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Noninvasive testing:

still needed?

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Evolution in the concept of ischemia-guided coronary revascularization:

from the early 80's to the present time



Predominant form of revasc: CABG Predominant form of revasc: CABG+PCI Predominant form of revasc: **PCI**



Controversial issues in stable CAD patients

- Which functional technique is better for assessing flowlimiting coronary artery disease? FFR or noninvasive imaging?
- Among noninvasive imaging, which technique is the most accurate? SPECT? CMR? PET? CT? Stress Echo?
- How to implement noninvasive imaging techniques in diagnostic algorithms with FFR?
- Is noninvasive imaging outdated in the era of FFR?



Duality of Coronary morphology and function

Two faces of the same disease



Tonino PA et al. JACC 2010 Fractional flow reserve

Coronary Stenosis *≠* **Myocardial Ischemia**

The functional significance of coronary lesions is determined by many factors



Prognostic role of perfusion imaging (SPECT)





Iskander, JACC 1998; 32: 57-62

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Survival benefit in patients undergoing revascularisation compared to medical treatment based on the presence and magnitude of ischemia



Hachamovitch et al. Circulation. 2003;107:2900

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The role of coronary morphology and function in treatment of stable CAD patients

The COURAGE study and COURAGE Nuclear substudy





Economic consequences of Available Diagnostic Strategies

The Economics of Noninvasive Diagnosis (END) Multicenter study



Zurich

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Table 8Indications for revascularization in stableangina or silent ischaemia





(@[†] Guidelines on myocardial revascularization

The Task Force on Myocardial Revascularization of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)



	Subset of CAD by anatomy	Class ^a	Level ^b	Ref. ^c	
For prognosis	Left main >50%	Т	A	30, 31, 54	
	Any proximal LAD >50%	I	А	30–37	
	2VD or 3VD with impaired LV function	I	В	30–37	
	Proven large area of ischaemia (>10% LV)	I	в	13, 14, 38	D
	Single remaining patent vessel >50% stenosi	I	С		
	IVD without proximal LAD and without >10% ischaemia	ш	A	39, 40, 53	
For symptoms	Any stenosis >50% with limiting angina or angina equivalent, unresponsive to OMT	I	A	30, 31, 39– 4 3	
	Dyspnoea/CHF and >10% LV ischaemia/viability supplied by >50% stenotic artery	lla	В	14, 38	
	No limiting symptoms with OMT	ш	С		

^aClass of recommendation.

^bLevel of evidence.

^cReferences.

With documented ischaemia or FFR < 0.80 for angiographic diameter stenoses 50-90%.

 $\label{eq:CAD} CAD = \mbox{coronary artery disease; CHF} = \mbox{chronic heart failure; FFR} = \mbox{fractional} \\ flow reserve; LAD = \mbox{left anterior descending; LV} = \mbox{left ventricle; OMT} = \mbox{optimal} \\ medical therapy; VD = \mbox{vessel disease.} \end{cases}$

How does FFR compare to noninvasive imaging of perfusion (SPECT)



Concordance between MPI and FFR is quite poor!* In 42% of patients there was concordance between FFR and MPI In 36% of patients MPI underestimated the number of ischemic territories In 22% of patients MPI overestimated the number of ischemic territoris

*Concordance was better if no or only 1 territory were ischemic by FFR





Melikian et al. J Am Coll Cardiol Intv 2010;3:307-14



Validation of FFR

Ref	Ν	Population	Ref method	Threshold
De Bruyne et al. Circ 1985	60	1-VD	Bicycle ECG	0.72*
Pijls et al. Circ 1995	60	1-VD, pre+post PCI	Bicycle ECG	0.74*
Pijls et al. NEJM 1996	45	1-VD, intermediate Stenoses	Bicycle ECG + TI SPECT + Stress Echo†	0.75*
Bartunek et al. JACC 1996	75	1-VD	Stress Echo	0.78*
Chalumeau et al. JACC 2000	127	MVD	MIBI SPECT	0.74**
Abe et al. Circ 2000	46	1-VD	TI SPECT	0.75*
De Bruyne et al. Circ 2001	57	Post MI	MIBI SPECT	0.75 – 0.80*

* 100% specificity; ** Optimal cut-off value, † With reversibility after revasc



Fundamental differences between FFR and functional noninvasive imaging









Conceptual Plot of CFR and FFR regions



Johnson & Gould. JACC Cardiovasc Imaging 2012

Discordant CFR (noninvasive perfusion) and FFR results:

- reflect divergent extremes of focal (epicardial) versus diffuse (macro +microvascular) disease
- Reflect clinically relevant basic coronary pathophysiology, not methodology



Possible algorithm integrating noninvasive imaging and FFR





The role of cardiac imaging in the FFR era

- Ischemia testing is crucial for the appropriate management of stable CAD patients
- Cardiac noninvasive functional imaging is a (cost-)effective gatekeeper of invasive angiography in patients with stable CAD
- Perfusion imaging (ideally with assessment of CFR) and FFR are not competing techniques, but complementary methodologies to assess a varying spectrum of focal epicardial versus diffuse (macro- and microvascular) disease in CAD patients, and to decide on the most appropriate treatment strategy (medical versus revascularization)



Thank You



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