CORONARY PHYSIOLOGY IN THE CATHLAB

Educational Training Program ESC European Heart House, Nice, April 25th – 27th, 2013



Course Directors:

Bernard De Bruyne, MD, PhD, Cardiovascular Center Aalst, Aalst, Belgium William F. Fearon, MD, Stanford University School of Medicine, Stanford, USA Nico H. J. Pijls, MD, PhD, Catharina Hospital, Eindhoven, The Netherlands

Andreas Gruentzig NEJM 1979

The New England Journal of Medicine

Copyright, 1979, by the Massachusetts Medical Society

Volume 301

JULY 12, 1979

Number 2

NONOPERATIVE DILATATION OF CORONARY-ARTERY STENOSIS

Percutaneous Transluminal Coronary Angioplasty

ANDREAS R. GRÜNTZIG, M.D., ÅKE SENNING, M.D., AND WALTER E. SIEGENTHALER, M.D.

a BEFLATION OF BALLOON DILATATION OF ADVANCING CATHETER CM REJECTION AND PULL BACK PRESSURE STENDSIS THROUGH STENDSIS PROXIMAL DISTAL TO PROXIMAL TO ranitia STENOSIS STEMOSIS 200_ 100

Even in the beginning Andreas Gruentzig strongly believed in the value of coronary pressure measurements, but investigators in those days were handicapped in 3 ways.....

- no reliable device to measure coronary pressure (only 3 F catheters instead of 0.014" pressure wires, resulting in gross overestimation of gradients)
- importance of *maximum hyperemia* was not yet recognized (baseline values are not very helpful for decision making)
- interpretation of gradients difficult and inconsistent,
 FFR was not available yet
 (Pa = 100, Pd = 70 mmHg → FFR = 0.70 Pa = 70, Pd = 40 mmHg → FFR = 0.57)

last 15 cm of 0.015 hollow guidewire

2.8F infusion catheter

.....

 glued together at the kitchen table and sterilized by ethylene oxide

Early 1990s: Development of FFR

Effect on the Pressure Gradient by the Presence of the Pressure Measuring Wire in the Stenosis



The presence of a 0.014" pressure monitoring guide wire in the stenosis does not create any clinically significant additional resistance.

B. De Bruyne, et al. J Am Coll Cardiol 1993.





Experimental basis of determining maximum coronary, myocardial, and collateral blood flow by pressure measurements for assessing functional stenosis severity before and after percutaneous transluminal coronary angioplasty. N H Pijls, J A van Son, R L Kirkeeide, B De Bruyne and K L Gould

Circulation. 1993;87:1354-1367

that same artery in the absence of that stenosis. Consequently, we express coronary flow reserve for a stenotic artery as a fraction of its normal expected value in that same artery in the absence of a stenosis. <u>We</u> therefore use the term "fractional flow reserve" (FFR).

$$\text{FFR}_{myo} = \frac{Q}{Q^N} = \frac{P_d - P_v}{P_a - P_v}$$



OPENING EUROPEAN HEART HOUSE, JANUARY 1994 First educational & training programm: *coronary physiology* (course directors: Patrick Serruys and Carlo di Mario)

1994 RADI

First pressure "wire

Concept of FFR

ST0189.11



1994 – 1997 validation studies of FFR

996

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

MEASUREMENT OF FRACTIONAL FLOW RESERVE TO ASSESS THE FUNCTIONAL SEVERITY OF CORONARY-ARTERY STENOSES

NICO H.J. PIJLS, M.D., PH.D., BERNARD DE BRUYNE, M.D., KATHINKA PEELS, M.D., PEPIJN H. VAN DER VOORT, M.D., HANS J.R.M. BONNIER, M.D., PH.D., JOZEF BARTUNEK, M.D., AND JACQUES J. KOOLEN, M.D., PH.D.

Abstract Background. The clinical significance of coronary-artery stenoses of moderate severity can be difficult to determine. Myocardial fractional flow reserve (FFR) is a new index of the functional severity of coronary stenoses that is calculated from pressure measurements made during coronary arteriography. We compared this index with the results of noninvasive tests commonly used to detect myocardial ischemia, to determine the usefulness of the index.

Methods. In 45 consecutive patients with moderate coronary stenosis and chest pain of uncertain origin, we performed bicycle exercise testing, thallium scintigraphy, stress echocardiography with dobutamine, and quantitative coronary arteriography and compared the results with measurements of FFR.

Results. In all 21 patients with an FFR of less than 0.75, reversible myocardial ischemia was demonstrated

unequivocally on at least one noninvasive test. After coronary angioplasty or bypass surgery was performed, all the positive test results reverted to normal. In contrast, 21 of the 24 patients with an FFR of 0.75 or higher tested negative for reversible myocardial ischemia on all the noninvasive tests. No revascularization procedures were performed in these patients, and none were required during 14 months of follow-up. The sensitivity of FFR in the identification of reversible ischemia was 88 percent, the specificity 100 percent, the positive predictive value 100 percent, the negative predictive value 88 percent, and the accuracy 93 percent.

Conclusions. In patients with coronary stenosis of moderate severity, FFR appears to be a useful index of the functional severity of the stenoses and the need for coronary revascularization. (N Engl J Med 1996;334:1703-8.) ©1996, Massachusetts Medical Society.



1997-2000 : clinical trials on FFR

How to apply coronary physiology in the catherization laboratory

PRIL 6-5, 200

How to apply coronary

physiology in the

(aboratory

Education and Training Program 2000

Nice **European Heart House**

april 6 - 8, 2000

HOW TO APPLY CORONARY PHYSIOLOGY IN THE CATHERIZATION LABORATORY, ETP NICE , April 6-8, 2000



Coronary Pressure

Second Edition

by Nico H.J. PIJLS and Bernard DE BRUYNE



Kluwer Academic Publishers, 2000

ISBN 0-7923-6170-9



RADI / SJM Pressure Wire0.014 sensor-tippedVolcano WirePTCA guidewires







absolute coronary blood flow



Qb= 25 x (-7.1 / -0.97) x 1.08 = 198 ml/min





Coronary Physiology in the Catheterization Laboratory

07 Apr 2011 - 09 Apr 2011, Sophia Antipolis - France

ESC Educational Courses



FAME

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812

JANUARY 15, 2009

VOL.360 NO.3

Fractional Flow Reserve versus Angiography for Guiding Percutaneous Coronary Intervention

Pim A.L. Tonino, M.D., Bernard De Bruyne, M.D., Ph.D., Nico H.J. Pijls, M.D., Ph.D., Uwe Siebert, M.D., M.P.H., Sc.D., Fumiaki Ikeno, M.D., Marcel van 't Veer, M.Sc., Volker Klauss, M.D., Ph.D., Ganesh Manoharan, M.D., Thomas Engstrøm, M.D., Ph.D., Keith G. Oldroyd, M.D., Peter N. Ver Lee, M.D., Philip A. MacCarthy, M.D., Ph.D., and William F. Fearon, M.D., for the FAME Study Investigators*

FAME 2

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Fractional Flow Reserve–Guided PCI versus Medical Therapy in Stable Coronary Disease

Bernard De Bruyne, M.D., Ph.D., Nico H.J. Pijls, M.D., Ph.D.,
Bindu Kalesan, M.P.H., Emanuele Barbato, M.D., Ph.D.,
Pim A.L. Tonino, M.D., Ph.D., Zsolt Piroth, M.D., Nikola Jagic, M.D.,
Sven Mobius-Winckler, M.D., Gilles Rioufol, M.D., Ph.D., Nils Witt, M.D., Ph.D.,
Petr Kala, M.D., Philip MacCarthy, M.D., Thomas Engström, M.D.,
Keith G. Oldroyd, M.D., Kreton Mavromatis, M.D., Ganesh Manoharan, M.D.,
Peter Verlee, M.D., Ole Frobert, M.D., Nick Curzen, B.M., Ph.D.,
Jane B. Johnson, R.N., B.S.N., Peter Jüni, M.D., and William F. Fearon, M.D.,
for the FAME 2 Trial Investigators*

Available on-line on Aug 28, 2012 on www.nejm.org

How has FFR Evolved?

<u>1990s</u>

A tool occasionally (rarely) used for deferring PCI on an intermediate lesion...

2013 and Beyond...

An indispensable component of PCI validated and utilized in a multitude of complex situations...

How has FFR Evolved?

Number of PubMed papers each year with "fractional flow reserve" in the title or abstract



A few announcements & rules of this meeting:

- Stupid questions do not exist
- Be as open and frank as you can, take part in the discussion
- Approach the speakers whenever you like and ask everything you ever wanted to ask about coronary physiology



OLCANO

PRECISION GUIDED THERAPY

With special thanks to:

ESC and Emmanuelle Bourg Josefa Cano Eva Tegner

And to St Jude Medical and Volcano Corp

