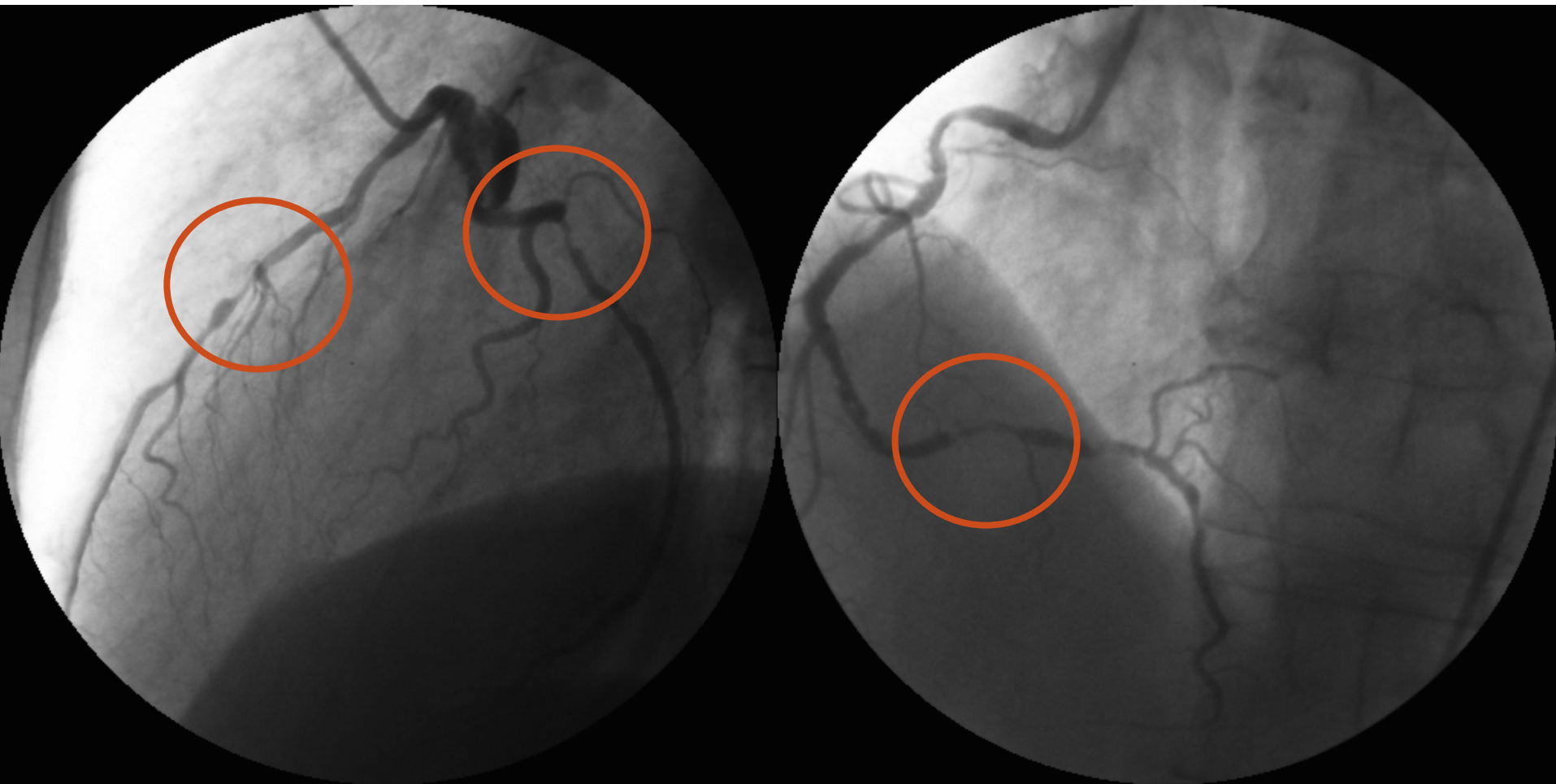


Definition of multivessel disease



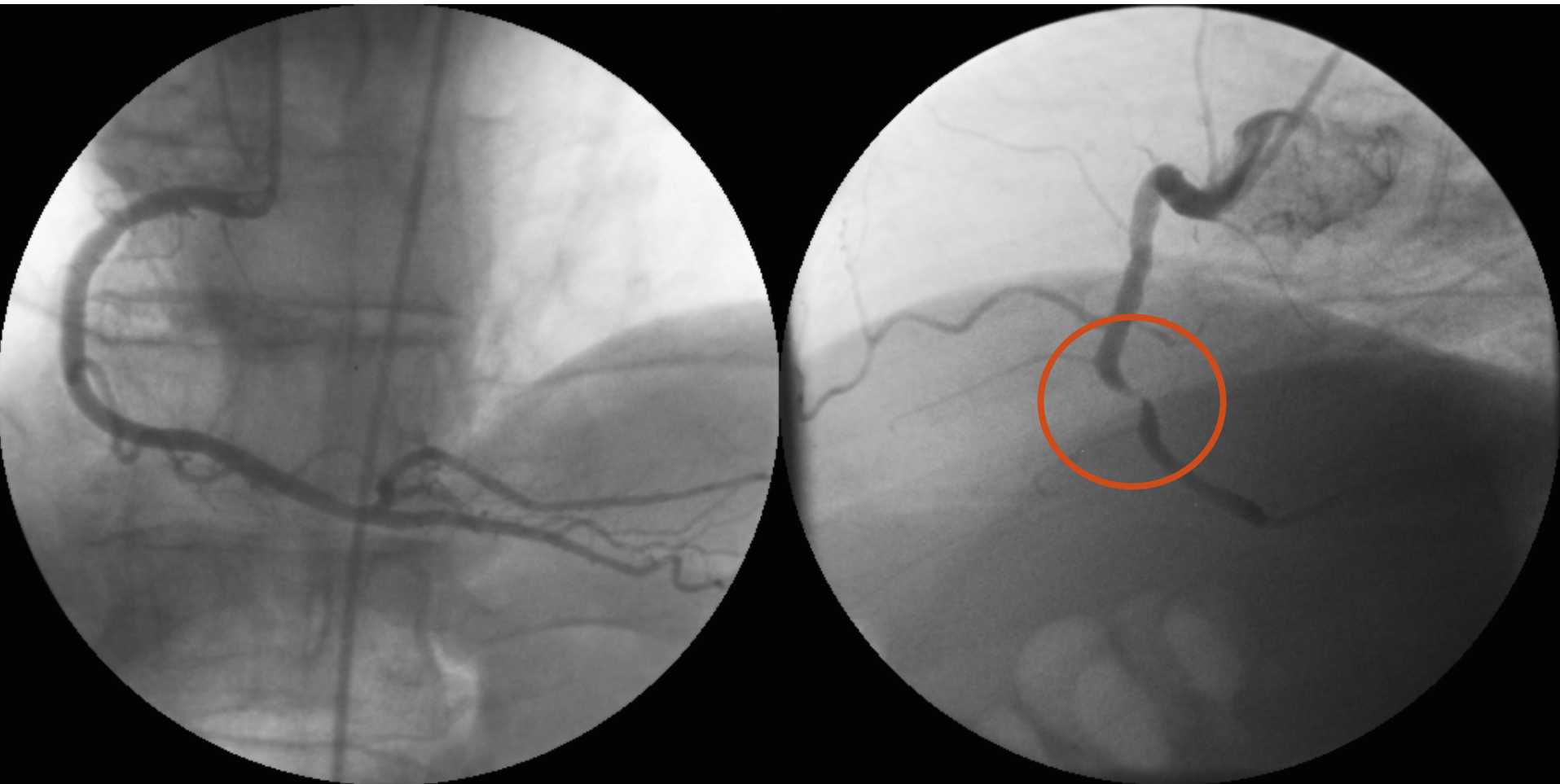
Eric Eeckhout
Centre Hospitalier Universitaire Vaudois
Lausanne - Switzerland

The spirit of the invasive cardiologist



It's all in the lumen

The spirit of the invasive cardiologist

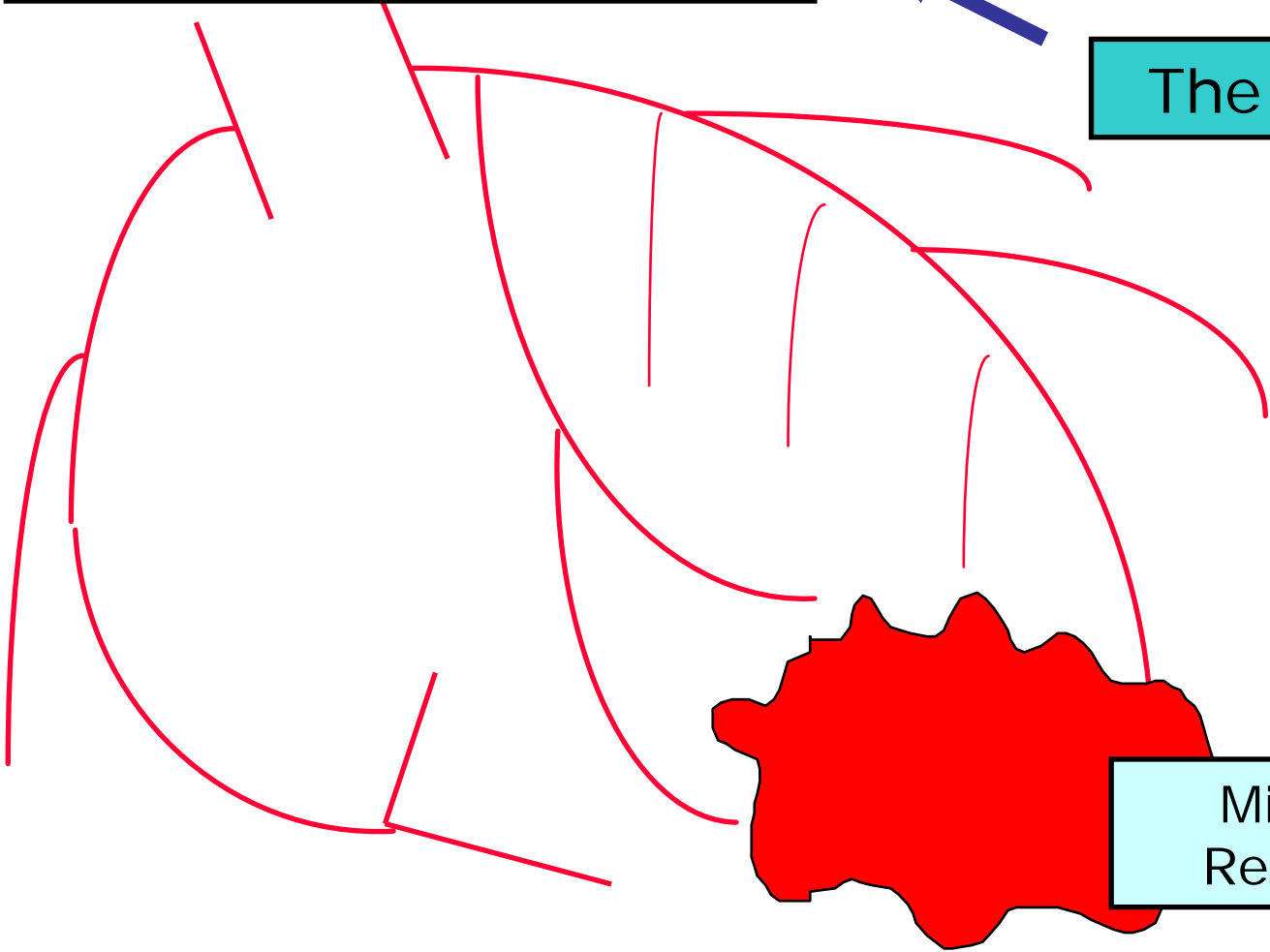


It's all in the lumen

Basics of coronary circulation

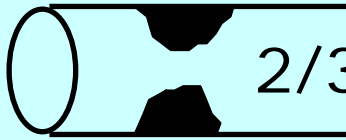

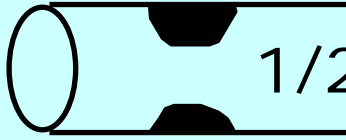



Epicardial arteries =
Conductance vessels

The epicardial box



Microcirculation :
Resistance vessels

Basics of coronary circulation

Diameter	Surface
 $2/3 = 67\%$	 90%
 $1/2 = 50\%$	 75%
 $1/3 = 33\%$	 50%
Diameter stenosis	Area stenosis

Looking at CAD in 2006

- Precise high-quality imaging by angiography.
- Extensive knowledge of « classical » CAD.
- Excellent additional or alternative tools for evaluation.
- Ability to judge the hemodynamic consequences of CAD.

Overview

- Introduction to the other speakers.
- Basics... back to the future.
- History of angiography.
- Defining the definition of multivessel disease.
- Discuss its clinical implications & limitations.

PROCEEDINGS
of the
32nd SCIENTIFIC SESSIONS

CONVENTION HALL, PHILADELPHIA, PA.
OCTOBER 23-25, 1959

Cine-Coronary Arteriography

*F. Mason Sones, Jr., Earl K. Shirey, William
L. Proudfit, and Richard N. Westcott, Cleveland,
Ohio*

A safe and dependable method has been devised for contrast visualization of the coronary arteries to objectively demonstrate atherosclerotic lesions.

The ascending aorta is catheterized by an approach from the right brachial artery, in the antecubital fossa. Selective opacification of the right and left coronary arteries is performed serially by injecting 20 to 30 ml. of 90 per cent Hypaque into the right and left sinuses of Valsalva adjacent to the orifices of the vessels during x-ray motion picture photography of the area of distribution of each vessel. Adequate opacification has been obtained without resorting to mechanical aortic occlusion or cardiac arrest with acetylcholine.

In more than 50 patients studied by this technique, a broad spectrum of problems has been encountered, ranging from iatrogenic disease to multiple total occlusions in those with remote and recent myocardial infarction. Selective coronary artery opacification has not produced angina, ventricular arrhythmias, or myocardial injury, even in patients experiencing angina at rest.

The method has demonstrated: 1. The presence of normal coronary arteries in patients with chest pain or electrocardiographic changes which had been interpreted as indicating the presence of arteriosclerotic heart disease. 2. Complete or partial segmental occlusion of 1 or more major arteries. 3. The presence of collateral arterial channels from 1 major artery to the area of distribution of another totally occluded segment.

PROCEEDINGS
of the
32nd SCIENTIFIC SESSIONS

CONVENTION HALL, PHILADELPHIA, PA.
OCTOBER 23-25, 1959

The ultimate usefulness of the method remains to be defined, but it should provide a more objective diagnostic standard than has previously been available for the evaluation of therapeutic measures which have been or may be applied in the treatment of arteriosclerotic heart disease.

**Distribution of Arterial Lesions Demonstrated by Selective
Cinecoronary Arteriography**

WILLIAM L. PROUDFIT, EARL K. SHIREY and F. MASON SONES, JR.
Circulation 1967;36:54-62

**Distribution of Arterial Lesions Demonstrated
by Selective Cinecoronary Arteriography**

By WILLIAM L. PROUDFIT, M.D., EARL K. SHIREY, M.D.,
AND F. MASON SONES, JR., M.D.

SUMMARY

The distribution of obstructions exceeding 30% of the normal diameter of the lumen of one or more major coronary arteries was studied in 627 of 1,000 patients who had selective cinecoronary arteriograms. An additional 99 patients had lesser degrees of narrowing, and in the arteriograms of 274 patients, normal arteries were demonstrated. An average of 2.0 lesions resulting in at least 50% luminal narrowing of major arteries was found per patient. The anterior descending coronary artery was involved slightly more frequently than were other vessels. More than 75% of the symptomatic patients had 90% or more obstruction of at least one vessel, and more than 50% had total occlusions of one or more vessels. A single major artery was the site of obstruction exceeding 30% of the luminal diameter in 131 patients (20.9% of the 627 patients), and in 43 of these (6.9%) the other arteries appeared to be entirely normal. Severe involvement of single arteries was most frequent in patients who had myocardial infarction without angina pectoris or in those who had rest pain only. No pattern of arterial involvement was pathognomonic of a clinical syndrome.

1959 – 1962

Initial experience
with coronary angiography

1967

Correlation established in vivo between
obstructive
CAD and angina pectoris

1968

Initial application of revascularization
by bypass surgery

1975

Methodological basis for
the first CABG RCT's & registries

CASS definitions of CAD*

- Graded from 0 to 3.
- Based on visual assessment.
- Threshold of 70% for epicardial artery of secondary branch.
- Threshold of 50% for the left main stem.
- Pending on the dominance of the circulation.

*Circulation, 1981.

CASS definitions of CAD

- Right, balanced or unknown dominance :
 - 1 vessel : >70% stenosis of epicardial vessel.
 - 2 vessel : >70% stenosis of 2 epicardial vessels.
>50% stenosis of the left main.
 - 3 vessel : >70% stenosis of 3 epicardial vessels.
Any of the above leading to 3.

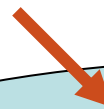
CASS definitions of CAD

- Left dominance :

- 1 vessel :
 - >70% stenosis of the LAD or RCA.
 - >70% lesion of any secondary branch.
- 2 vessel :
 - >70% stenosis of the Lcx.
 - Any of the above leading to 2.
- 3 vessel :
 - >50% stenosis of the left main.
 - Any of the above leading to 3.

1975

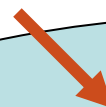
Methodological basis for
the first CABG RCT's & registries

**1975-1981**

Definition of multivessel disease

**1982-1984**

Publication of RCT & registries
disclosed the clinical impact
of the extent of CAD

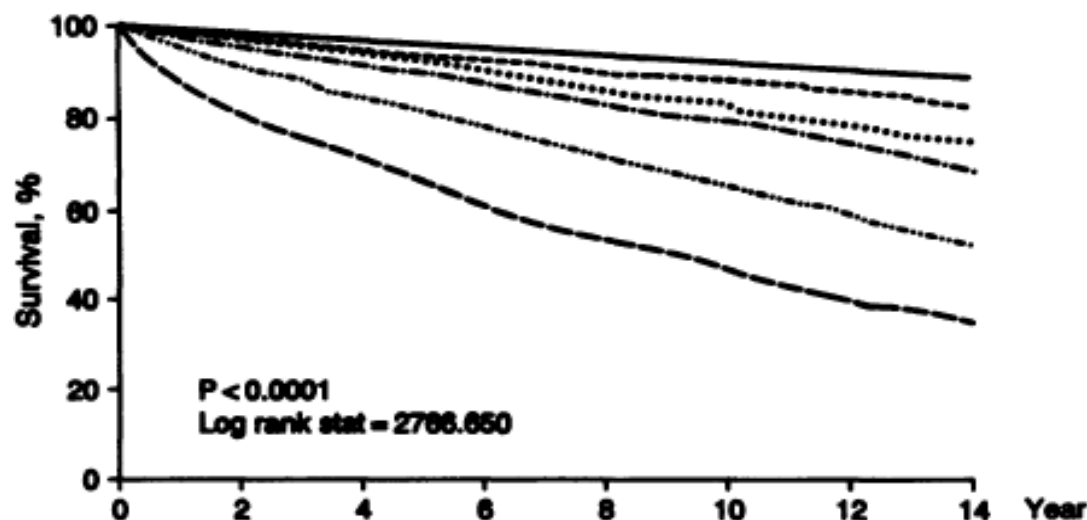
**1982-1994**

*Precise idea about the
natural history of CAD

Natural history of CAD

Adjusted 12 year survival :

Normal :	91%.
Mild disease :	86%.
Moderate :	79%.
1 vessel :	74%.
2 vessel :	59%.
3 vessel :	40%.



Visual CAD as a prognostic marker.

Qualitative angiographic assessment

- Daily practice on a world wide level.
- **Single dimensional reading.**
- Errors in reading diagnostic images :
 - Over estimation of severe lesions.
 - Under estimation of mild lesions.
- Errors after PCI :
 - Over estimation of the result.
- Important intra & inter-observer variability.
 - Cath lab program.
 - Time of the day.
 - Occupation.
- Vessels at risk : left main, mid LAD, distal RCA.
- **Of no value for the intermediate lesion.**

Qualitative angiographic assessment

- Solutions to improve accuracy ?

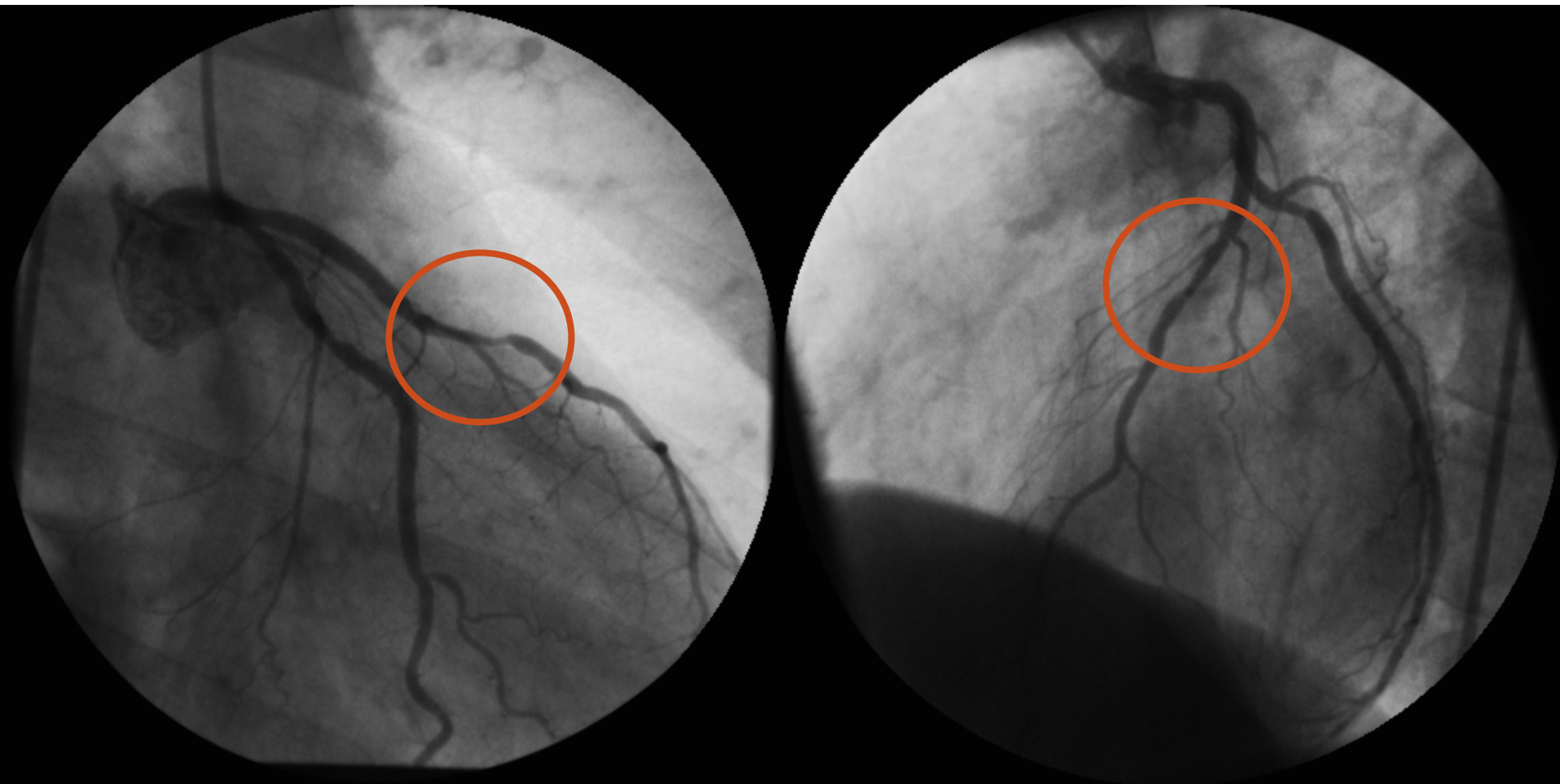
Use nitrates !

Projections with a meaning.

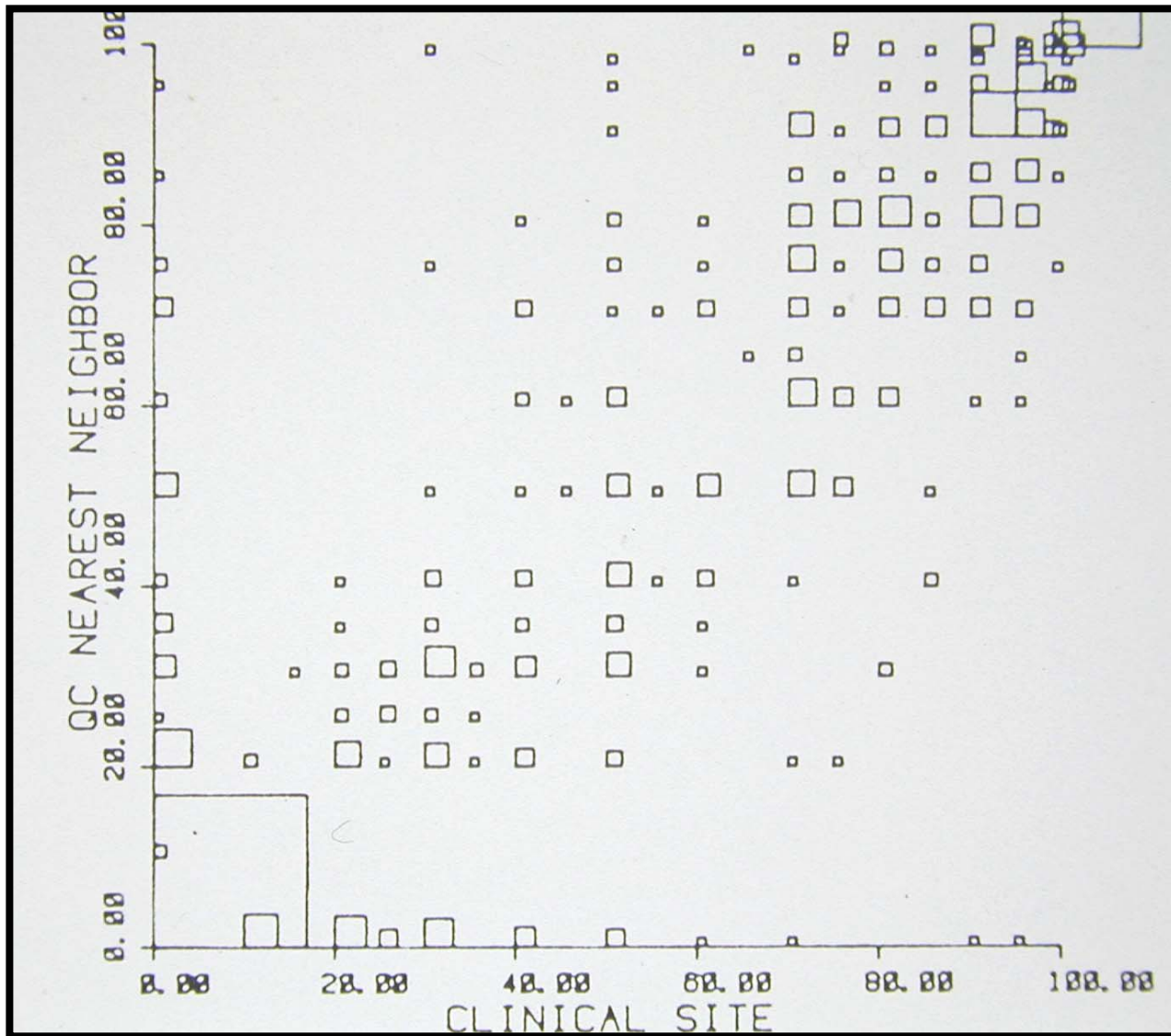
Consensus rather than expert opinion.

Operator volume rather than long-term
experience.

Qualitative angiographic assessment



Qualitative angiographic assessment



Fischer et al., Cathet Cardiovasc Diagn 1982

Qualitative angiographic assessment

- **Practical consequences :**

- Overuse – inappropriate PCI or CABG.

In randomized PCI & CABG trials (and of all times).

No proof of concept of plaque sealing.

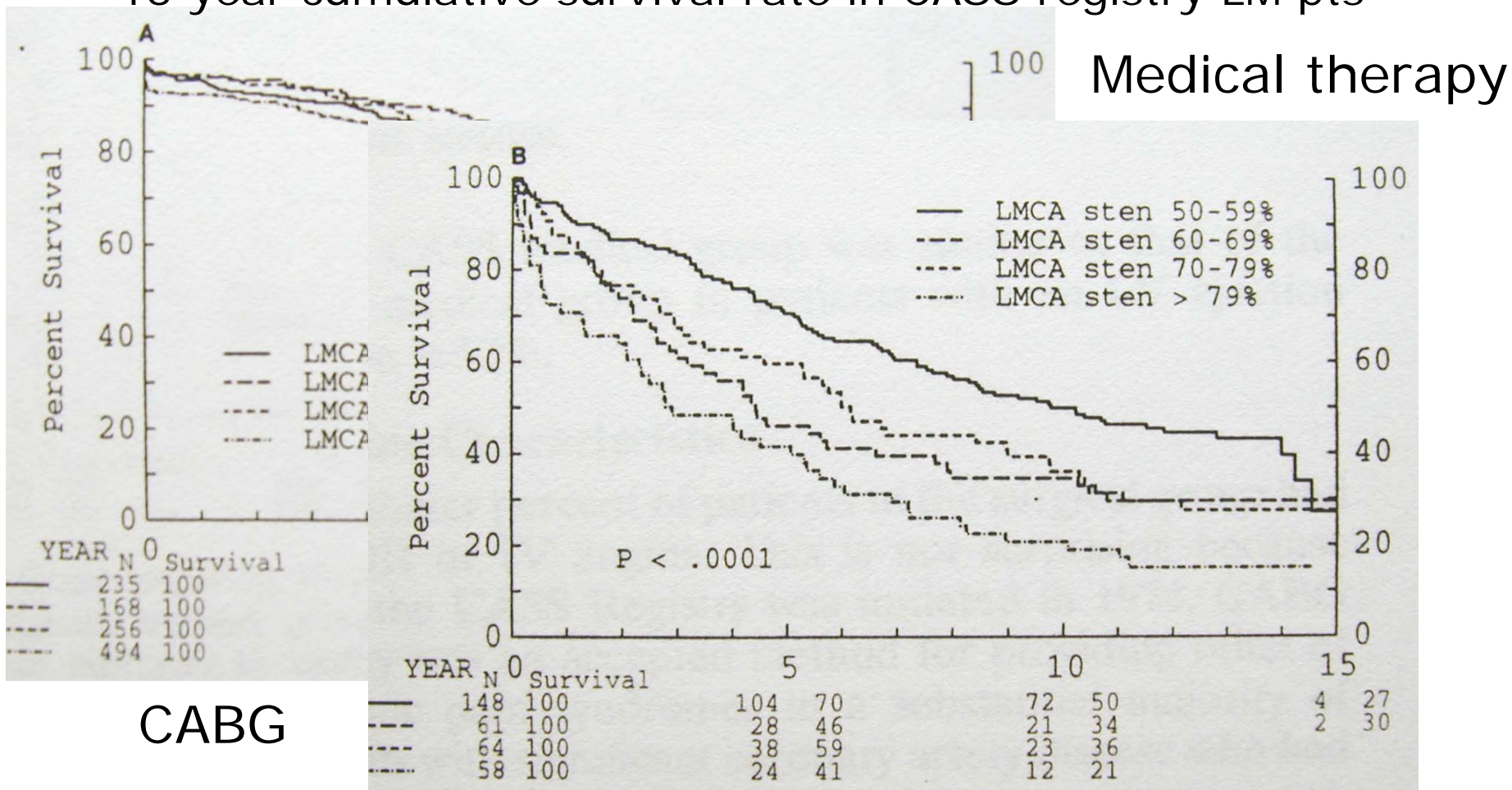
(healed asymptomatic plaque principle).

- Underuse – incomplete revascularization.

Hemodynamically significant lesions are potentially left untreated.

Qualitative angiographic assessment

15 year cumulative survival rate in CASS registry LM pts

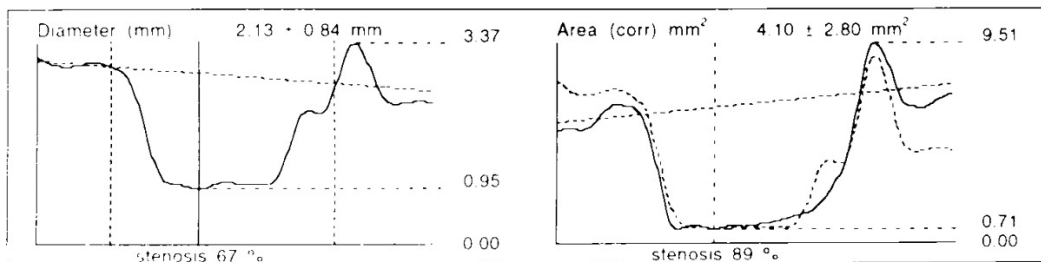
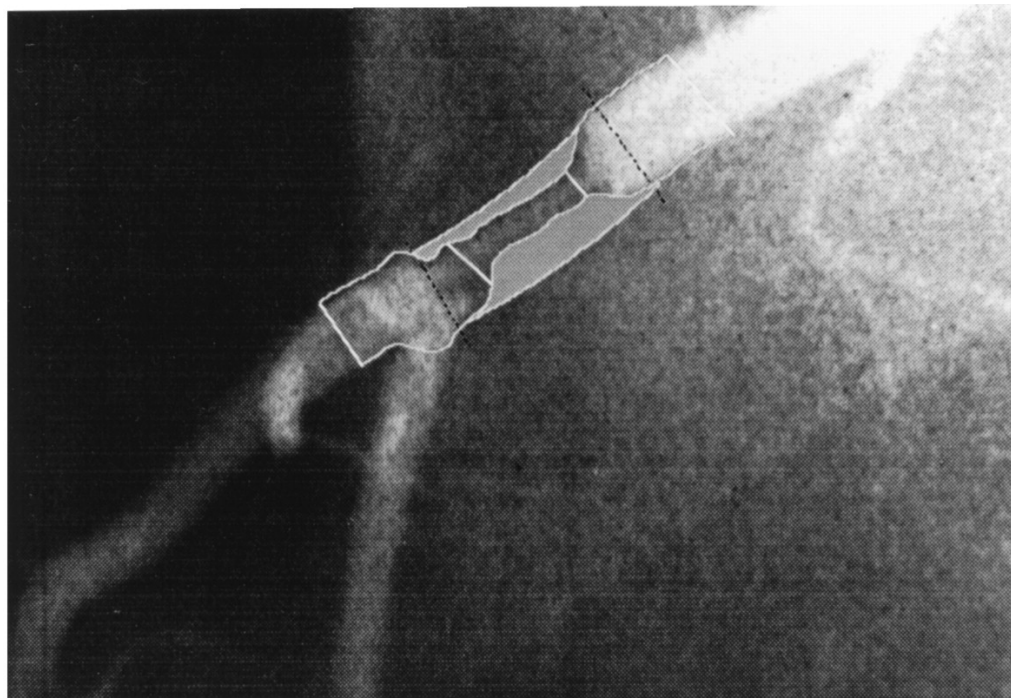


Medium survival not affected by CABG if <60% stenosis

Quantitative angiographic assessment

- Digitized algorithm developed in the early 80's.
- **Single dimension reading (again).**
- More precise :
 Important reduction in intra & inter-observer variability.
- Essential tool for end point evaluation :
 Plaque regression trials.
 Interventional cardiology trials.
 Trials on endothelial function.

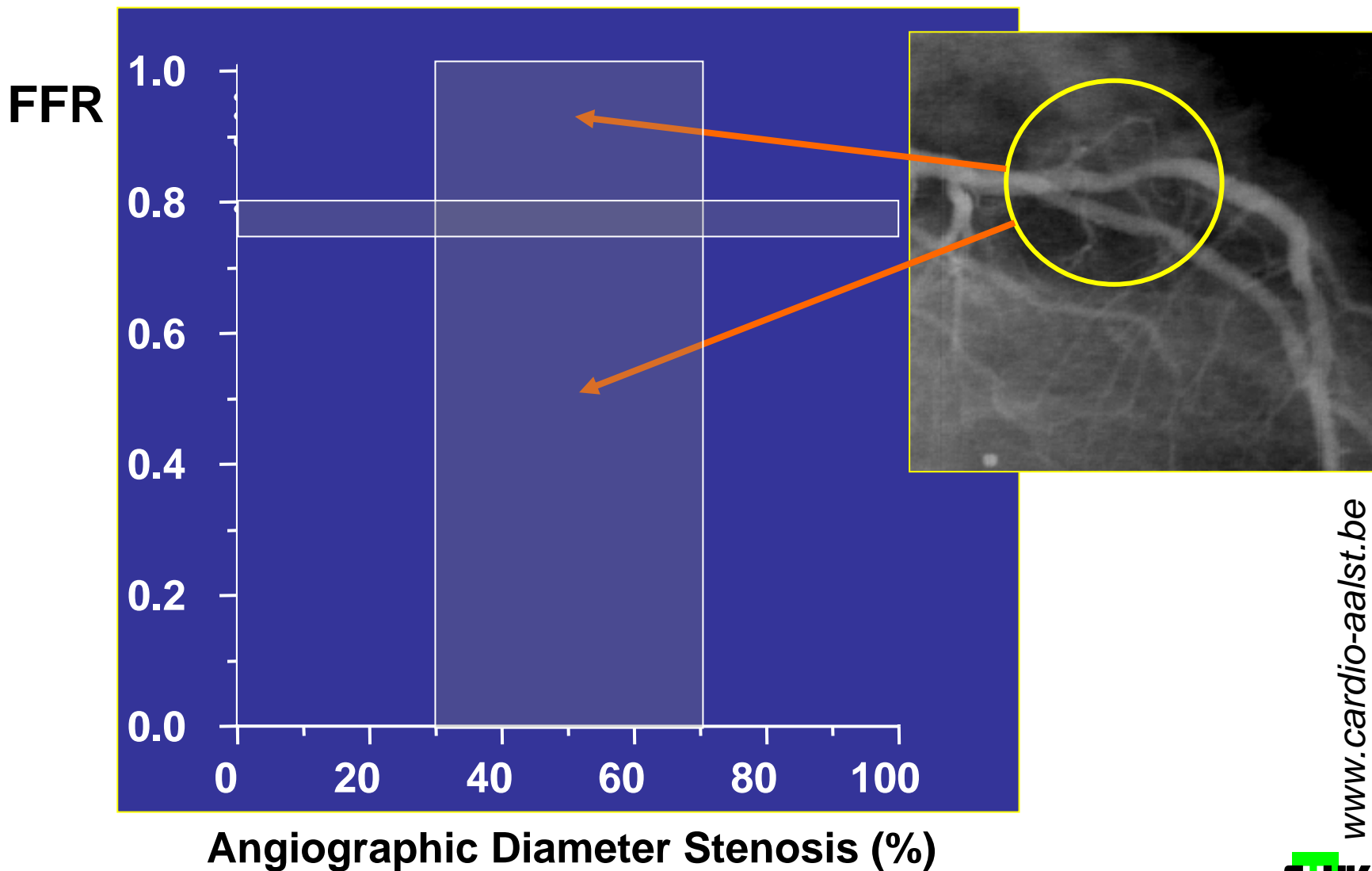
Quantitative angiographic assessment



Quantitative angiographic assessment

- Limitations & caveats :
 - Segment foreshortening.
 - Vessel remodeling – diffuse sclerosis.
 - Post stenotic dilatation – side-branch vessel overlap.
- Only few systems have been validated & validated systems are rarely used.

Angiography versus FFR



Angiographic Diameter Stenosis (%)

By courtesy of B. De Bruyne

A landscape photograph featuring a bright sunburst in the upper left corner, casting light over a valley filled with white clouds. In the foreground, a dark, grassy hillside slopes down towards the right, with a single, bare tree standing in the middle ground. The sky is a clear, pale blue.

The spirit of the invasive cardiologist

MIBI PET MRI

MSCT

IVUS Angioscopy FFR OCT VH

It's all in the lumen

In practice

- Proof of ischemia and beyond prior to catherization.
- Always attempt classification of the extent of CAD on a baseline diagnostic angiogram.
(for prognostic & therapeutic reasons)
- Remember tricks to improve accuracy of the reading.

Conclusions

- Defining multivessel disease in patients with intermediate lesions has become obsolete.
- Time has come to redefine multivessel disease guided by contemporary diagnostic tools.
- Bearing this in mind and in the era of modern drug therapy for CAD, a certain type of revascularization practice is questionable.
- This practice has to a some extent been applied in most RCT in this field. There is room for a least a critical appraisal of certain dogmas on revascularization.