IX° Rencontre Franco-Suisse de Cardiologie de l'ACCT
2 - 5 février 2015, Zermatt, Suisse

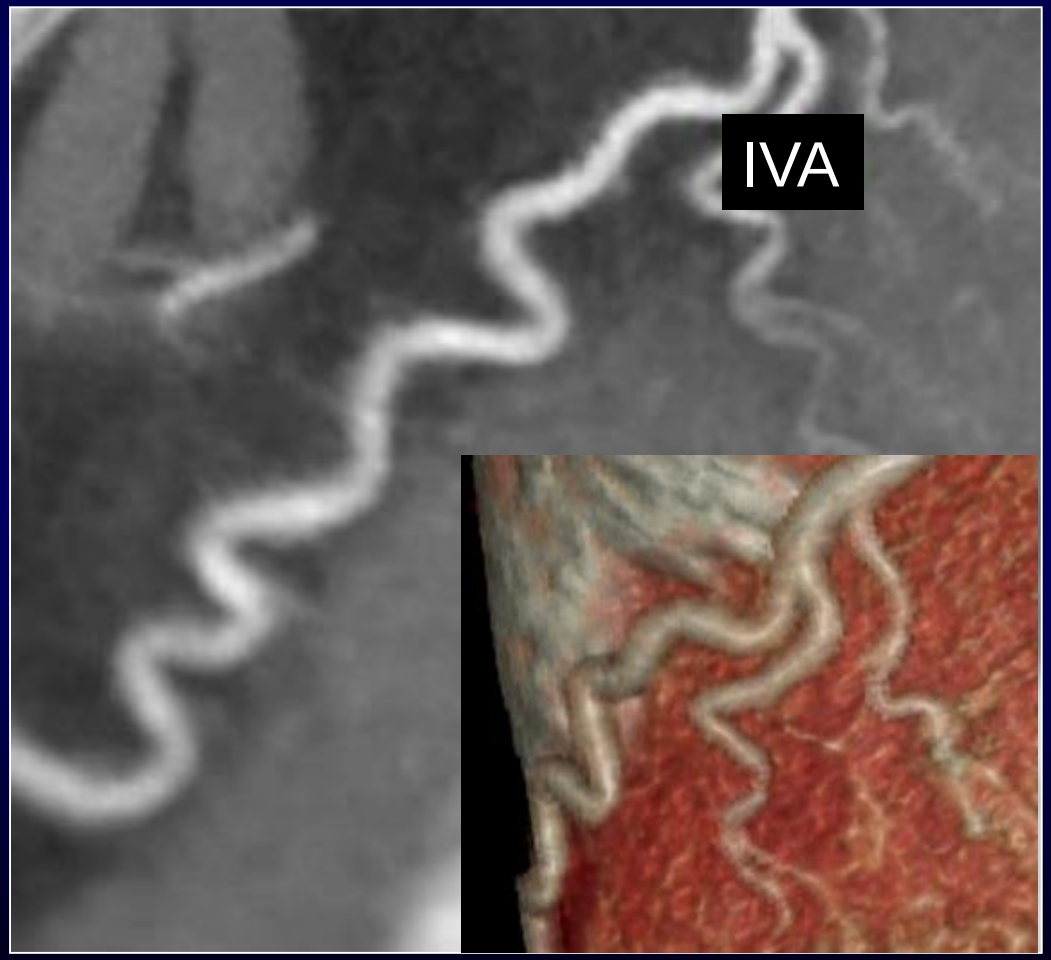
Ponts musculaires
et
Anomalies de connexion des artères coronaires

Pierre Aubry
Centre Hospitalier Bichat (Paris)
Centre Hospitalier de Gonesse (Gonesse)

Groupe ANOCOR
(ANOmalies de connexion proximale des artères CORonaires)

Ponts musculaires


IVA

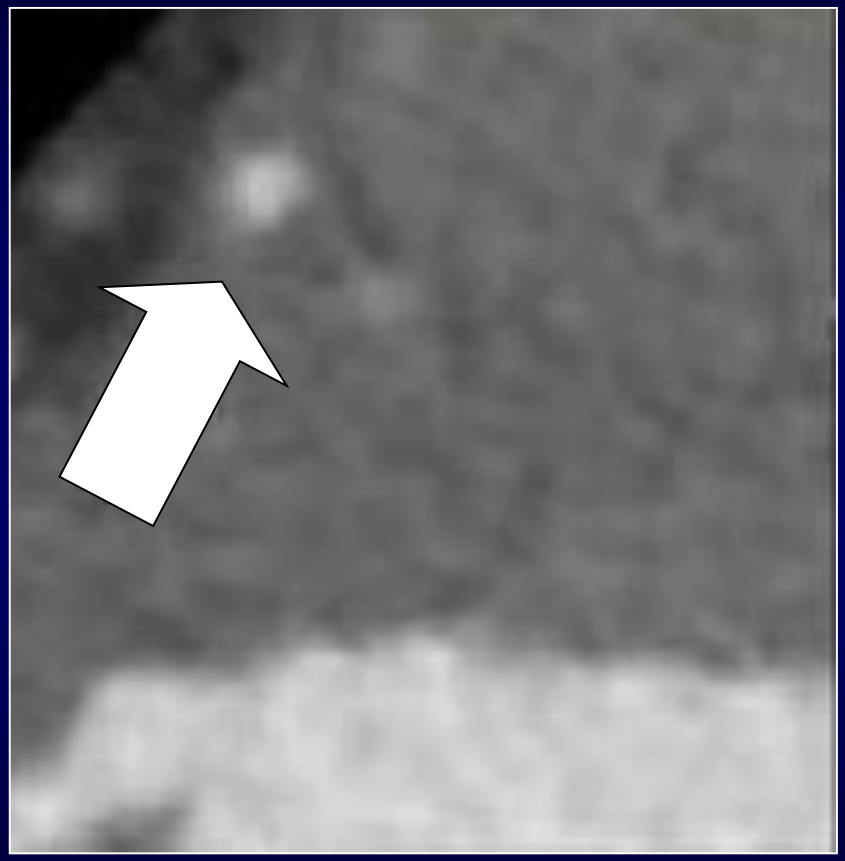

IVA

Ponts musculaires

Ponts musculaires

Trajets segmentaires intramyocardiques

Trajets segmentaires intramyocardiques



Trajets segmentaires intramyocardiques

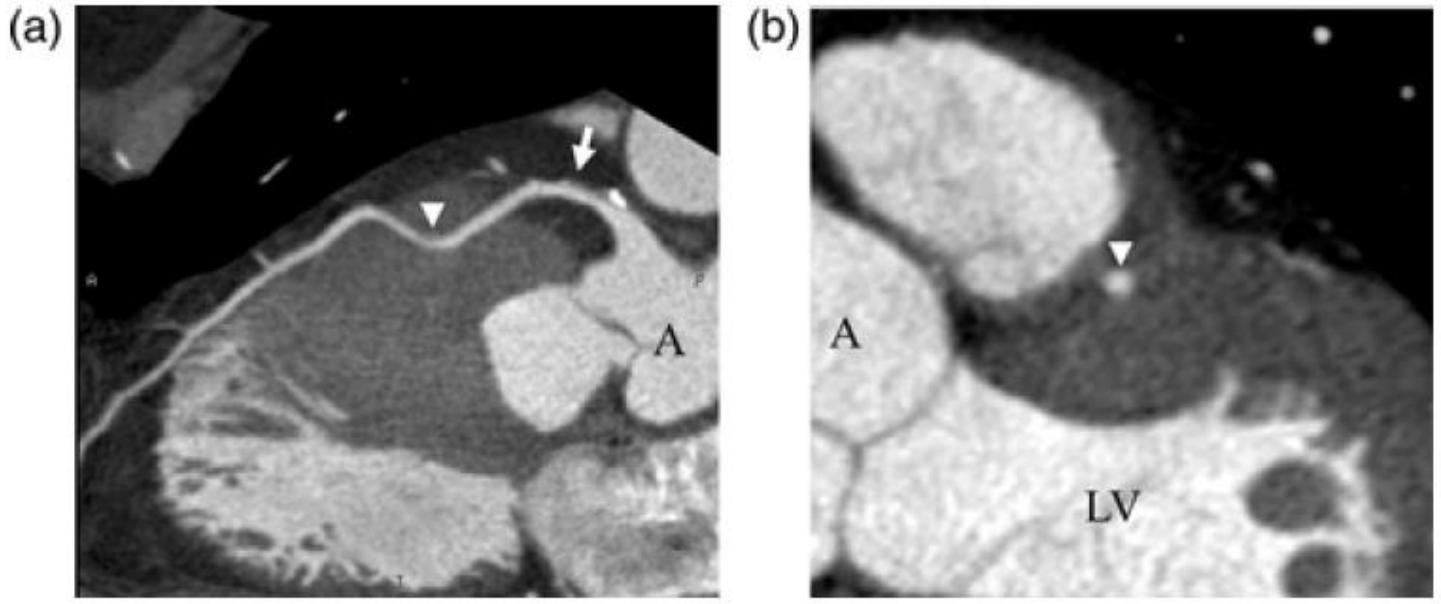
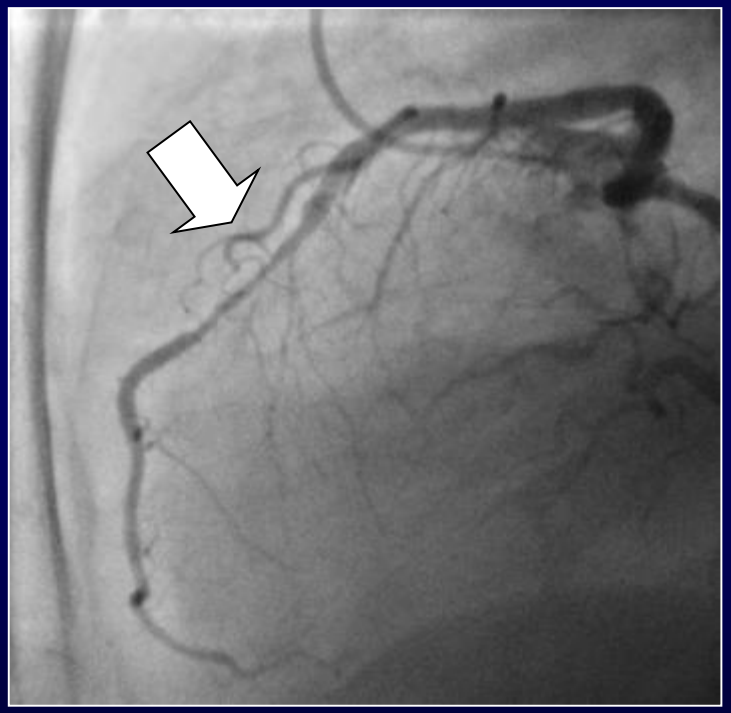


Fig. 3 64-slice mutidetector CT coronary angiography images of a myocardial bridge. Curved reformatted (a) and true short axial (b) images of the left anterior descending artery (arrow) show tunneled 3 cm coronary artery segment in the mid LAD which is surrounded by thick myocardium (arrowhead). A = aorta, LV = left ventricle

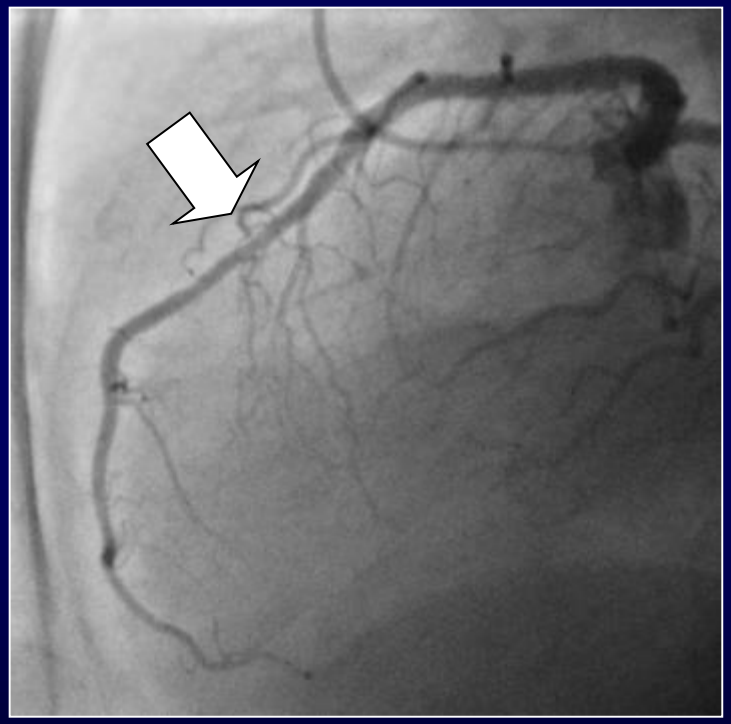
Prévalence

- Anatomique 25-80%
- Angiographique (coronarographie) 1-15%
- Angiographique (scanner coronaire) 20-30%

Angiographie



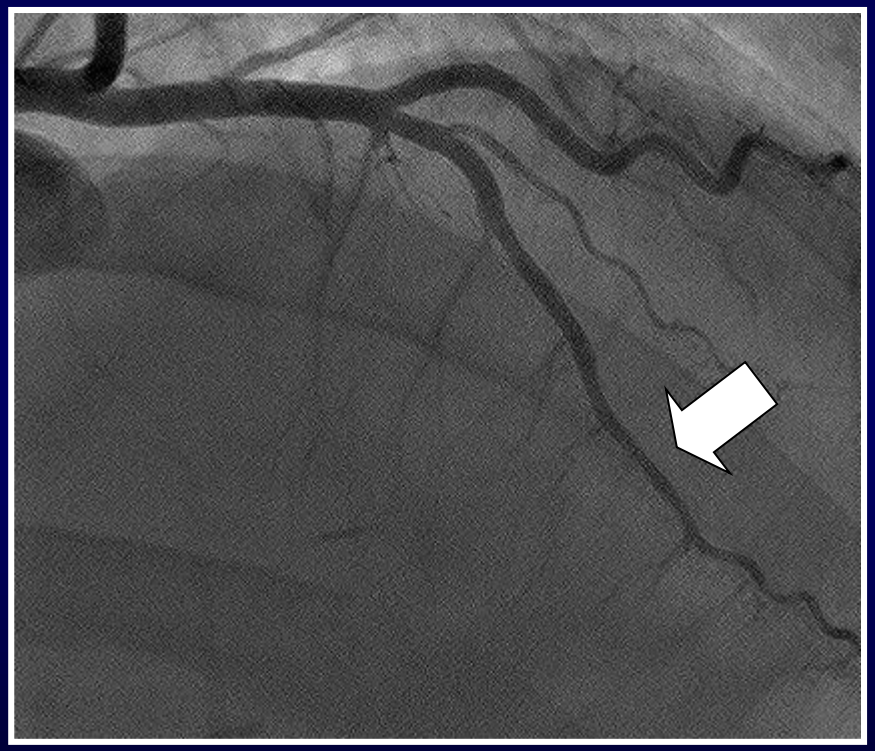
systole



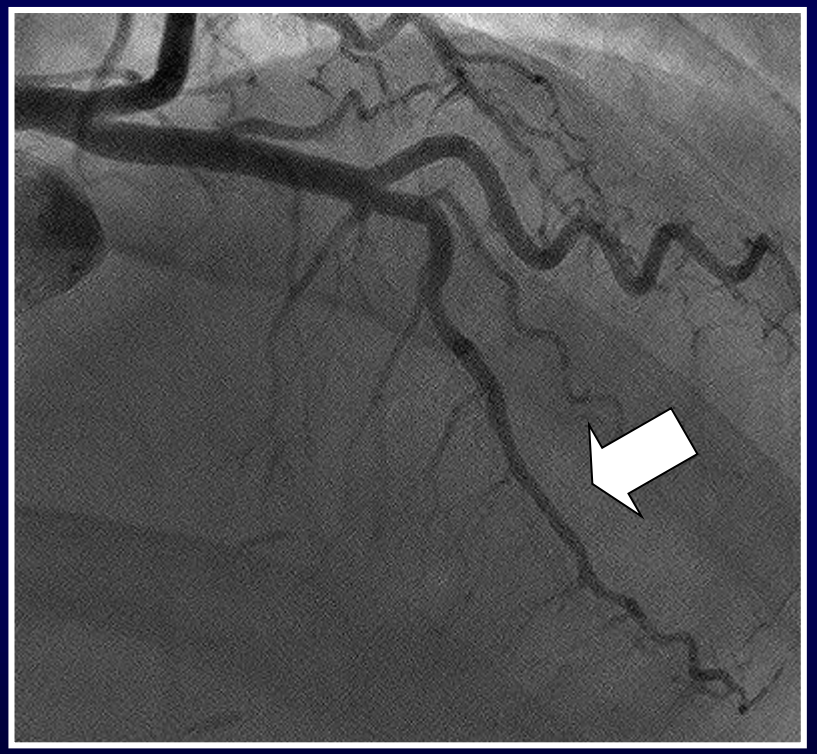
diastole

Trajets segmentaires intramyocardiques

Angiographie

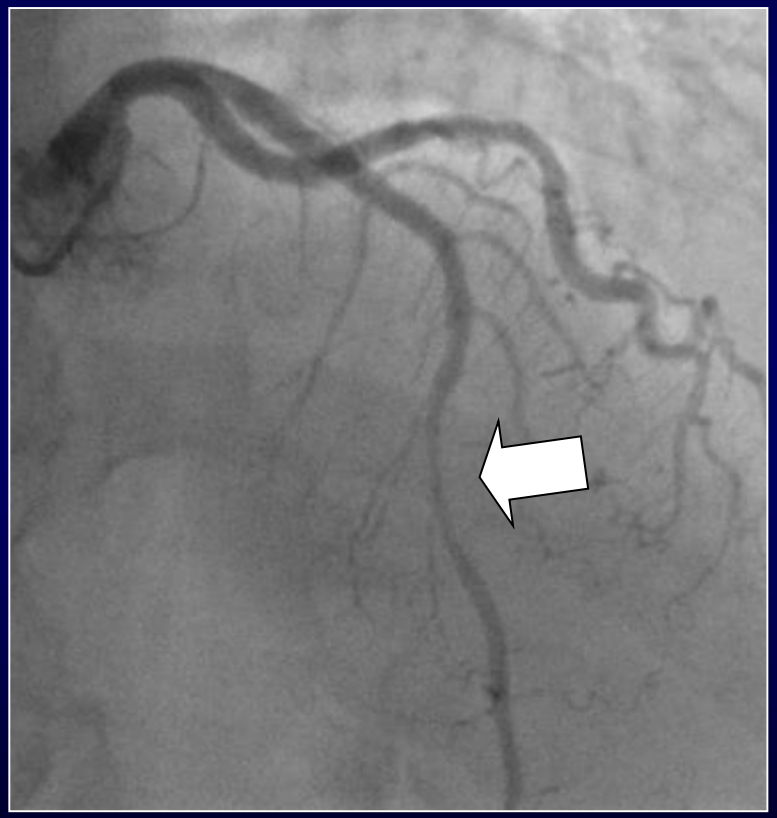


diastole

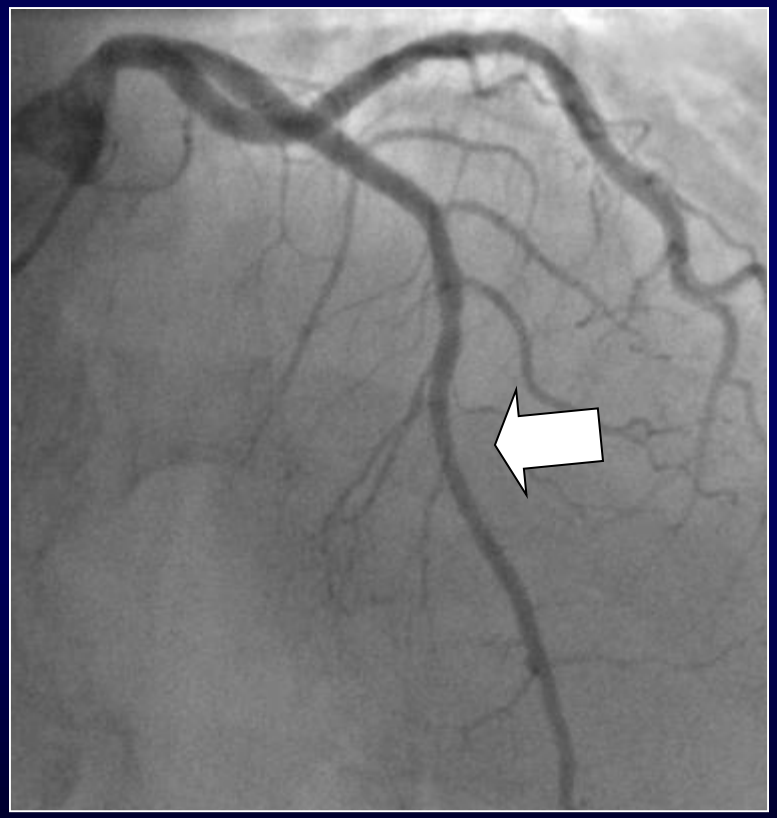


systole

Angiographie après nitrés



systole

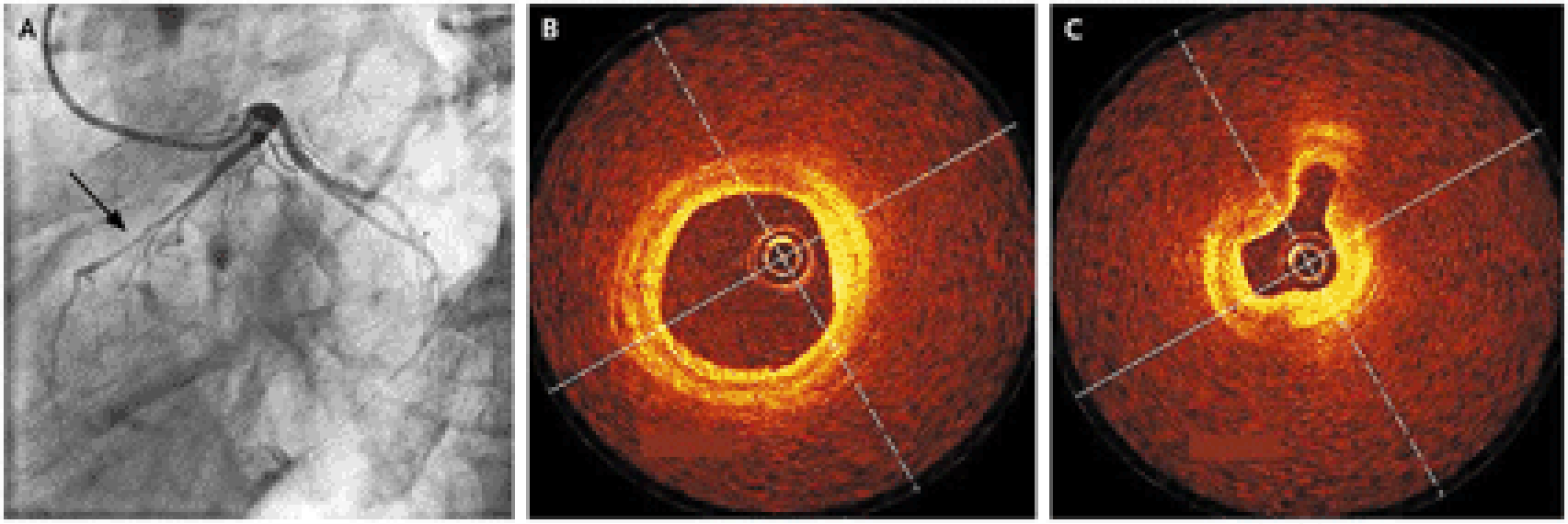


diastole

Effets des nitrés

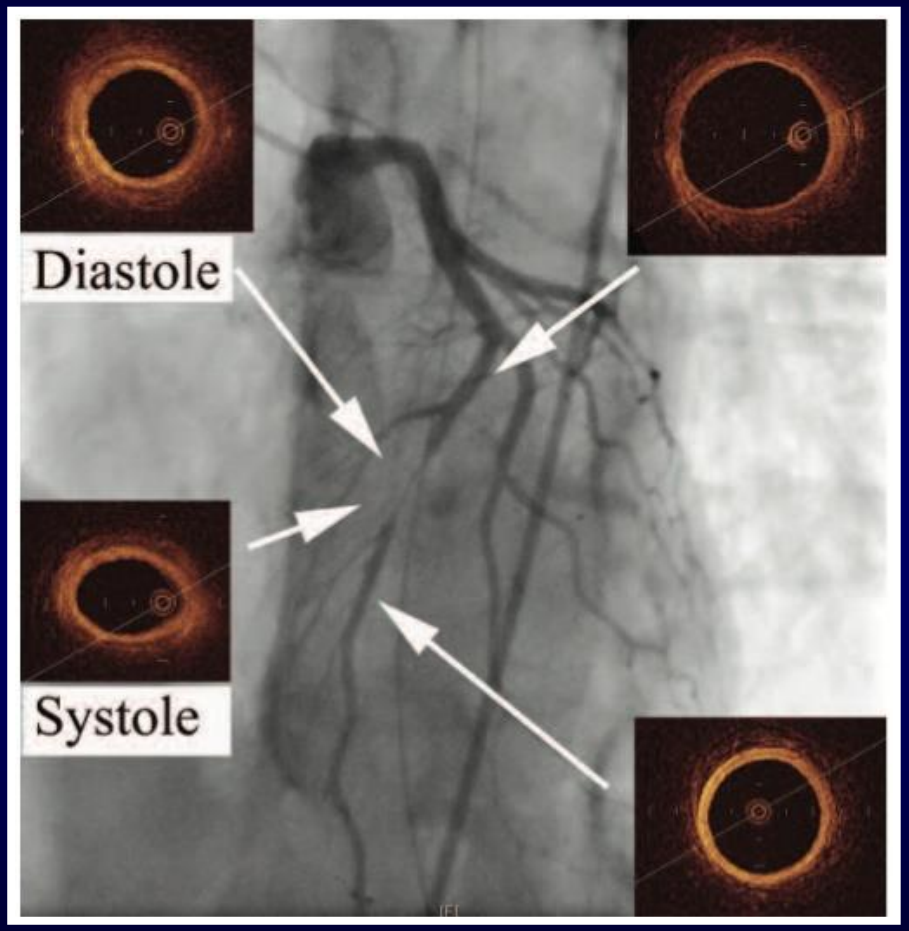
majoration de la réduction luminale systolique

- Diminution de la tension pariétale coronaire
- Diminution de la pression intraluminale coronaire
- Augmentation de la contractilité (réflexe sympathique)


A
B
C

Trajets segmentaires intramyocardiques

Imagerie endocoronaire



Mizuno A. et al. J Inv Cardio 2012

Classification

- Particularité anatomique toujours bénigne ?
- Anomalie congénitale parfois à risque ?

Signification clinique

Analyse de la littérature

Cas cliniques ou petites séries

- Angor typique ou atypiques
- Infarctus du myocarde
- Tachycardie ventriculaire
- Mort subite

Management

Recommandations sur les cardiopathies congénitales nord-américaines (2008) - européennes (2010)

Aucune information

Management

- Bilan exhaustif cardiaque
- Recherche d’une ischémie myocardique
- Bétabloquants
- Stenting
- Chirurgie

Management

- Bilan exhaustif cardiaque
- Recherche d’une ischémie myocardique
- Bétabloquants
- Stenting
- Chirurgie

Stenting

Tsujita K. et al. Am J Cardiol 2009

- LAD with muscular bridge (n = 70)
- Stenting of LAD atherosclerotic lesion
- Stent extended into the muscular bridge segment (n = 24)
- TLR at 1 year : 24%
- Stent non extended into the muscular bridge segment (n = 46)
- TLR at 1 year : 3%

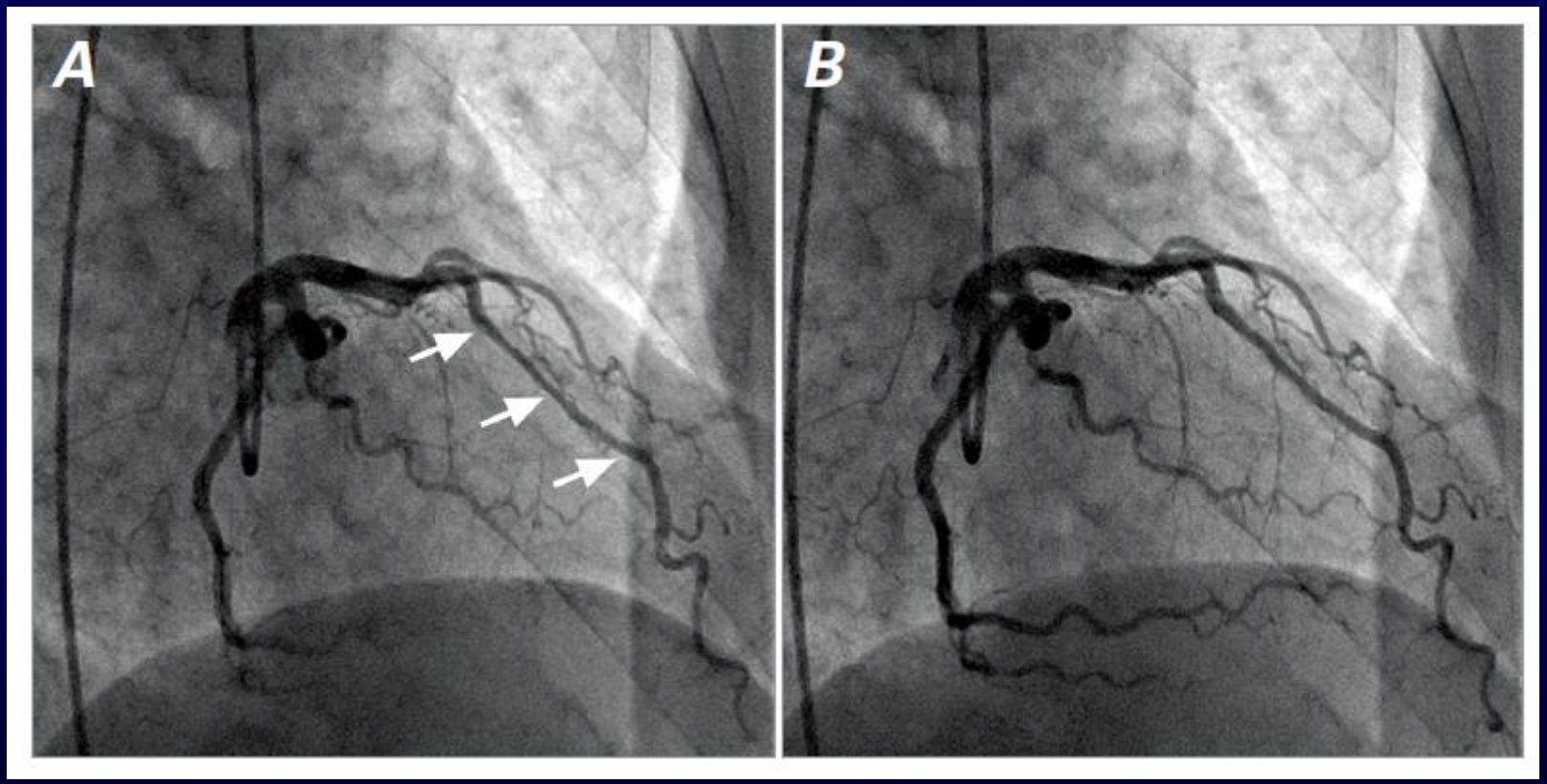
Ernst A. et al. J Invas Cardio 2013

- 15 consecutive stenting for symptomatic muscular bridge
- Intervention with DES
- 1-year clinical follow-up
- TLR : 19%

Trajets intramyocardiques

Chirurgie

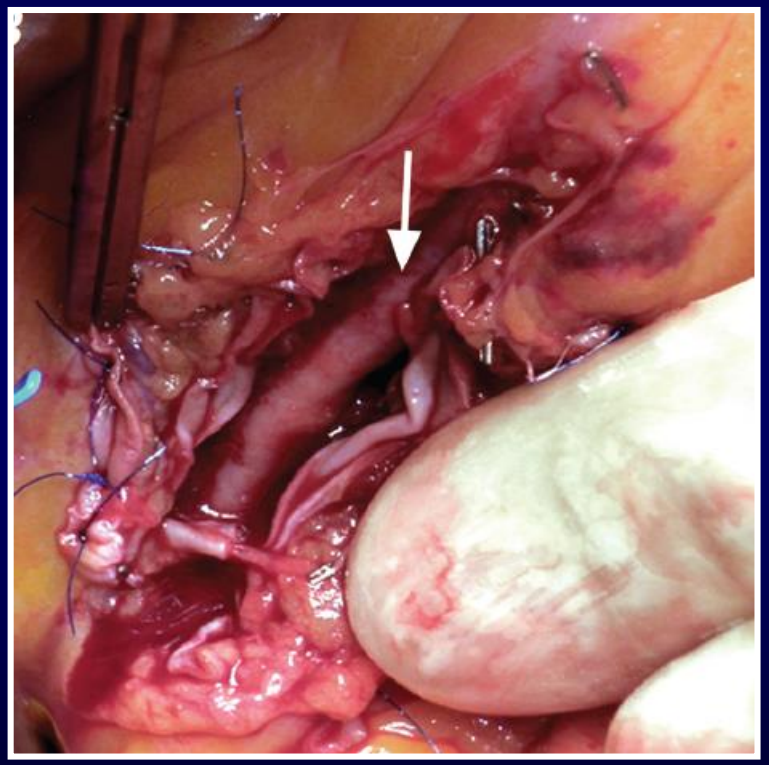
Onan B. et al. Tex Heart J 2012

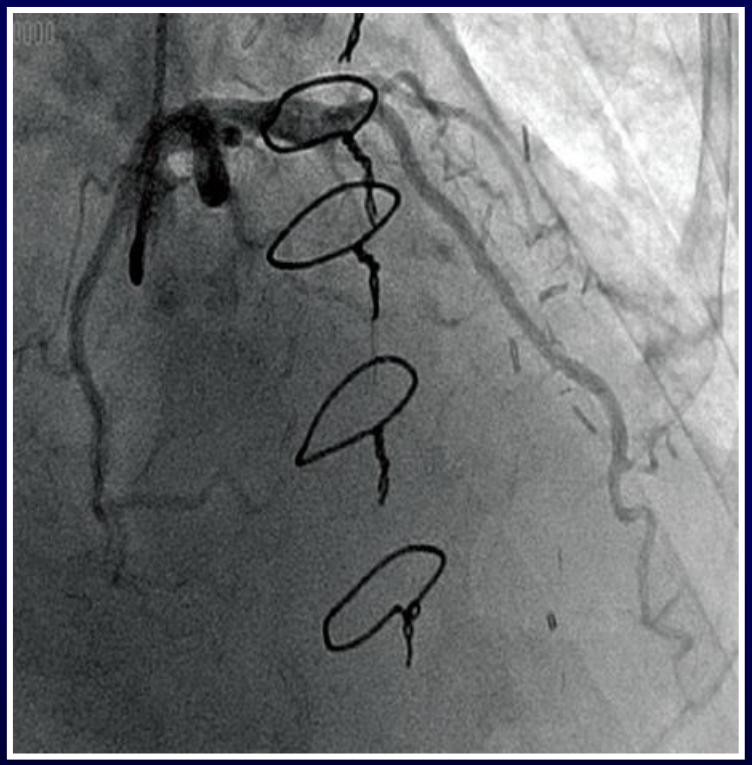


systole diastole

Chirurgie

Onan B. et al. Tex Heart J 2012





systole

Trajets intramyocardiques

Evénement cardiaque fréquent
(douleur thoracique suspecte)
associé à une particularité anatomique fréquente
(pont musculaire)

- Lien statistique
- Lien de causalité ?
- Lien de confusion ?

Myocardial bridging of the coronary arteries

Sorajja P. et al 2013

« Because of the wide variations in morphology and clinical presentations seen in patients with myocardial bridging, a large registry of such patients is needed to develop a better understanding of outcome and management »

Anomalies de connexion des artères coronaires chez l'adulte

anoCor

25 JOURNÉES EUROPÉENNES de la SOCIÉTÉ FRANÇAISE de CARDIOLOGIE

Paris, 14-17 janvier 2015

Isolated ANOmalous connections of the CORonary arteries: an observational cohort of more than 450 young people or adults (ANOCOR study)

Pierre Aubry (Paris), Xavier Halna du Fretay (Orléans), Patrick Dupouy (Antony), Guillaume Leurent (Rennes), Matthieu Godin (Rouen), Loïc Belle (Annecy), Philippe Couppie (Haguenau), Phalla Ou (Paris), Jean-Michel Juliard (Paris), on behalf of the ANOCOR investigators.

GACI

Groupe Athérome et Cardiologie Interventionnelle de la Société Française de Cardiologie

Rationale

- Rare abnormalities (5/1000 invasive CA)
- Lot of case reports
- Heterogeneous management
- Lack of established evidence-based guidelines
- Need of a risk stratification model
- Few prospective studies with large cohorts

(AAOCA / ANOCOR)

AAOCA: anomalous aortic origin of coronary artery
ANOCOR: anomalous connections of the coronary arteries
CA: coronary angiography

ANOCOR investigators

(n = 71)

GACI
Groupe Athérome et Cardiologie Interventionnelle de la Société Française de Cardiologie

Abi Khalil Wissam
Aguirre Luc
Akesbi Abdel
Aubry Pierre
Banus Yves
Belle Loïc
Benamer Hakim
Biron Yves
Boiffard Emmanuel
Bouallal Rachid
Boudvillain Olivier
Bourkaïb Ryad
Brasselet Camille
Bressollette Erwan
Brunel Philippe
Champagnac Didier
Coco Michel
Commeau Philippe
Cook Stéphane
Couppie Philippe
De Poli Fabien
Delorme Laurent
Descoutures Fleur
Didier Romain
Ducrocq Gregory
Dupouy Patrick
Durier Chloé
Gérardin Benoît
Gibault-Genty Géraldine
Gilard Martine
Godin Matthieu
Goy Jean-Jacques
El Mahmoud Rami
Estève Jean-Baptiste
Faurie Benjamin
Garbarz Eric
Georges Jean-Louis
Haffner-Debus Claire
Halna du Fretay Xavier
Hanssen Michel
Hascoet Sébastien
Jacquemin Laurent
Jeanneteau Julien
Joseph Thierry
Juliard Jean-Michel
Karsenty Bernard
Koning René
La Scala Eugénio
Leddet Pierre
Lemesle Gilles
Leurent Guillaume
Levy Raphy
Livarek Bernard
Loubeyre Christophe
Maillard Luc
Mangin Lionel
Marlière Stéphanie
Nejjari Mohammed
Ohlmann Patrick
Poulos Nabil
Py Antoine
Ranc Sylvain
Rialan Antoine
Roriz Ricardo
Rougier Pierre
Staat Patrick
Thuaire Christophe
Togni Mario
Van Rothem Jérôme
Varenne Olivier
Voudris Vassilis

Design

Diagnosis of ANOCOR by investigator

Medical report + compact discs of coronary angiography

Data center : Department of Cardiology - Bichat Hospital

Angiographic analysis committee

Enrollment in ANOCOR study

Follow-up questionnaire at 1, 3 and 5 years

Study endpoints

- Primary endpoint:
  - to determine the therapeutic strategy of diagnosed patients with ANOCOR

- Secondary endpoints:
  - to identify the circumstances of diagnosis
  - to describe the frequency of each type of ANOCOR
  - to evaluate the morbimortality in the follow-up period according to the initial therapeutic strategy

Recruited patients
n = 490

Non enrolled patients
n = 12

- 6 non ANOCOR
- 4 anatomical variants
- 1 doubloon
- 1 out of time

Non analysed patients
n = 17

?

Enrolled patients
n = 461

Angiographic analysis committee

- Patrick Dupouy
- Jean-Michel Juliard
- Jean-Pierre Laissy
- Phalla Ou

Steering committee

- Pierre Aubry
- Candice Estellat
- Reza Farnoud
- Xavier Halna du Fretay

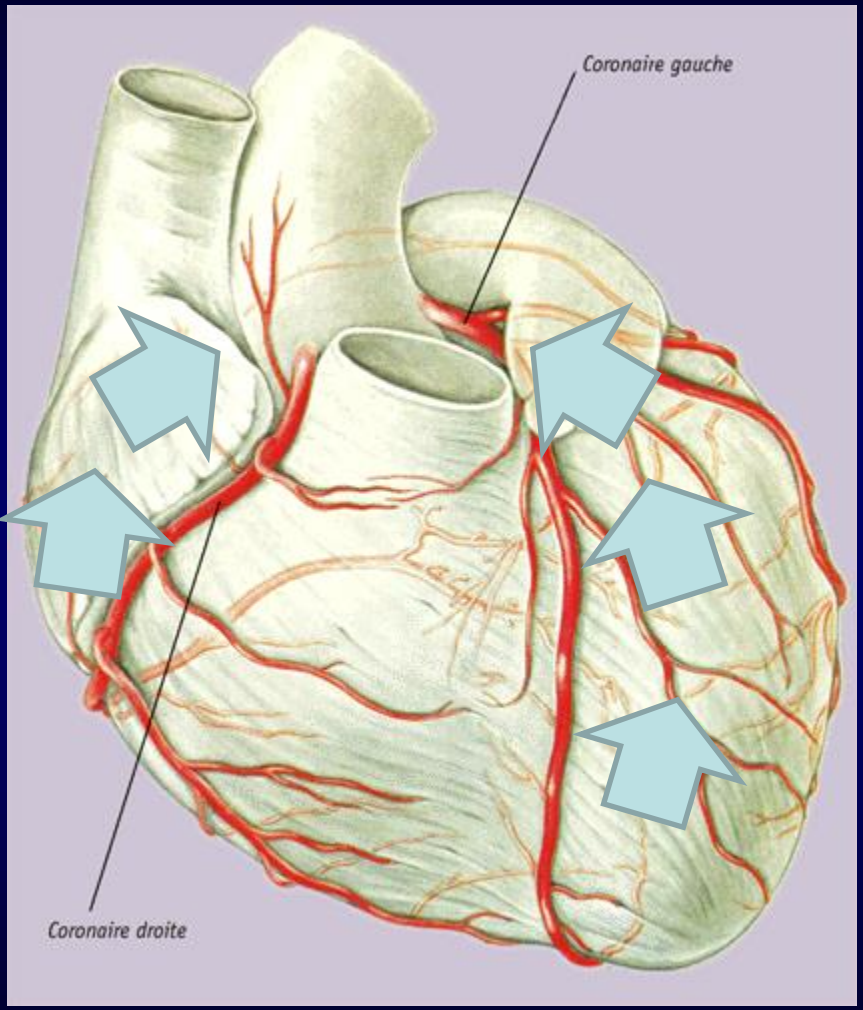
Patient characteristics

(n = 399 patients)

Gender (male/female) (n, %)	285 (71) / 114 (29)
Age (years) (mean ± SD)	64.0 ± 13.2
Age (years) (min - max)	16 - 95
Age (years) (n, %) ≤ 35 > 35	 16 (4.0) 383 (96.0)

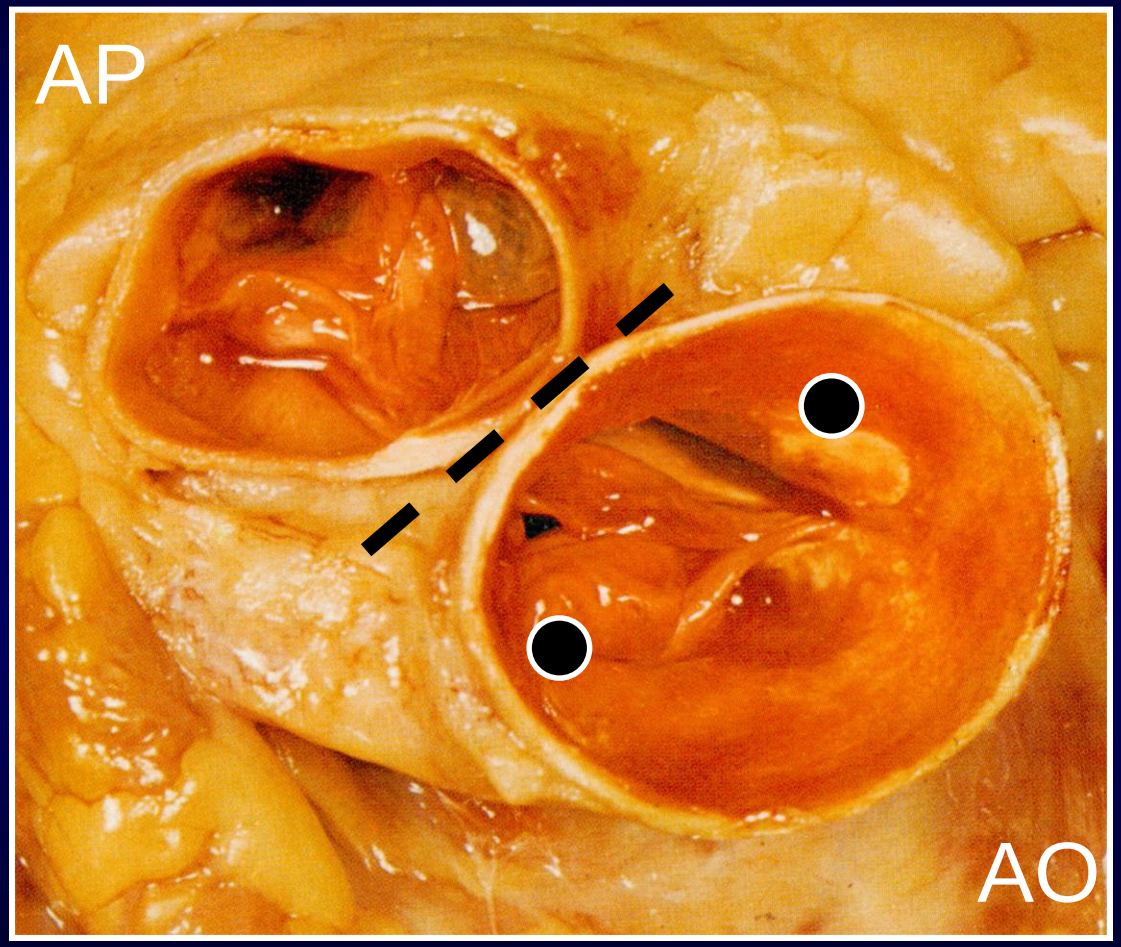
Connexion des artères coronaires

Développement centripète



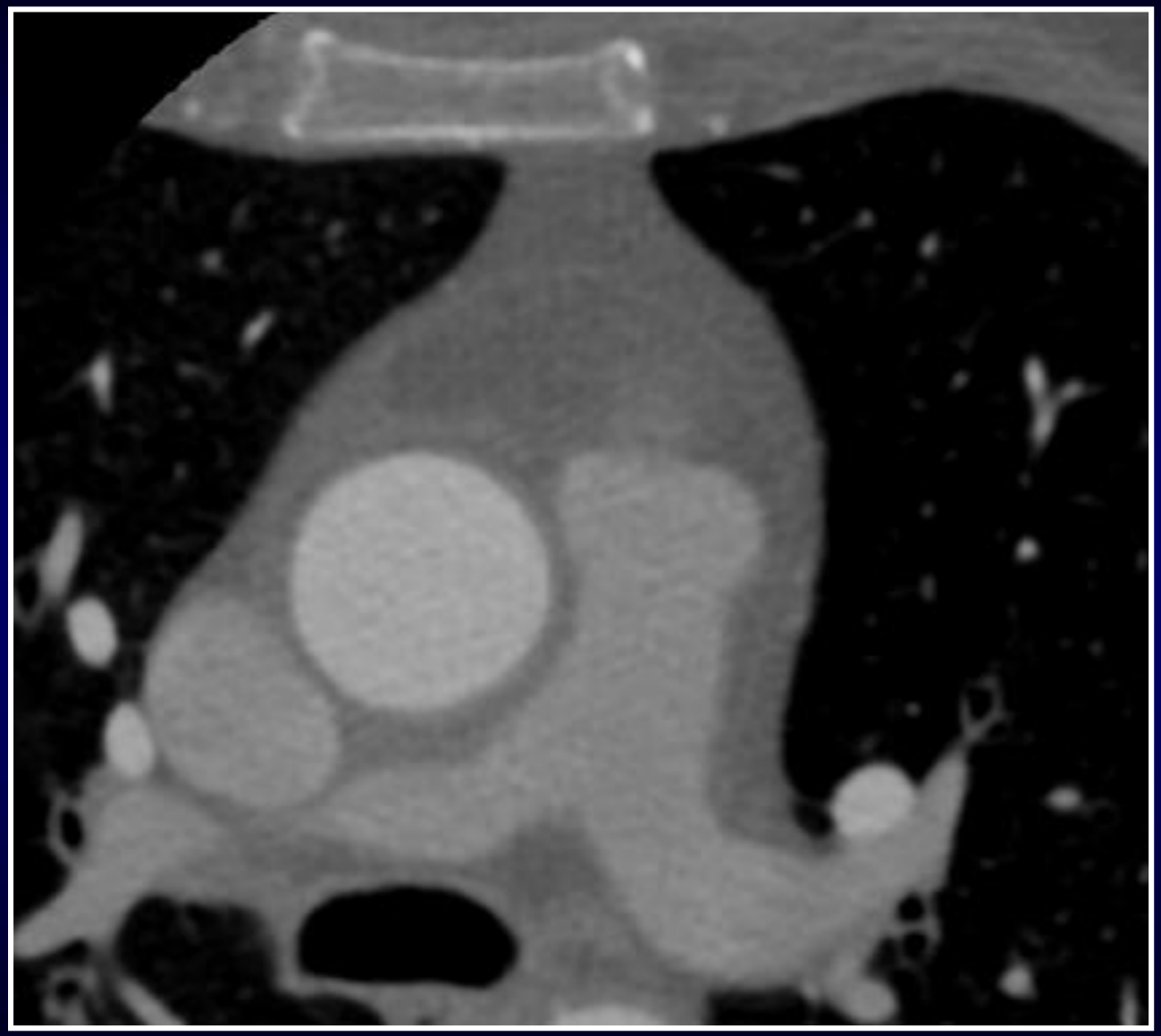
Connexion des artères coronaires

AVANT

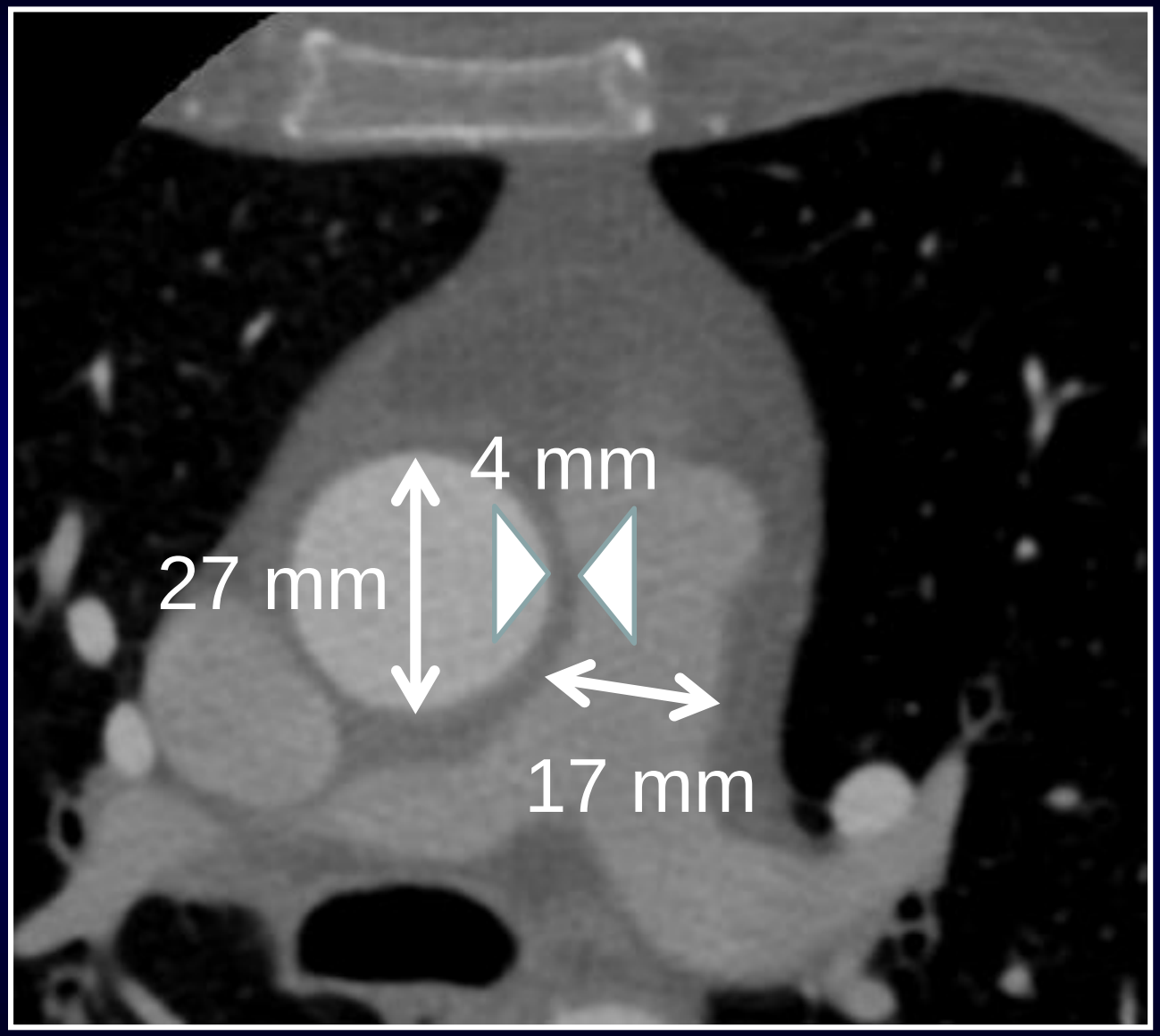


ARRIERE

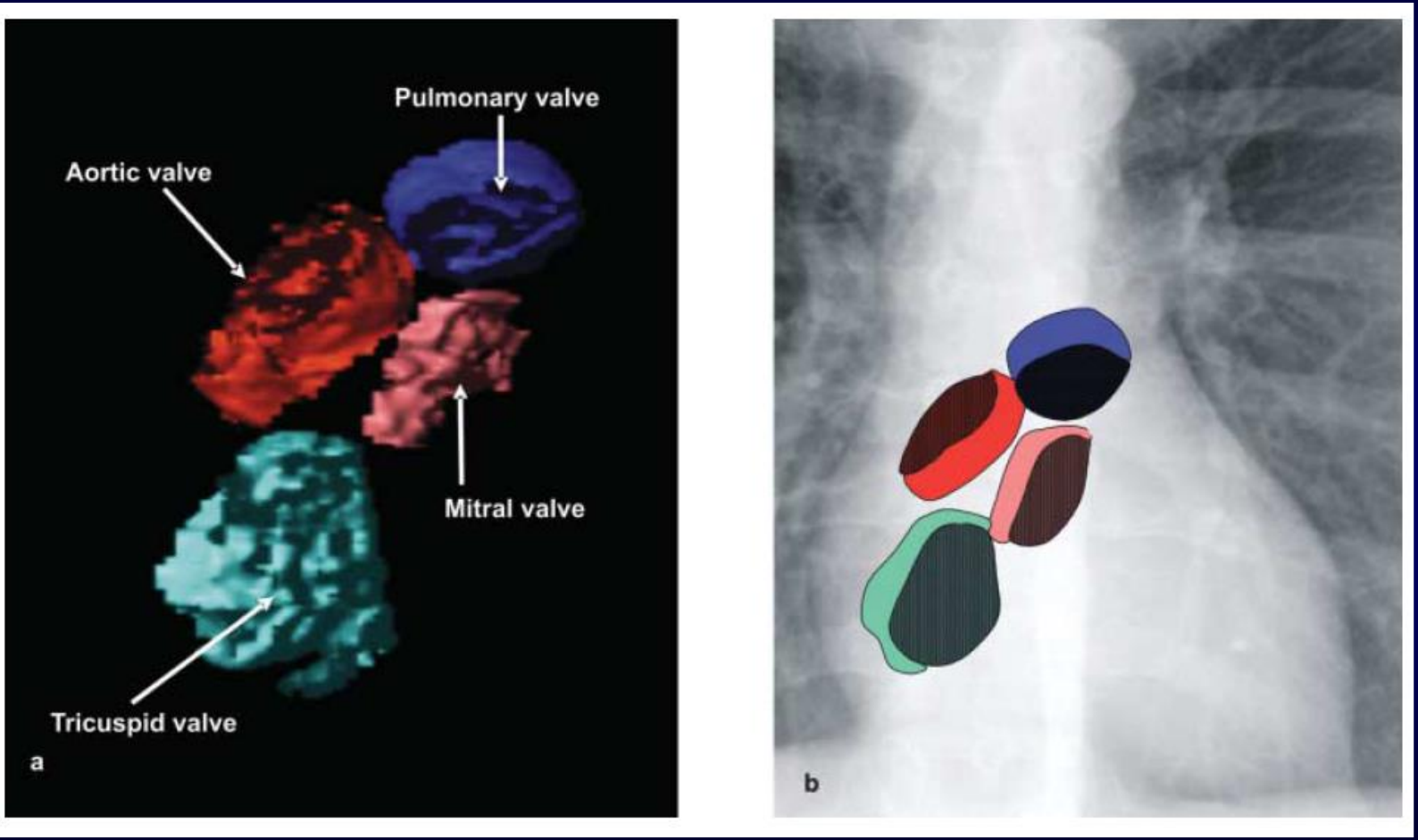
Connexion des artères coronaires



Connexion des artères coronaires

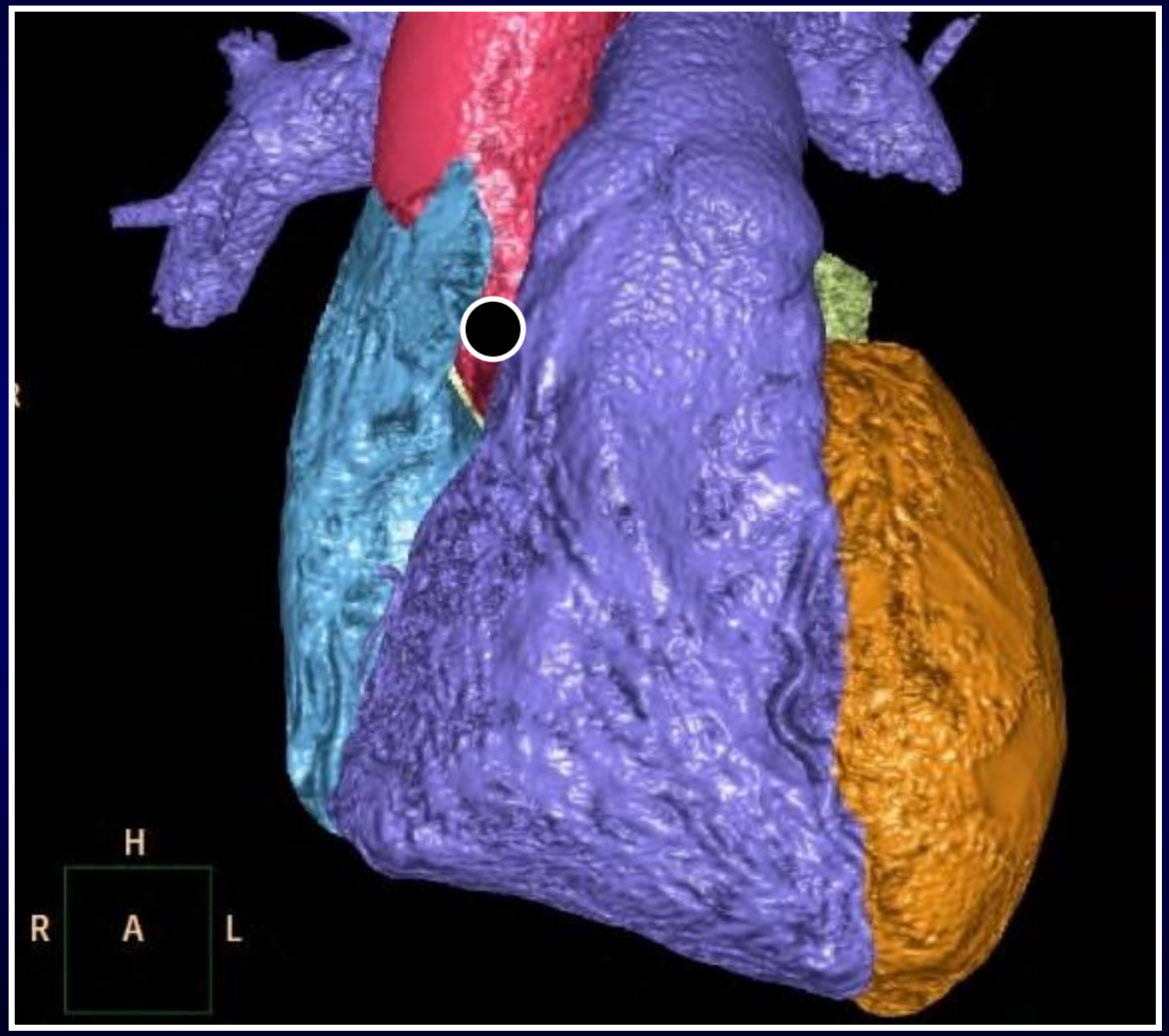


Anomalies de connexion des artères coronaires



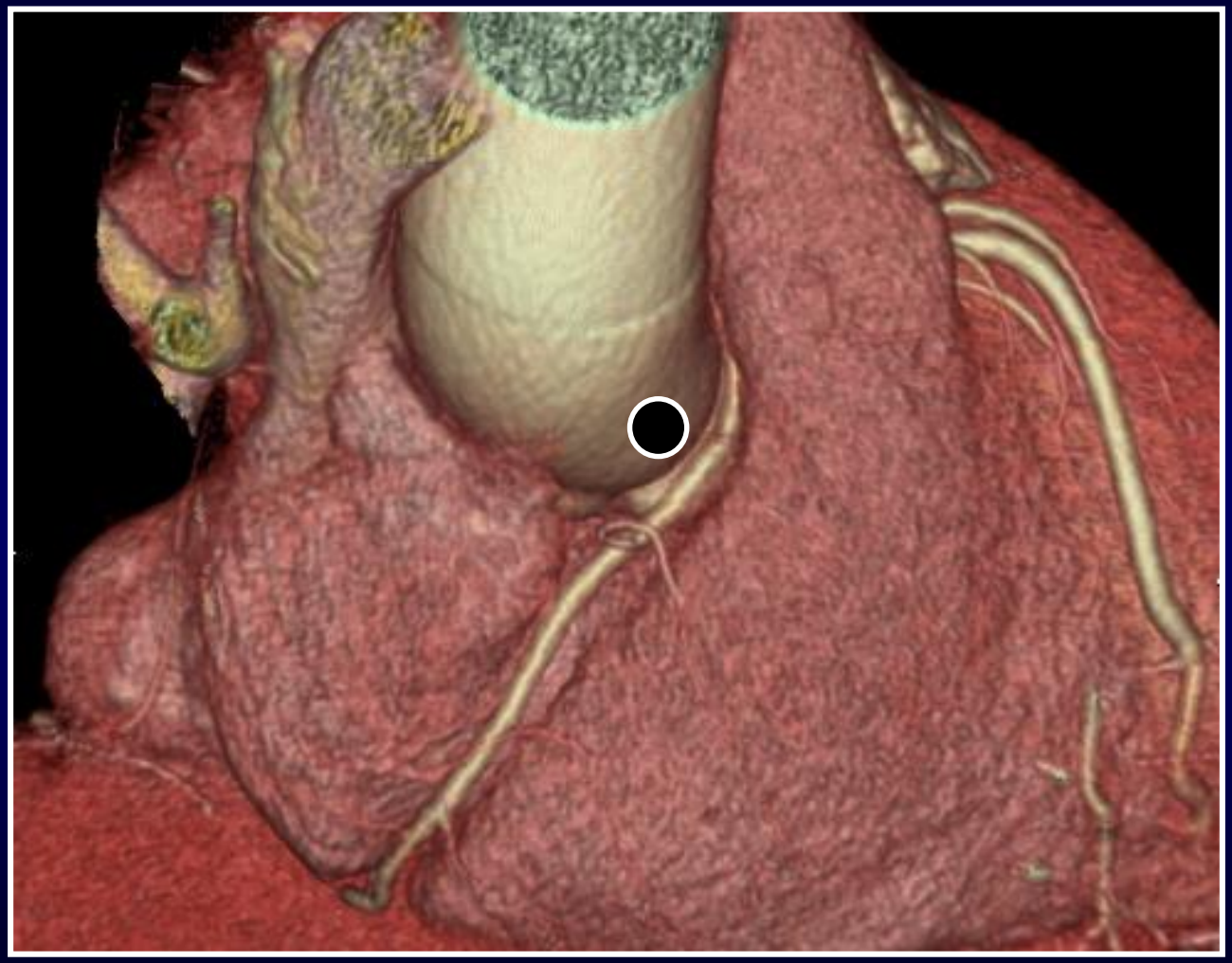
Connexion des artères coronaires

Connexion normale de la coronaire droite

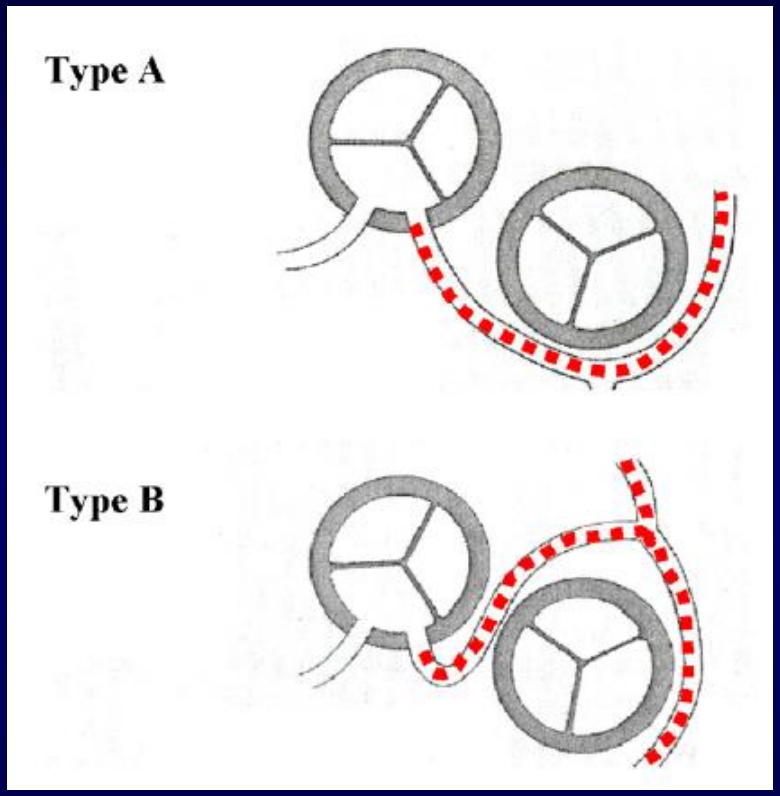


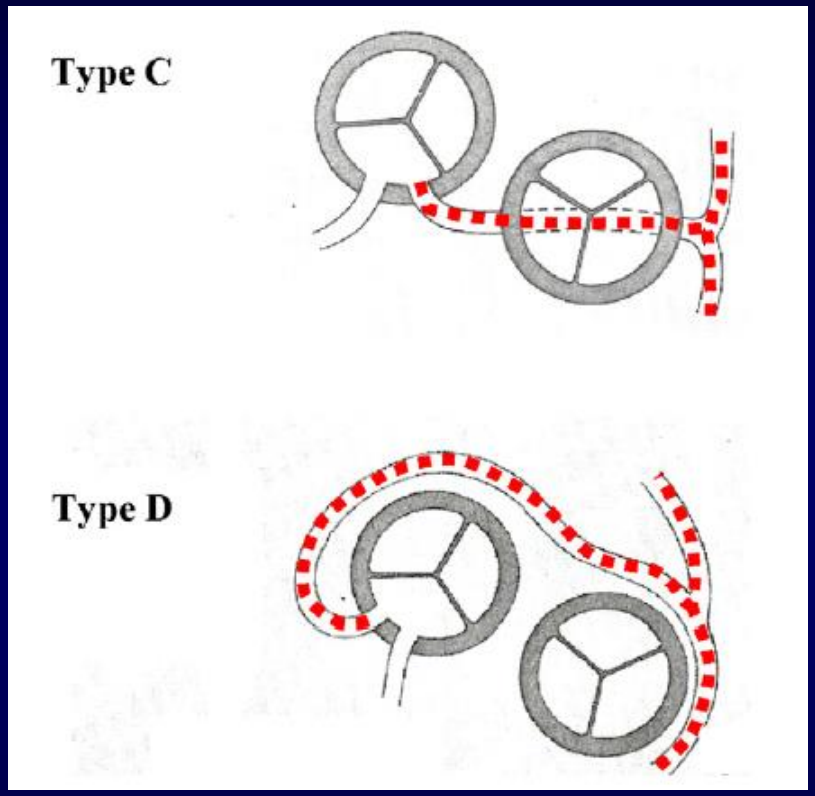
Anomalies de connexion des artères coronaires

Connexion anormale de la coronaire droite



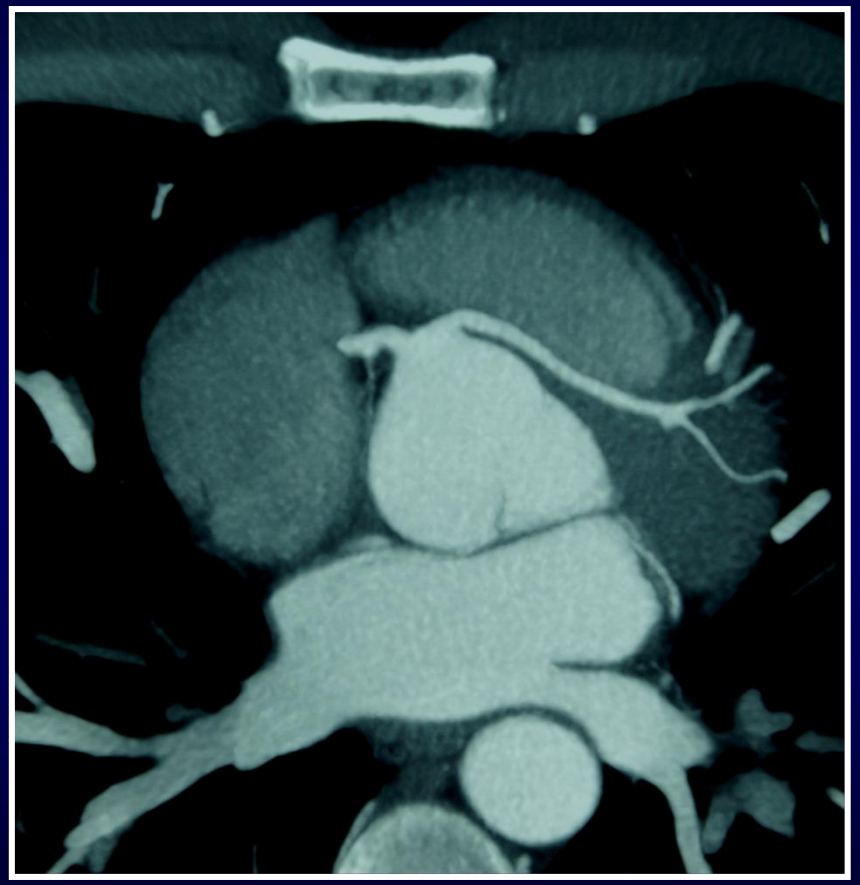
Classification des trajets



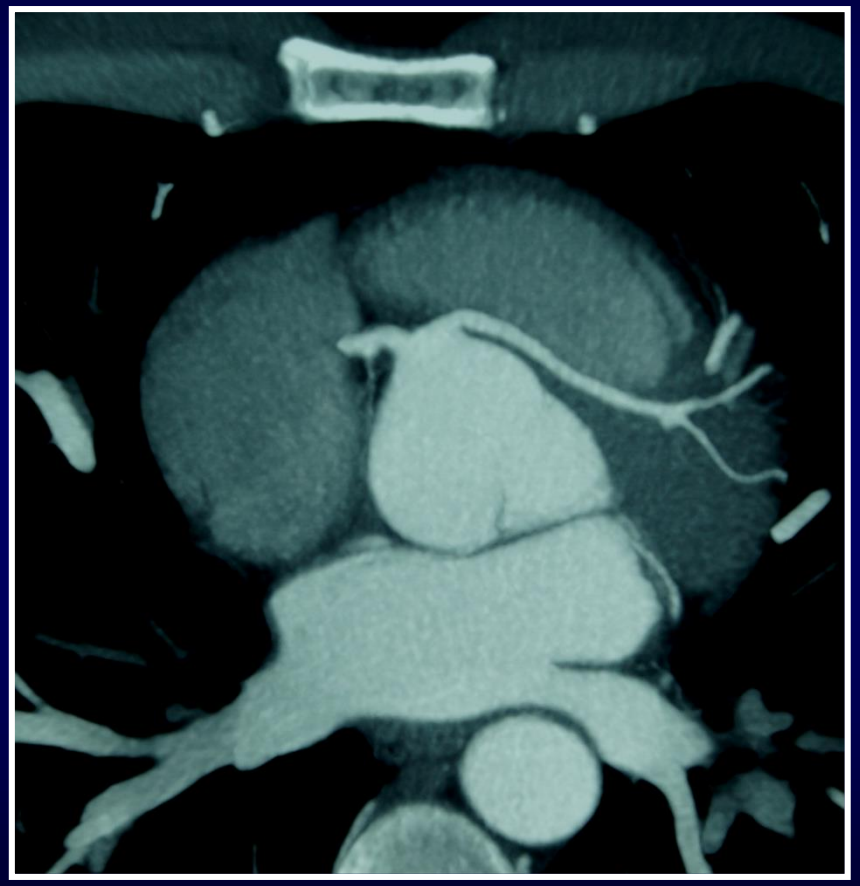


Trajet interartériel ou interaortopulmonaire
Définition inadaptée ?

Classification des trajets



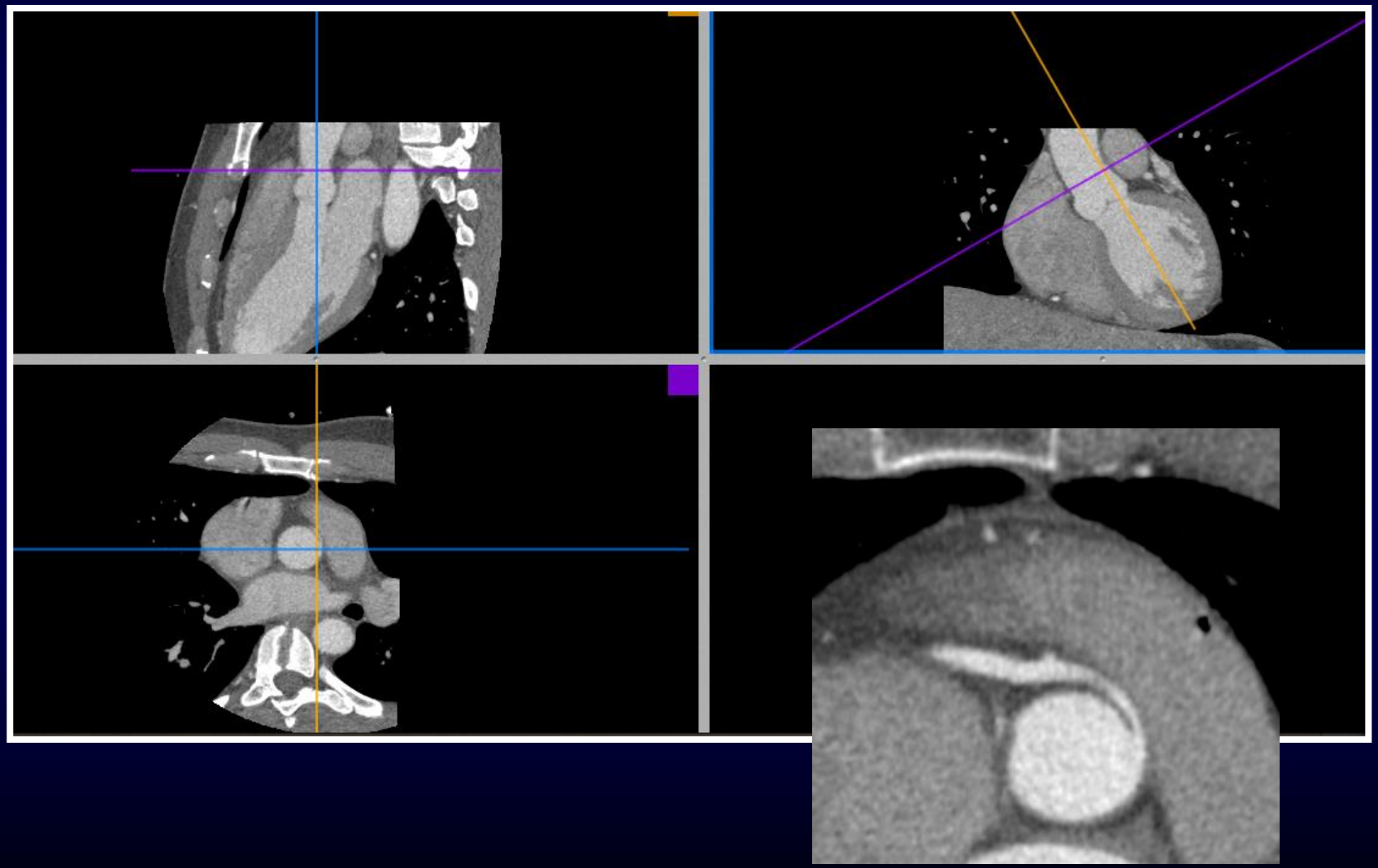
Classification des trajets



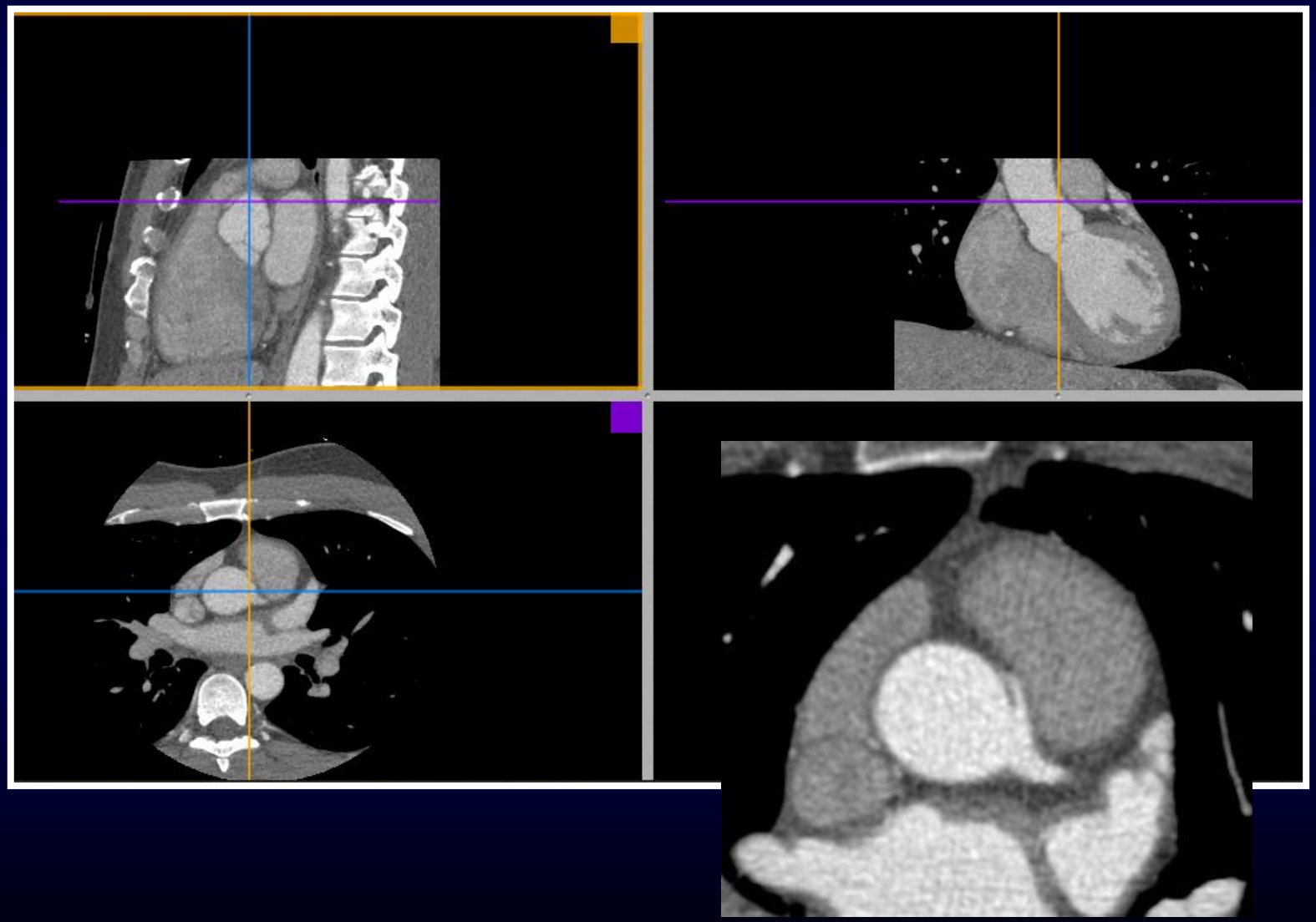
Anomalie sans risque

Anomalie à risque

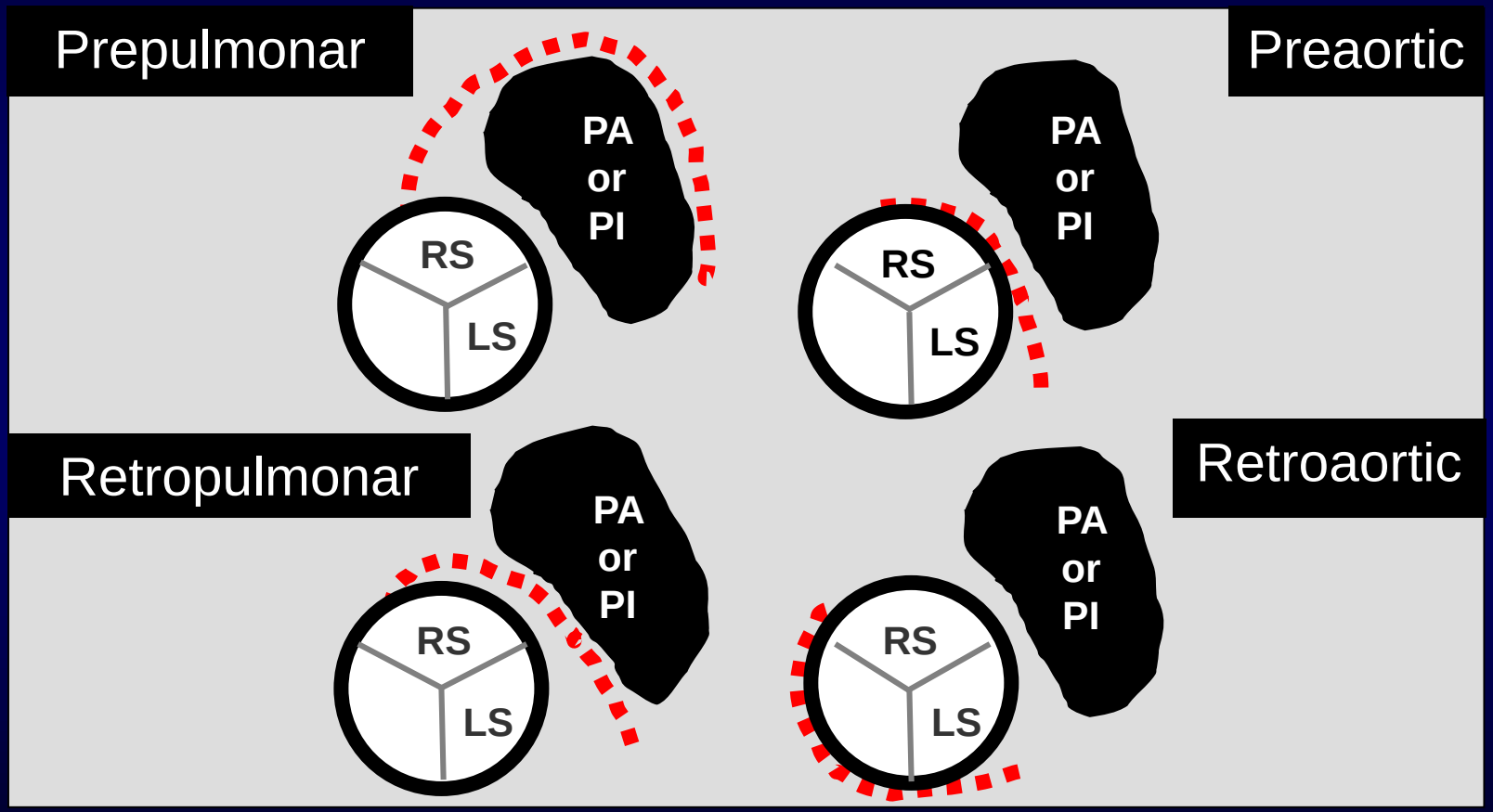
Classification des trajets



Classification des trajets

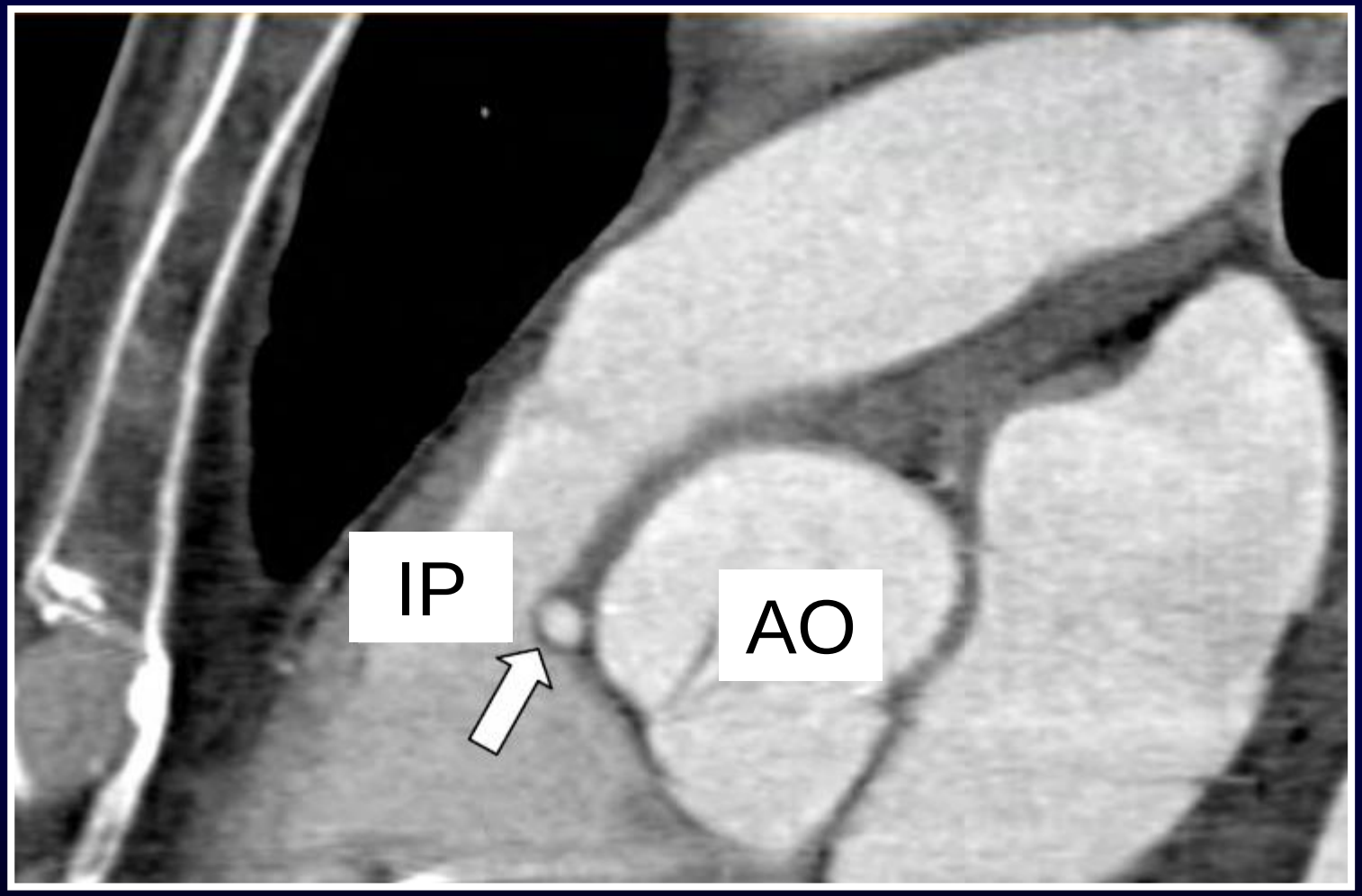


Type of course



PA: pulmonary artery, PI : pulmonary infundibulum
LS: left sinus, RS: right sinus

Classification des trajets



Trajet rétropulmonaire

Classification des trajets

Classification des anomalies de trajet initial d'une artère coronaire avec connexion ectopique [2].

Type	Anomalie de trajet initial
A	Trajet pré-pulmonaire (tronc ou infundibulum)
B	Trajet rétro-pulmonaire (tronc ou infundibulum)
C	Trajet pré-aortique avec passage intramural
D	Trajet pré-aortique sans passage intramural
E	Trajet rétro-aortique
F	Absence d'anomalie de trajet initial
G	Autres anomalies de trajet initial

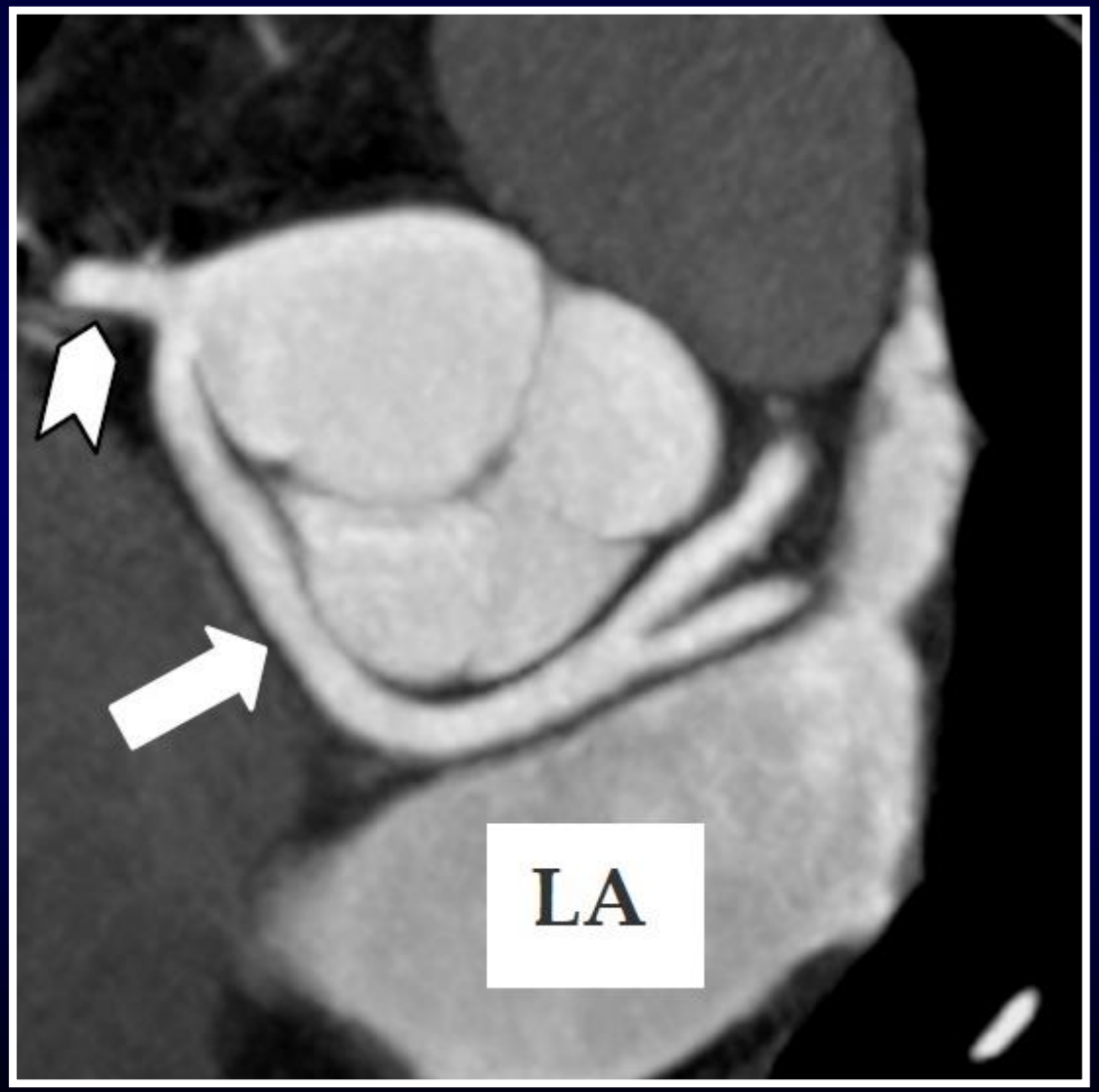
Aubry P, Halna du Fretay X, Calvert PA, Dupouy P, Hyafil F, Laissy J-P, et al. Proximal anomalous connections of coronary arteries in adults. In: Rao PS, editor. Congenital heart disease: selected aspects. Intech; 2012. www.intechopen.com/books/congenital-heart-disease-selected-aspects/proximal-anomalous-connections

Anomalies de connexion des artères coronaires

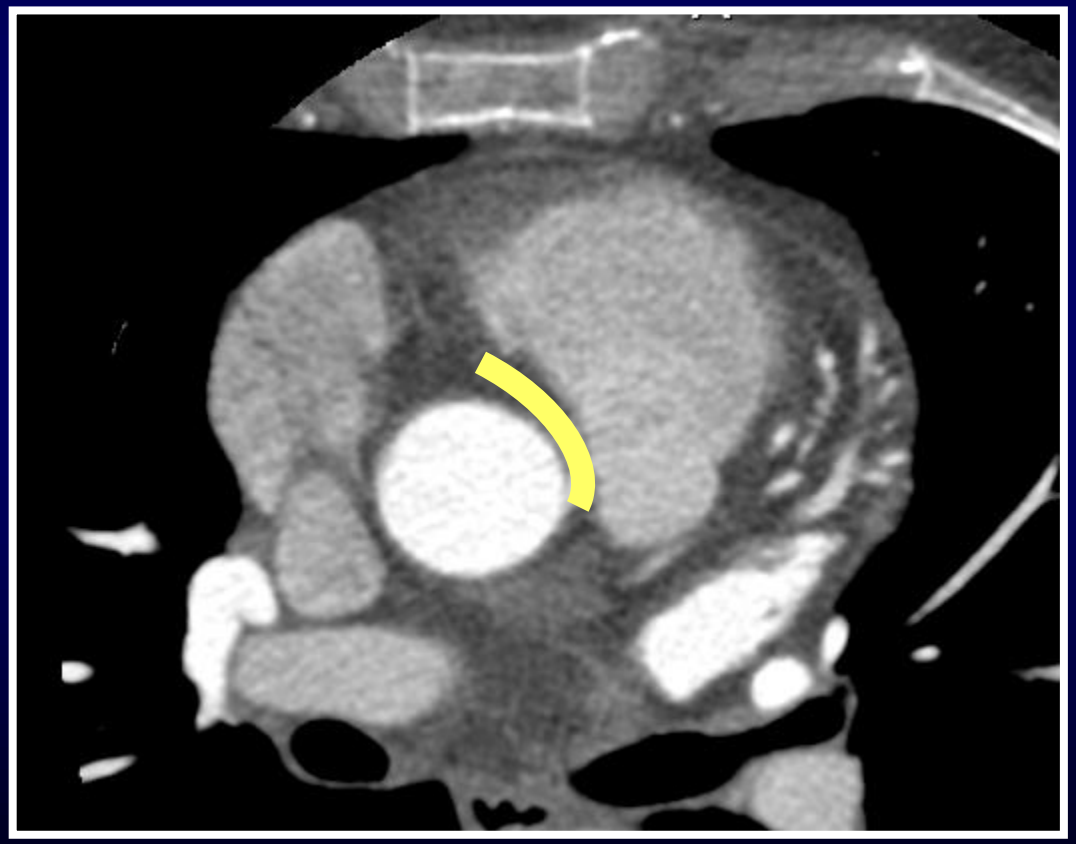
Tronc gauche connecté à la coronaire droite

Anomalies de connexion des artères coronaires

Tronc gauche connecté à la coronaire droite

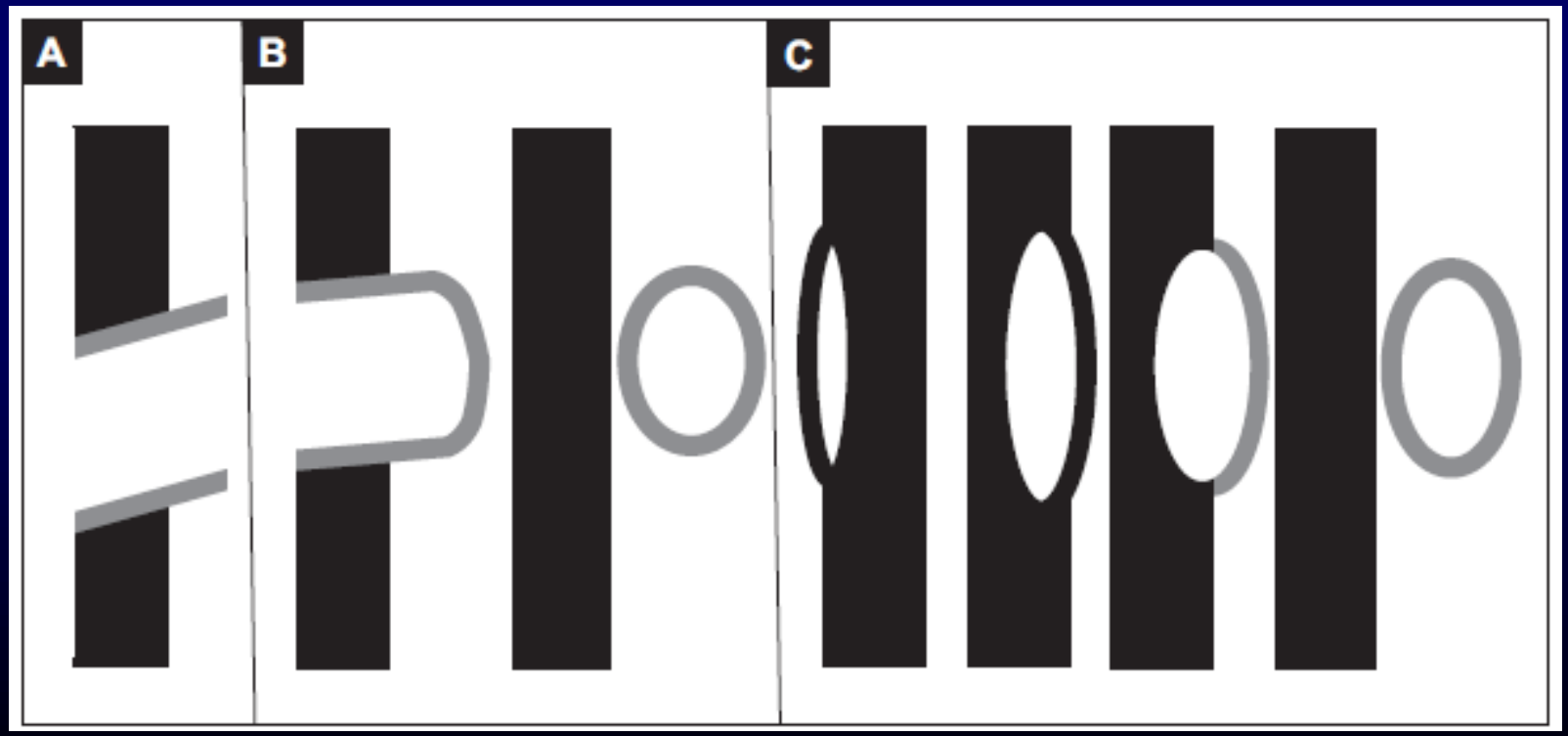


Trajets pré-aortiques
Compression ou adaptation ?

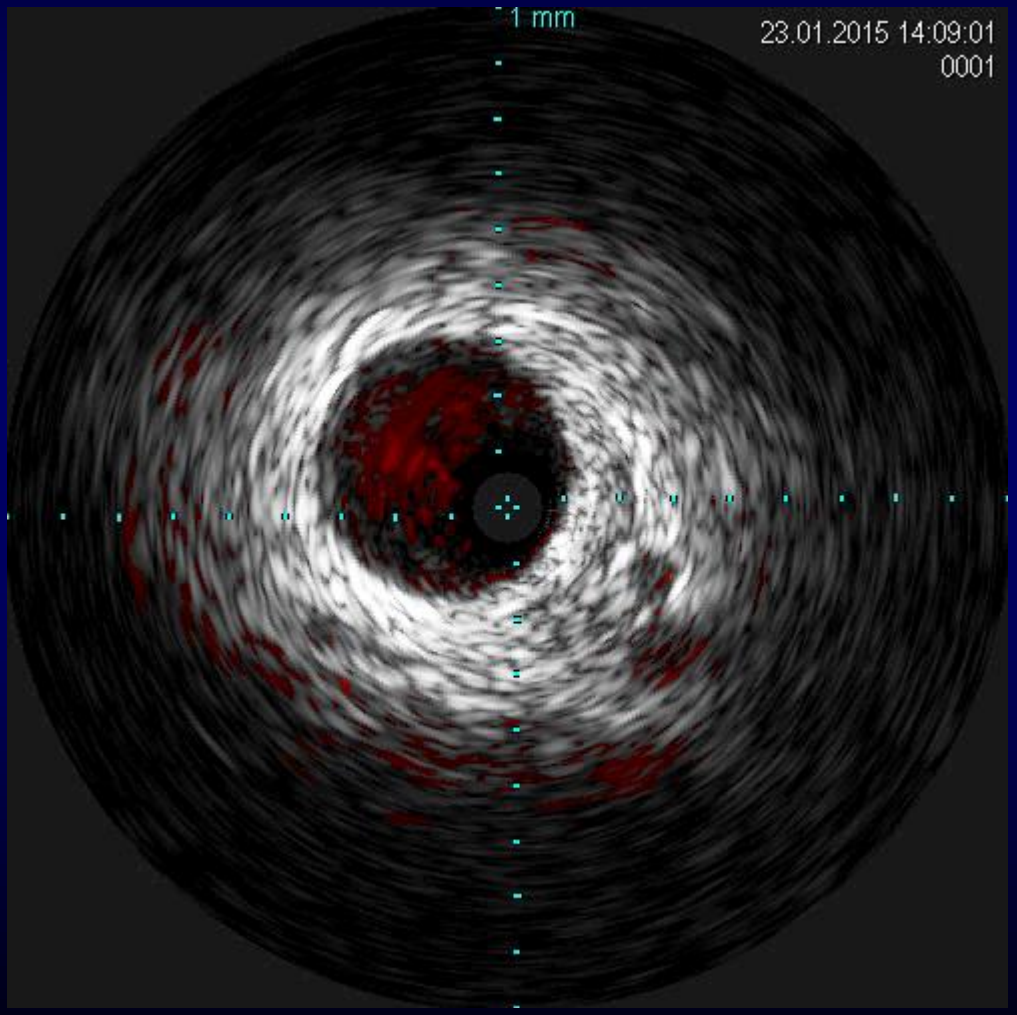


Trajets pré-aortiques
Compression ou adaptation ?

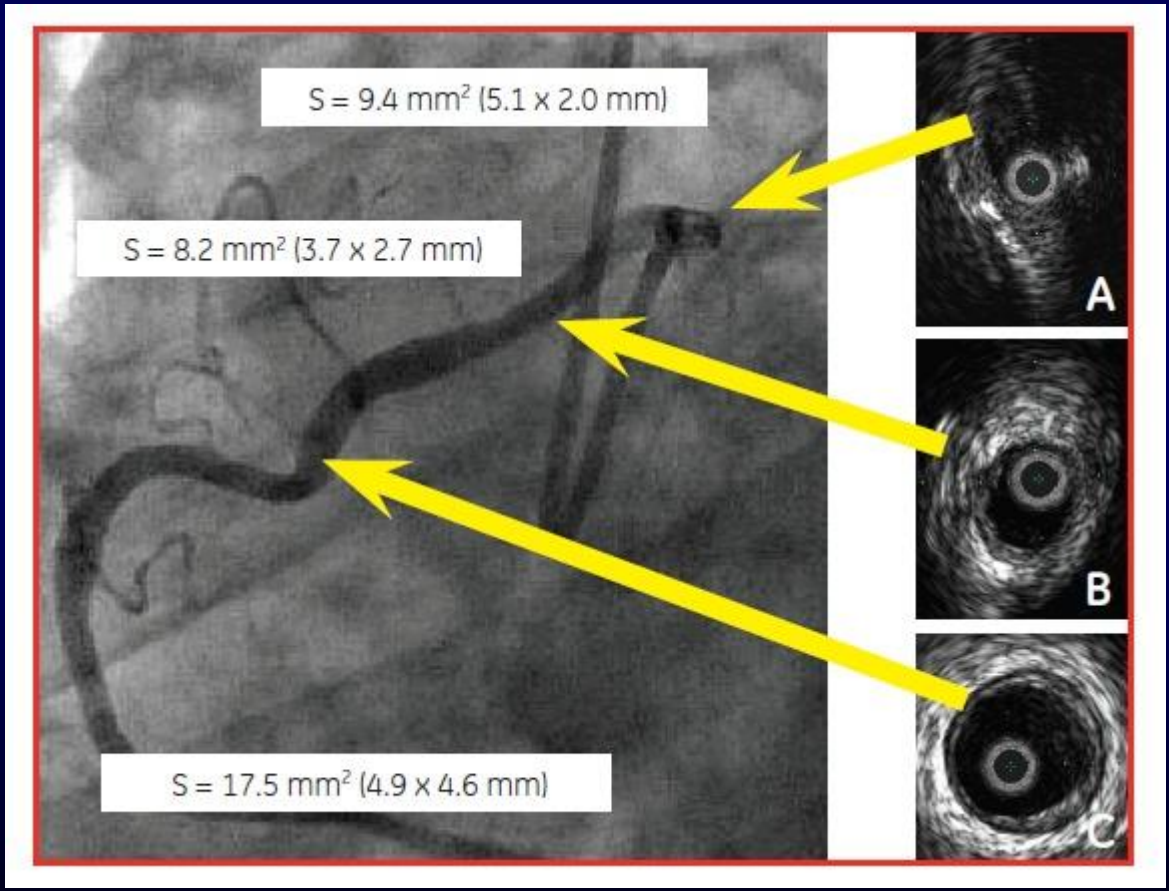
A : connexion normale
B : connexion avec trajet préaortique
C : connexion avec trajet préaortique et passage intramural



Trajets pré-aortiques
Compression ou adaptation ?



Trajets pré-aortiques
Compression ou adaptation ?

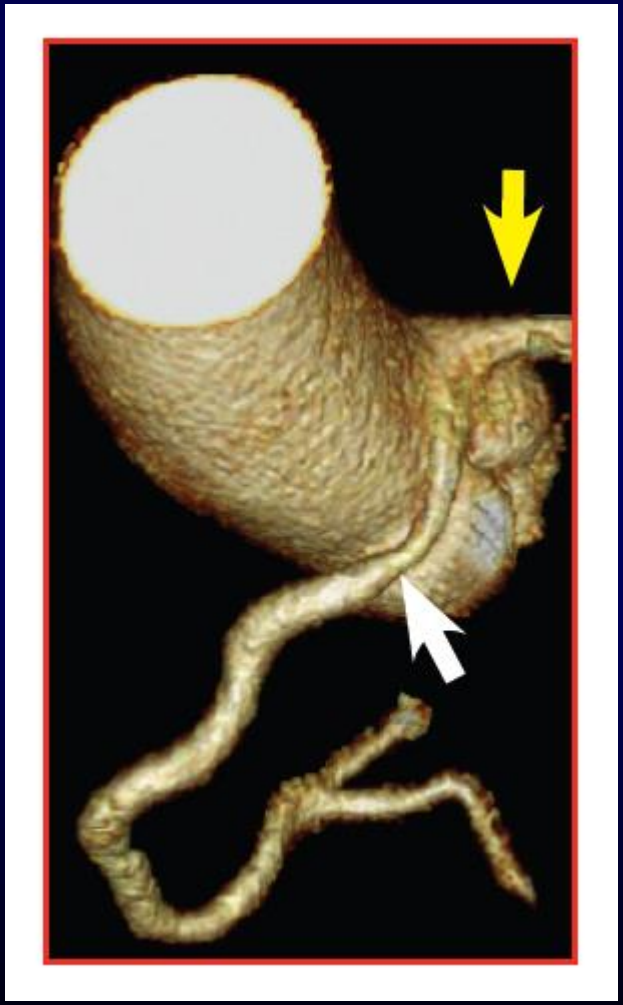


segment intramural

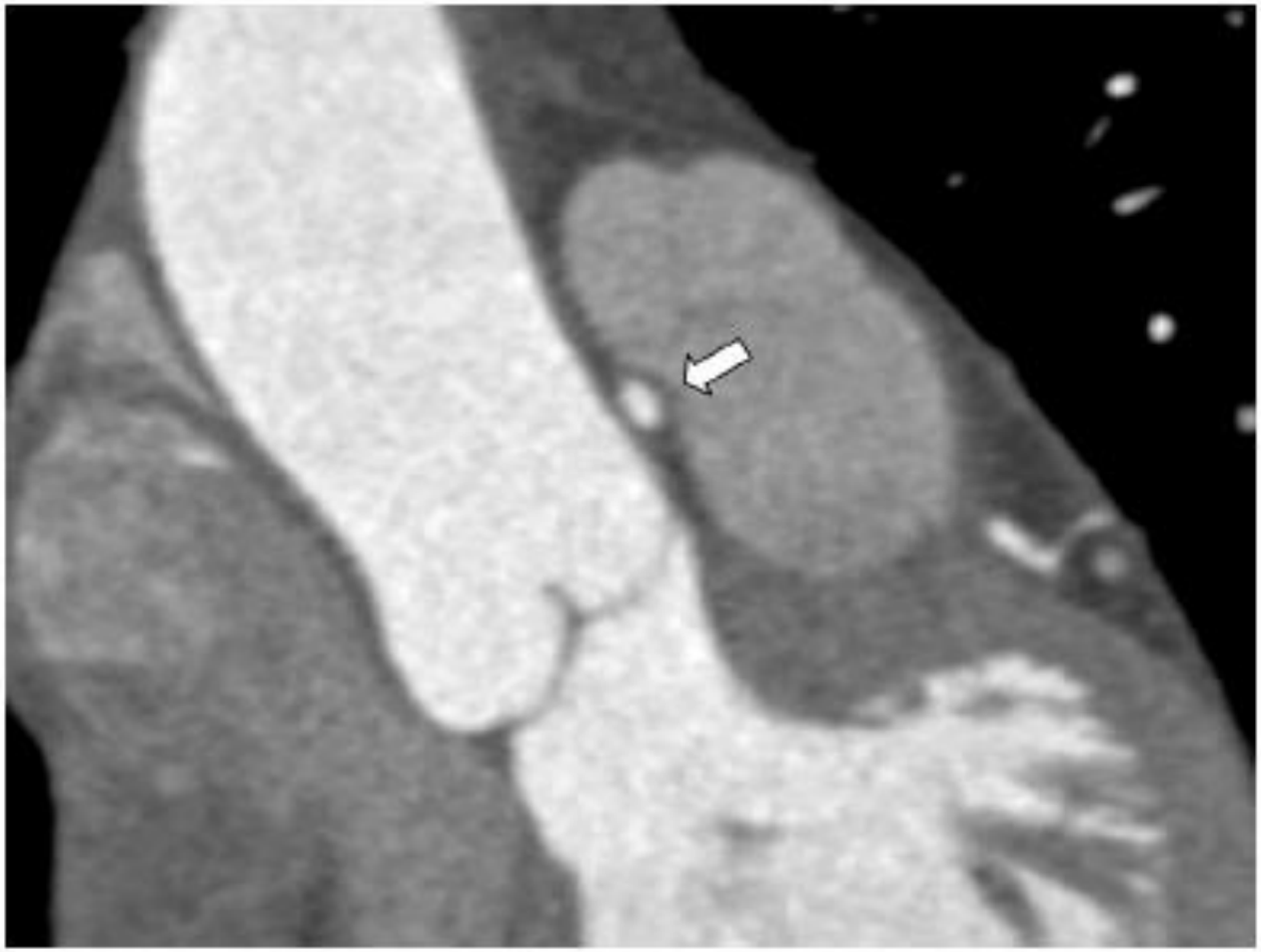
segment juxtamural

segment extramural

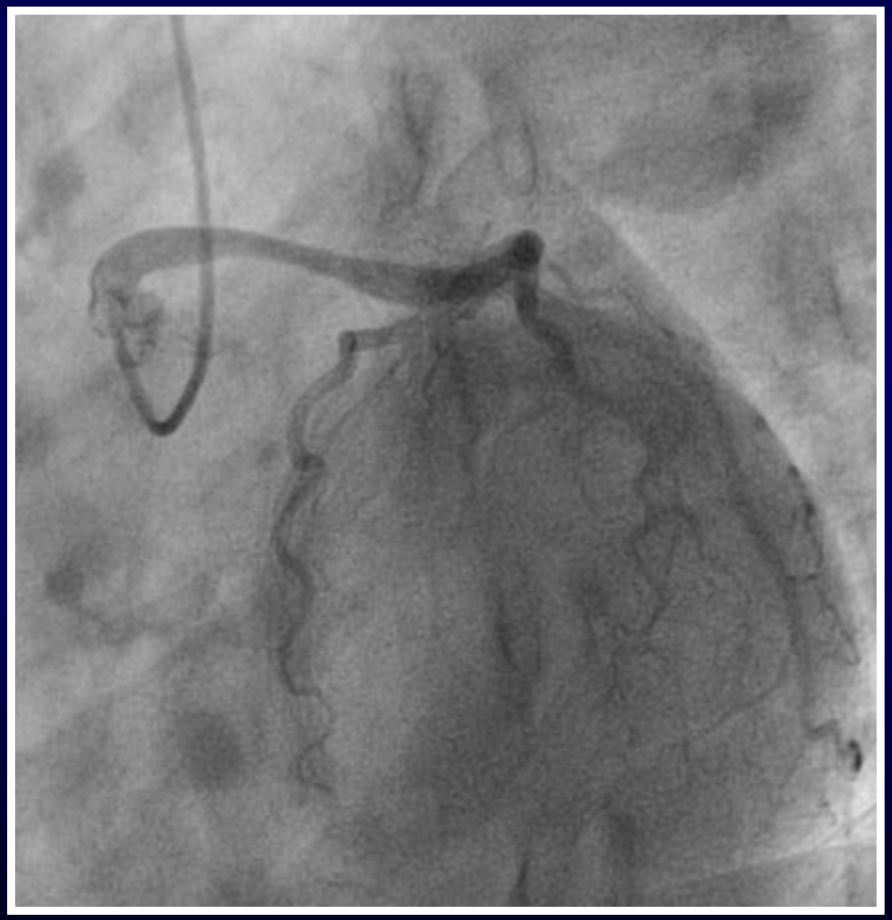
Trajets pré-aortiques
Compression ou adaptation ?



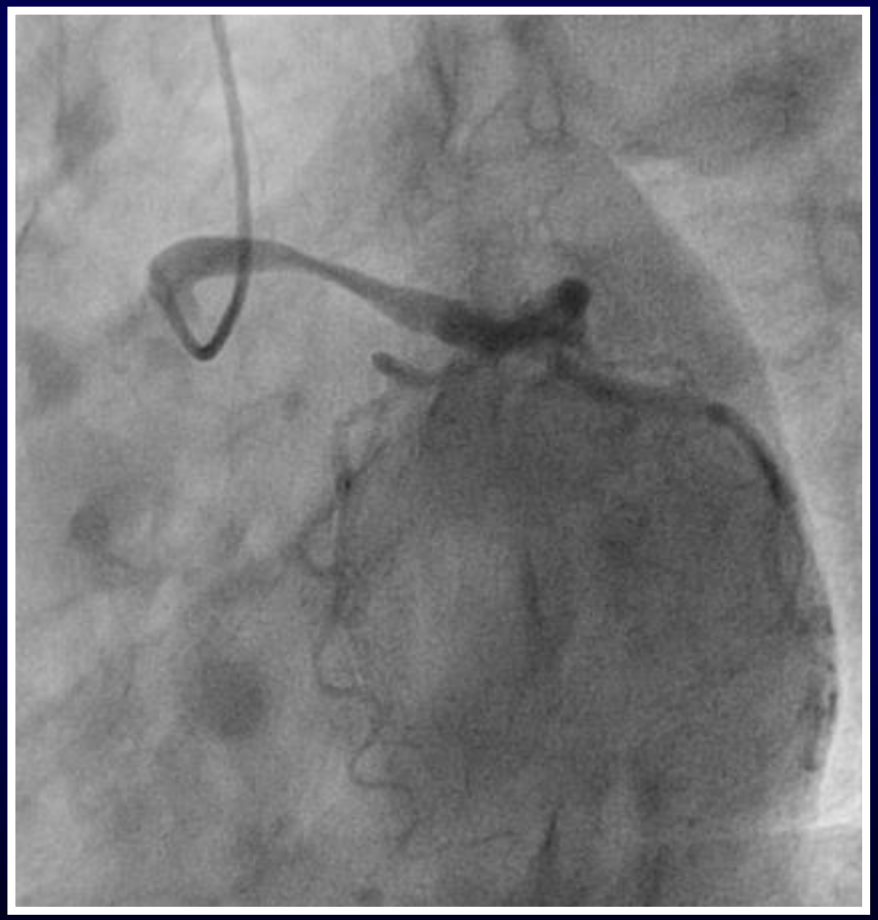
Trajets pré-aortiques
Compression ou adaptation ?



Trajets pré-aortiques
Compression ou adaptation ou les deux ?

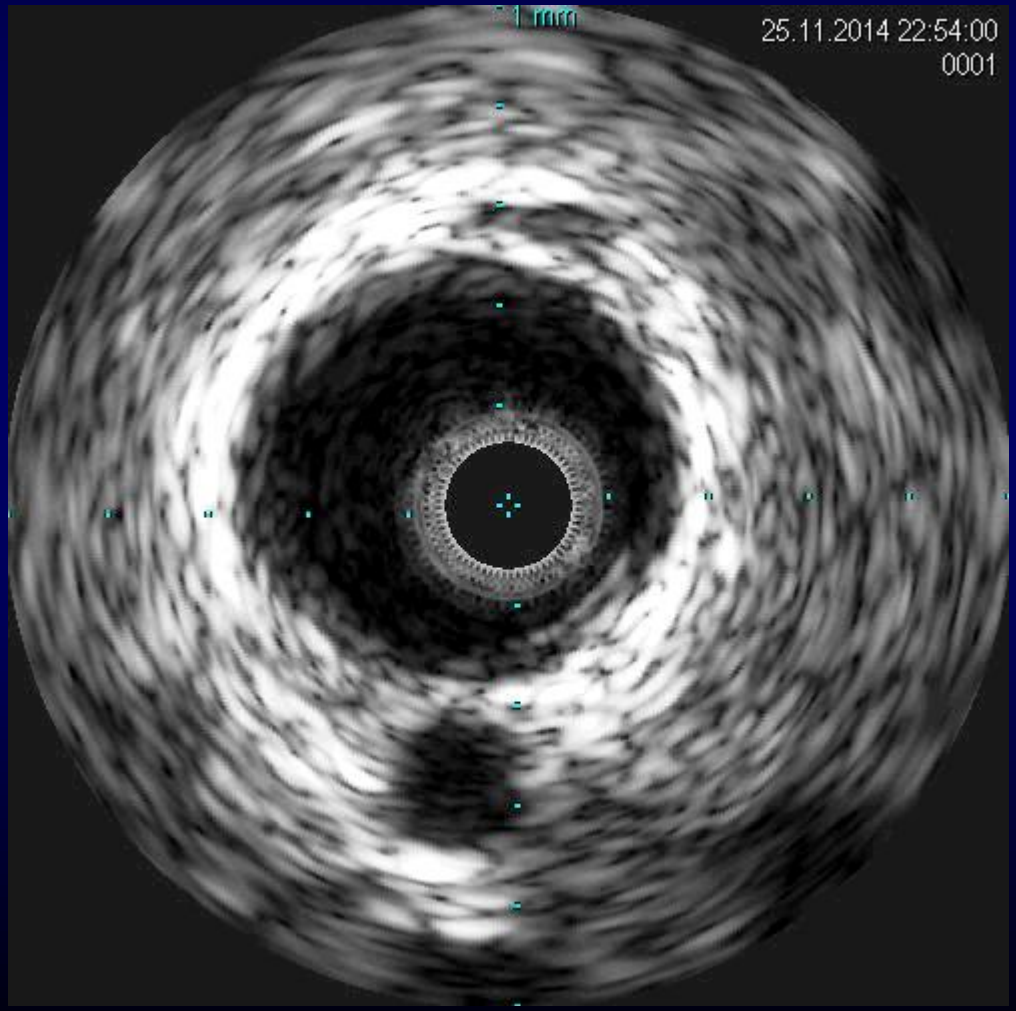


diastole



systole

Trajets pré-aortiques
Compression ou adaptation ou les deux ?



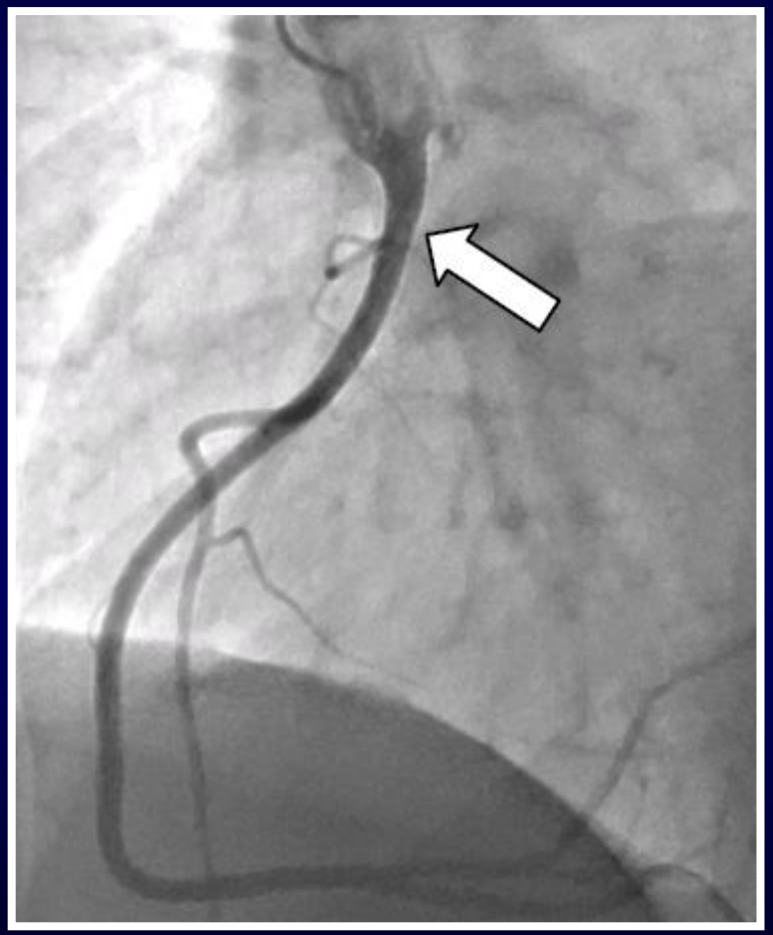
Ce que l’on sait (ou on croit savoir …)

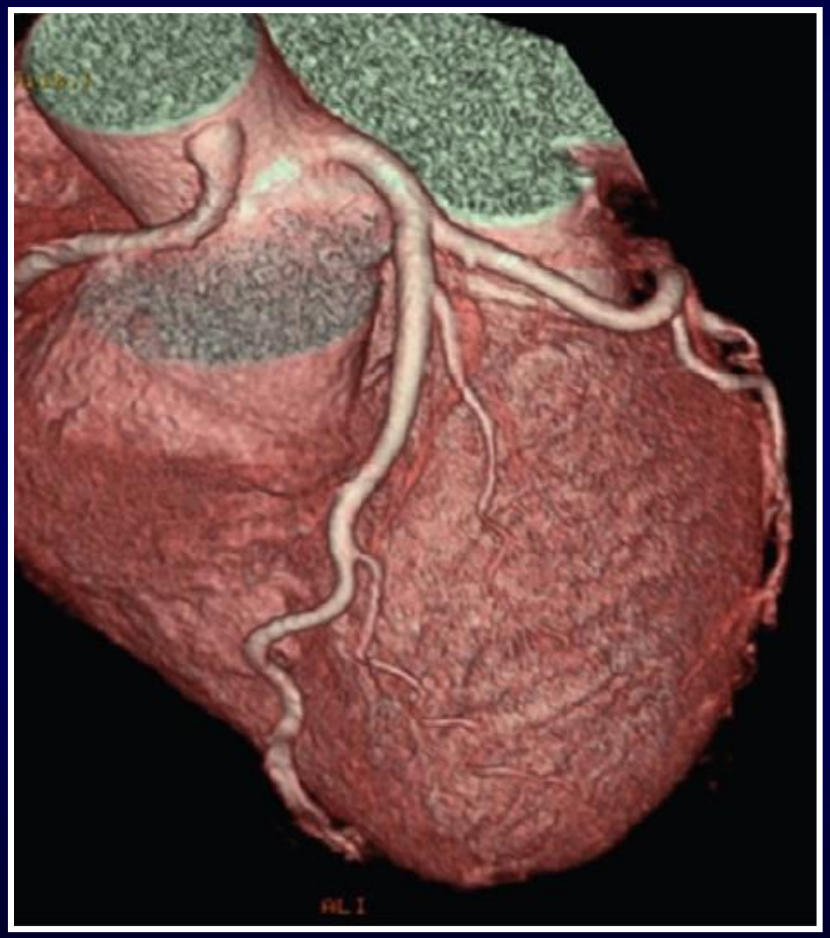
Prévalence angiographique

- ~ 5/1000 (coronarographie)
- ~ 10/1000 (scanner coronaire)

Anomalies de connexion des artères coronaires

Coronaire droite connectée dans l'aorte ascendante





Répartition des anomalies selon l'artère

Angiographic data
Type of coronary artery
(n = 372)

Left main coronary artery (n, %)	43 (11.6)
LAD coronary artery (n, %)	12 (3.2)
Circumflex coronary artery (n, %)	194 (52.2)
Right coronary artery (n, %)	123 (33.0)

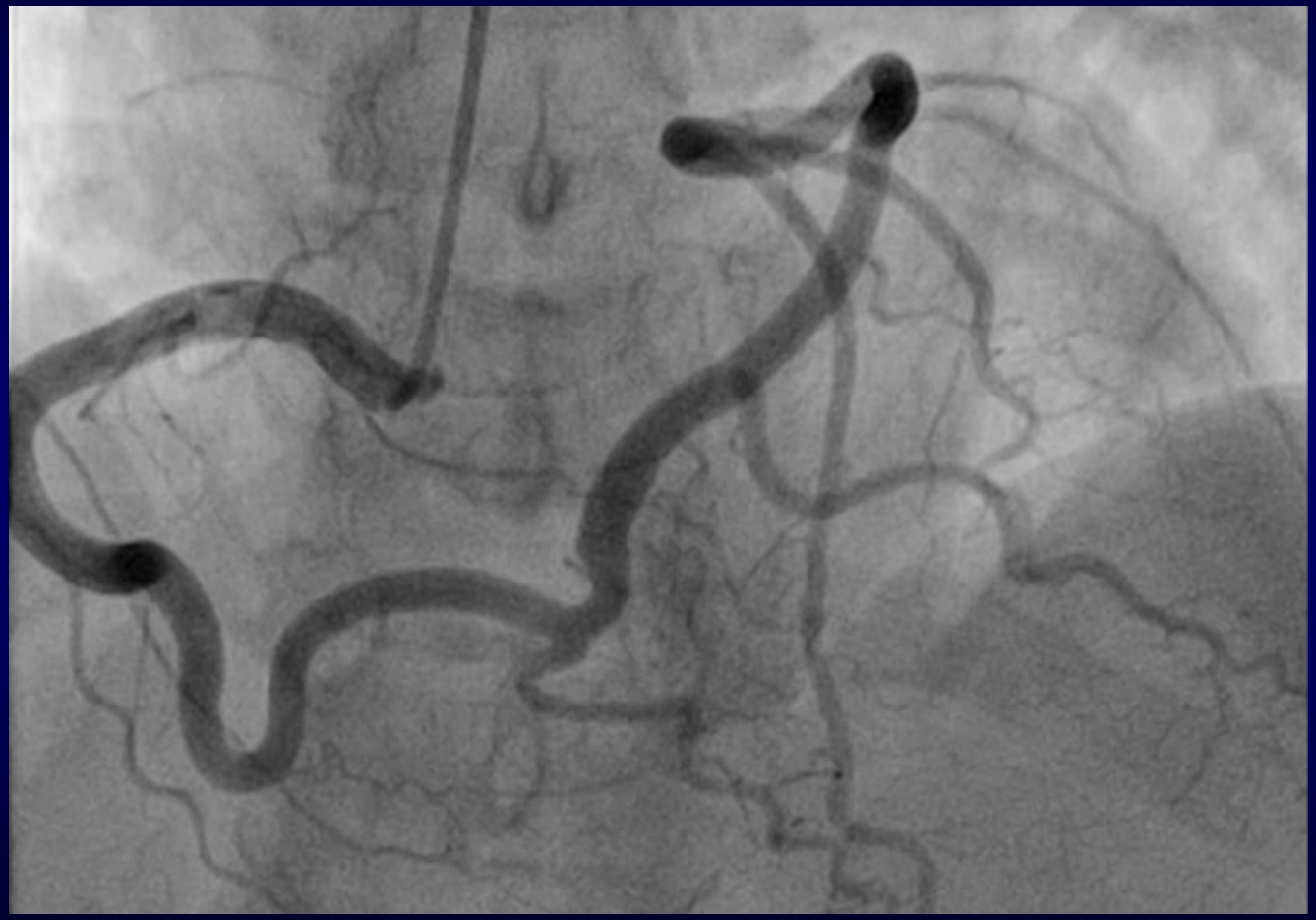
LAD: left anterior descending

Répartition des anomalies selon la connexion

Angiographic data
Type of connection
(n = 368)

Opposite sinus (n, %)	170 (46.2)
Contralateral artery (n, %)	164 (44.6)
Appropriate sinus (n, %)	4 (1.1)
Non coronary sinus (n, %)	1 (0.3)
Above the sinotubular jonction (n, %)	20 (5.4)
Single coronary artery (n, %)	5 (1.3)
Pulmonary artery (n, %)	4 (1.1)

Type of connection



Single coronary artery

Répartition des trajets

Angiographic data
Type of course
(n = 401)

Left main or LAD coronary artery (n)	50
Prepulmonar course (n, %)	17 (34.0)
Retropulmonar course (n, %)	23 (46.0)
Preaortic course (n, %)	4 (8.0)
Retroaortic course (n, %)	6 (12.0)
Circumflex coronary artery (n)	194
Retroaortic course (n, %)	191 (98.4)
Other courses (n, %)	3 (1.6)
Right coronary artery (n)	119
Preaortic course (n, %)	111 (89.0)
Other courses (n, %)	8 (11.0)

LAD: left anterior descending

Anomalies de connexion des artères coronaires

Risque de mort subite

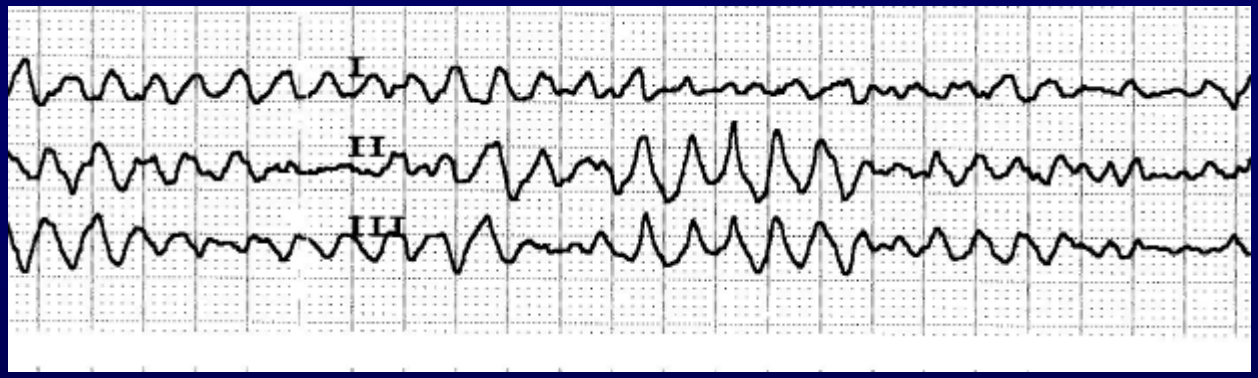
Table 1. Causes of Sudden Death in 387 Young Athletes*

Cause	No. of Athletes	Percent
Hypertrophic cardiomyopathy	102	26.4
Commotio cordis	77	19.9
Coronary artery anomalies	53	13.7
Left ventricular hypertrophy of indeterminate causation†	29	7.5
Myocarditis	20	5.2
Ruptured aortic aneurysm (Marfan syndrome)	12	3.1
Arrhythmogenic right ventricular cardiomyopathy	11	2.8
Tunneled (bridged) coronary artery‡	11	2.8
Aortic valve stenosis	10	2.6
Atherosclerotic coronary artery disease	10	2.6
Dilated cardiomyopathy	9	2.3
Myxomatous mitral valve degeneration	9	2.3
Asthma (or other pulmonary condition)	8	2.1
Heat stroke	6	1.6
Drug abuse	4	1.0
Other cardiovascular cause	4	1.0
Long QT syndrome§	3	0.8
Cardiac sarcoidosis	3	0.8
Trauma causing structural cardiac injury	3	0.8
Ruptured cerebral artery	3	0.8

Maron B. J Am Coll Cardiol 2005

Cause de la mort subite

Trouble du rythme ventriculaire grave



Formes à risque de mort subite

- Anomalous connection with a preaortic course
- Intramural pathway
- Anomalous connection with the pulmonary artery*

* in relation with myocardial infarction, mitral regurgitation, heart failure

Age de découverte

- < 35 ans : risque majoré
- > 35 ans : risque minoré

Ischémie myocardique

- Peut être absente dans les formes à risque symptomatiques
- Pas de protocole codifié

Anomalies de connexion des artères coronaires

Existence de recommandations

ACC/AHA 2008 Guidelines for the Management of Adults With Congenital Heart Disease

- Atrial septal defect
- Ventricular septal defect
- Atrioseptal septal defect
- Patent ductus arteriosus
- Aortic valves diseases
- Associated disorders of the ascending aorta
- Coarctation
- Right ventricular outflow tract
- Coronary artery abnormalities
- Pulmonary hypertension/Eisenmenger
- Tetralogy of Fallot
- Dextro-transposition of the great arteries
- Congenitally corrected transposition of the great vessels
- Ebstein's anomaly
- Tricuspid atresia/single ventricle

J Am Coll Cardiol 2008;52:e143-263

Anomalies de connexion des artères coronaires

8.5. Recommendations for Congenital Coronary Anomalies of Ectopic Arterial Origin

CLASS I

3. Surgical coronary revascularization should be performed in patients with any of the following indications:
   a. Anomalous left main coronary artery coursing between the aorta and pulmonary artery. (*Level of Evidence: B*)
   b. Documented coronary ischemia due to coronary compression (when coursing between the great arteries or in intramural fashion). (*Level of Evidence: B*)
   c. Anomalous origin of the right coronary artery between aorta and pulmonary artery with evidence of ischemia. (*Level of Evidence: B*)

8.6. Recommendations for Anomalous Left Coronary Artery From the Pulmonary Artery

CLASS I

1. In patients with an anomalous left coronary artery from the pulmonary artery (ALCAPA), reconstruction of a dual coronary artery supply should be performed. The surgery should be performed by surgeons with training and expertise in CHD at centers with expertise in the management of anomalous coronary artery origins. (*Level of Evidence: C*)

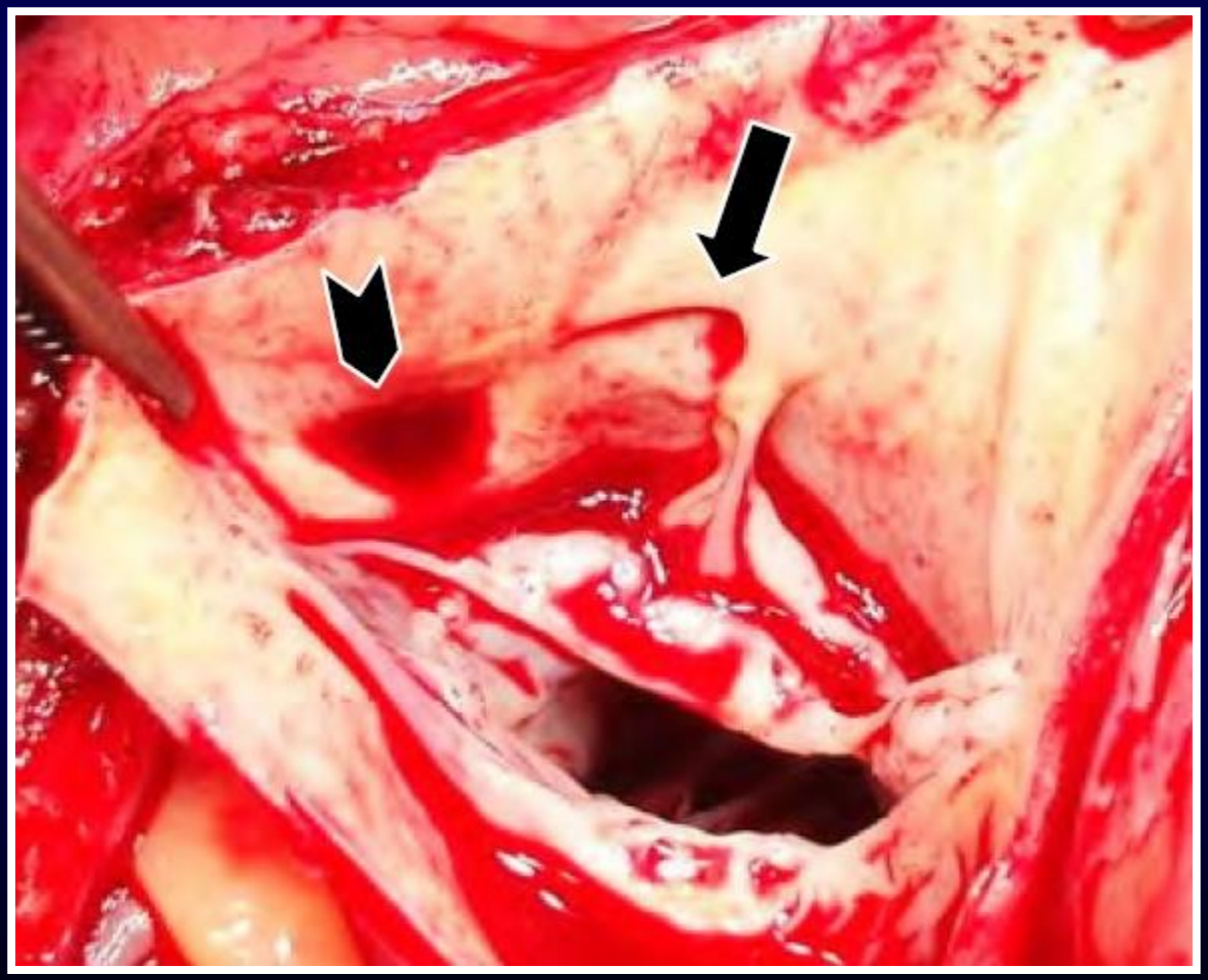
Type de chirurgie

Préferer la réparation au pontage

Type de réparation mal codifié

Difficulté de cathéterisme

anomalies avec passage intramural



Prévalence de l'athérome sur les segments ectopiques

Plus élevée pour les cironflexes ectopiques

Discordance
entre
les recommandations et les pratiques

Angiographic data
Risk classification
(n = 401)

Low-risk ANOCOR (n, %)	279 (69.6)
High-risk ANOCOR (n, %)	119 (30.7)
Non defined risk (n, %)	3 (0.7)

ANOCOR: anomalous connections of the coronary arteries

Management

Management of ANOCOR (n)	408
No treatment (n, %)	264 (67.2)
Medical treatment alone (n, %)	69 (17.3)
Angioplasty (n, %)	34 (8.7)
Surgery (n, %)	16 (4.1)
Awaiting decision (n, %)	25 (6.4)
Other managements (n)	381
No treatment (n,%)	70 (10.9)
Medical treatment alone (n, %)	132 (35.7)
Angioplasty (n, %)	106 (28.6)
Coronary or valvular surgery (n, %)	53 (13.3)
Awaiting decision (n, %)	20 (5.4)

ANOCOR: anomalous connections of the coronary arteries

Ce que l’on ne sait pas (ou peu …)

Prévalence dans la population générale

1 à 2/1000

CIV 1/1.000 naissances

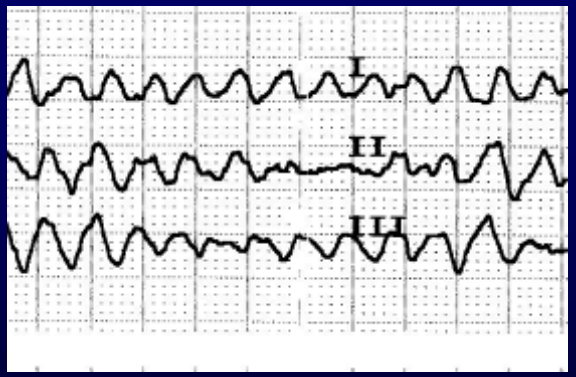
800.000 naissances annuelles en France
incidence annuelle : 800 à 1600 ANOCOR

Risque annuel de mort subite

?

Mécanisme de la mort subite

?



Survie sans événement cardiaque grave

Anomalies non corrigées

Anomalies corrigées

?

Avis des européens

?

Formes familiales

Facteur génétique ?

Management

Management of ANOCOR (n)	408
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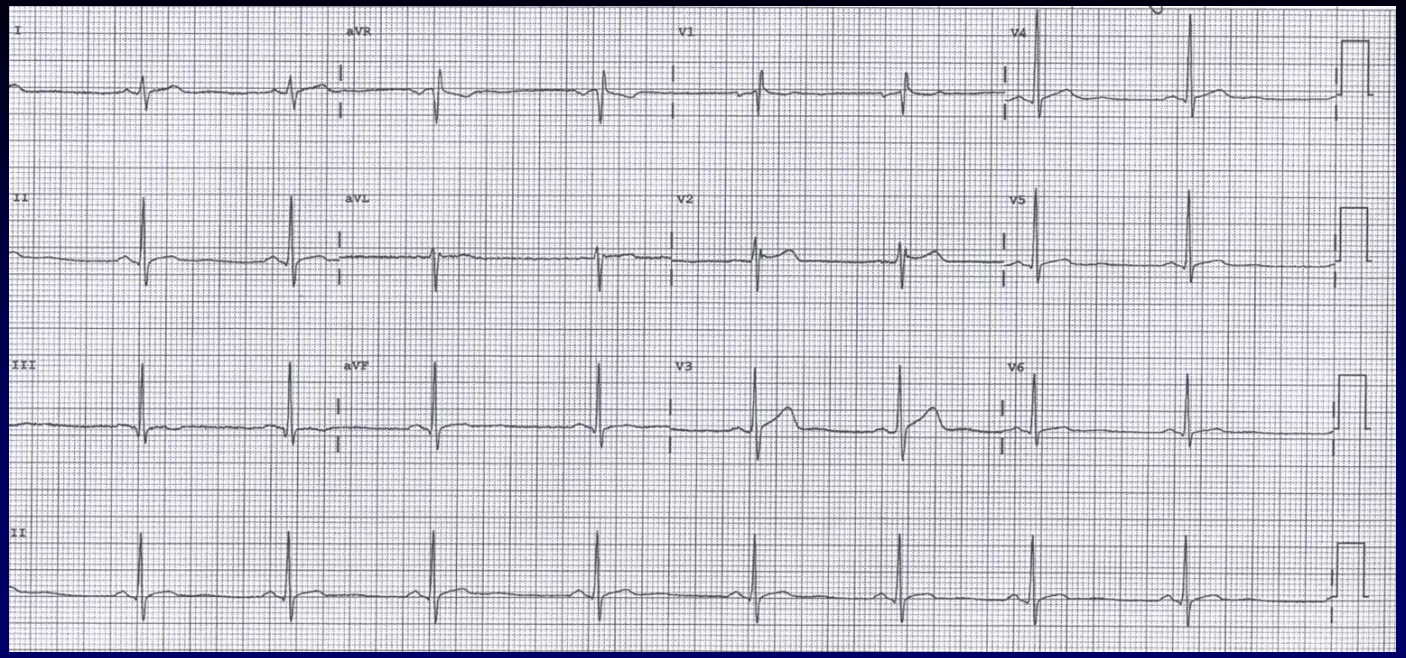
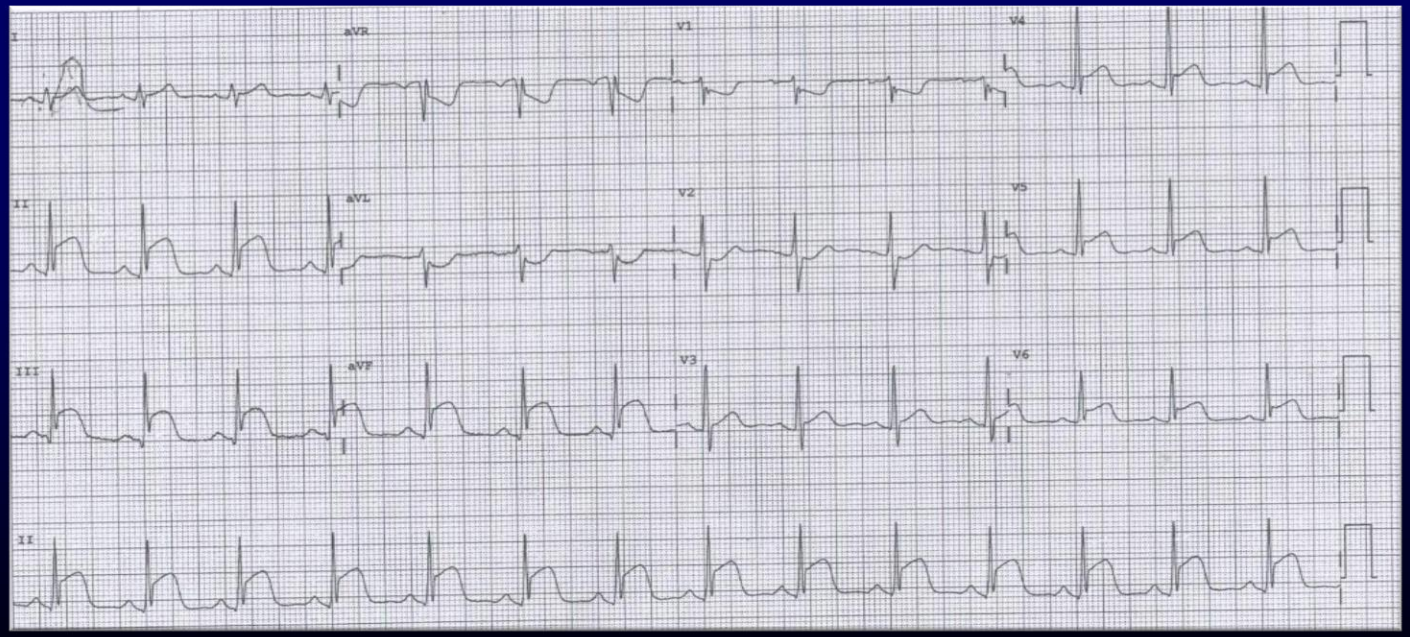
Awaiting decision (n, %)	20 (5.4)

ANOCOR: anomalous connections of the coronary arteries

Cas clinique

- Homme de 36 ans
- Pas de facteurs de risque
- Myocardite localisée en 2010 (IRM)
- Douleur thoracique suspecte
- ECG et troponine normaux
- Récidive douloureuse intense à J1
- Modifications ECG
- Troponine US à 4000


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II


I
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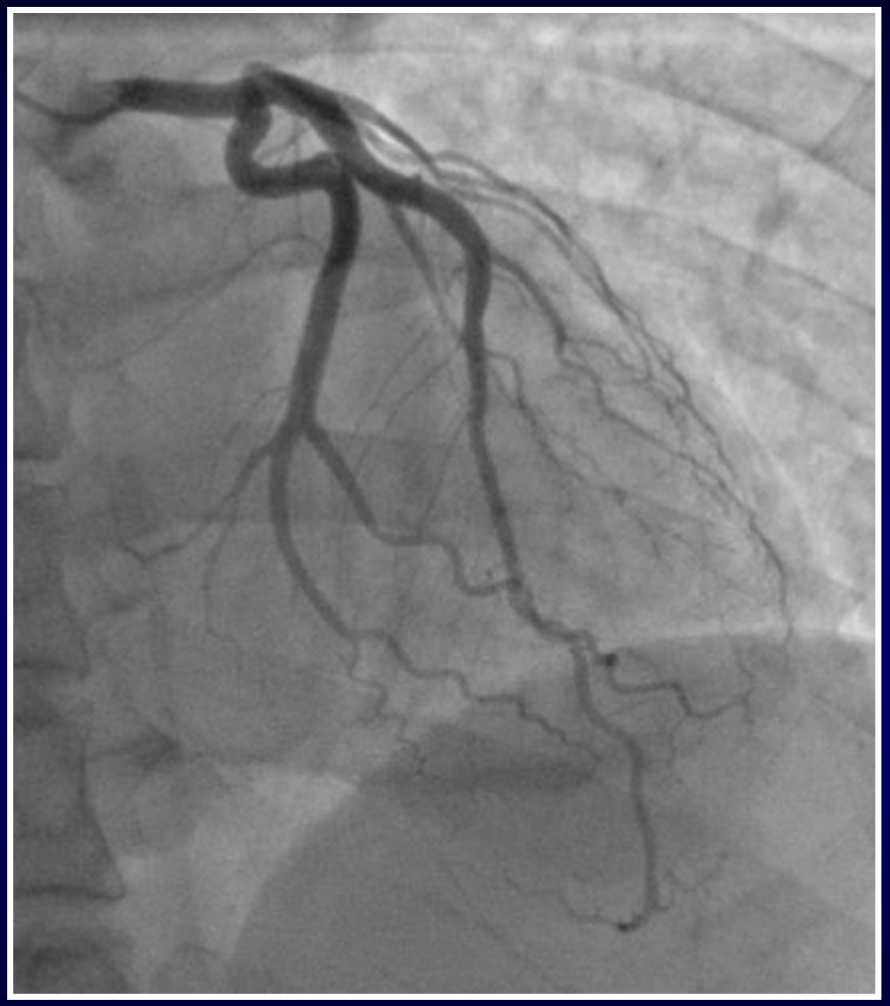
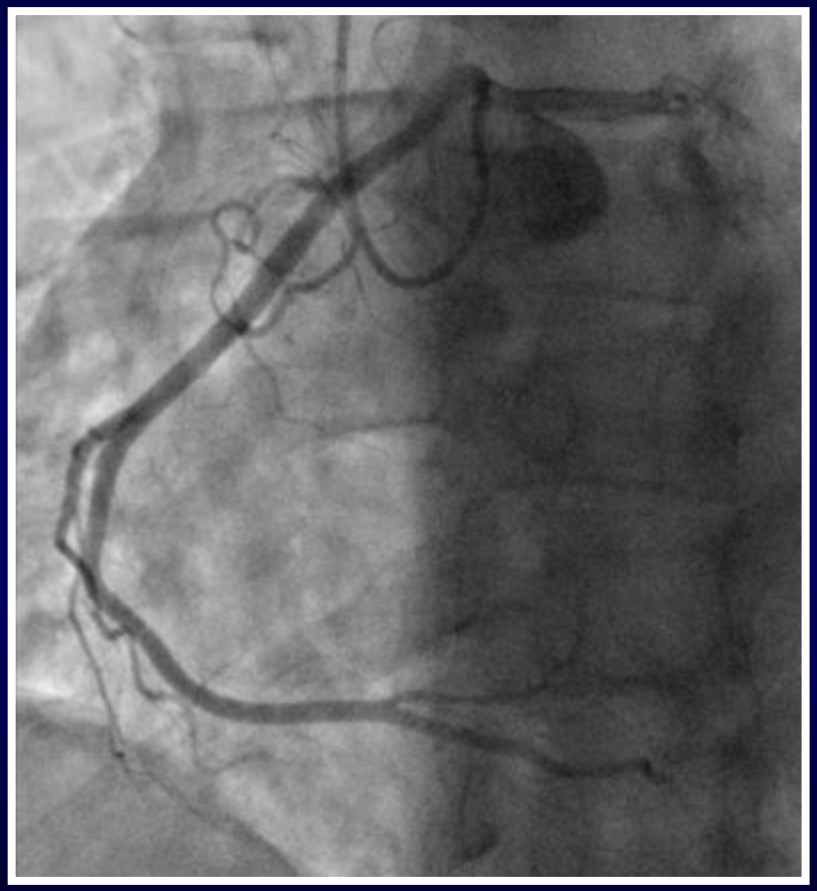
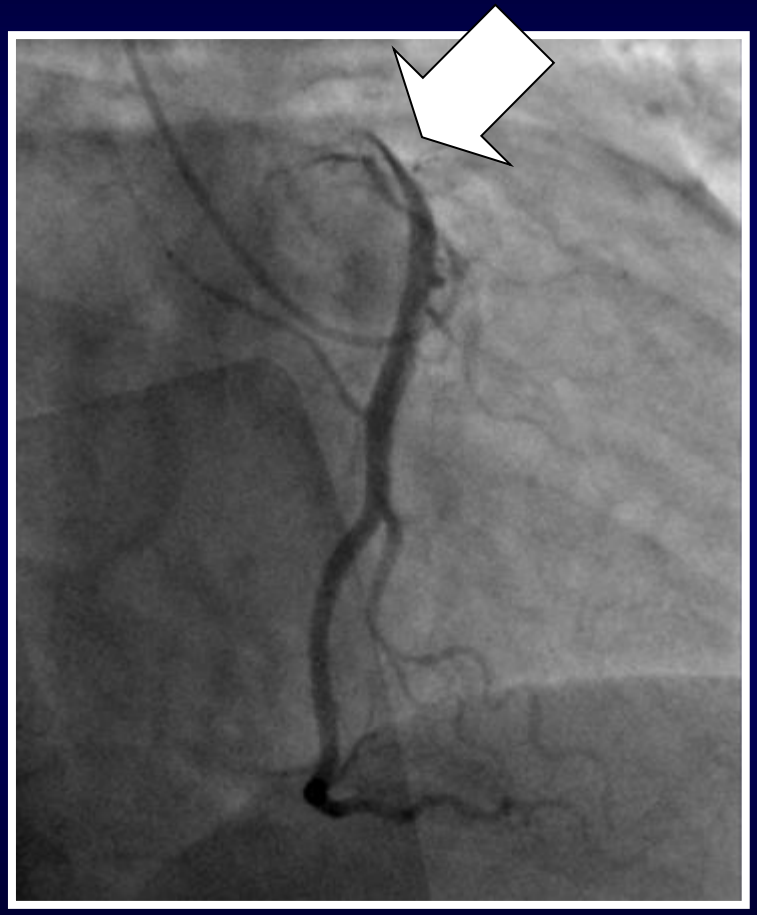
II







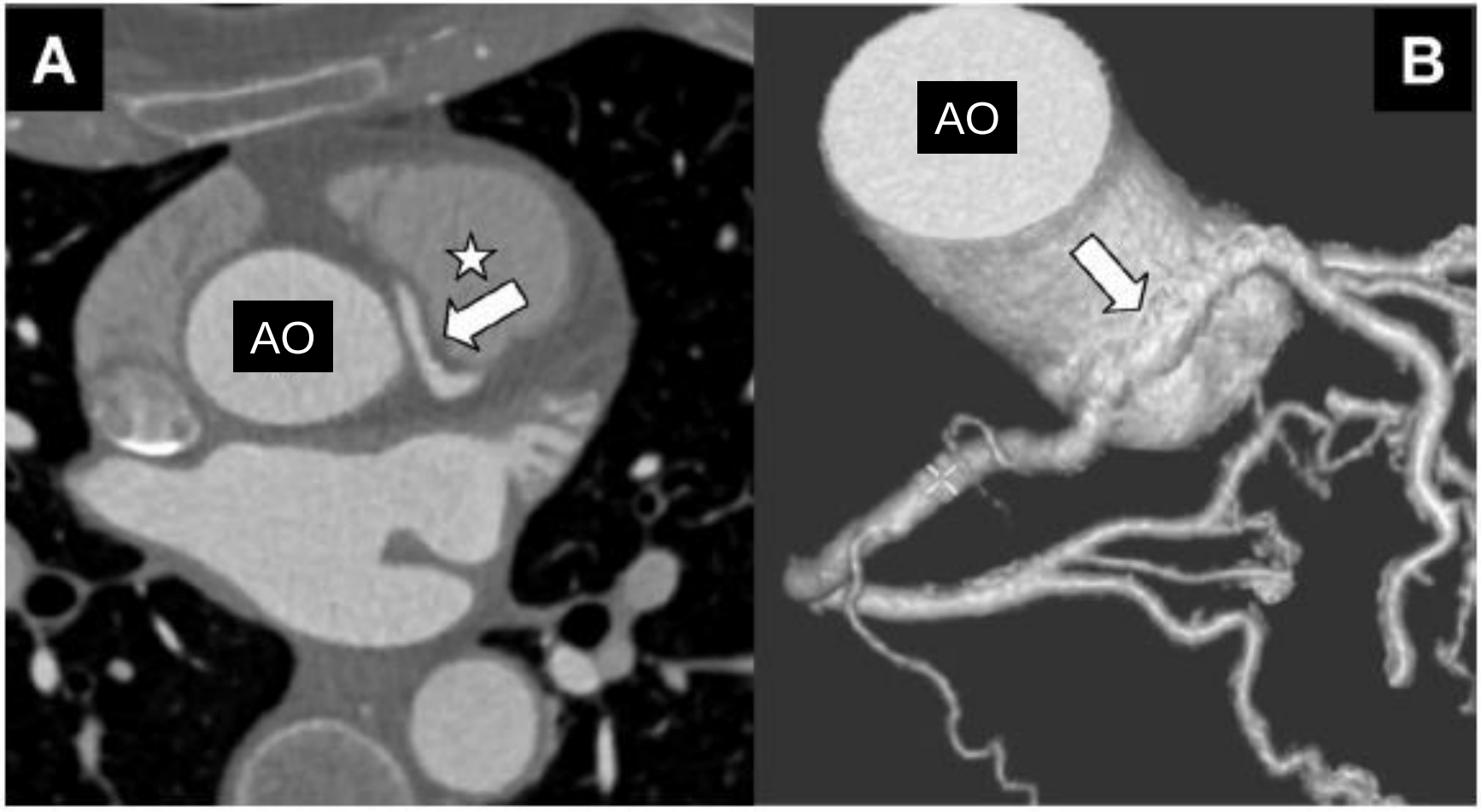
Méthergin 0.4 mg IV

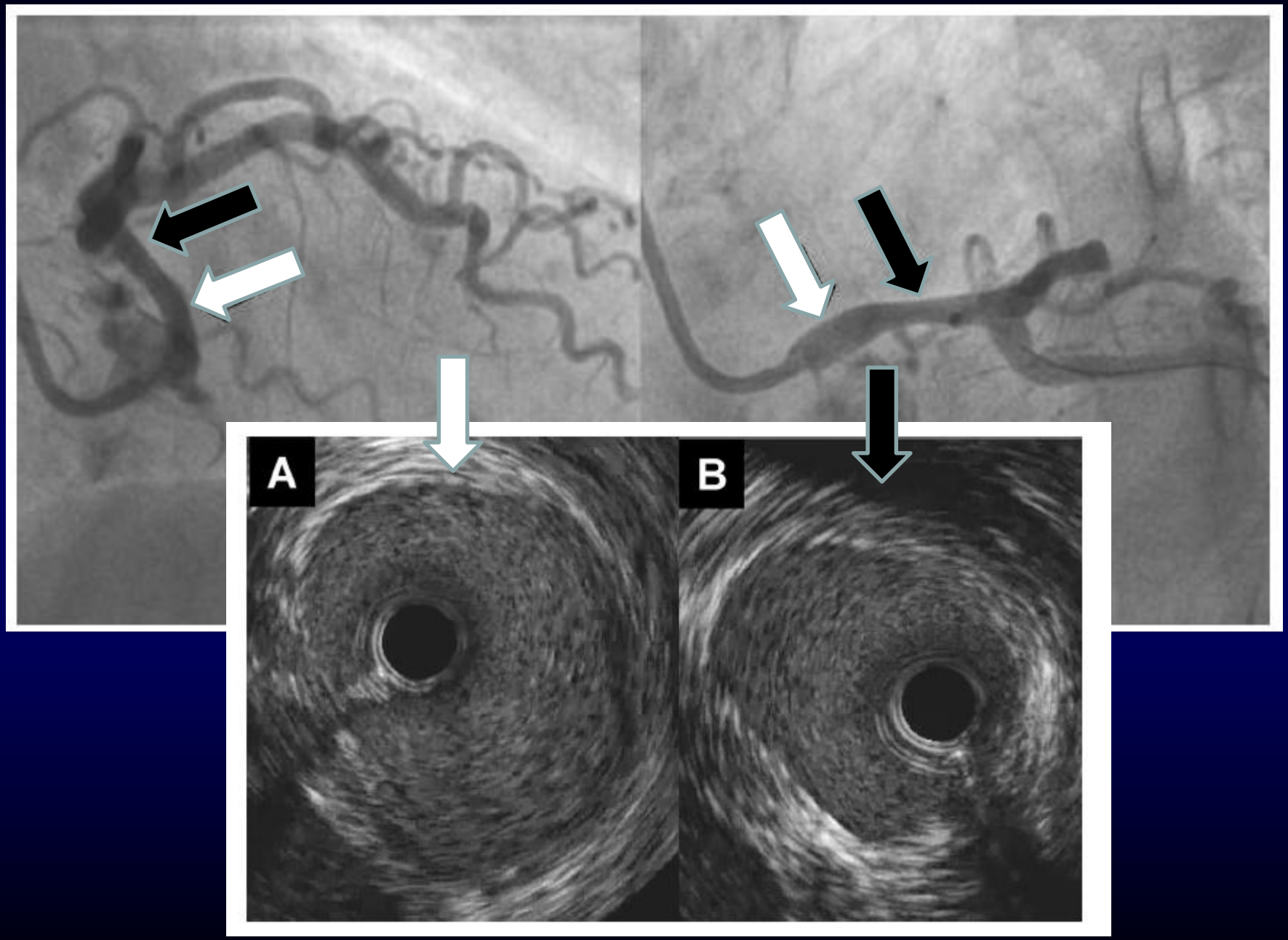
Risordan 1 mg IC

Que proposer ?

Cas clinique

- Femme de 61 ans
- HTA, sevrage tabagique
- Chimiothérapie avec 5-fluoro-uracile
- Précordialgies gauches
- Dyspnée d’effort stade II NYHA
- ECG et échocardiogramme normaux
- Scanner coronaire
- Anomalie de connexion du tronc commun
- Ischémie limitée antéroseptale isotopique


A
AO
B
AO


A
B

Que proposer ?

Informations

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