



# Mise au point actuelle lors de suspicion de maladie coronarienne

Pr Erwin Schroeder

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Grande journée ECU UCL / SSMG  
Actualités diagnostiques et thérapeutiques

*Gosselies, 9 février 2019*

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CHU UCL Namur asbl, Av. Docteur G. Thérassé, 1 - B5530 Yvoir (Belgique)

Dinant • Godinne • Sainte-Elisabeth

# Plan de l'exposé

- **Procédure d'une coronarographie (vidéo)**
- **Les complications d'une coronarographie**
- **Les contre-indications d'une coronarographie**
- **La mise au point non invasive**
- **Les bonnes indications d'une coronarographie**



# Les complications d'une coronarographie

- Décès
- AVC
- Complications vasculaires → au niveau de l'endroit de ponction  
→ au niveau du trajet artériel
- Bradycardie, troubles de la conduction (BAV)
- Troubles du rythme ventriculaire, supraventriculaire
- Dissection coronaire, aortique
- Dysfonction VG, OAP
- Malaise vagal
- Nausées, vomissements
- Insuffisance rénale
- Réaction allergique aux produits de contraste
- Hyperthyroïdie

# Les contre-indications d'une coronarographie

- Examen inutile (risques > bénéfices potentiels)
- Co-morbidités : état grabataire, démence, mauvais pronostic
- Absence de consentement / manque d'information au patient (famille)
- Impossibilité de rester en position couchée (> 30')
- Absence d'accès vasculaire
- Hyperthyroïdie
- Absence de préparation anti-allergique
- Anémie sévère, IRC, troubles ioniques
- Prise de médicaments: Metformine, anticoagulants (?)
- Impossibilité de supporter un traitement antiagrégant, par ex. hémorragie active, HECE

# La mise au point non invasive en cas de suspicion de maladie coronaire

- Anamnèse, examen clinique cardiovasculaire
- ECG de repos (cf. anciens tracés)
- Echocardiographie (ETT)
- ECG de 24 h ?
- Tests paracliniques non invasifs à la recherche d'ischémie myocardique
  - 2 techniques ≠ :
    - augmentation des besoins myocardiques en O<sub>2</sub> (cyclo, dobutamine)
    - vasodilatation artériolaire (Persantine, Adénosine)
- Angiographie coronaire non invasive par angio CT

# Les tests non invasifs à la recherche d'ischémie myocardique

- Effort "simple", toujours avec ECG !
- Scintigraphie de stress (effort, dobutamine, vasodilatation)
- Echocardiographie de stress (dobutamine, effort)

# Physiologie de l'effort dynamique

- **Augmentation continue de la FC**
  - FC maximale théorique :  $220 - \text{âge}$  (tjrs obtenir  $FC > 85\% \text{ FMT}$ )
  - FC augmente par  $\downarrow$  tonus vagal et ensuite par libération des catécholamines
- **Augmentation du volume systolique éjecté**
  - $\uparrow$  du retour veineux
  - $\uparrow$  contractilité via les catécholamines
  - Vitesse de relaxation  $\uparrow$
- **Diminution des résistances périphériques (malgré l'augmentation de la TA)**
  - Arrêt brutal de l'effort donnera une chute de la TA

Nom:

No ID:

Cas n°:

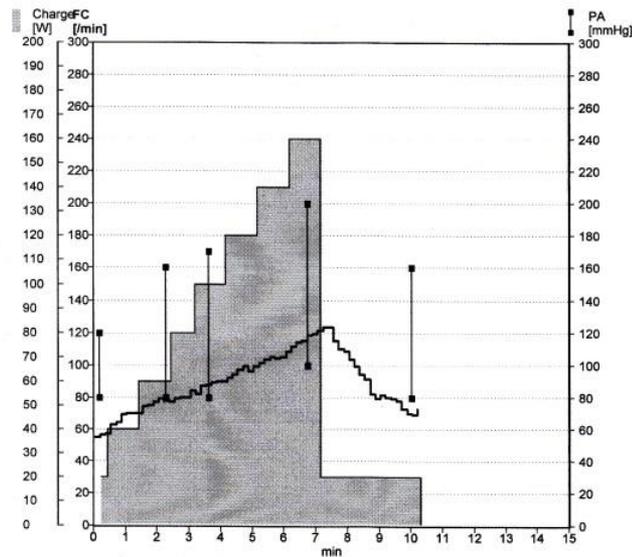
Né: 23.07.1949  
 Age: 65 A  
 Sexe: M  
 Taille: 175.0 cm  
 Poids: 90.0 kg  
 Indic:  
 Med:

Charge max: 160W (155) W (103.0) %  
 FC max: 123 (155) /min (79) %  
 PA max: 200 / 100 mmHg  
 PA \* FC max 246 mmHg/min  
 Min. BP x HR 67 mmHg/min  
 DP-Factor 3.7  
 Surface corporelle 2.058 m<sup>2</sup>  
 PWC 150/170: 208 / 242 W  
 PWC rel: 2.31 / 2.69 W/kg

Critère d'arrêt:

Rem:

Protocole: DEFAULT  
 Ergo / PA: Ergoline 900/911 digital / -



Rest time 0:14    Durée effort 6:56    Durée récupération 3:09    Durée totale 10:19

Interprétation

Nom:

No ID:

Cas n°:

**Critère d'arrêt:**

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 Durée effort 6:56  
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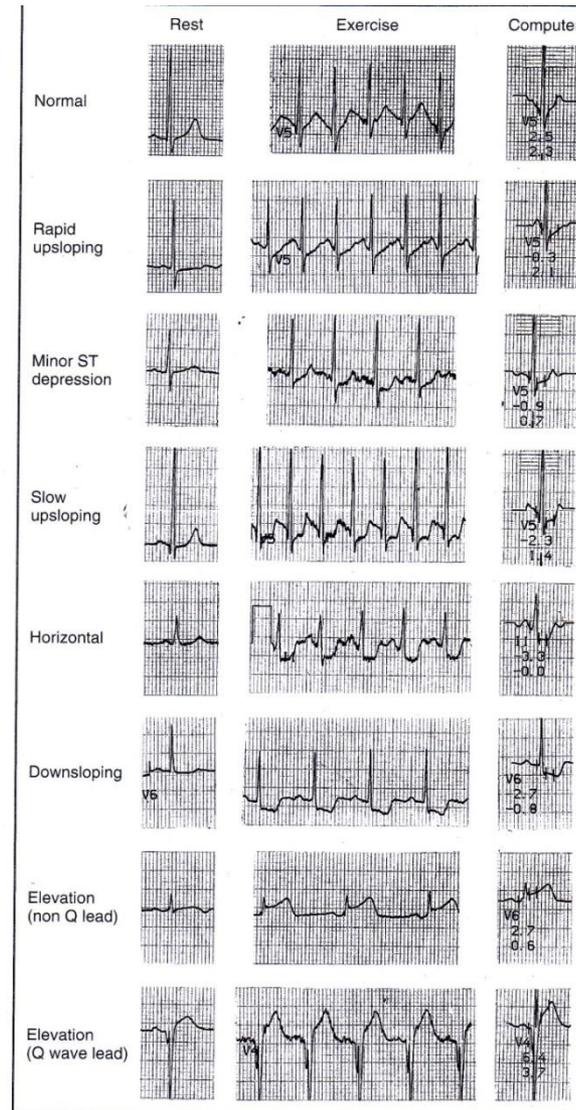
Protocole: DEFAULT

Ergo / PA: Ergoline 900/911 digital / -

**Protocole Paliers**

ST@J +60ms

	Temps mm:ss	Charge [W]	FC [/min]	PA [mmHg]	ST V5 [mm]	P	Y	D	B	R	ES
Pré	0:14	0	56	120/80	0.3	0	0	0	0	0	-
Charge1	0:13	20	60	-	0.3	0	0	0	0	0	-
Charge2	1:12	40	73	-	0.2	0	0	0	0	0	-
Charge3	2:12	60	77	160/80	0.1	0	0	0	0	0	-
Charge4	2:57	80	82	-	0.2	0	0	0	0	0	-
Charge5	3:56	100	91	170/80	0.0	0	0	0	0	0	-
Charge6	4:56	120	100	-	0.0	0	0	0	0	0	-
Charge7	5:56	140	109	-	-0.1	0	0	0	0	0	-
STMax	6:50	160	121	200/100	0.0	0	0	0	0	0	-
Charge8	6:56	160	123	200/100	0.0	0	0	0	0	0	-
Réc	1:00	20	101	-	0.6	0	0	0	0	0	-
Réc	2:00	20	78	-	0.4	0	0	0	0	0	-
Réc	3:00	20	67	160/80	-0.1	0	0	0	0	0	-
Fin	3:09	20	68	-	-0.1	0	0	0	0	0	-



# Epreuve d'effort

- Disponibilité dans tous les cabinets de consultations (cabinets privés, polycliniques)
- Cycloergomètre (tapis roulant)
- Défibrillateur disponible
- ECG 12 dérivations au repos (position assise)
- ECG 12 dérivations en permanence, analyse automatique de la repolarisation (ST en V5)
- TA automatique (manuelle)
- Schéma progressif (paliers de 20 W/minute)
- Conditions d'arrêt :
  - Épuisement
  - FC maximale atteinte (220 – âge)
  - Symptômes : dyspnée, angor, trouble du rythme, chute de la TA
  - Troubles significatifs de la repolarisation (ST ↓, ST ↑ )

# Contre-indications à l'effort dynamique

- **C.I. absolues :**
  - Infarctus aigu du myocarde
  - Angor instable
  - RAO symptomatique
  - Arythmie ventriculaire (antécédent d'ARCA)
- **C.I. relatives :**
  - HTA sévère
  - Notion d'une sténose du TC
  - Notion ATA/AAA

# Test à la Dobutamine

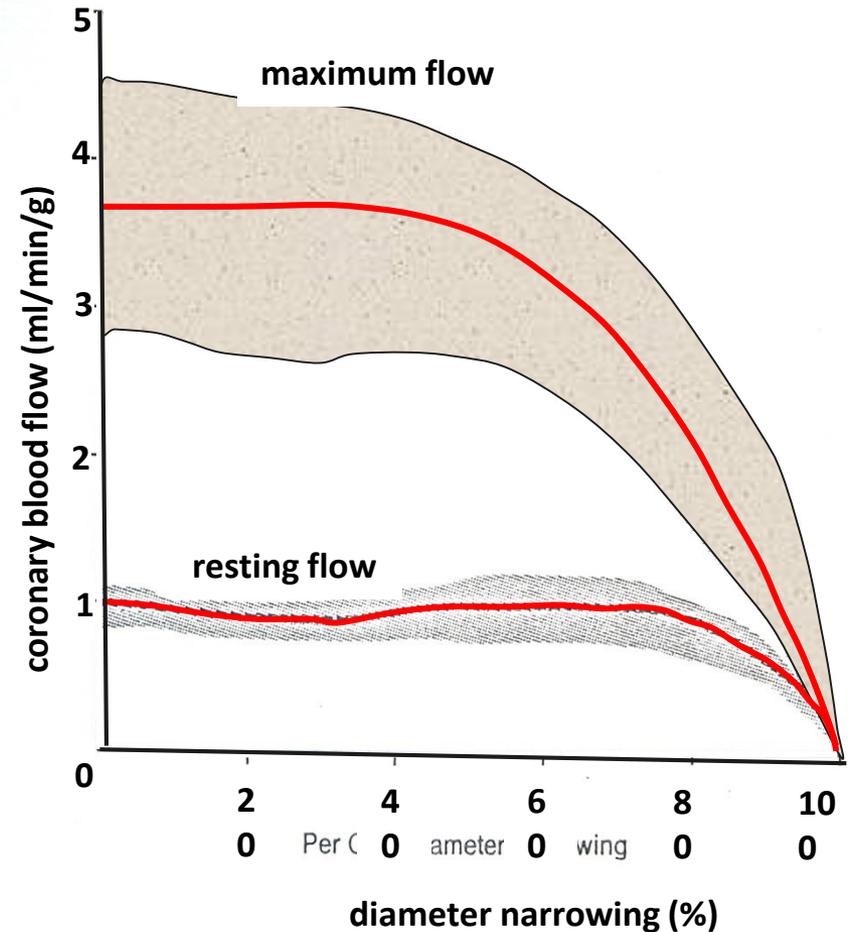
- Imiter les effets d'un effort physique ("effort au repos")  
FC ↑, SV ↑, MVO<sub>2</sub> ↑, TA N
- **Catéchamines** : paliers de 3 minutes 5-10-20- 40 g/kg/min.  
(si nécessaire atropine)
- Eviter les β<sup>-</sup>
- **Effets secondaires** : trouble du rythme V
- **Indications** :
  - ✓ Alternative à l'effort physique pour la recherche d'ischémie (raisons orthopédiques, art. m. inf., patients très âgés, BB, PMK, asthme, BPCO)
  - ✓ Evaluer la réserve contractile (low dose) :
    - Étude de la viabilité myocardique (stressing) avant revascularisation
    - En présence d'un RAO avec dysfonction VG
  - ✓ Avec technique d'imagerie (échocardiographie, RMN, scintigraphie)
  - ✓ Infrastructures disponibles dans tous les hôpitaux (polycliniques)

# Coronary blood flow at rest and during stress

Under resting conditions, coronary blood flow remains normal until coronary artery lumen is severely reduced to  $\pm 85\%$  diameter stenosis.

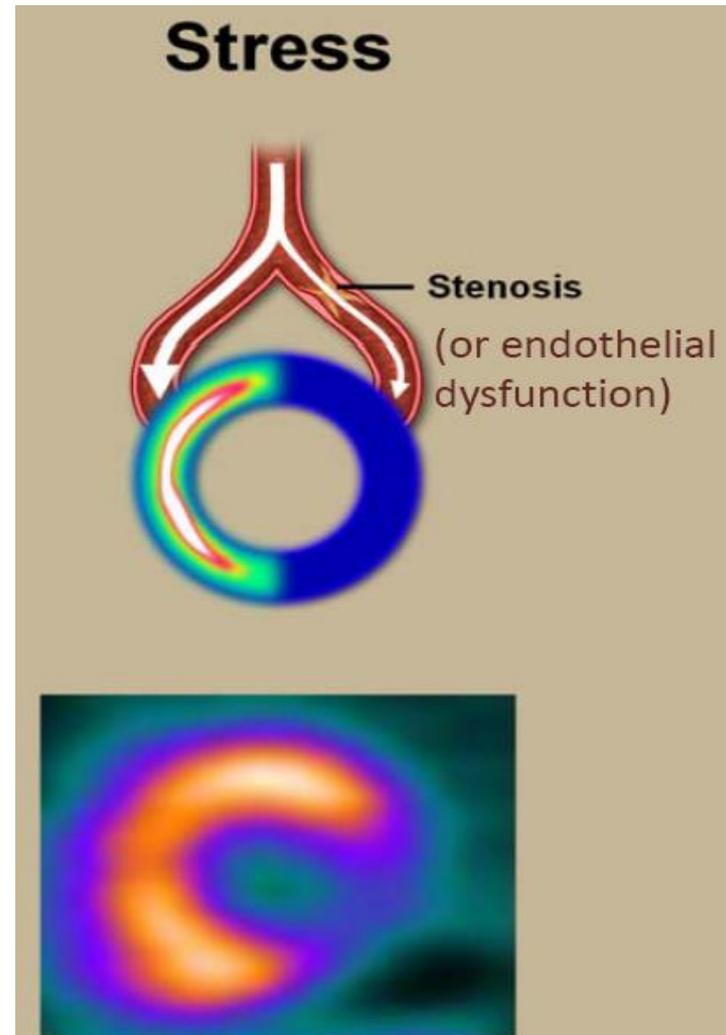
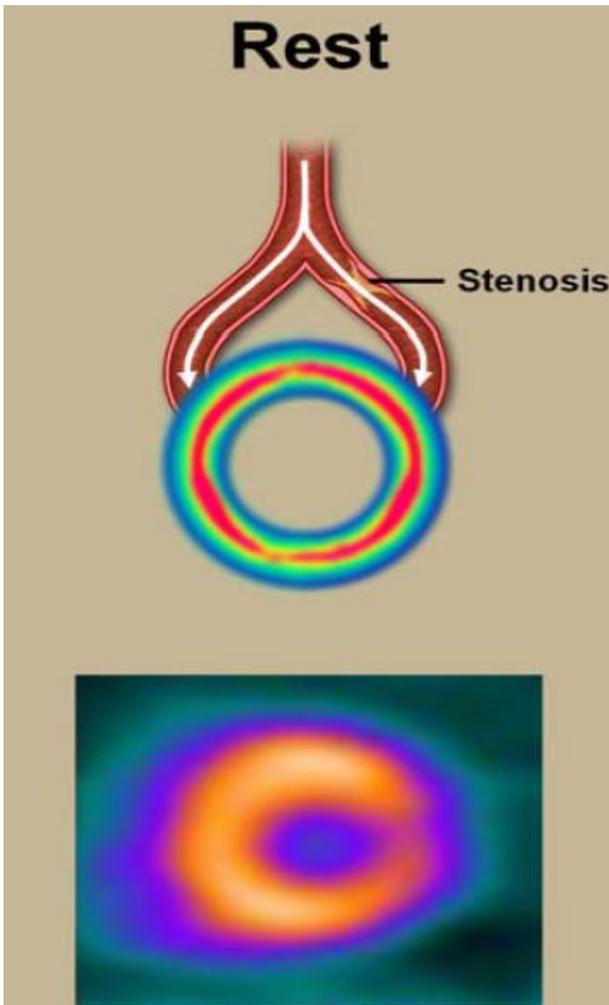
However, in response to exercise stress or to pharmacologic coronary artery arteriolar vasodilators maximum coronary flow becomes impaired with mild coronary stenosis.

Coronary flow reserve



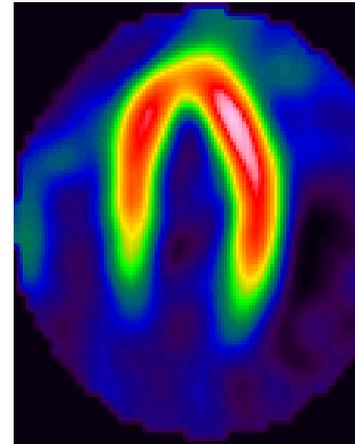
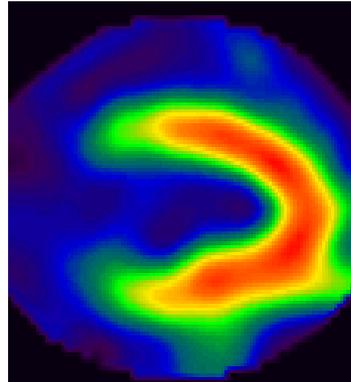
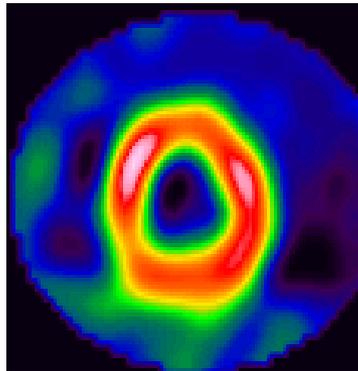
Gould, 1974

# Myocardial Perfusion Imaging

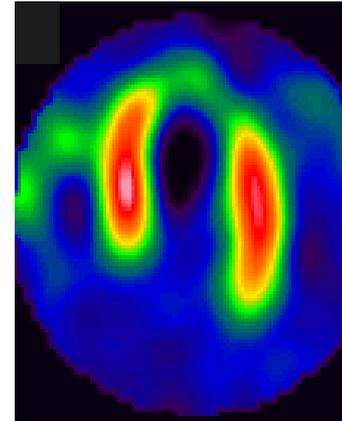
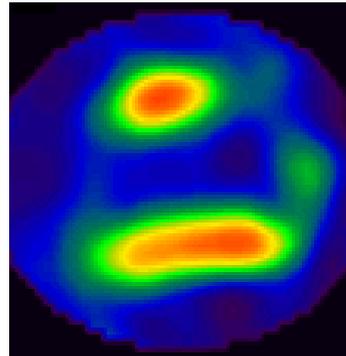
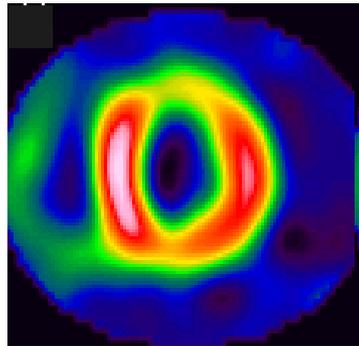


# Angina pectoris and 75% stenosis on LAD

Rest



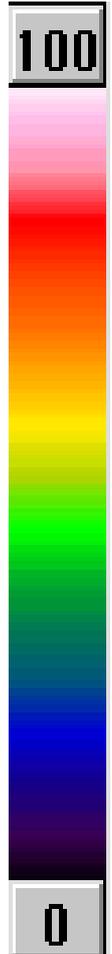
Stress



short axis

vertical  
long axis

horizontal  
long axis



# Epreuves de vasodilatation artériolaire pharmacologique (1)

- Adénosine (dipyridamol)
- Vasodilatation artériolaire maximale, permet de détecter des disparités régionales inhomogènes dans perfusion maximale en présence de sténoses d'a. épicaudiques (de sévérités différentes/éventuellement "vols coronaaires")
- **Faux négatif** : atteinte tritronculaire responsable d'une diminution "homogène" de la réserve coronaire.
- **Effets secondaires** : bronchospasme, pauses sinusales, flush, douleurs thoraciques

# Epreuves de vasodilatation artériolaire pharmacologique (2)

- **C.I.** : asthme, BPCO, BAV
- **Précautions** : éviter "antidotes" : thé, café, etc..
- **Associées avec techniques**
  - d'images de la perfusion (MNUC, RMN, CT)
  - de la contractilité - écho, RMN
- **Indications** : alternative à l'effort physique pour la recherche d'ischémie
  - raisons orthopédiques, art. m. inf., pt très âgé, BB, PMK

# Imagerie par CT scan (1)

- **Scanner multibarettes 128-256**
- **ECG gating (prospectif, rétrospectif)**
- **Examen à blanc (sans injection) → score calcique**
  - **Diagnostic - Pronostic**
  - **Angiographie coronaire difficilement interprétable si score d'Agatson > 400**
  - **Pas fait chez patients jeunes, pathol. congénitale, path. Valvulaire**
- **Nécessité d'injecter du contraste radioiodé par voie IV (60 ml)**
  - C.I. relatives :**
    - **Allergie au contraste iodé, hyperthyroïdie, insuffisance rénale, décomp. cardiaque**
    - **Fibrillation auriculaire, tachycardie**
    - **Artéfacts par prothèses mécaniques / boîtier de PMK**

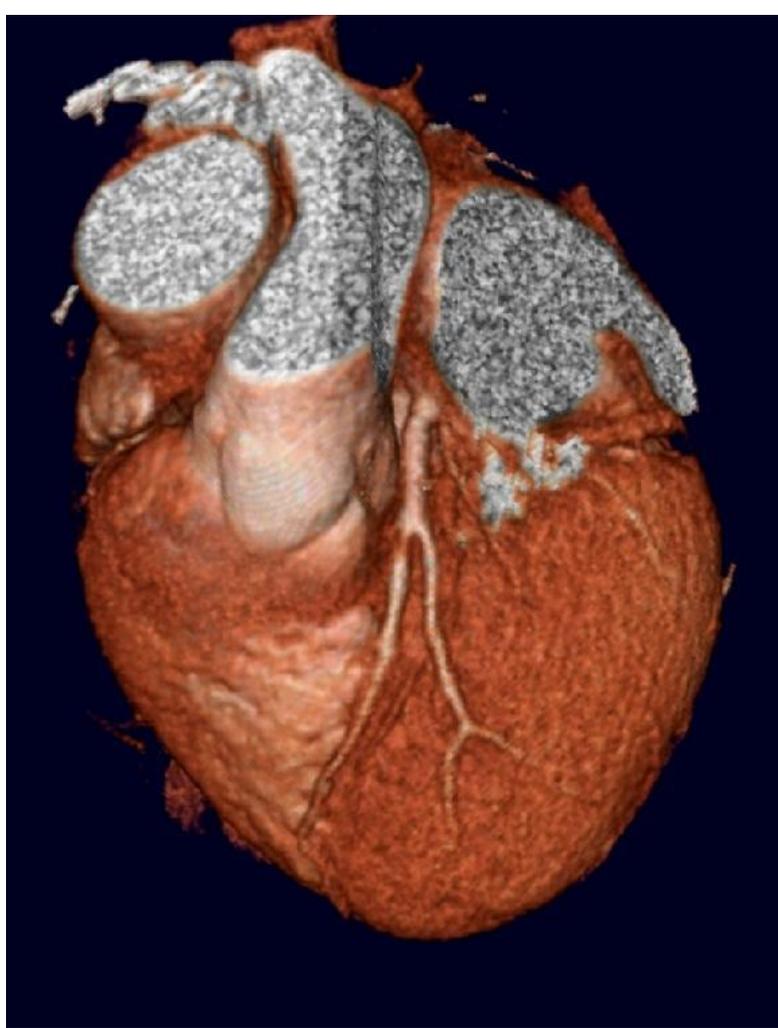
# Imagerie par CT scan (2)

- Opacification des lumières des structures cardiovasculaires / du myocarde
- **Données morphologiques :**
  - Similaires à l'échocardiographie via reconstruction des coupes
  - Précises, reproductibles : diamètres des cavités, épaisseurs des parois
  - Mesures des densités : air, sang, myocarde, graisse, calcifications
- **Données fonctionnelles :** par comparaison diastole – systole des  $\phi$  - volumes – épaisseurs myocardiques
  - Volumes systolique – diastolique du VG, volume éjecté
  - Fraction d'éjection du VG
  - Cinétique régionale du VG
  - Viabilité du myocarde (2<sup>e</sup> acquisition : analyse d'une accumulation de contraste)
- Irradiation : 5 – 10 msv

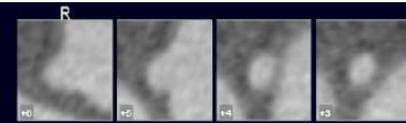
# Imagerie par CT scan (3)

- **Angiographie coronaire par angio CT**
  - Technique du ECG-gating : images diastoliques
  - Luminographie, mesures de la sévérités de la sténose (% DS)
  - Analyses des plaques d'athérome
  - Détection des anomalies congénitales (utile en préopératoire)
  - Analyse morphologique des greffons artériels/veineux utilisés en chir. de revascularisation myocardique
  - Très bonne performance diagnostique pour exclure une atteinte coronaire obstructive
    - Alternative à la coro. diagnostique (ex-invasif) avec la conclusion : "artères coronaires lisses"
    - Alternative à la coro. diagnostique préopératoire (avant remplacement ou plastie de la VA ou VM)
  - Critères de remboursement/prescription en vigueur en Belgique

# MSCT-CA



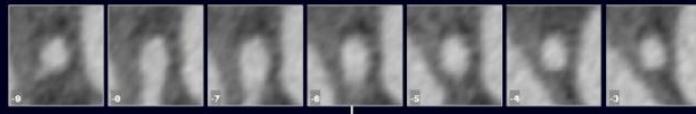
FRANCOIS, LOUIS  
694264  
Age: 58 years  
M  
07 Nov 2005  
08:42:45



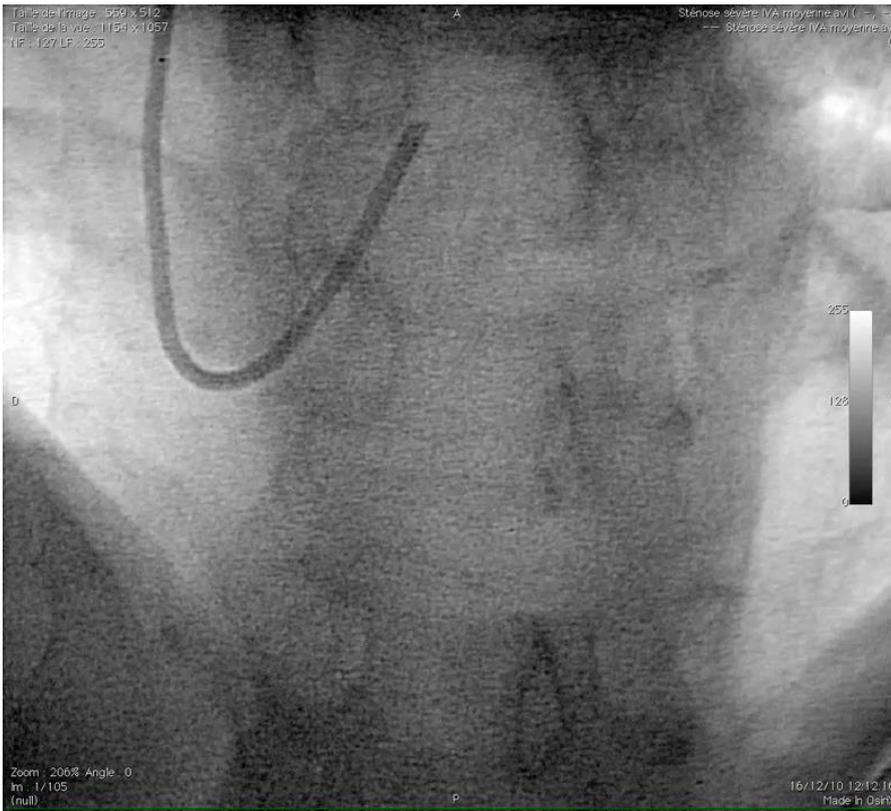
UCL MONT-GODINNE  
CT  
01\_CoronaryRoutine (Adult)  
CorCTA 0.75 B50f -350ms



kVP: 120  
mA: 317  
msec: 238  
mAs: 528  
Thk: 0.75 mm  
Sensation 64  
Orient: -120°, 62°, -74°



VitreD  
WL: 248/115  
Segmented  
Vessel 1



# Coronarographie



**Homme 45 ans**  
**FRCV=0**  
**DRS typiques**  
**EE -/- 300 watts**

Tomographie commandée par ordinateur du cœur, avec moyen de contraste, avec évaluation de l'anatomie coronaire, y compris les séries éventuelles de scanners sans contraste..... N 330

- La prestation 458570-458581 n'est attestée que sur prescription du médecin spécialiste en cardiologie.
- La prestation 458570-458581 n'est attestée que s'il est satisfait aux conditions suivantes :
  - a) pour des patients présentant une "angine de poitrine" atypique, avec un "risque intermédiaire" selon les critères décrits dans les "European Society of Cardiology (ECS) Guidelines";
  - b) et pour lesquels soit on ne peut pas tirer de conclusion claire des tests non invasifs antérieurs pour l'ischémie myocardique, ou soit la réalisation de tests non invasifs pour l'ischémie myocardique s'avère impossible ou contre-indiquée.
- La motivation reprenant l'indication pour l'examen est mentionnée sur la prescription.
- Cette motivation et indication sont reprises dans le rapport de l'examen.
- Le rapport de l'examen est tenu à la disposition du médecin conseil.
- Toutes ces données font partie du dossier médical du médecin spécialiste prescripteur.
- La prestation 458570-458581 ne peut pas être cumulée avec la prestation 459550-459561.
- Dans le cas où la prestation 458570-458581 doit être interrompue après une première série de scanners sans contraste, seule la prestation 459550-459561 peut être attestée.

**A.R. 10.04.2016**

**Table 13 Clinical pre-test probabilities<sup>a</sup> in patients with stable chest pain symptoms<sup>108</sup>**

Age	Typical angina		Atypical angina		Non-anginal pain	
	Men	Women	Men	Women	Men	Women
30–39	59	28	29	10	18	5
40–49	69	37	38	14	25	8
50–59	77	47	49	20	34	12
60–69	84	58	59	28	44	17
70–79	89	68	69	37	54	24
>80	93	76	78	47	65	32

ECG = electrocardiogram; PTP = pre-test probability; SCAD = stable coronary artery disease.

<sup>a</sup> Probabilities of obstructive coronary disease shown reflect the estimates for patients aged 35, 45, 55, 65, 75 and 85 years.

- Groups in white boxes have a PTP <15% and hence can be managed without further testing.
- Groups in blue boxes have a PTP of 15–65%. They could have an exercise ECG if feasible as the initial test. However, if local expertise and availability permit a non-invasive imaging based test for ischaemia this would be preferable given the superior diagnostic capabilities of such tests. In young patients radiation issues should be considered.
- Groups in light red boxes have PTPs between 66–85% and hence should have a non-invasive imaging functional test for making a diagnosis of SCAD.
- In groups in dark red boxes the PTP is >85% and one can assume that SCAD is present. They need risk stratification only.

ESC Guidelines 2013; 34 : 2949-3003

**Table 16 Use of coronary computed tomography angiography for the diagnosis of stable coronary artery disease**

Recommendations	Class <sup>a</sup>	Level <sup>b</sup>
Coronary CTA should be considered as an alternative to stress imaging techniques for ruling out SCAD in patients within the lower range of intermediate PTP for SCAD in whom good image quality can be expected.	<b>IIa</b>	<b>C</b>
Coronary CTA should be considered in patients within the lower range of intermediate PTP for SCAD after a non conclusive exercise ECG or stress imaging test or who have contraindications to stress testing in order to avoid otherwise necessary invasive coronary angiography if fully diagnostic image quality of coronary CTA can be expected.	<b>IIa</b>	<b>C</b>
Coronary calcium detection by CT is not recommended to identify individuals with coronary artery stenosis.	<b>III</b>	<b>C</b>
Coronary CTA is not recommended in patients with prior coronary revascularization.	<b>III</b>	<b>C</b>
Coronary CTA is not recommended as a 'screening' test in asymptomatic individuals without clinical suspicion of coronary artery disease.	<b>III</b>	<b>C</b>

CTA = computed tomography angiography; ECG = electrocardiogram; PTP = pre-test probability; SCAD = stable coronary artery disease.

<sup>a</sup> Class of recommendation.

<sup>b</sup> Level of evidence.

*ESC Guidelines 2013; 34 : 2949-3003*

# Les caractéristiques des tests non invasifs dans le contexte du diagnostic de la maladie coronaire

- Sensibilité/spécificité des tests non invasifs (vs coro : "Golden standard")
- Probabilité pré-test → post-test
- Impact de la prévalence sur les valeurs prédictives positives / négatives
- Notion de la réserve de flux
- Cascade ischémique
- Les performances des différents tests diagnostiques
- Les avantages / inconvénients des différents tests
- Impact sur le pronostic vital selon :
  - l'étendue de la zone d'ischémie
  - l'atteinte coronaire

# Valeurs diagnostiques des méthodes non invasives

- **Résultats des tests** :  $VP/FP/VN/FN$
- **Sensibilité** :  $VP/VP + FN$
- **Spécificité** :  $VN/VN + FP$
- **VPP** :  $VP/VP + FP$
- **VPN** :  $VN/VN + FN$
- **Accuracy** :  $VP + VN / \Sigma$
- **Probabilité pré-test/post-test**

**Table 13 Clinical pre-test probabilities<sup>a</sup> in patients with stable chest pain symptoms<sup>108</sup>**

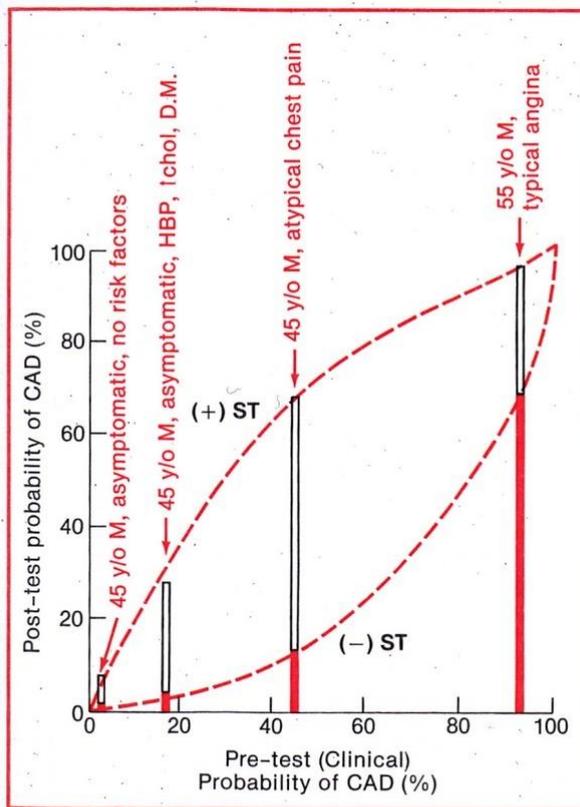
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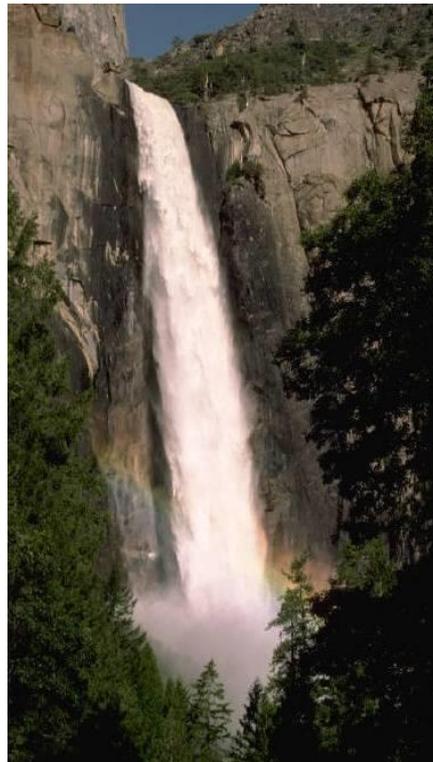
**FIGURE 6-11.** Use of Bayes theorem to calculate the probability of coronary artery disease (CAD). Four specific patient examples are shown by vertical bars where the height of the solid dark bar illustrates results for a negative exercise electrocardiogram (ECG)(-) ST, and a clear bar shows the results for a positive exercise ECG (+) ST. The posttest probability of coronary disease is optimal in patients with an intermediate coronary disease prevalence. (From Patterson, R. E., and Horowitz, S. F.: Importance of epidemiology and biostatistics in deciding clinical strategies for using diagnostic tests: A simplified approach using examples from coronary artery disease. Reprinted by permission of the American College of Cardiology. *J. Am. Coll. Cardiol.* 13:1653, 1989.)

# Temporal sequence of ischemic events

*Rest*



*Stress*



**Perfusion heterogeneity**

**Metabolic alteration**

**Diastolic dysfunction**

**Regional dyssynergy**

**ECG changes**

**Angina**

**Stress** 

**Table 12** Characteristics of tests commonly used to diagnose the presence of coronary artery disease

	Diagnosis of CAD	
	Sensitivity (%)	Specificity (%)
Exercise ECG <sup>a, 91, 94, 95</sup>	45–50	85–90
Exercise stress echocardiography <sup>96</sup>	80–85	80–88
Exercise stress SPECT <sup>96,99</sup>	73–92	63–87
Dobutamine stress echocardiography <sup>96</sup>	79–83	82–86
Dobutamine stress MRI <sup>b,100</sup>	79–88	81–91
Vasodilator stress echocardiography <sup>96</sup>	72–79	92–95
Vasodilator stress SPECT <sup>96, 99</sup>	90–91	75–84
Vasodilator stress MRI <sup>b,98, 100-102</sup>	67–94	61–85
Coronary CTA <sup>c,103-105</sup>	95–99	64–83
Vasodilator stress PET <sup>97, 99, 106</sup>	81–97	74–91

CAD = coronary artery disease; CTA = computed tomography angiography; ECG = electrocardiogram; MRI = magnetic resonance imaging; PET = positron emission tomography; SPECT = single photon emission computed tomography.

<sup>a</sup> Results without/with minimal referral bias.

<sup>b</sup> Results obtained in populations with medium-to-high prevalence of disease without compensation for referral bias.

<sup>c</sup> Results obtained in populations with low-to-medium prevalence of disease.

ESC Guidelines 2013; 34 : 2949-3003

## Indications for diagnostic testing in patients with suspected CAD and stable symptoms

	Asymptomatic <sup>a</sup>		Symptomatic						Ref <sup>e</sup>	
	Probability of significant disease <sup>b</sup>									
			Low (<15%)		Intermediate (15–85%)		High (>85%)			
	Class <sup>c</sup>	Level <sup>d</sup>	Class <sup>c</sup>	Level <sup>d</sup>	Class <sup>c</sup>	Level <sup>d</sup>	Class <sup>c</sup>	Level <sup>d</sup>		
<b>Anatomical detection of CAD</b>										
Invasive angiography	III	A	III	A	IIb	A	I	A	50–52,54	
CT angiography <sup>f,g</sup>	III	B	III	C	IIa	A	III	B	57–62	
<b>Functional test</b>										
Stress echo	III	A	III	A	I	A	III	A	63–65	
Nuclear imaging	III	A	III	A	I	A	III	A	60,66–70	
Stress MRI	III	B	III	C	I	A	III	B	71–75	
PET perfusion	III	B	III	C	I	A	III	B	67,69,70,76,77	
<b>Combined or hybrid imaging test</b>										
	III	C	III	C	IIa	B	III	B	78–83	

CAD = coronary artery disease; CT = computed tomography; MRI = magnetic resonance imaging; PET = positron emission tomography.

<sup>a</sup>Screening for silent (asymptomatic) myocardial ischaemia may be considered in selected high-risk patients, such as those with diabetes mellitus.<sup>84</sup>

<sup>b</sup>Pre-test probability of CAD. Low 0–15%; intermediate 15–85%; high >85% as assessed using the criteria based on ESC Guidelines of SCAD.<sup>47</sup>

<sup>c</sup>Class of recommendation.

<sup>d</sup>Level of evidence.

<sup>e</sup>References.

<sup>f</sup>This refers to CT angiography, not calcium scoring.

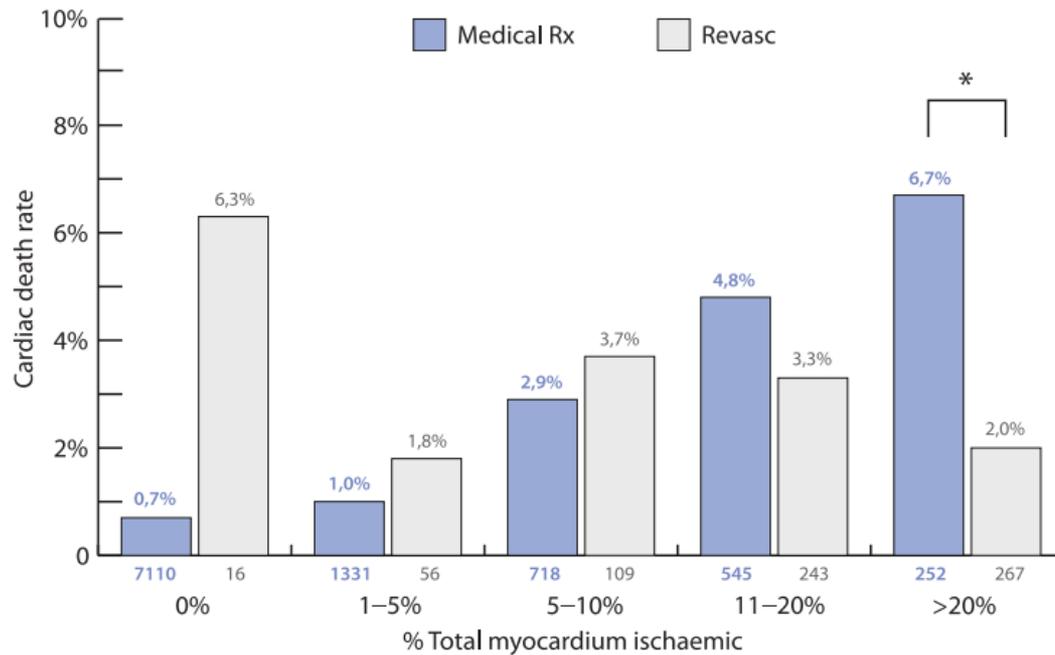
<sup>g</sup>CT is considered to perform best in the lower range of pre-test probability (15–50%).<sup>47</sup>

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**Table W1 Advantages and disadvantages of stress imaging techniques and coronary CTA**

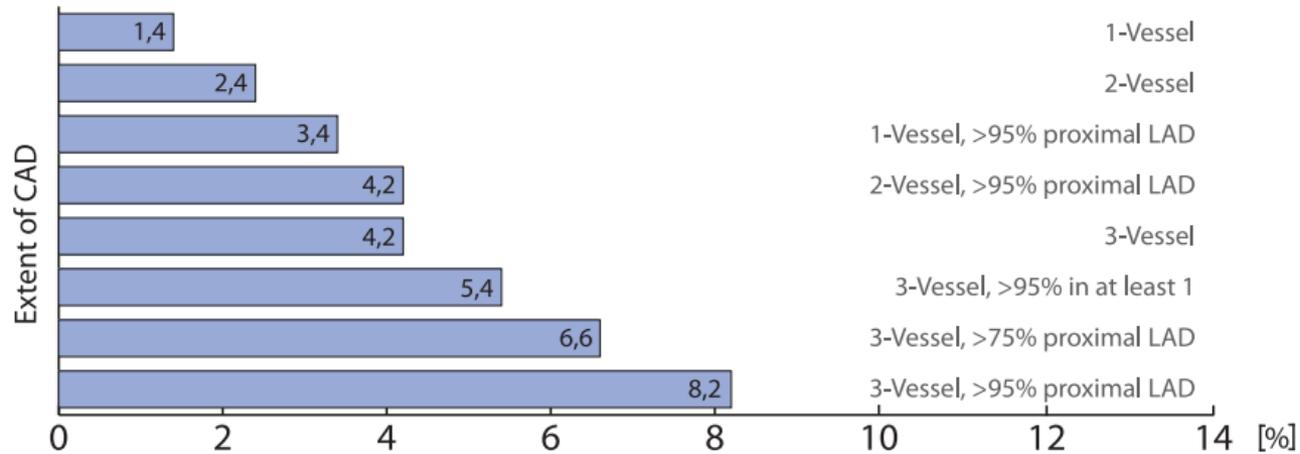
Technique	Advantages	Disadvantages
Echocardiography	Wide access Portability No radiation Low cost	Echo contrast needed in patients with poor ultrasound windows Dependent on operator skills
SPECT	Wide access Extensive data	Radiation
PET	Flow quantitation	Radiation Limited access High cost
CMR	High soft tissue contrast including precise imaging of myocardial scar No radiation	Limited access in cardiology Contra-indications Functional analysis limited in arrhythmias Limited 3D quantification of ischaemia High cost
Coronary CTA	High NPV in pts with low PTP	Limited availability Radiation Assessment limited with extensive coronary calcification or previous stent implantation Image quality limited with arrhythmias and high heart rates that cannot be lowered beyond 60–65/min Low NPV in patients with high PTP

CMR = cardiac magnetic resonance; CTA = computed tomography angiography; NPV = negative presictive value; PET = positron emission tomography; PTP = pre-test probability; pts = patients; SPECT = single photon emission computed tomography.



**Figure W2** Relationship between cardiac mortality and extent of myocardial ischaemia, depending on type of therapy.<sup>45</sup> Numbers below columns indicate numbers of patients in each group. \* $P < 0.02$ . Medical Rx = medical therapy; Revasc = revascularization.

### Annual Mortality with Medical Therapy



**Figure W3** Cardiac death rates in patients on medical therapy with different extents of angiographically defined coronary artery disease. LAD = left anterior descending.<sup>46</sup>

# Apport de la coronarographie dans le diagnostic de la maladie coronaire

- **Coronarographie : angiographie sélective des artères coronaires**  
→ **informations morphologiques :**
  - $\phi$ , MLD, RD, % sténose
  - Longueur de la sténose, localisations
  - Caractéristiques : angulation, bi/trifurcation, branches diagonales, calcifications
  - Qualité du lit d'aval
  - Collatérales homo/hétérolatérale
- **Analyse visuelle / quantitative des sténoses**
- **Évaluation précise par les mesures de gradient au repos et en hyperémie (FFR)**
- **Offre une évaluation assez précise → approche thérapeutique la + appropriée**  
R/  $\theta$  médical – PAC – angioplastie coronaire
- **But des procédures de revascularisation myocardique :**
  - soulager les symptômes, améliorer la qualité de vie
  - améliorer le pronostic vital / réduire les événements majeurs (MACE)

**Table 6** Guide for calculating the SYNTAX score

Steps	Variable assessed	Description
Step 1	Dominance	The weight of individual coronary segments varies according to coronary artery dominance (right or left). Co-dominance does not exist as an option in the SYNTAX score.
Step 2	Coronary segment	<p>The diseased coronary segment directly affects the score as each coronary segment is assigned a weight depending on its location, ranging from 0.5 (i.e. the posterolateral branch) to 6 (i.e. left main in case of left dominance).</p> <p>© ESC 2018</p>
Step 3	Diameter stenosis	<p>The score of each diseased coronary segment is multiplied by two in case of a stenosis 50–99% and by five in case of total occlusion.</p> <p>In case of total occlusion, additional points will be added as follows:</p> <ul style="list-style-type: none"> <li>● Age &gt;3 months or unknown +1</li> <li>● Blunt stump +1</li> <li>● Bridging +1</li> <li>● First segment visible distally +1 per non-visible segment</li> <li>● Side branch at the occlusion +1 if &lt;1.5 mm diameter +1 if both &lt;1.5 mm and ≥1.5 mm diameter +0 if ≥1.5 mm diameter (i.e. bifurcation lesion)</li> </ul>

*continued*

Step 4	Trifurcation lesion	The presence of a trifurcation lesion adds additional points based on the number of diseased segments: <ul style="list-style-type: none"> <li>• 1 segment +3</li> <li>• 2 segments +4</li> <li>• 3 segments +5</li> <li>• 4 segments +6</li> </ul>
Step 5	Bifurcation lesion	The presence of a bifurcation lesion adds additional points based on the type of bifurcation according to the Medina classification: <sup>126</sup> <ul style="list-style-type: none"> <li>• Medina 1,0,0–0,1,0–1,1,0 +1</li> <li>• Medina 1,1,1–0,0,1–1,0,1–0,1,1 +2</li> </ul> <p>Moreover, the presence of a bifurcation angle &lt;70° adds one additional point</p>
Step 6	Aorto-ostial lesion	The presence of aorto-ostial lesion segments adds one additional point
Step 7	Severe tortuosity	The presence of severe tortuosity proximal of the diseased segment adds two additional points
Step 8	Lesion length	Lesion length >20 mm adds one additional point
Step 9	Calcification	The presence of heavy calcification adds two additional points
Step 10	Thrombus	The presence of thrombus adds one additional point
Step 11	Diffuse disease/ small vessels	The presence of diffusely diseased and narrowed segments distal to the lesion (i.e. when at least 75% of the length of the segment distal to the lesion has a vessel diameter <2 mm) adds one point per segment number

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SYNTAX = Synergy between Percutaneous Coronary Intervention with TAXUS and Cardiac Surgery.

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# La coronarographie : aspects pratiques

- Programme B2 (B1 n'existe plus), B2 sans B3, B2 avec B3 (chir. cardiaque)
- Infrastructure : matériel, personnel, disponibles
- Hôpital avec service des urgences, USI, salle d'op., labo
- Disponibilité 24h/24h et 365 jrs/an
- Aspects économiques :
  - honoraires (APR DRG à basse variabilité)
  - disponibles / stents : forfaits
- Contrôles de qualité sur les indications : souhaitables !  
En attente....

## Recommendations for decision-making and patient information in the elective setting

Recommendations	Class <sup>a</sup>	Level <sup>b</sup>
It is recommended that patients undergoing coronary angiography are informed about benefits and risks, as well as potential therapeutic consequences, ahead of the procedure.	I	C
It is recommended that patients are adequately informed about short- and long-term benefits and risks of the revascularization procedure with information about local experience, and allowed enough time for informed decision-making.	I	C
It is recommended that institutional protocols are developed by the Heart Team to implement the appropriate revascularization strategy in accordance with current Guidelines.	I	C
In PCI centres without on-site surgery, it is recommended that institutional protocols are established with partner institutions providing cardiac surgery.	I	C

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PCI = percutaneous coronary intervention.

<sup>a</sup>Class of recommendation.

<sup>b</sup>Level of evidence.

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## Indications for revascularization in patients with stable angina or silent ischaemia

Extent of CAD (anatomical and/or functional)		Class <sup>a</sup>	Level <sup>b</sup>
<b>For prognosis</b>	Left main disease with stenosis >50%. <sup>c 68–71</sup>	I	A
	Proximal LAD stenosis >50%. <sup>c 62,68,70,72</sup>	I	A
	Two- or three-vessel disease with stenosis >50% with impaired LV function (LVEF ≤35%). <sup>c 61,62,68,70,73–83</sup>	I	A
	Large area of ischaemia detected by functional testing (>10% LV) or abnormal invasive FFR. <sup>d 24,59,84–90</sup>	I	B
	Single remaining patent coronary artery with stenosis >50%. <sup>c</sup>	I	C
<b>For symptoms</b>	Haemodynamically significant coronary stenosis <sup>c</sup> in the presence of limiting angina or angina equivalent, with insufficient response to optimized medical therapy. <sup>e 24,63,91–97</sup>	I	A

CAD = coronary artery disease; FFR = fractional flow reserve; iwFR = instantaneous wave-free ratio; LAD = left anterior descending coronary artery; LV = left ventricular; LVEF = left ventricular ejection fraction.

<sup>a</sup>Class of recommendation.

<sup>b</sup>Level of evidence.

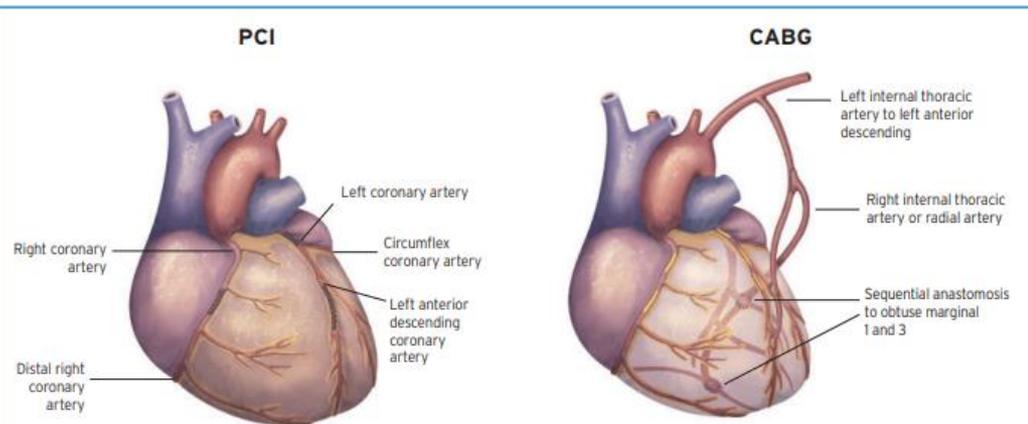
<sup>c</sup>With documented ischaemia or a haemodynamically relevant lesion defined by FFR ≤0.80 or iwFR ≤0.89 (see section 3.2.1.1), or >90% stenosis in a major coronary vessel.

<sup>d</sup>Based on FFR <0.75 indicating a prognostically relevant lesion (see section 3.2.1.1).

<sup>e</sup>In consideration of patient compliance and wishes in relation to the intensity of anti-anginal therapy.

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### FAVOURS PCI

#### Clinical characteristics

Presence of severe co-morbidity (not adequately reflected by scores)

Advanced age/frailty/reduced life expectancy

Restricted mobility and conditions that affect the rehabilitation process

#### Anatomical and technical aspects

MVD with SYNTAX score 0-22

Anatomy likely resulting in incomplete revascularization with CABG due to poor quality or missing conduits

Severe chest deformation or scoliosis

Sequelae of chest radiation

Porcelain aorta\*

### FAVOURS CABG

#### Clinical characteristics

Diabetes

Reduced LV function (EF  $\leq$ 35%)

Contraindication to DAPT

Recurrent diffuse in-stent restenosis

#### Anatomical and technical aspects

MVD with SYNTAX score  $\geq$ 23

Anatomy likely resulting in incomplete revascularization with PCI

Severely calcified coronary artery lesions limiting lesion expansion

#### Need for concomitant interventions

Ascending aortic pathology with indication for surgery

Concomitant cardiac surgery

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CABG = coronary artery bypass grafting; Cx = circumflex; DAPT = dual antiplatelet therapy; EF = ejection fraction; LAD = left anterior descending coronary artery; LIMA = left internal mammary artery; LV = left ventricular; MVD = multivessel coronary artery disease; PCI = percutaneous coronary intervention; PDA = posterior descending artery; RA = radial artery; RIMA = right internal mammary artery; SYNTAX = Synergy between Percutaneous Coronary Intervention with TAXUS and Cardiac Surgery.  
\*Consider no-touch off-pump CABG in case of porcelain aorta.

**Figure 3** Aspects to be considered by the Heart Team for decision-making between percutaneous coronary intervention and coronary artery bypass grafting among patients with stable multivessel and/or left main coronary artery disease.

453596 453600 Coronarographie digitale par cathétérisme cardiaque avec minimum deux séquences filmées par pontage N 886

*"A.R. 26.10.2011" (en vigueur 1.1.2012)*

"Une angiographie du ventricule gauche avec ou sans l'aorte thoracique, y compris le cathétérisme cardiaque gauche et le calcul de la fraction d'éjection du ventricule gauche font partie intégrante de la présente prestation excepté chez les patients dont la situation médicale ne permet pas une extension de l'examen. Pour ces patients, la motivation médicale pour la limitation de l'examen est conservée dans le dossier médical.

Toutes les manipulations indispensables pour effectuer les examens sont comprises dans les prestations 453574-453585 et 453596-453600.

Les prestations 453574-453585 et 453596-453600 ne sont remboursables que si elles ont été demandées et effectuées selon les "guidelines" de la "European Society of Cardiology".

En cas de cardiopathie ischémique chronique, les prestations 453574-453585 et 453596-453600 ne peuvent être portées en compte qu'après avoir effectué au moins un test préalable d'ischémie fonctionnelle du myocarde (test d'effort, écho-stress, scintigraphie de stress du myocarde) qui démontre l'ischémie.

S'il est dérogé à ces conditions, la motivation détaillée est conservée dans le dossier médical.

*A.R. 10.04.2016*

## Enfin ...

# Les bonnes indications d'une coronarographie

- Syndromes coronariens aigus : STEMI, N-STEMI, angor instable
- Angor stable avec preuves d'ischémie myocardique (cf. art. 17)
- Ischémie silencieuse avec preuves d'ischémie myocardique
  - Bilan préopératoire (procédures majeures à haut risque)
  - Diabète II ? IRC ?
- Absence de contre-indications

**Primum non nocere**

**Priorité sur la qualité ./ . quantité des examens**



# A stepwise approach

**Step 1:** Urgent surgery

**Step 2:** Active or unstable cardiac conditions

**Step 3:** What is the risk of the surgical procedure?

**Step 4:** What is the functional capacity of the patient?

**Step 5:** In patients with poor low functional capacity:  
consider the risk of surgical procedure

**Step 6:** Consider cardiac risk factors

**Step 7:** Consider non invasive testing

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doi:10.1093/eurheartj/ehu282



**Step 1 - Urgent surgery** → **NO** → **Step 2**

**YES**

Patient or surgical specific factors dictate the strategy and do not allow further cardiac testing: the consultant provides recommendations on peri-operative management, surveillance for cardiac events and continuation of chronic CV medical treatment.

**Surgery**

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European Heart Journal (2014) 35, 2383–2431  
doi:10.1093/eurheartj/ehu282



## Step 2 - Active or unstable cardiac condition(s):

• Unstable angina pectoris
• Acute heart failure
• Significant cardiac arrhythmias
• Symptomatic valvular heart disease
• Recent myocardial infarction <sup>a</sup> and residual myocardial ischemia

→ **No** → **Step 3**

**Yes**

- Postpone the procedure
- Treatment options should be discussed in a multi-disciplinary team involving **all** peri-operative care physicians

**Surgery**

[www.escardio.org/guidelines](http://www.escardio.org/guidelines)

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## Step 3 - Risk of surgical procedure: 30-day CV death and MI

Low-risk: < 1%	Intermediate-risk: 1-5%	High-risk: > 5%
<ul style="list-style-type: none"> <li>• Superficial surgery</li> <li>• Breast</li> <li>• Dental</li> <li>• Endocrine: thyroid</li> <li>• Eye</li> <li>• Reconstructive</li> <li>• Carotid asymptomatic (CEA or CAS)</li> <li>• Gynecology: minor</li> <li>• Orthopaedic: minor (meniscectomy)</li> <li>• Urological: minor (transurethral resection of the prostate)</li> </ul>	<ul style="list-style-type: none"> <li>• Intra-peritoneal: splenectomy, hiatal hernia repair, cholecystectomy</li> <li>• Carotid symptomatic (CEA or CAS)</li> <li>• Peripheral arterial angioplasty</li> <li>• Endovascular aneurysm repair</li> <li>• Head and neck surgery</li> <li>• Neurological or orthopaedic: major (hip and spine surgery)</li> <li>• Urological or gynaecological: major</li> <li>• Renal transplant</li> <li>• Intra-thoracic: non-major</li> </ul>	<ul style="list-style-type: none"> <li>• Aortic and major vascular surgery</li> <li>• Open lower limb revascularization or amputation or thrombo-embolectomy</li> <li>• Duodeno-pancreatic surgery</li> <li>• Liver resection, bile duct surgery</li> <li>• Oesophagectomy</li> <li>• Repair of perforated bowel</li> <li>• Adrenal resection</li> <li>• Total cystectomy</li> <li>• Pneumonectomy</li> <li>• Pulmonary or liver transplant</li> </ul>

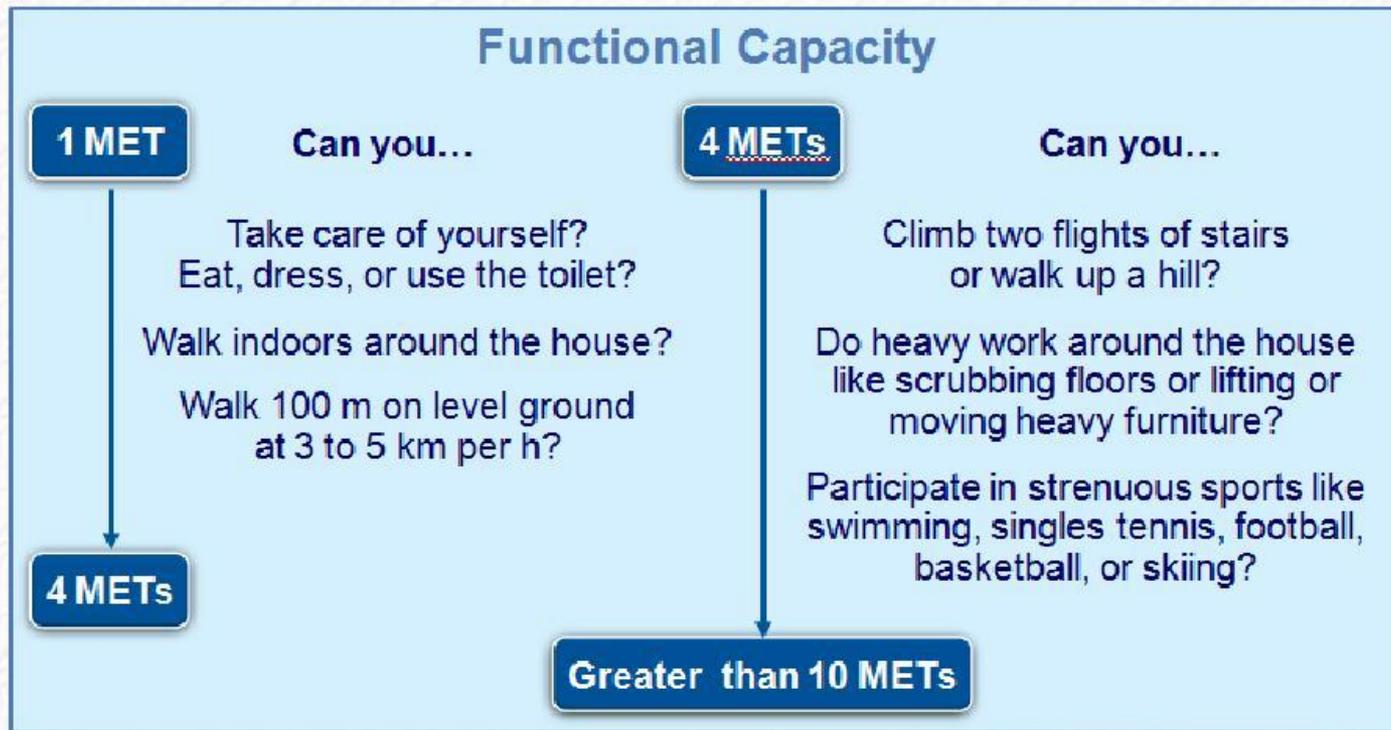
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# Step 4 - Functional capacity of the patient scheduled for intermediate or high-risk surgery



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doi:10.1093/eurheartj/ehu282



## Step 4 - Functional capacity of the patient scheduled for intermediate or high-risk surgery

Good ( $\geq 4$  METS)

Moderate or poor ( $< 4$  METS)

Step 5

Recommendations	Class	Level
In patients with known IHD or myocardial <u>ischaemia</u> , initiation of a titrated low-dose beta-blocker regimen may be considered before surgery.	IIb	B
In patient with heart failure and systolic dysfunction, ACEI should be considered before surgery.	IIa	C
In patients undergoing vascular surgery, initiation of statin therapy should be considered.	IIa	B

Surgery

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## Step 5 - In patients with functional capacity <4 METS consider risk of surgery

Intermediate risk surgery

High risk surgery

Step 6

Recommendations	Class	Level
In patients with one or more clinical risk factors <u>non-invasive testing</u> may be considered.	IIb	B
In patients with one or more clinical risk factors <u>baseline ECG</u> is recommended.	I	C

Surgery

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## Step 6

# Clinical risk factors

- Ischaemic heart disease (angina pectoris and/or previous myocardial infarction<sup>a</sup>)
- Heart failure
- Stroke or transient ischaemic attack
- Renal dysfunction (serum creatinine  $>170 \mu\text{mol/L}$  or  $2 \text{ mg/dL}$  or a creatinine clearance of  $<60 \text{ mL/min/1.73 m}^2$ )
- Diabetes mellitus requiring insulin therapy

<sup>a</sup> According to the universal definition of myocardial infarction

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# Step 6

## Cardiac risk factors in high-risk surgery

1. Ischaemic heart disease
2. Heart failure
3. Stroke or TIA
4. Renal dysfunction
5. Diabetes mellitus

Recommendations	Class	Level
<b>Number of risk factors <math>\leq 2</math></b> Rest <b>echocardiography</b> and biomarkers for evaluation of LV function may be considered.	<b>IIb</b>	<b>B-C</b>

Surgery

Number of risk factors  $\geq 3$

Step 7

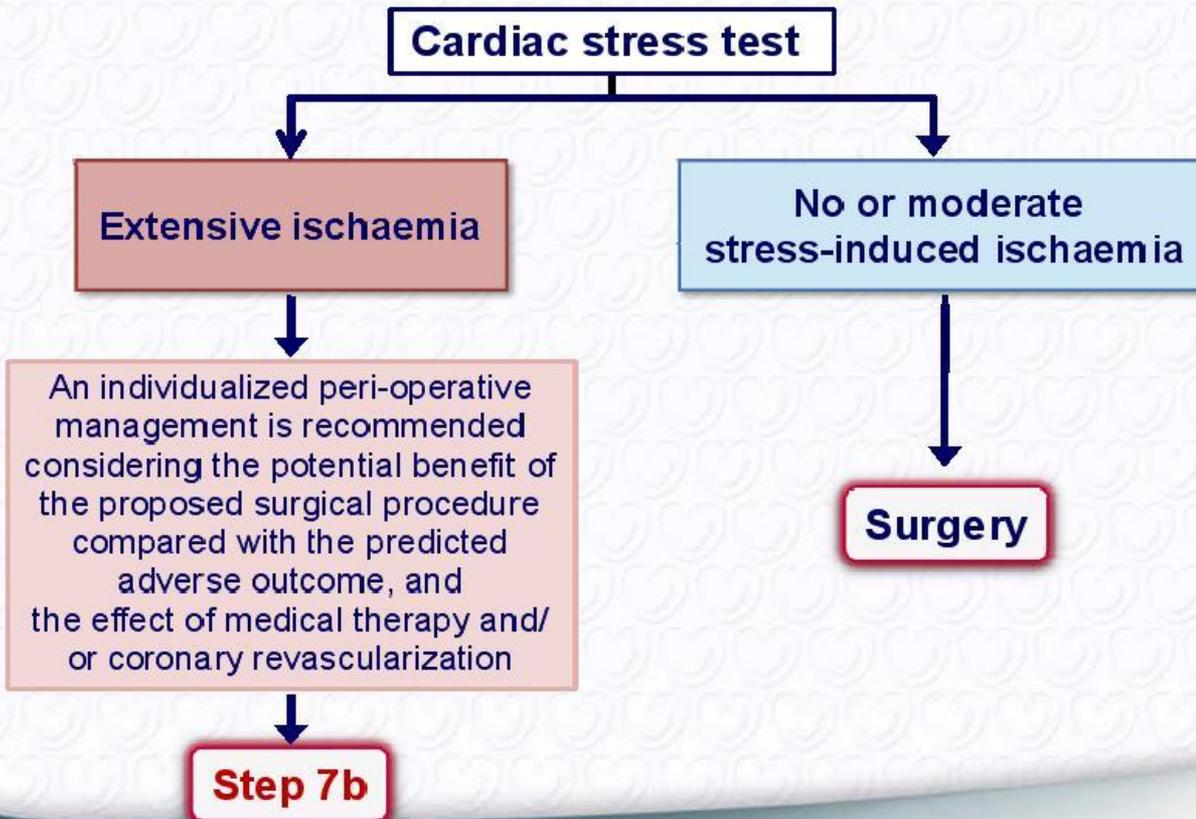
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## Step 7 – Pre-operative testing

Consider also for patient counselling, surgery, and anaesthesia technique

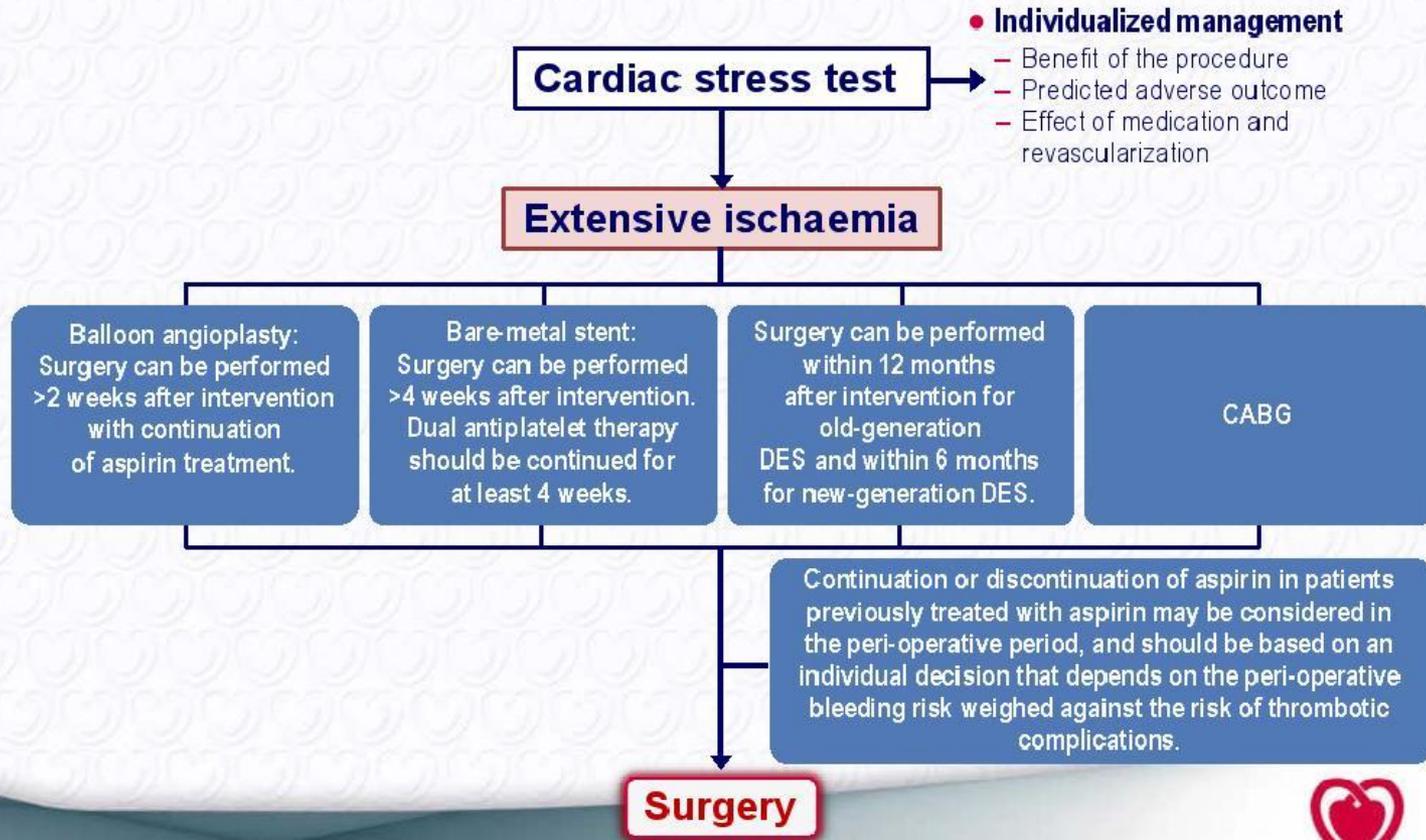


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## Step 7b Extensive stress induced ischaemia



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# Place des différentes techniques non invasives en clinique courante

	Maladie coronaire		Fonction VG	Valvulopathie	Pathol. congénitale	Effets secondaires
	Diagnostic	Viabilité				
ECG effort	+	-	(+)	(+)	-	(-)
Méd. Nucléaire*	+	+	+	-	-	* T
CT scan*	+	(+)	+	+	(+)	*
RMN	-	+	(+)	+	+	T
Echo TT	-	(+)	+	+	+	-
Echo OE	-	-	(+)	++	+	±

PS : imagerie + ex. clinique + symptômes (+ tolérance à l'effort, qualité de vie)  
 + comorbidités : approche intégrée !

**Table 20 Risk stratification by invasive or non-invasive coronary arteriography in patients with stable coronary artery disease**

Recommendations	Class <sup>a</sup>	Level <sup>b</sup>
ICA (with FFR when necessary) is recommended for risk stratification in patients with severe stable angina (CCS 3) or with a clinical profile suggesting a high event risk, particularly if the symptoms are inadequately responding to medical treatment.	I	C
ICA (with FFR when necessary) is recommended for patients with mild or no symptoms with medical treatment in whom non-invasive risk stratification indicates a high event risk and revascularisation is considered for improvement of prognosis.	I	C
ICA (with FFR when necessary) should be considered for event risk stratification in patients with an inconclusive diagnosis on non-invasive testing, or conflicting results from different non-invasive modalities.	IIa	C
If coronary CTA is available for event risk stratification, possible overestimation of stenosis severity should be considered in segments with severe calcification, especially in patients at high intermediate PTP. Additional stress imaging may be necessary before referring a patient with few/no symptoms to ICA.	IIa	C

CCS = Canadian Cardiovascular Society; CTA = computed tomography angiography; FFR = fractional flow reserve; ICA = invasive coronary angiography; PTP = pre-test probability; SCAD = stable coronary artery disease.

<sup>a</sup> Class of recommendation.

<sup>b</sup> Level of evidence.

*ESC Guidelines 2013; 34 : 2949-3003*