E. Davies et al. Circulation. 2011;124:1565-1572

Intravenous Adenosine Infusion is Safe and Well Tolerated During Coronary Fractional Flow Reserve Assessment in Severe Aortic Stenosis

Dušan Stanojevic, Prasad Gunasekaran, Micah Levine, Mark Reichuber, Randall Genton, Ashwani Mehta, Matthew Earnest, Mark Wiley, Peter Tadros, Buddhadeb Dawn, Kamal Gupta
Division of Cardiovascular Diseases and the Cardiovascular Research Institute
University of Kansas Medical Center and Hospital, Kansas City, Kansas

ACC 2015

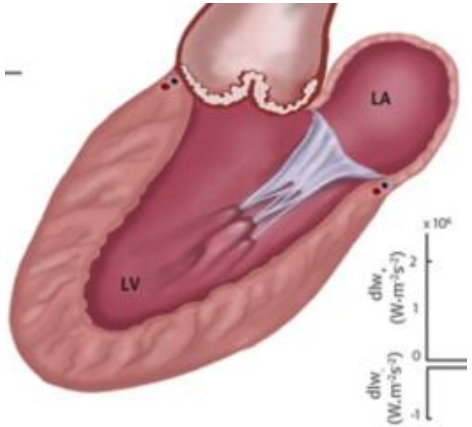
Table 1. Comparison of Hemodynamic Profiles of Patients with Severe Aortic Stenosis Undergoing Adenosine Infusion for FFR Estimation

	Baseline	Lowest during Infusion	p-value
Systolic BP (mm Hg)	158.6±26.6	106.4±26.1	<0.01
Diastolic BP (mm Hg)	79.7±12.9	61±11.4	<0.01
MAP (mm Hg)	105.8±15.6	75.5±12.3	<0.01
HR (bpm)	76.5±22.9	59.1±12.5	<0.01

BP=blood pressure; HR=heart rate; MAP = mean arterial pressure; FFR=fractional flow reserve; p<0.05 was considered statically significant

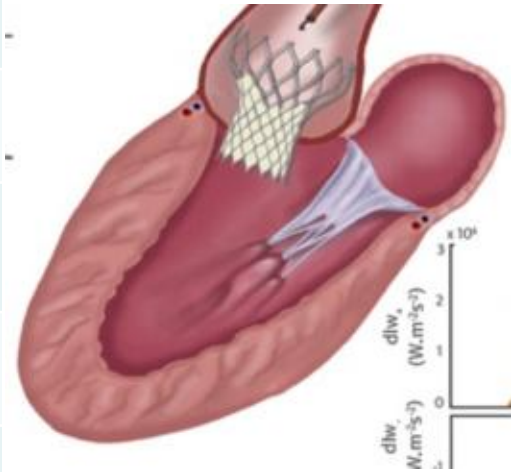
Postulated Physiologic Changes after TAVR for Lesion Assessment

Aortic Stenosis



	Aortic Stenosis	TAVR
CFR	↓	↑
IMR	↑	↓
Dia Suction Wave	↓	↑
LV Relax	↓	↑
FFR	↑	↓

Post TAVR



Coronary Blood flow in Aortic Valve Disease

FFR and hypertrophy, microvascular dysfunction

Coronary Artery Disease in Valvular Heart Disease

Implications and Future considerations for FFR in Vavlular HD