Mercredi 18 mars 2026
Hôpital LARIBOISIERE

Anomalies coronaires congénitales (ANOCOR)

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HÔPITAUX UNIVERSITAIRES PARIS NORD VAL DE SEINE
Bichat - Claude-Bernard
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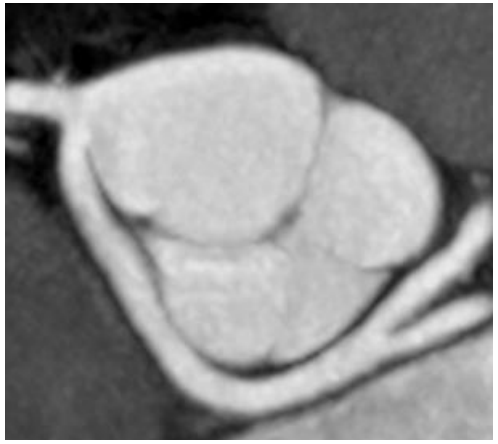
Groupement Hospitalier de Territoire
Saint-Denis Gonesse
Plaine de France

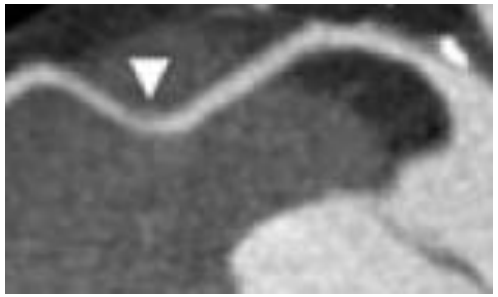
ANOMALIES CORONAIRES CONGENITALES

Connexion



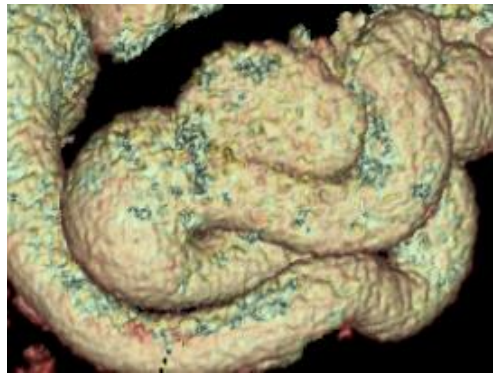
Connexion anormale

Trajet



Pont myocardique

Terminaison



Fistule coronaire

Connexions aortiques anormales

1. Ce que l'on sait assez bien
2. Ce que l'on sait plus ou moins bien
3. Ce que l'on ne sait pas bien

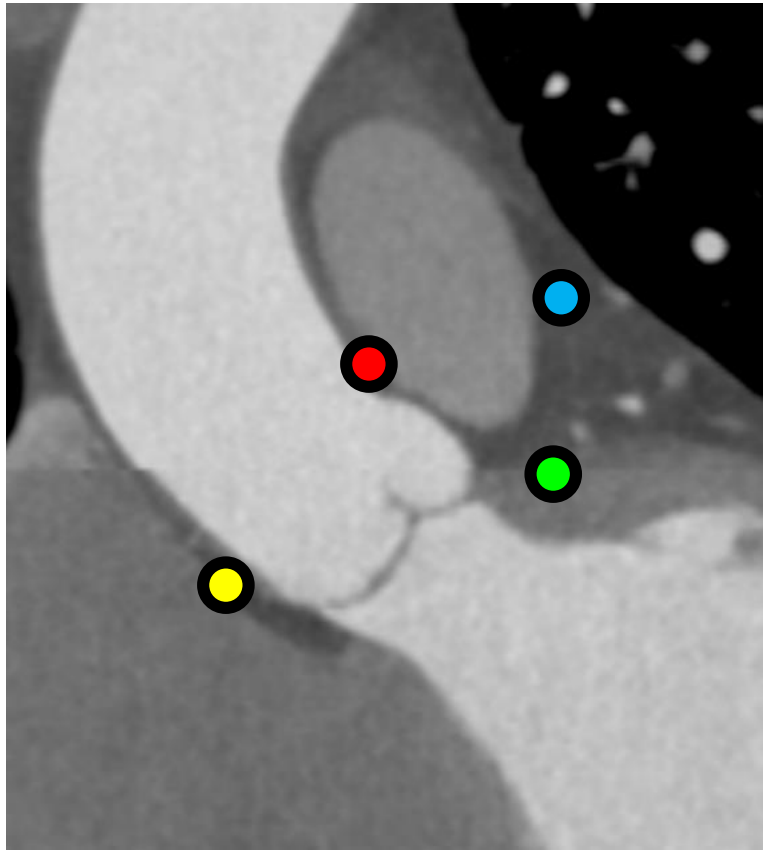
Connexions aortiques anormales

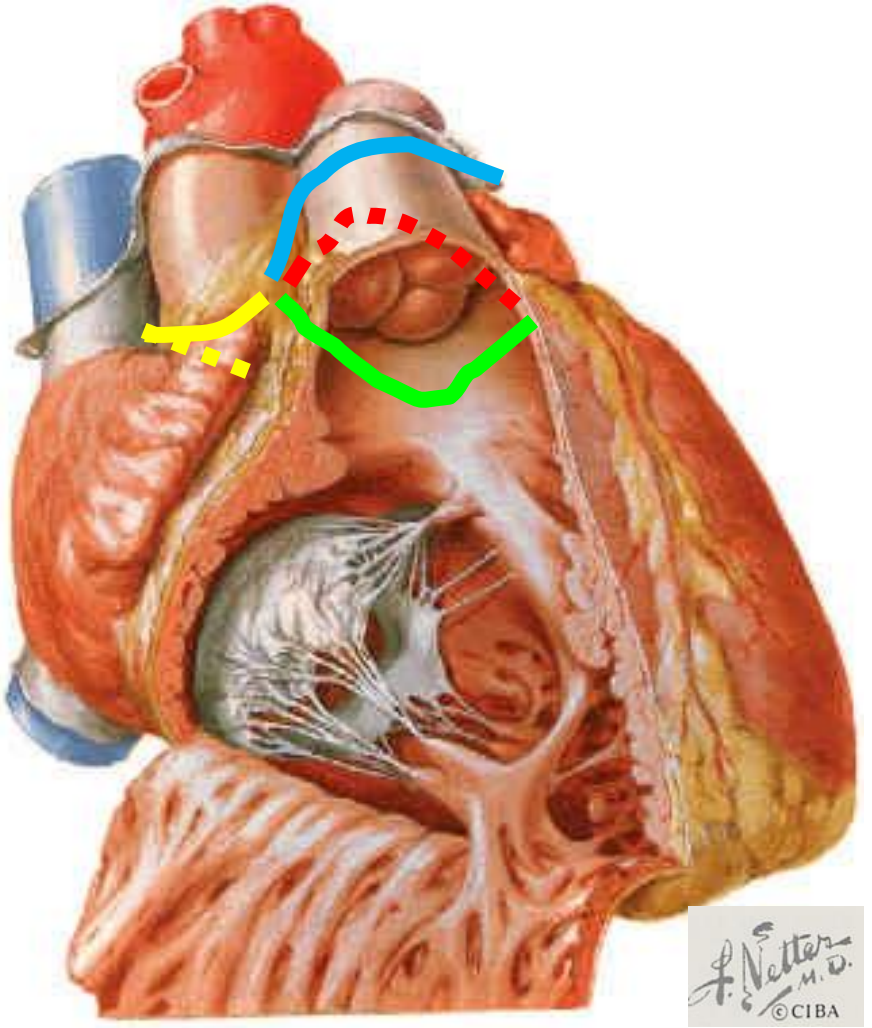
1. Ce que l'on sait assez bien

- Prévalence des types anatomiques
- Risques selon l'anatomie
- Modes d'imagerie
- Techniques chirurgicales
- Maladie coronaire associée

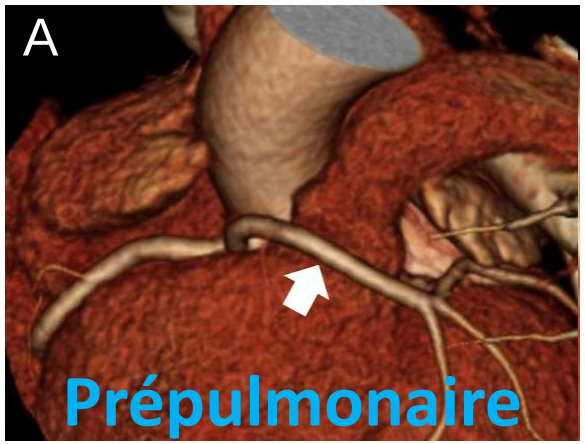
Classification anatomique par le trajet

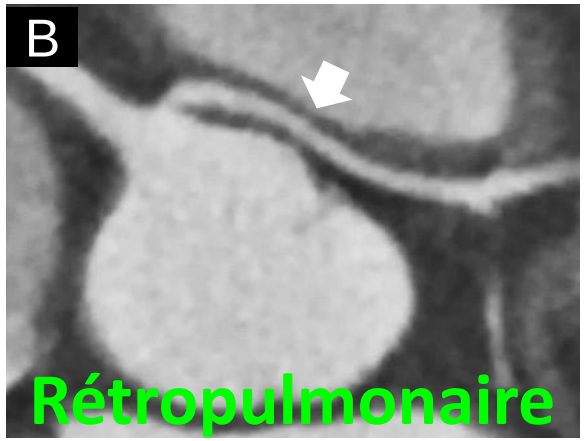
- Prépulmonaire
- Rétropulmonaire
- Interartériel
- Rétroaortique

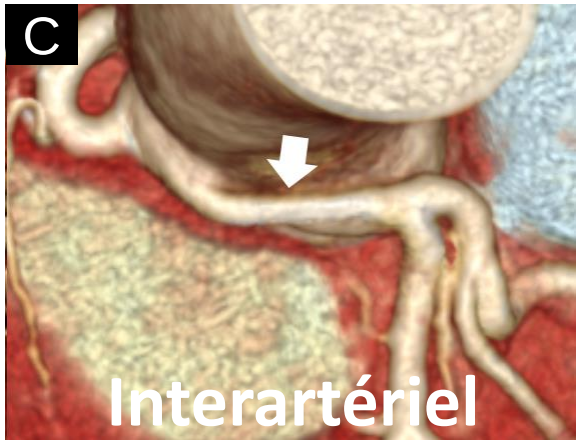


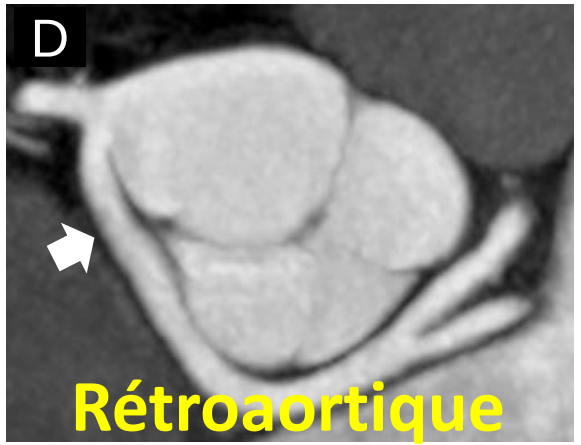


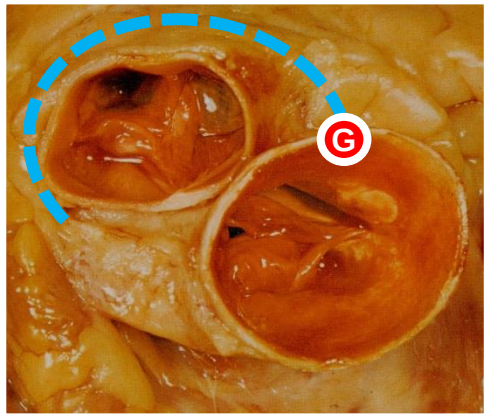
Classification anatomique par l'artère (tronc/IVA) et le trajet



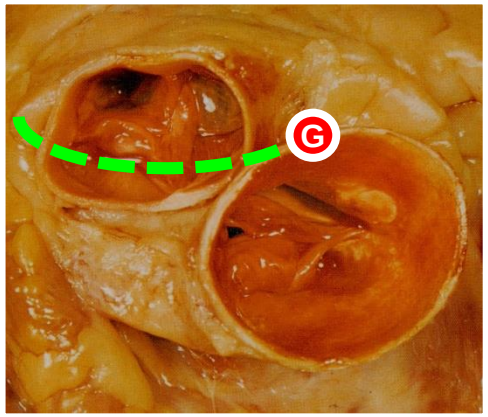








30%



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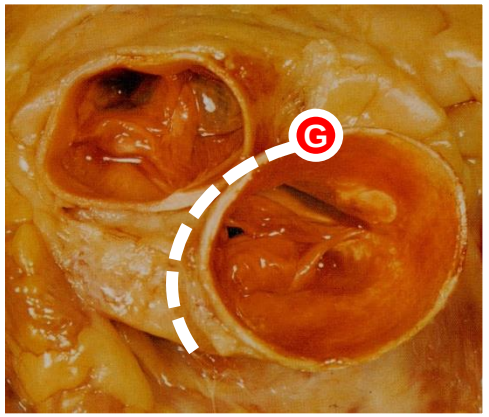

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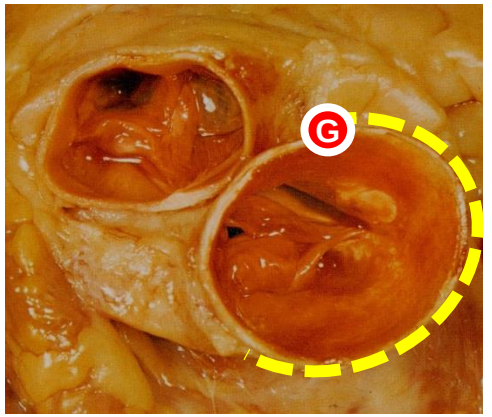
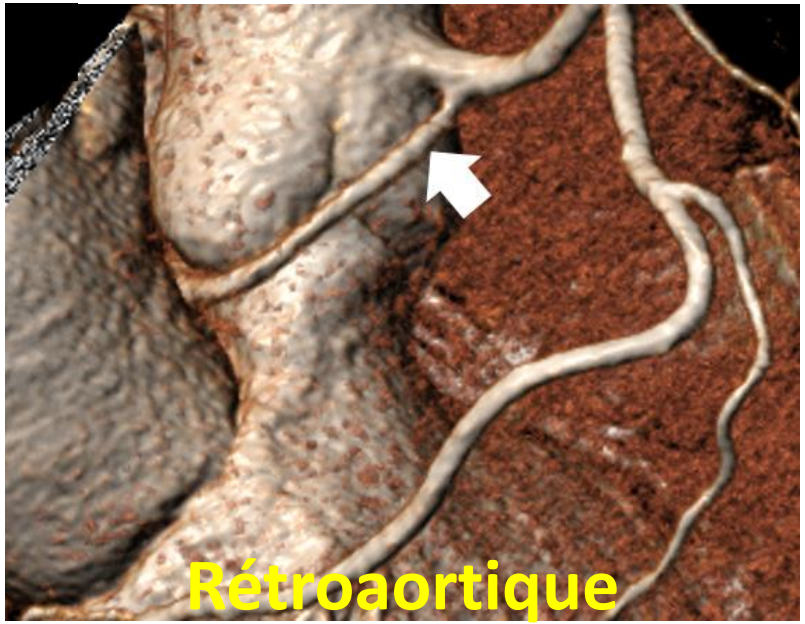
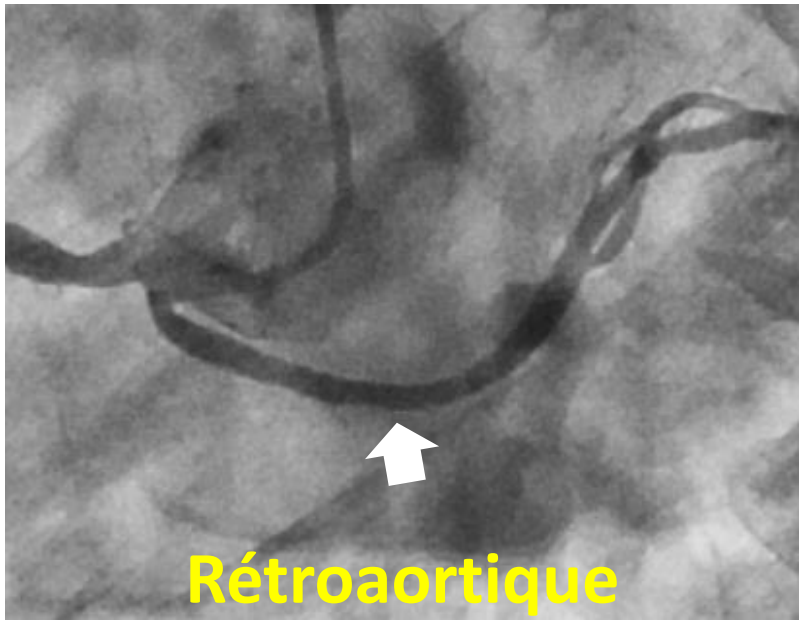
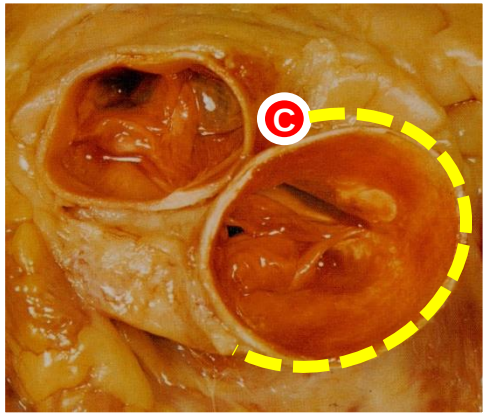


15%

Classification anatomique par l'artère (circonflexe) et le trajet

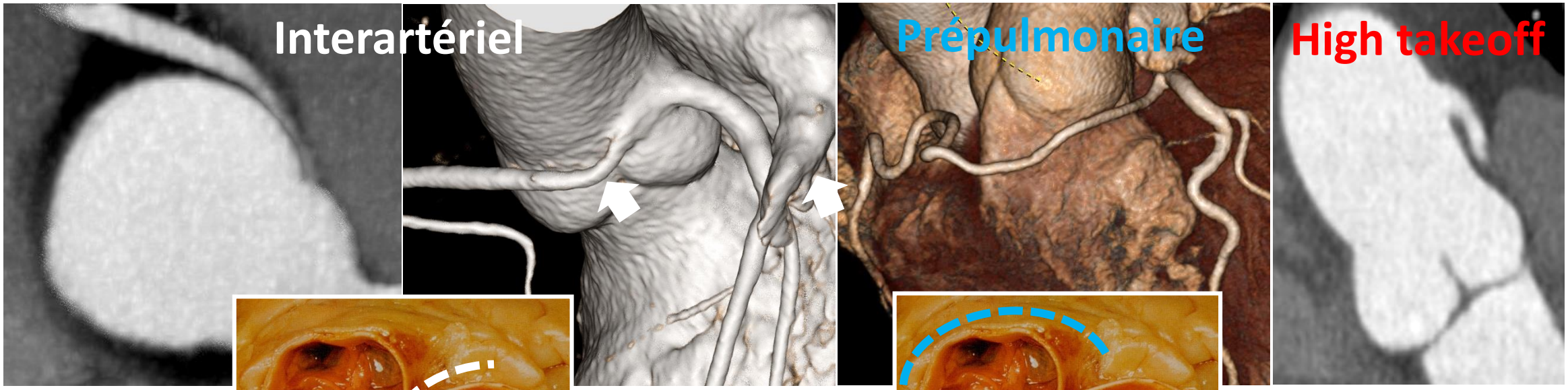






99%

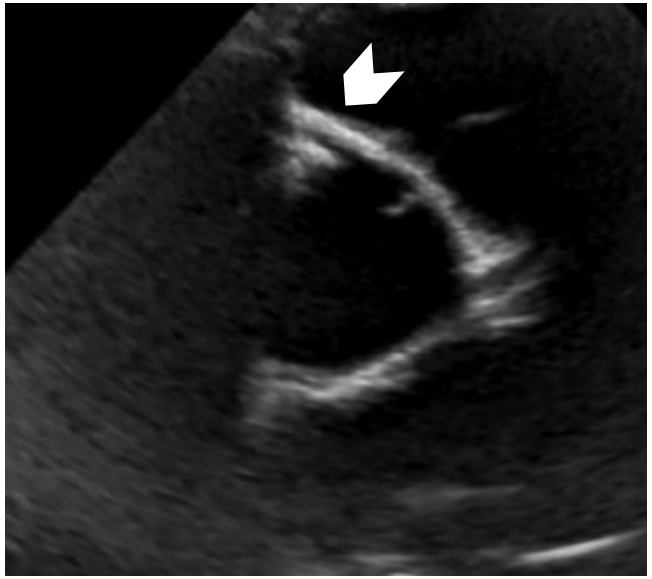
Classification anatomique par l'artère (droite) et le trajet



95%

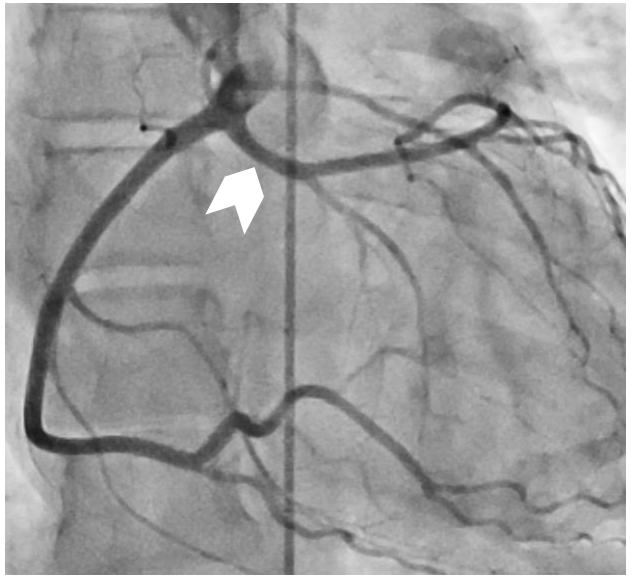
< 5%

Prévalence selon le mode d'imagerie



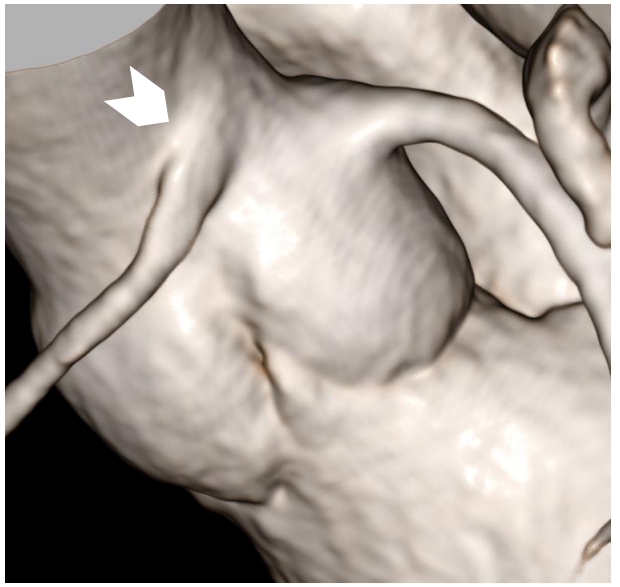
Echocardiographie

0.2%



Coronarographie

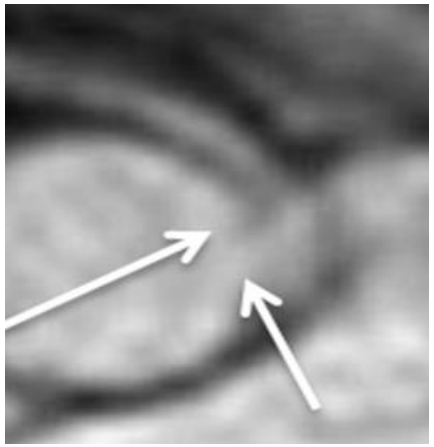
0.6%



Scanner

0.8%

Prevalence of AAOCA with interarterial course in general population



Clinical Investigation

High-Risk Cardiovascular Conditions in Sports-Related Sudden Death:

Prevalence in 5,169 Schoolchildren Screened via Cardiac Magnetic Resonance

Angelini P Texas Heart Journal 2018

- L-ACAOS-IA = 2
- R-ACAOS-IA = 17
- **Total ACAOS-IA = 19**

- Prevalence L-ACAOS-IA = 0.04%
- Prevalence R-ACAOS-IA = 0.32%
- **Total prevalence ACAOS-IA = 3.5/1000**

ACAOS: anomalous coronary artery from opposite sinus; IA: interarterial.

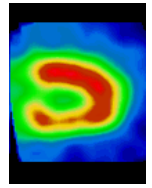
Définition européenne d'une maladie rare : qui n'affecte pas plus d'1 personne sur 2 000 dans la population européenne.

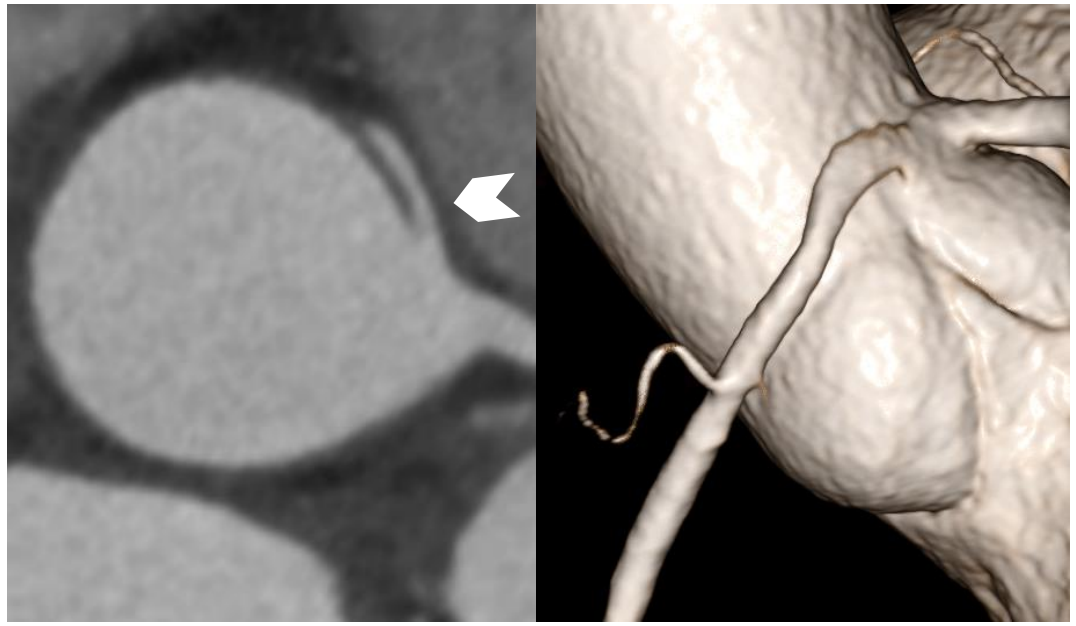
Connexions aortiques anormales

1. Ce que l'on sait assez bien

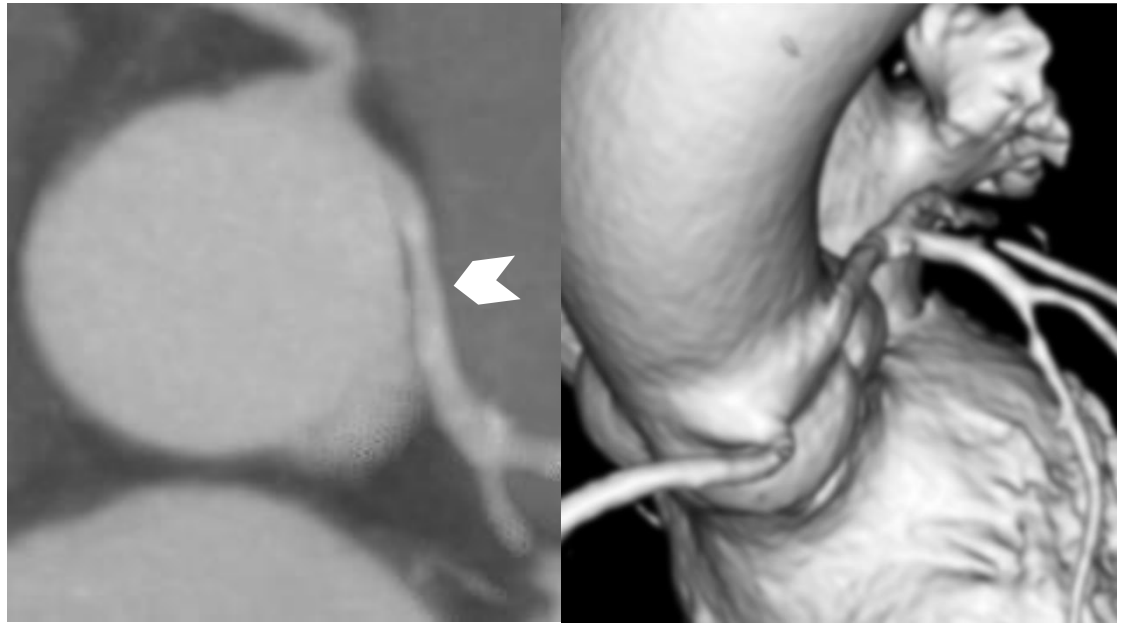
- Prévalence des types anatomiques
- Risques selon l'anatomie
- Modes d'imagerie
- Techniques chirurgicales
- Maladie coronaire associée

Anomalies de connexion aortique à risque



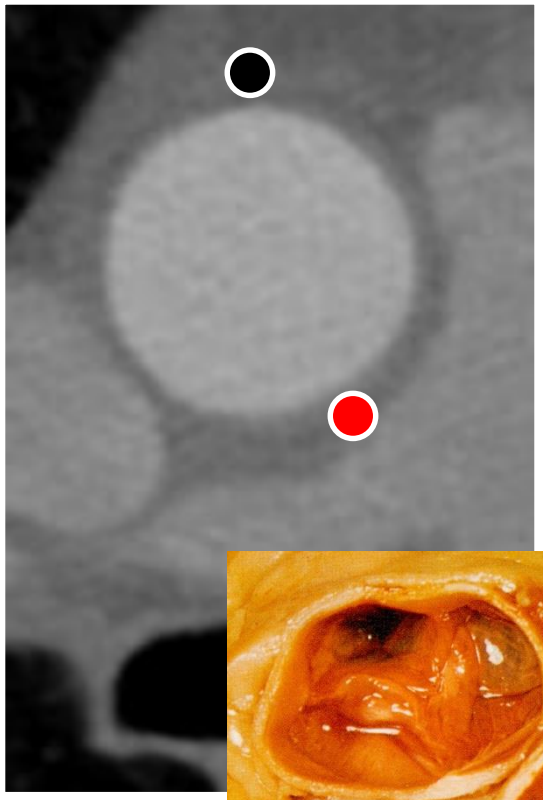


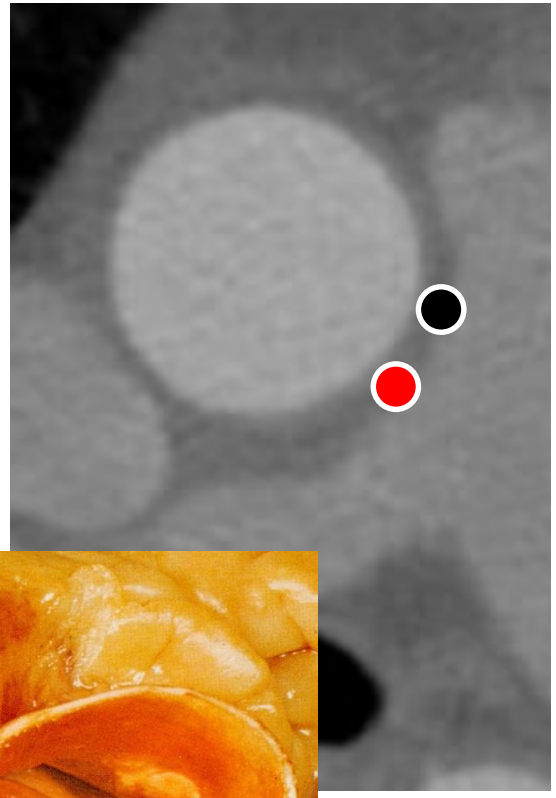
ANOCOR droite interartérielle

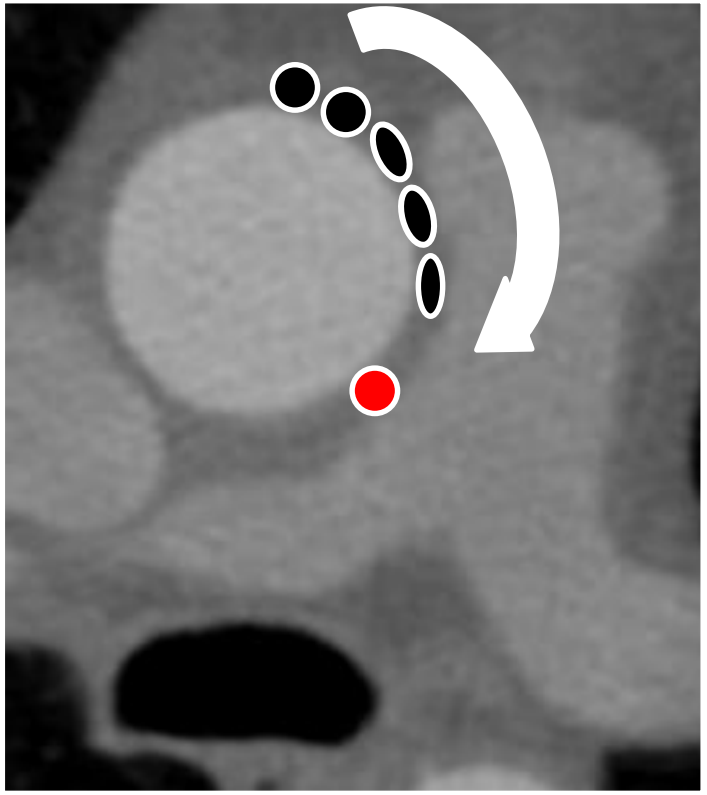


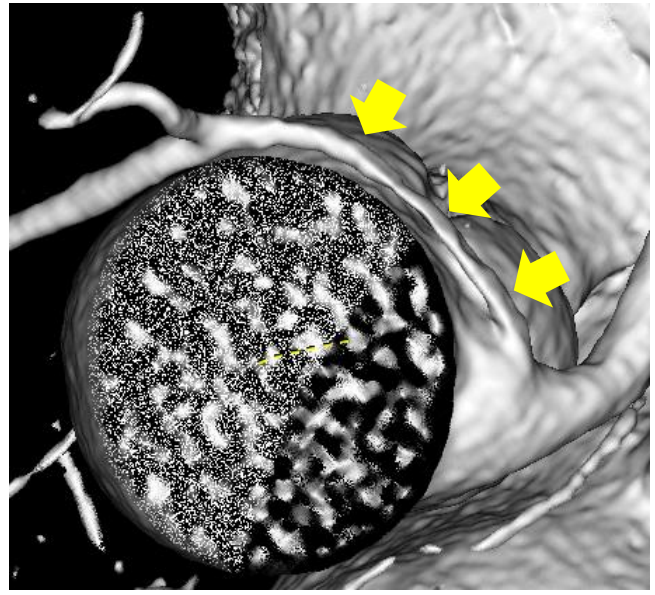
ANOCOR gauche interartérielle

Trajet interartériel et adaptation vasculaire

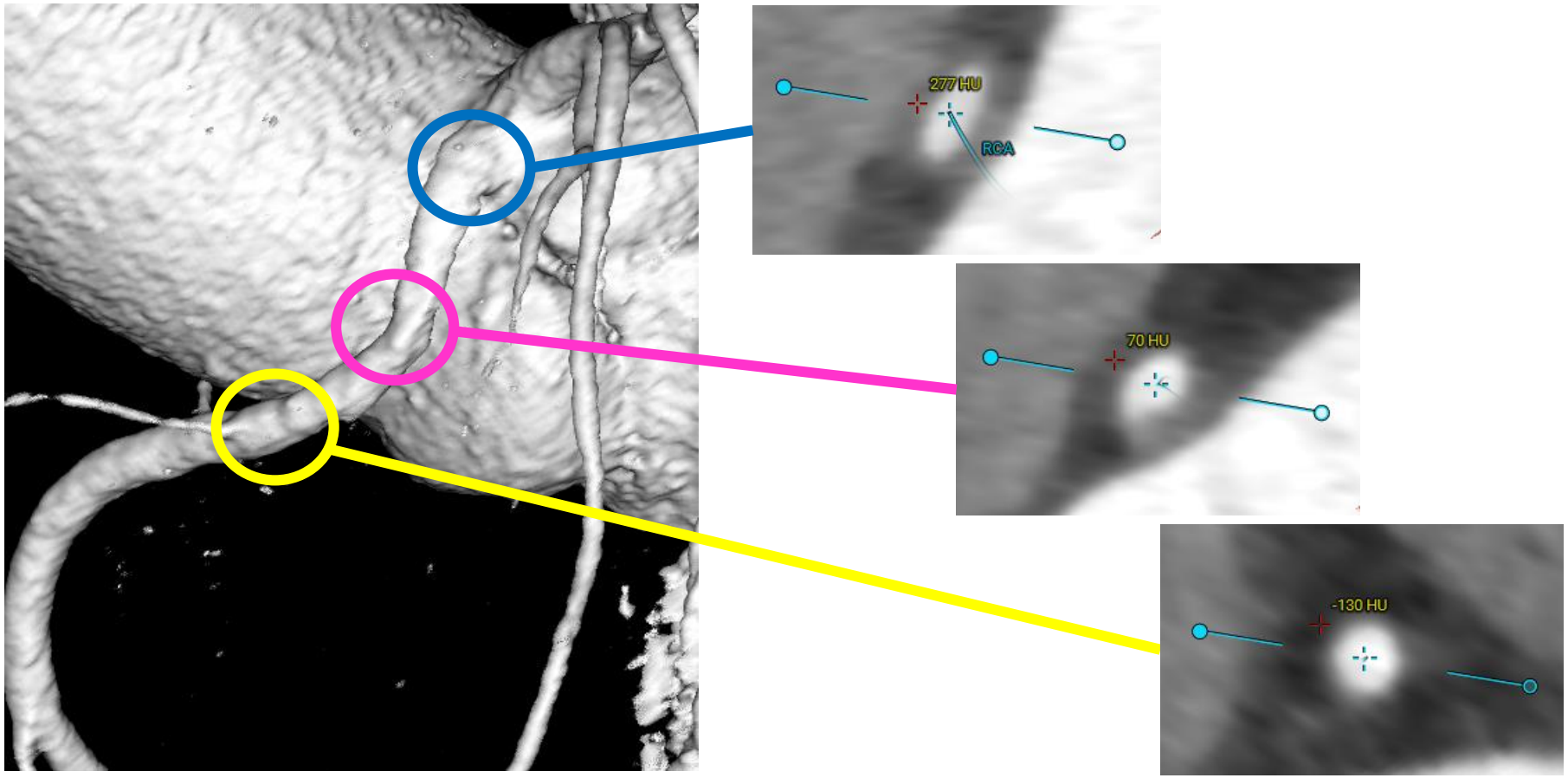




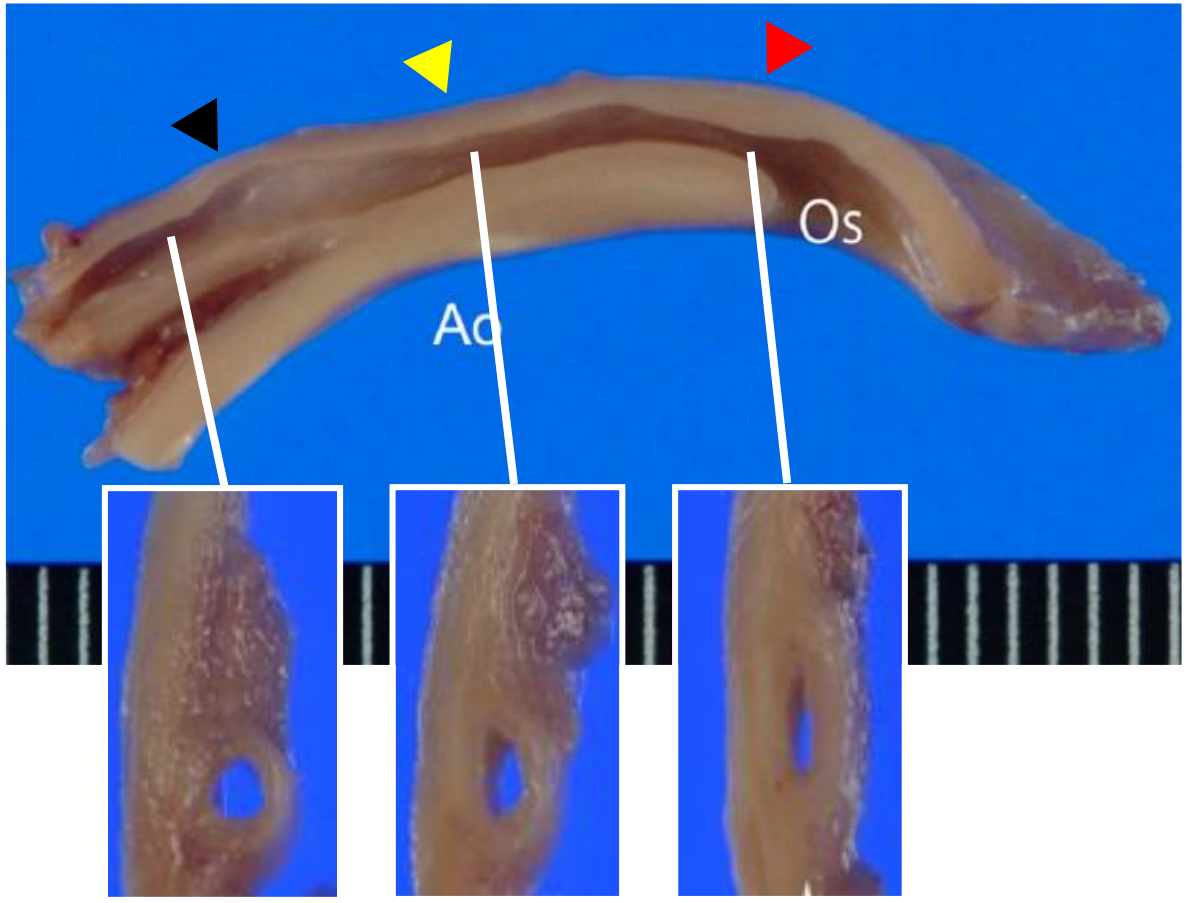




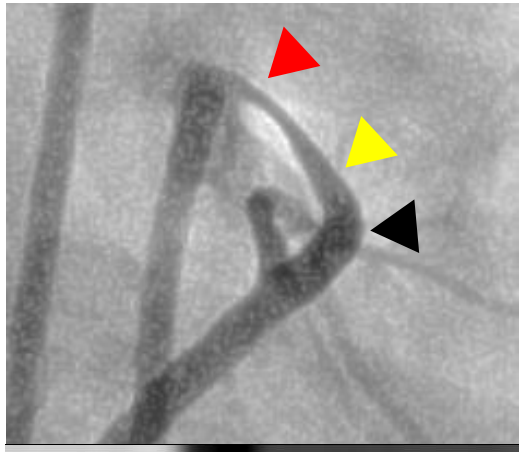
Trajet interartériel et adaptation vasculaire

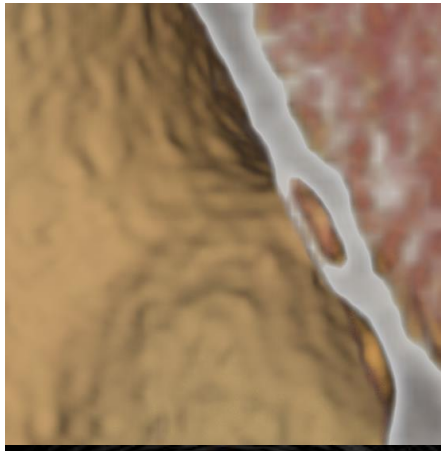


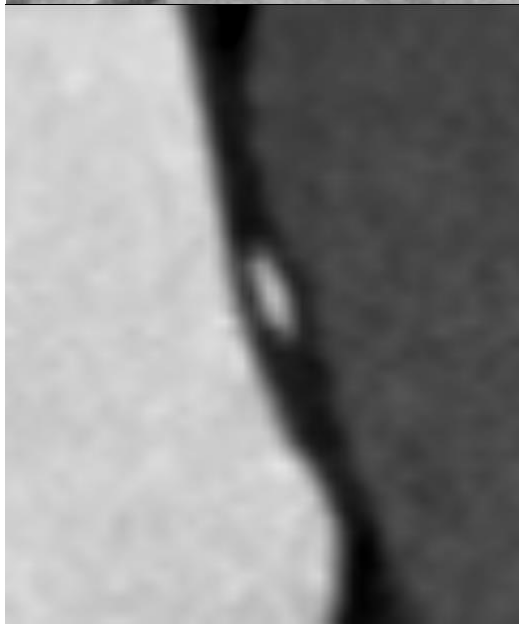
Trajet interartériel avec passage intramural aortique

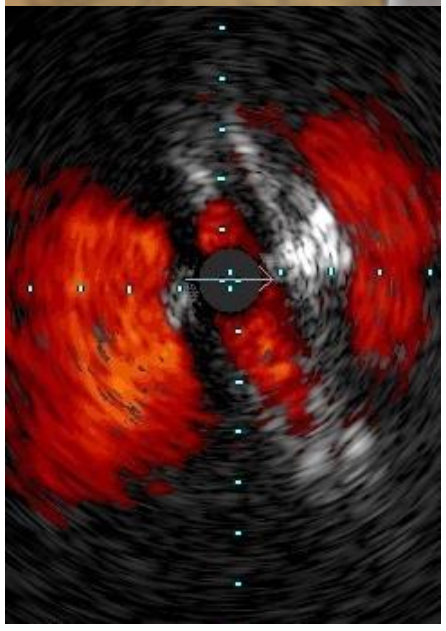


Hata Y et al. Cardiovasc Pathol. 2014.

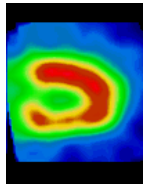


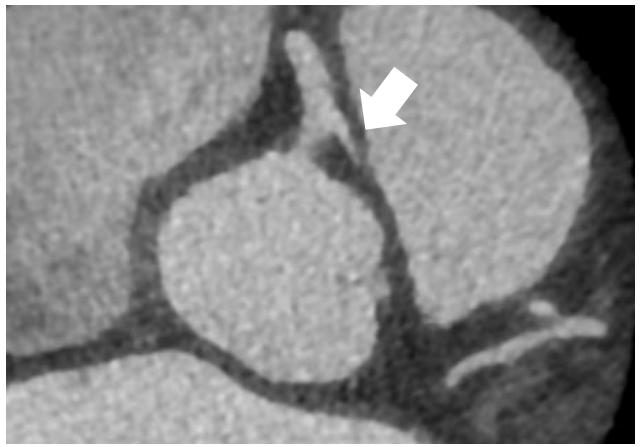


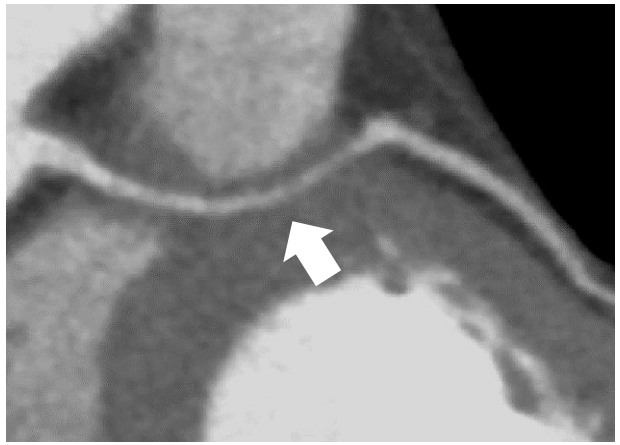


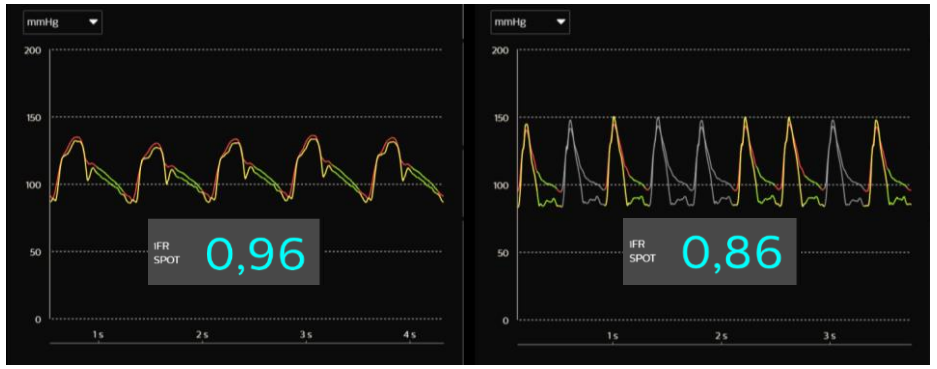


Anomalies de connexion aortique très rarement à risque

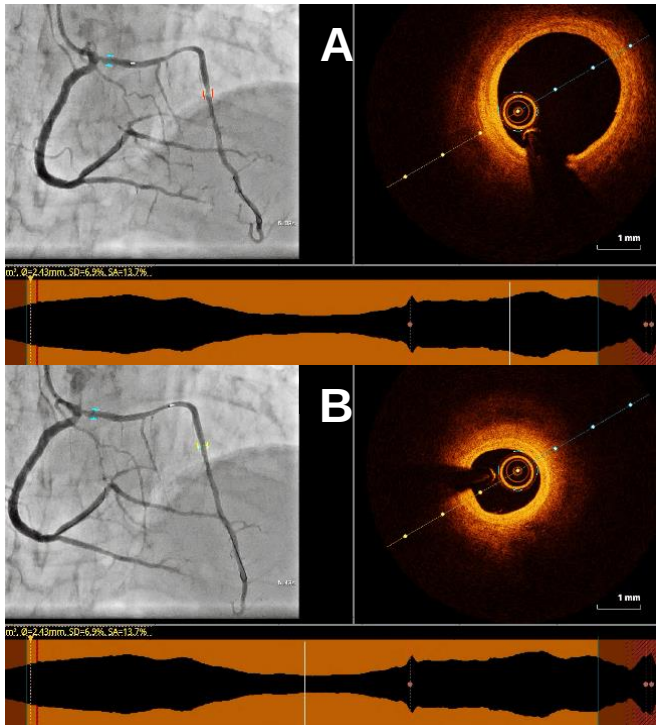








ANOCOR gauche rétropulmonaire

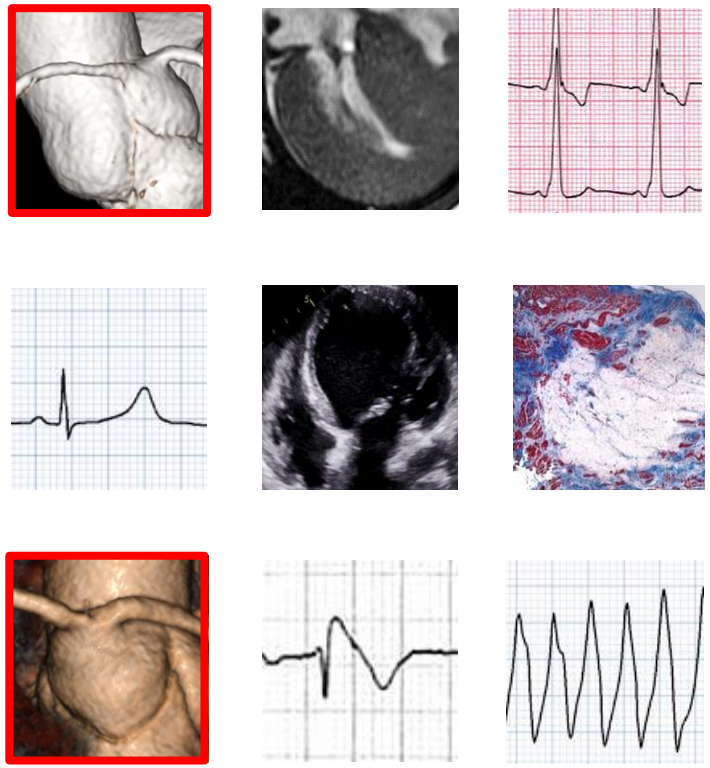


Anomalies de connexion aortique non à risque

ANOCOR prépulmonaire

ANOCOR rétroaortique

Prévalence des cardiopathies congénitales à risque



Cardiopathie	Prévalence*
ANOCOR droite avec trajet interartériel	**0.3%**
Cardiomyopathie hypertrophique	0.2%
Syndrome pré-excitation ventriculaire	0.15%
Syndrome du QT long	0.04%
Cardiomyopathie dilatée idiopathique	0.04%
Dysplasie ventriculaire droite arythmogène	0.04%
ANOCOR gauche avec trajet interartériel	**0.03%**
Syndrome de Brugada	0.02%
Tachycardie ventriculaire catécholergique	0.01%

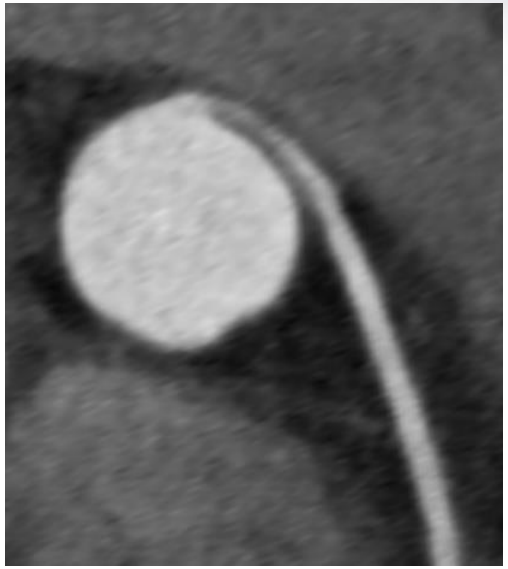
*Prévalence de la cardiopathie en population générale (estimations)

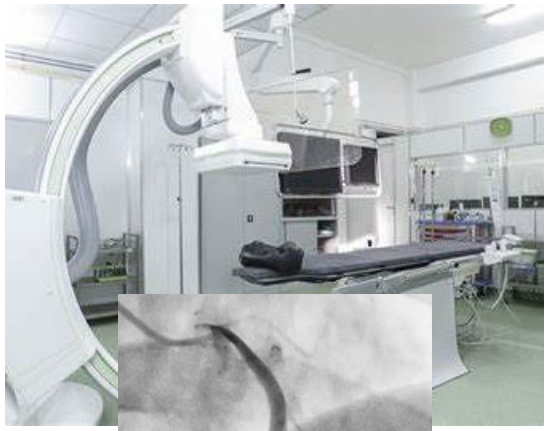
Connexions aortiques anormales

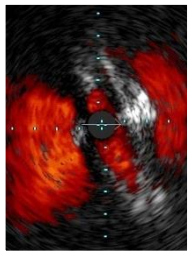
1. Ce que l'on sait assez bien

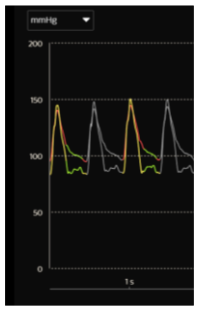
- Types anatomiques et prévalence
- Risques selon l'anatomie
- Modes d'imagerie
- Techniques chirurgicales
- Maladie coronaire associée

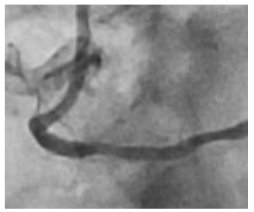
Outils d'imagerie

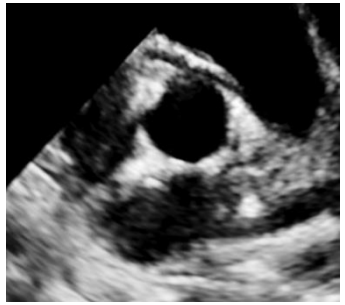


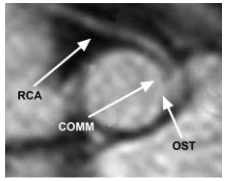




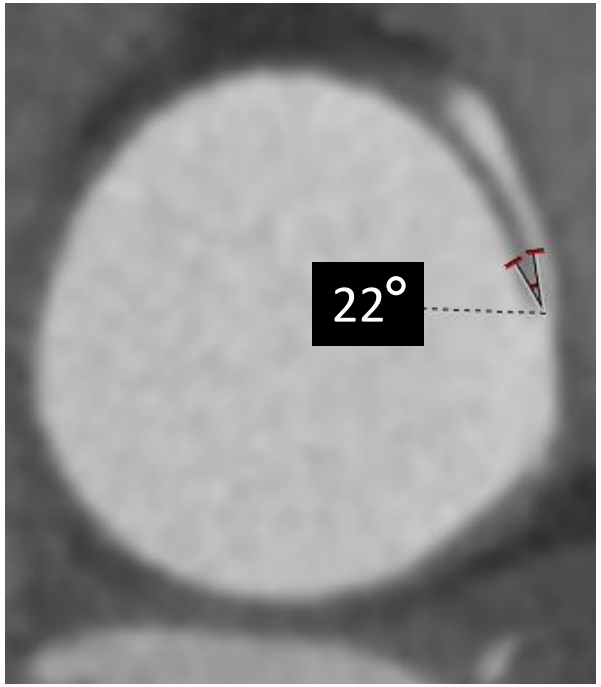




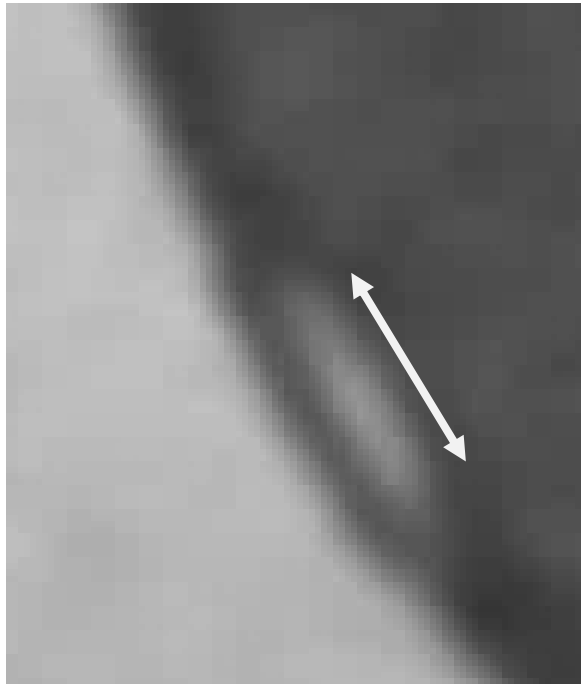




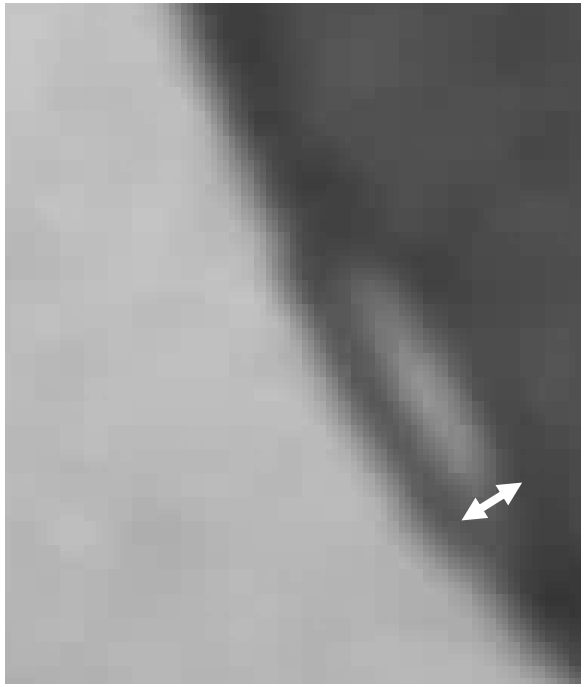
Analyse tomographique coronaire droite avec trajet interartériel



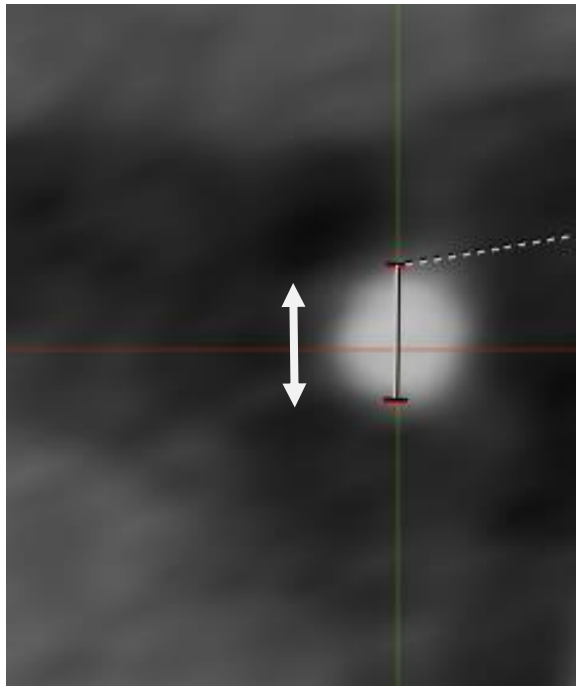
Angle de connexion



Grand axe



Petit axe



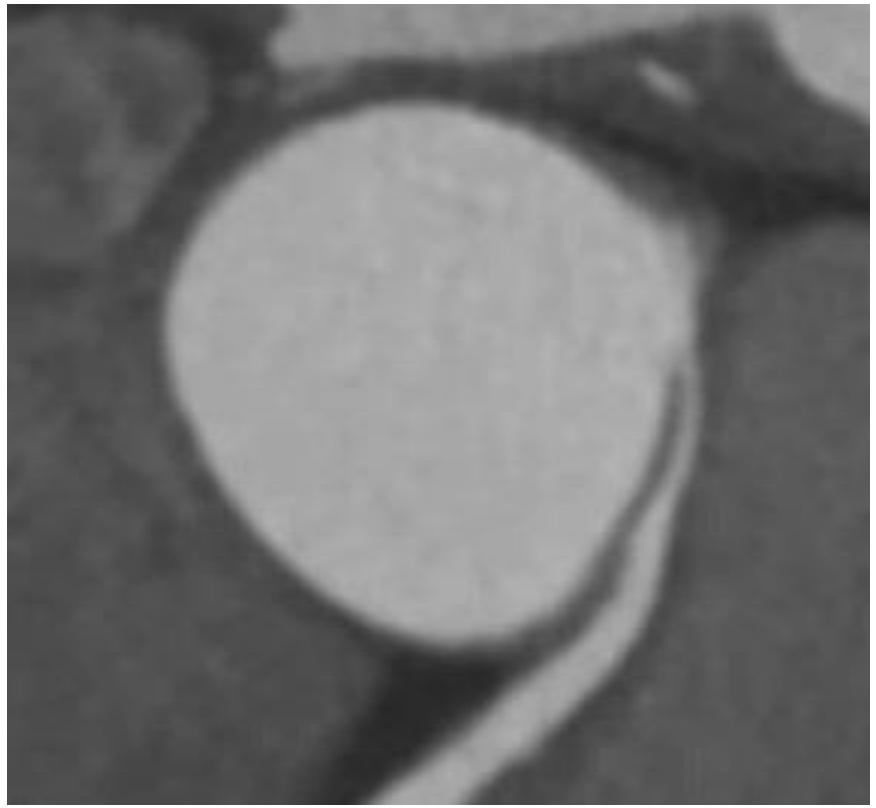
Référence

Diagnostic tomographique d'un passage intramural aortique

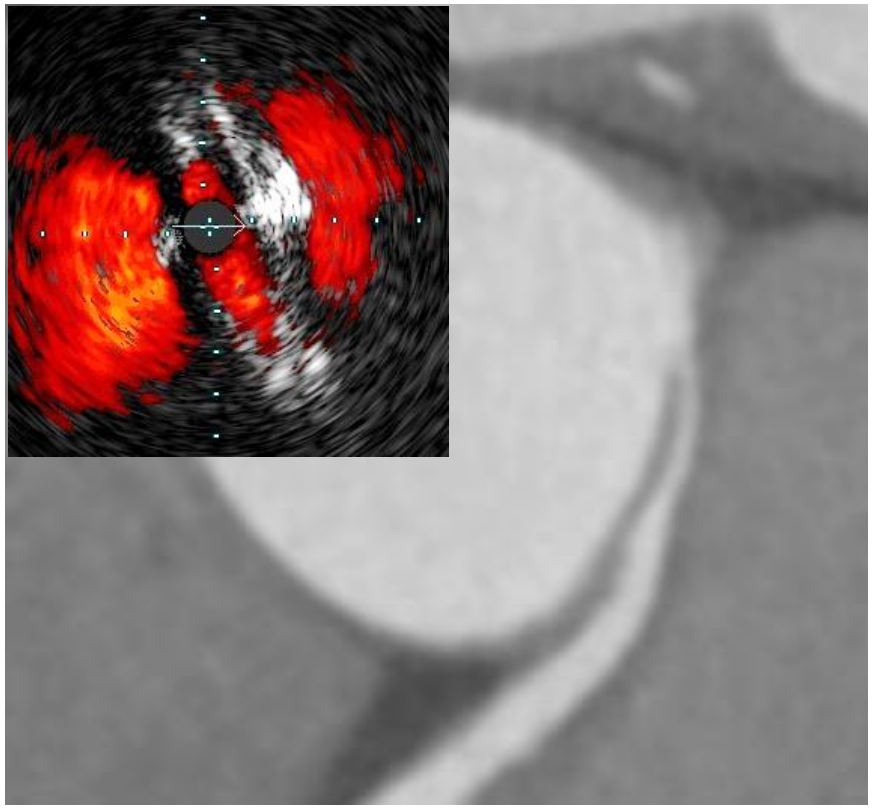
- Degré d'excentricité (grand axe/petit axe) ≥ 2.0
- Angle de connexion ≤ 35°
- Réduction de diamètre ≥ 50%

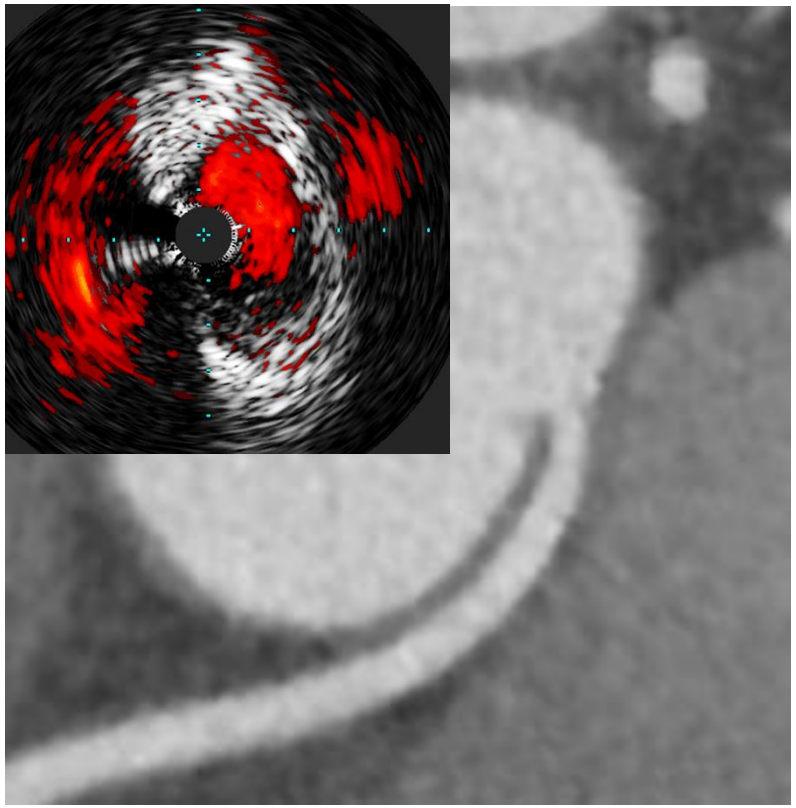
- **3 critères présents** : passage intramural aortique certain
- **2 critères présents** : passage intramural aortique incertain
- **0/1 critère présent** : passage intramural aortique absent

Diagnostic tomographique d'un passage intramural aortique

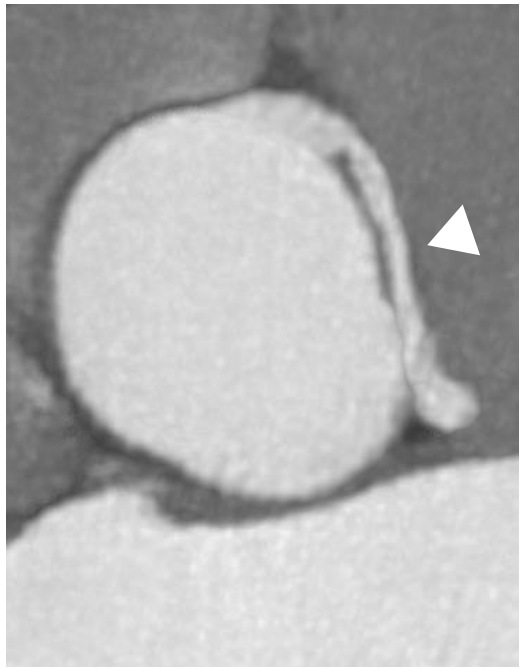
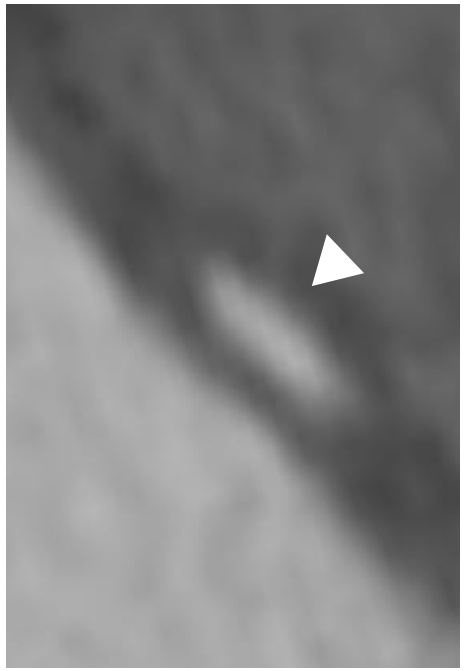
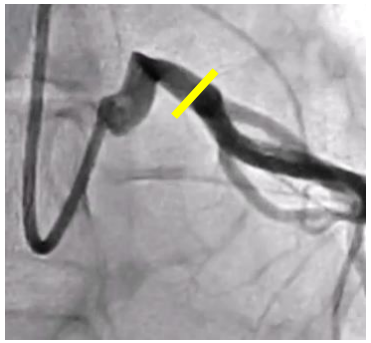
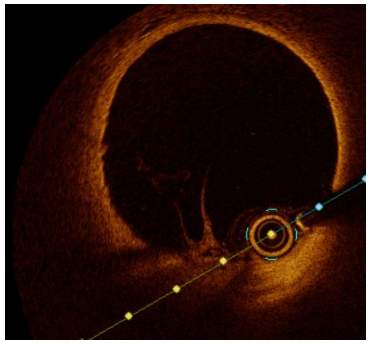
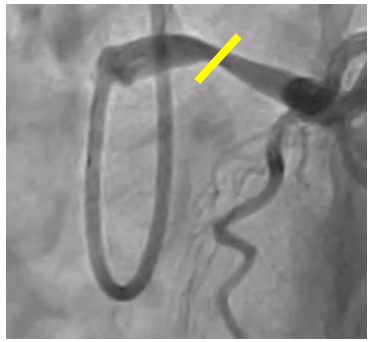
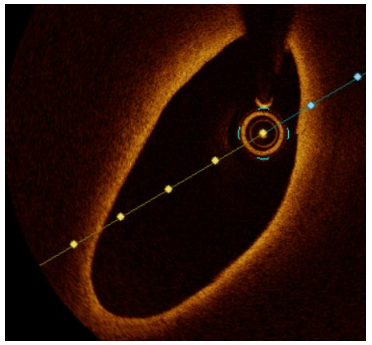


Diagnostic tomographique d'un passage intramural aortique
Echographie endocoronaire (IVUS)

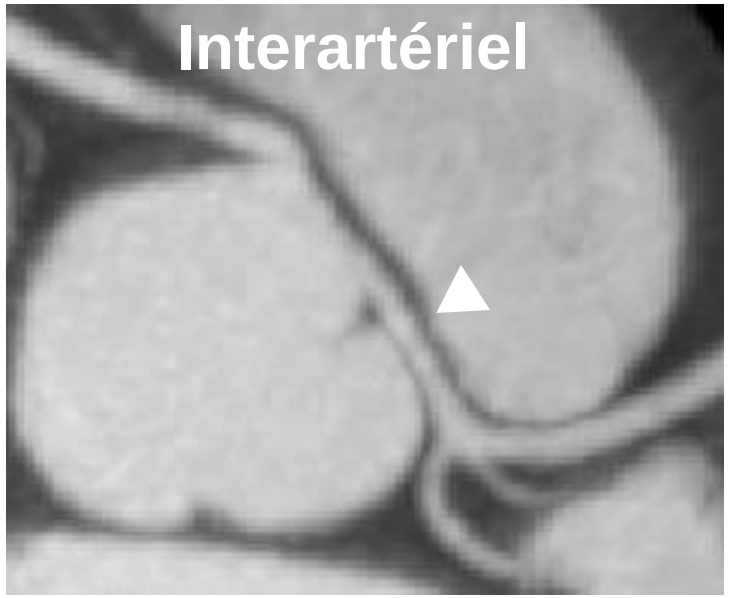




Diagnostic tomographique d'un passage intramural aortique
Tomographie par cohérence optique (OCT)

Trajets à ne pas confondre



Received: 11 October 2016 | Revised: 21 February 2017 | Accepted: 28 May 2017
DOI: 10.1111/chd.12504

ORIGINAL ARTICLE

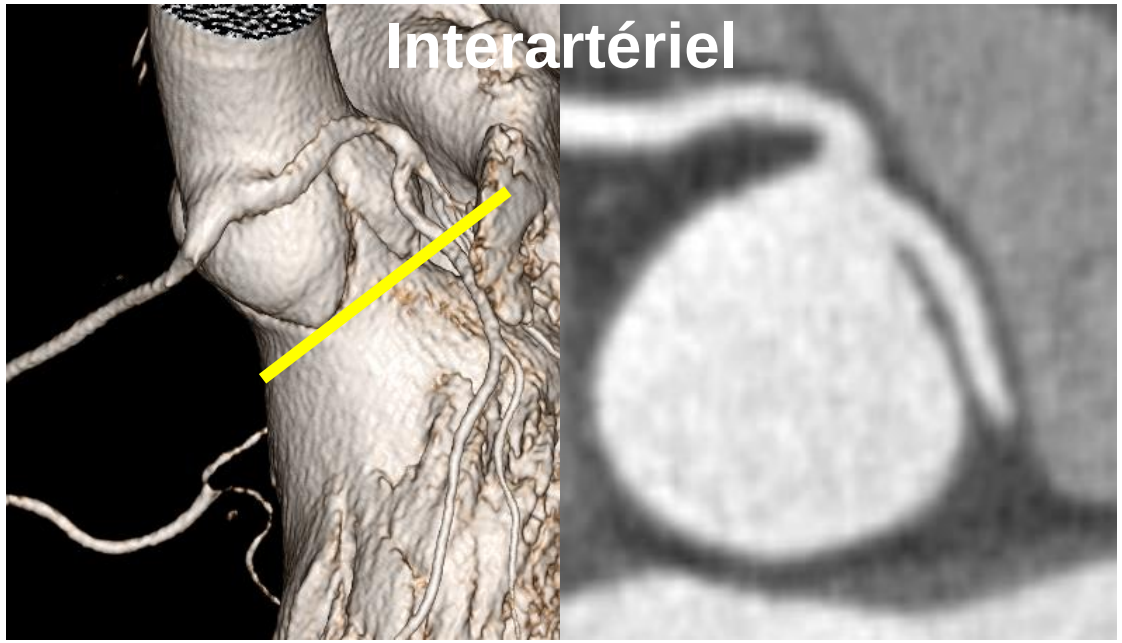
WILEY Congenital Heart Disease

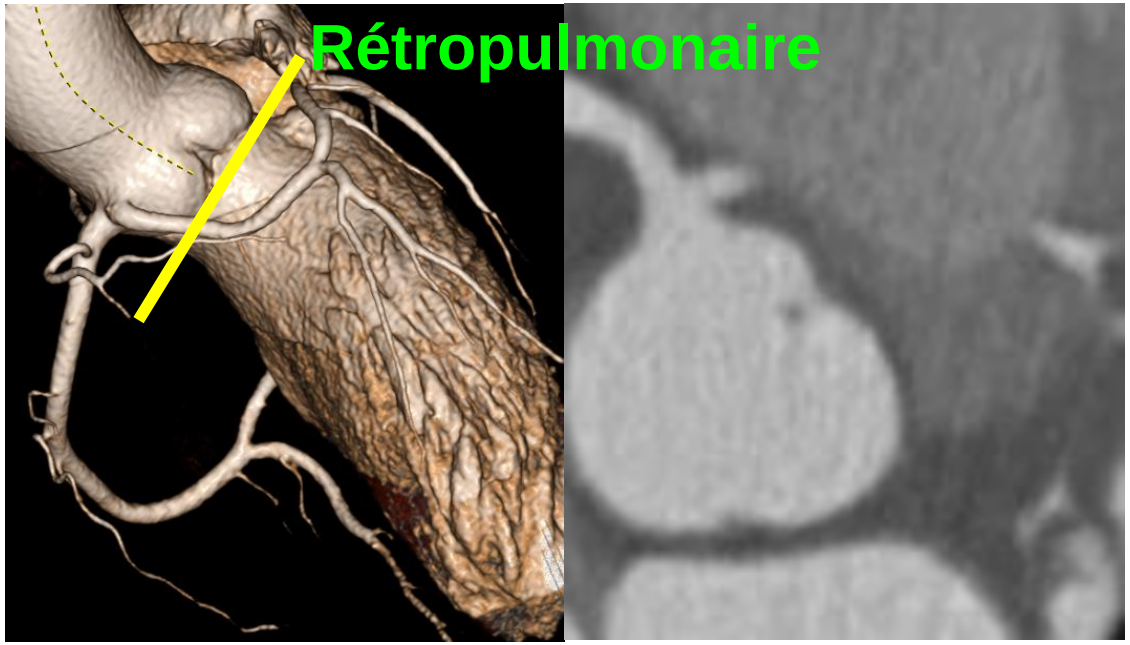
Interobserver variability in the classification of congenital coronary abnormalities: A substudy of the anomalous connections of the coronary arteries registry

Athanasios Koutsoukis, MD[1] | Xavier Halna du Fretay, MD[2] | Patrick Dupouy, MD[3] | Phalla Ou, MD, PhD[4] | Jean-Pierre Laissy, MD, PhD[4] | Jean-Michel Juliard, MD[5] | Fabien Hyafil, MD[6] | Pierre Aubry, MD[5] | on behalf of the ANOCOR Investigators*

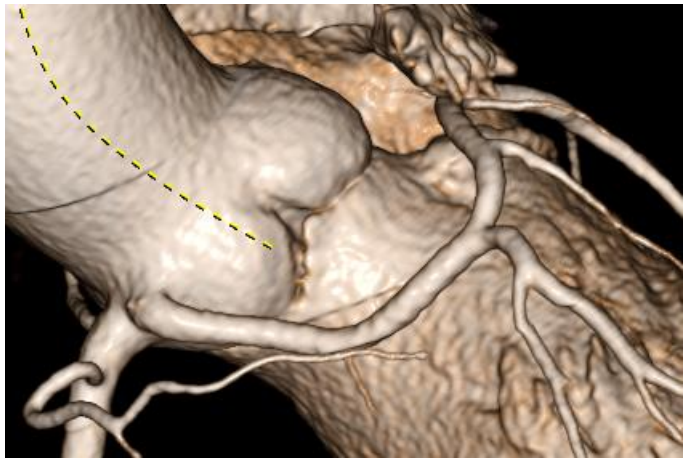
Koutsoukis A. Congenit Heart Dis. 2017.

Trajets à ne pas confondre



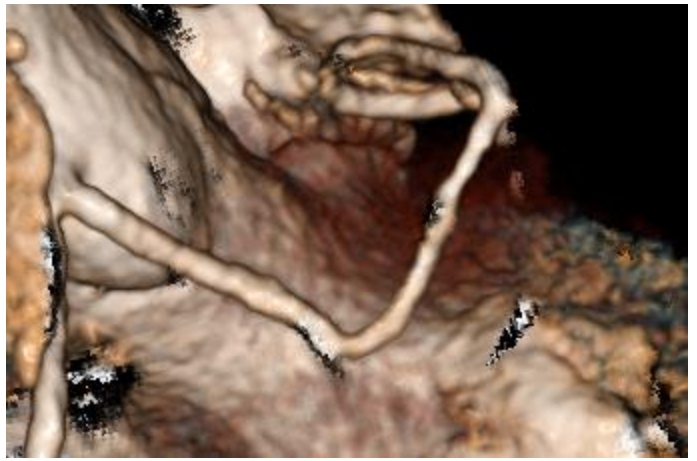


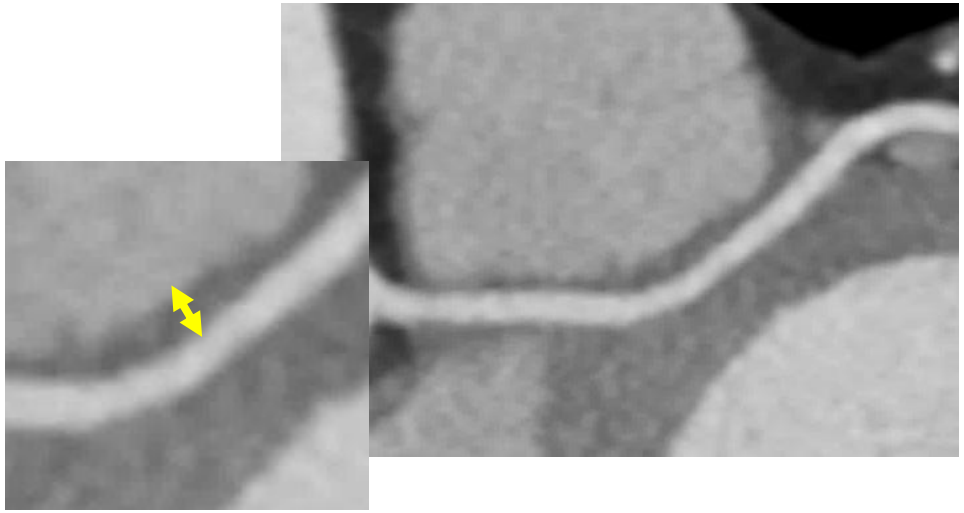
Trajet rétropulmonaire avec passage intramyocardique

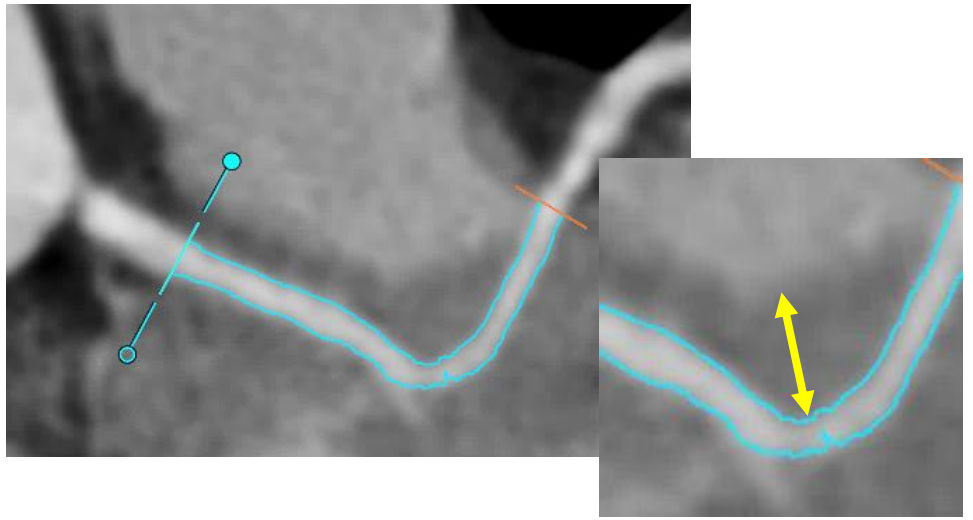


Profondeur :

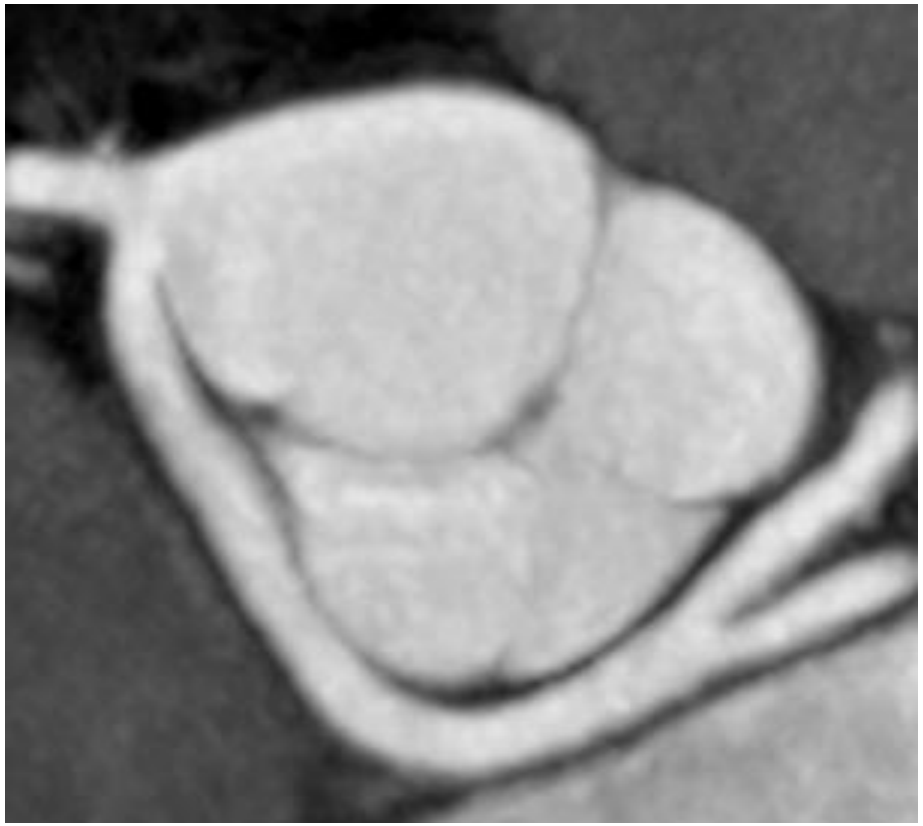
- 0
- < 3.0 mm
- ≥ 3.0 mm

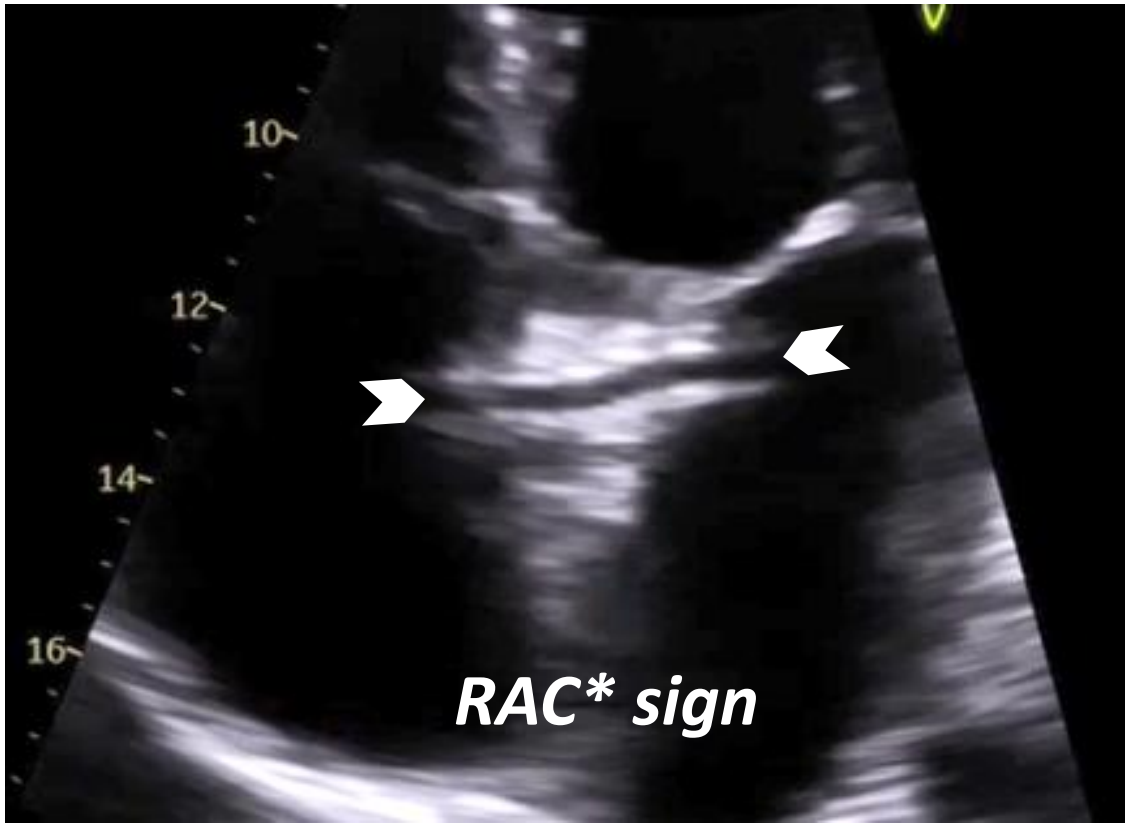






Anomalie de connexion avec trajet rétroaortique





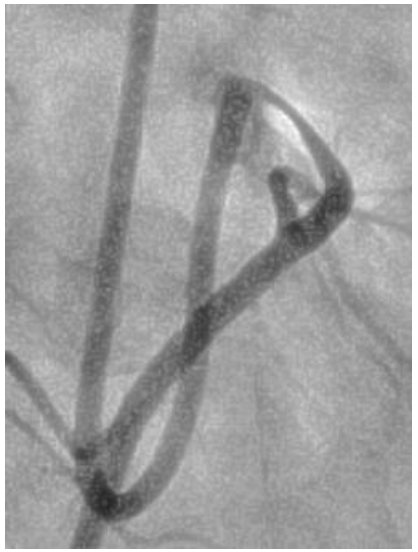
*Retroaortic anomalous coronary

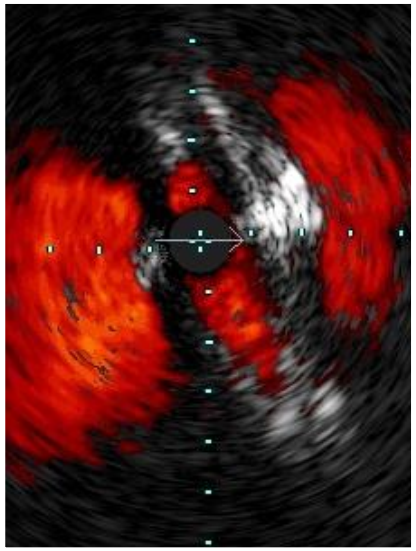
Connexions aortiques anormales

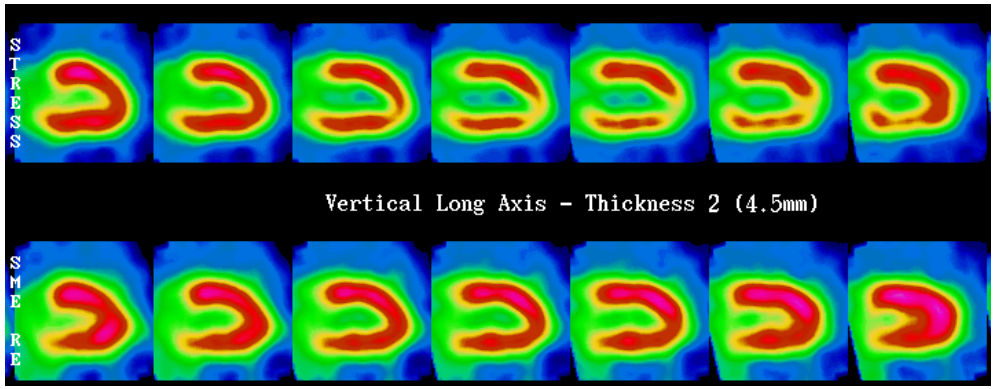
2. Ce que l'on sait plus ou moins bien

- Prévalence et mécanismes de l'ischémie myocardique
- Prévalence et incidence de la mort subite
- Recommandations sur la prise en charge
- Restriction sportive

Connexions aortiques anormales et ischémie myocardique



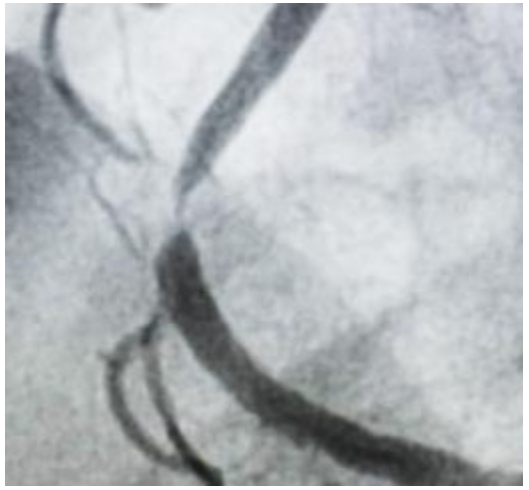


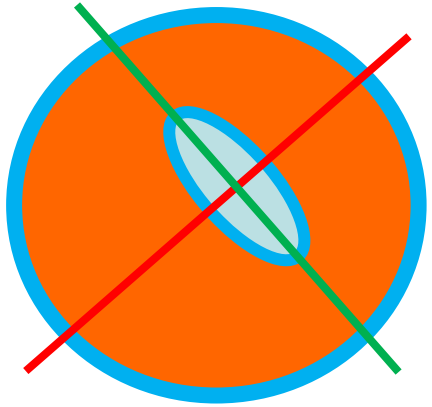


Prévalence ≈ 15%

Connexions aortiques anormales et ischémie myocardique

ATHEROME

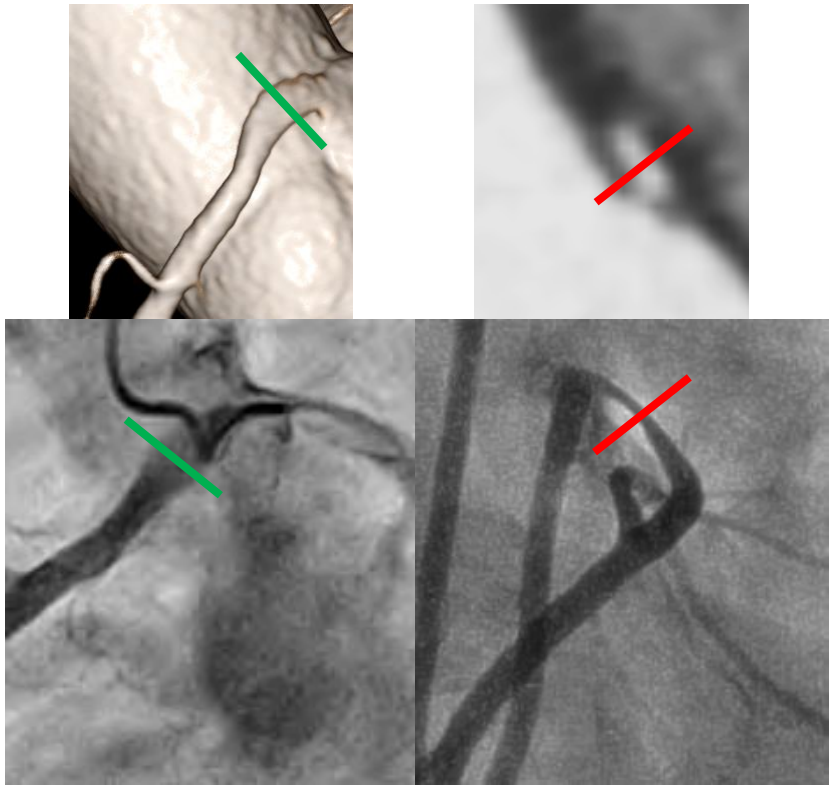


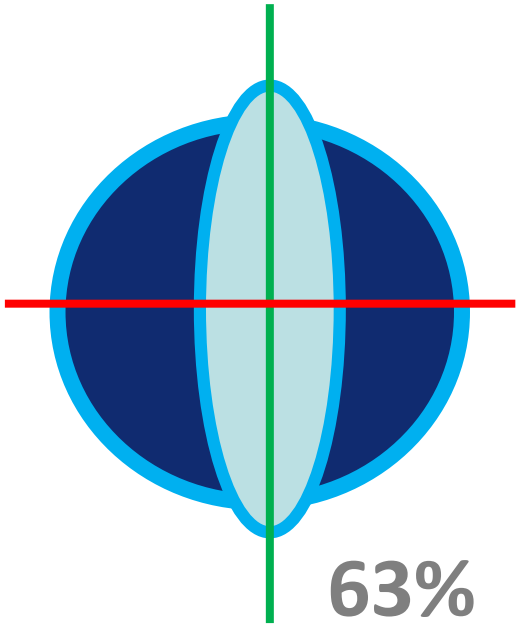


92%

Réduction de surface : > 70%

ANOCOR





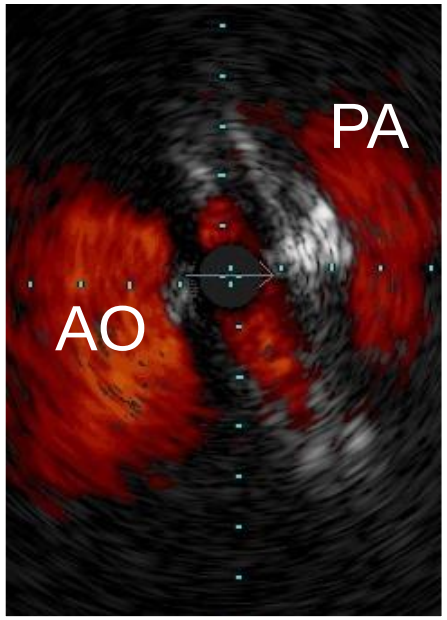
63%

Réduction de surface : 35-70%

Connexions aortiques anormales et ischémie myocardique

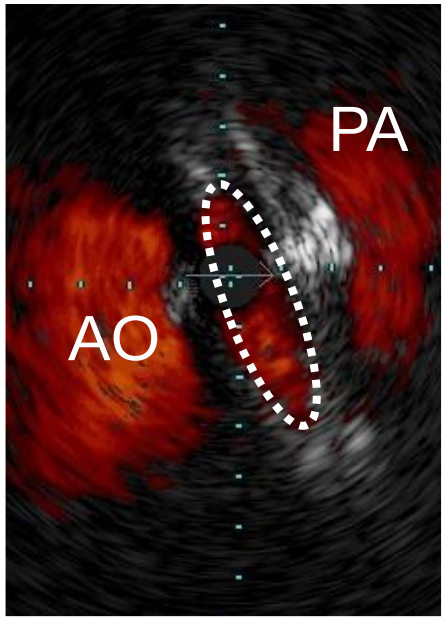
Two-Tier Concept

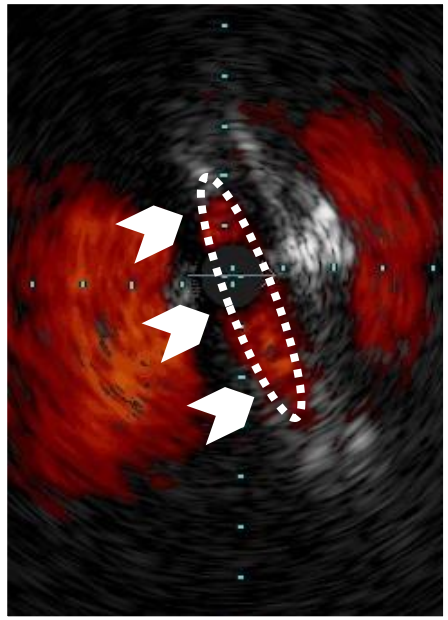
Fixed Component



Reduction in lumen area: 35-70%

Dynamic Component





Reduction in lumen area: > 70%

Strenuous Exertion

Wall stress ⬆

Bigler MR et al. Front Cardiovasc Med. 2021.

Connexions aortiques anormales et ischémie myocardique

TABLE 3 | Overview of possible stress protocols in assessing patients with ACAOS.

	Physical exercise		Adenosine	Regadenoson	Norepinephrine	Dobutamine	Dobutamine + volume challenge
Protocol/dose	85% of max. HR	100% of max. HR	140 μg/kg/min	Bolus: 400 μg	0.01 μg/kg/min	40 μg/kg/min	40 μg/kg/min + saline: 1.5–3 l+ atropine: 1 mg
Applied in	Non-invasive testing	Non-invasive testing	Non-invasive / invasive testing	Non-invasive testing	Invasive testing	Non-invasive / invasive testing	Invasive testing
Increase in coronary blood flow to detect relevant fixed stenosis	+++	+++++	+++	+++	++	++++	++++
Increased heart minute volume to provoke dynamic lateral compression	++	+++++	-	-	+++	++	++++
Reproducibility of symptoms	+++	+++++	-	-	++	++	+++
Tolerability	++++	++++	++	+++	++	++	++

HR, heart rate.

Bigler MR et al. Front Cardiovasc Med. 2021.

Connexions aortiques anormales

2. Ce que l'on sait plus ou moins bien

- Prévalence et mécanismes de l'ischémie myocardique
- Prévalence et incidence de la mort subite
- Recommandations sur la prise en charge
- Restriction sportive

Sudden cardiac death in young athletes

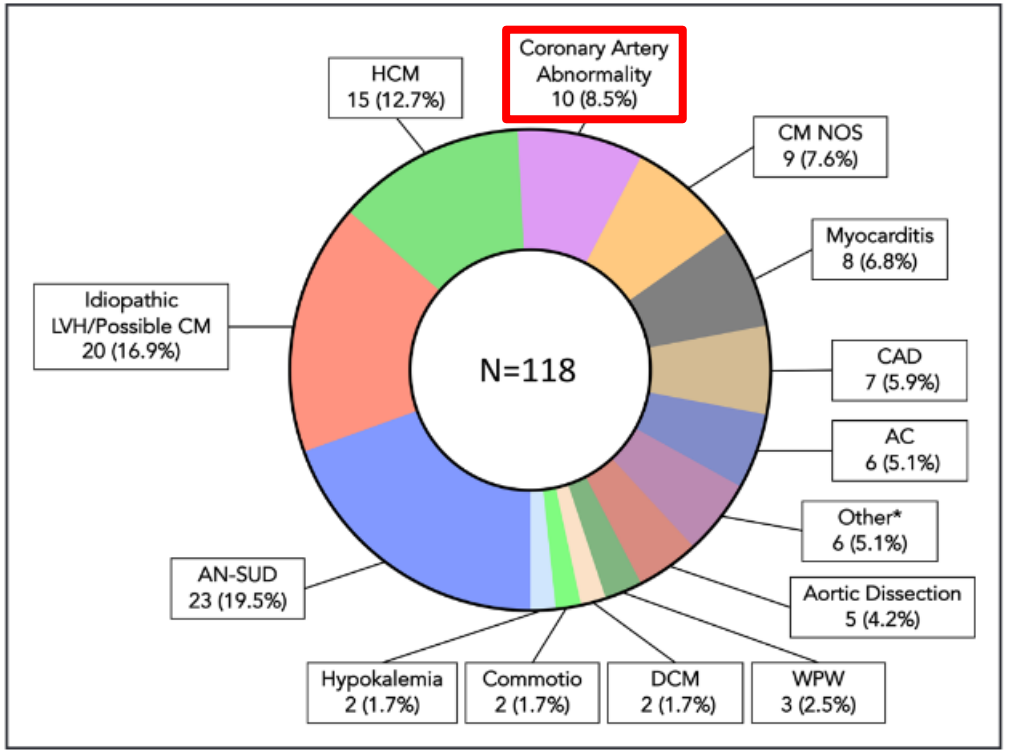
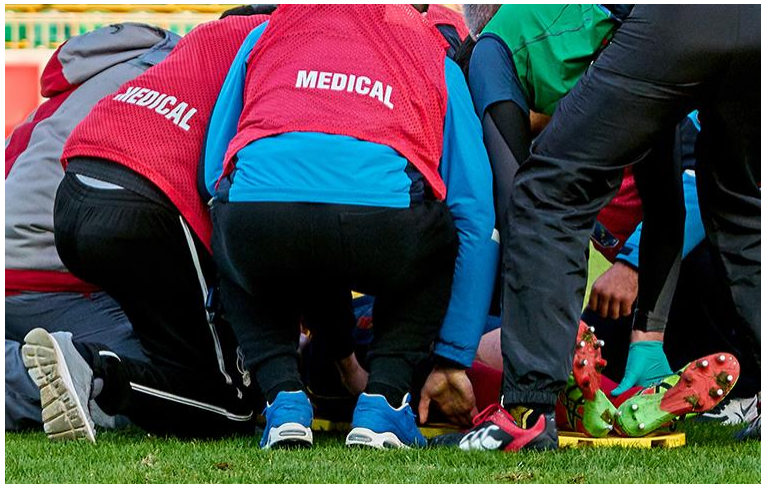


Figure 3. Causes of sudden cardiac death or findings on cardiac autopsy among National Collegiate Athletic Association athletes (n=118).

*Other: 1 each of long QT syndrome, complications of congenital heart disease, idiopathic left ventricular hypertrophy (LVH)/possible sickle cell trait, Kawasaki disease, complications after heart transplant, and sudden cardiac death in individual with pacemaker for idiopathic atrioventricular block. AC indicates arrhythmogenic cardiomyopathy; AN-SUD, autopsy-negative sudden unexplained death; CAD, coronary artery disease; CM, cardiomyopathy; DCM, dilated cardiomyopathy; HCM, hypertrophic cardiomyopathy; NOS, not otherwise specified; and WPW, Wolff-Parkinson-White syndrome.

Petek BJ et al. Circulation. 2024.

Incidence de la mort subite



?

Q. Please give me the incidence of sudden cardiac death for each AAOCA.

OpenAI GPT-3

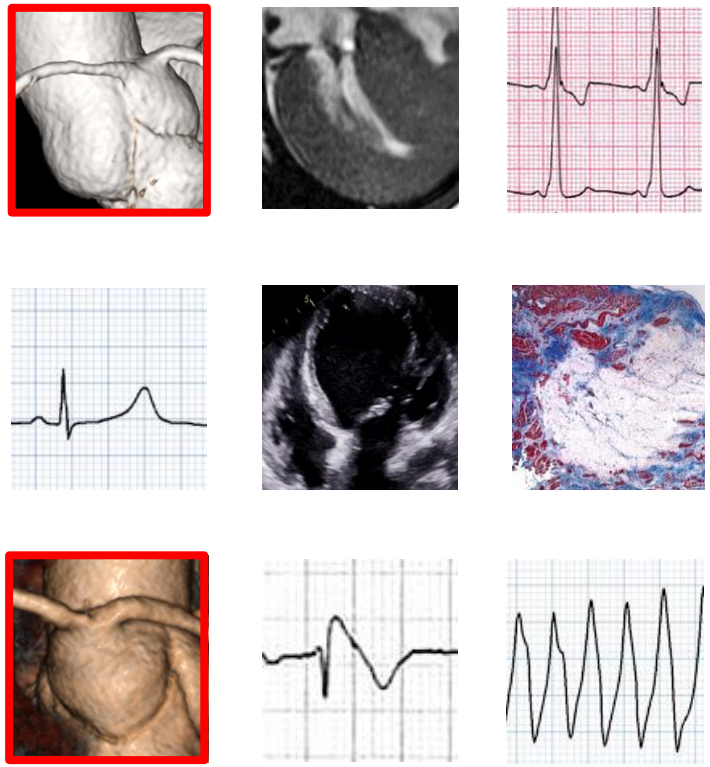
1. Anomalous Origin of the Right Coronary Artery (ARCA):
   1. Studies suggest that ARCA is one of the more common types of AAOCA.
   2. The incidence of SCD associated with ARCA has been reported to be relatively low, but exact figures may vary.

2. Anomalous Origin of the Left Coronary Artery from the Pulmonary Artery (ALCAPA):
   1. ALCAPA, also known as Bland-White-Garland syndrome, is a rare but serious congenital anomaly.
   2. SCD is a recognized complication of untreated ALCAPA, particularly in infants, where it can occur early in life due to myocardial ischemia.

3. Anomalous Origin of the Left Coronary Artery from the Right Sinus (ALCA):
   1. The incidence of SCD associated with ALCA can vary.
   2. Some studies have suggested that ALCA may carry a higher risk of SCD compared to other types of AAOCA, especially when the anomalous artery takes an interarterial course between the aorta and pulmonary artery.

4. Other Anomalous Origins (e.g., Anomalous Origin of Circumflex Artery):
   1. Incidence rates of SCD for less common variants of AAOCA may be less well-documented.
   2. The risk of SCD in these cases may depend on factors such as the specific anatomical course of the anomalous artery and the presence of associated cardiovascular abnormalities.

Incidence de la mort subite
Cardiopathies congénitales à risque



Cardiopathie	Incidence annuelle*
Tachycardie ventriculaire catécholergique	1.5%
Cardiomyopathie hypertrophique	1-2%
Syndrome de Brugada	1%
Syndrome de QT long	0.5-1%
Cardiomyopathie dilatée idiopathique	0.5-1%
Dysplasie ventriculaire droite arythmogène	0.5-1%
ANOCOR gauche avec trajet interartériel	**0.2%**
Syndrome pré-excitation ventriculaire	0.1%
ANOCOR droite avec trajet interartériel	**0.02%**

*Incidence annuelle de mort subite (estimations)

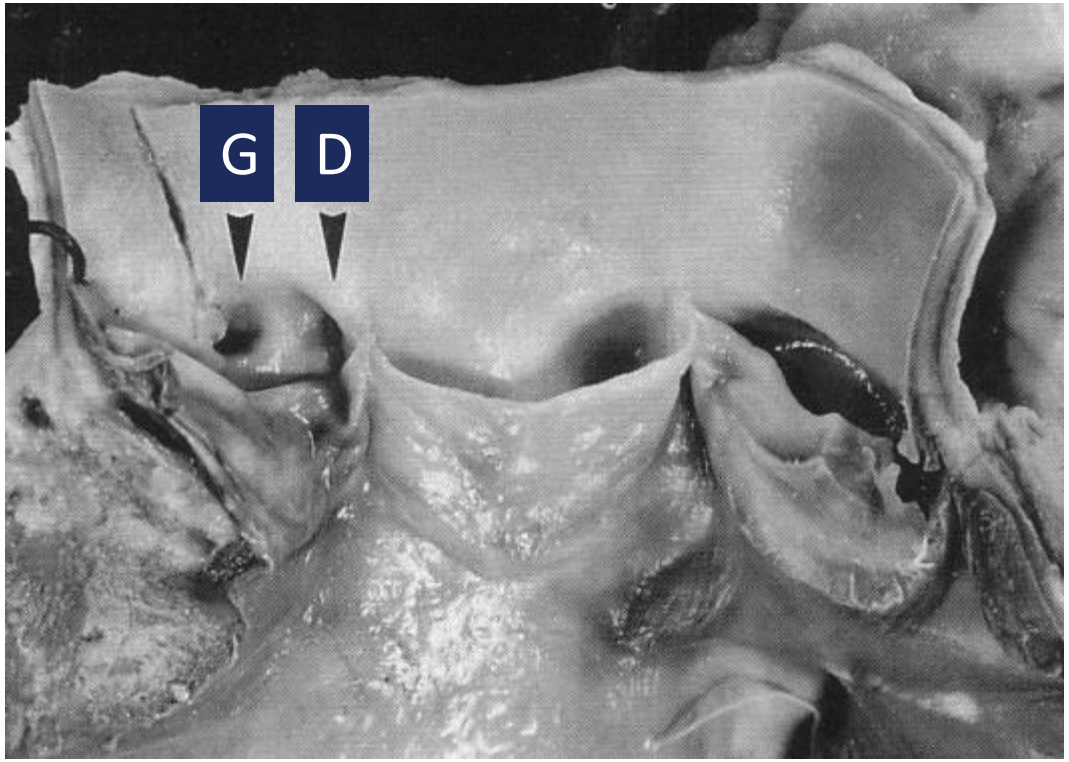
Connexions aortiques anormales

3. Ce que l'on ne sait pas bien

- Mécanismes de la mort subite
- Score de risque de mort subite
- Dépistage chez le sportif
- Place de l'angioplastie

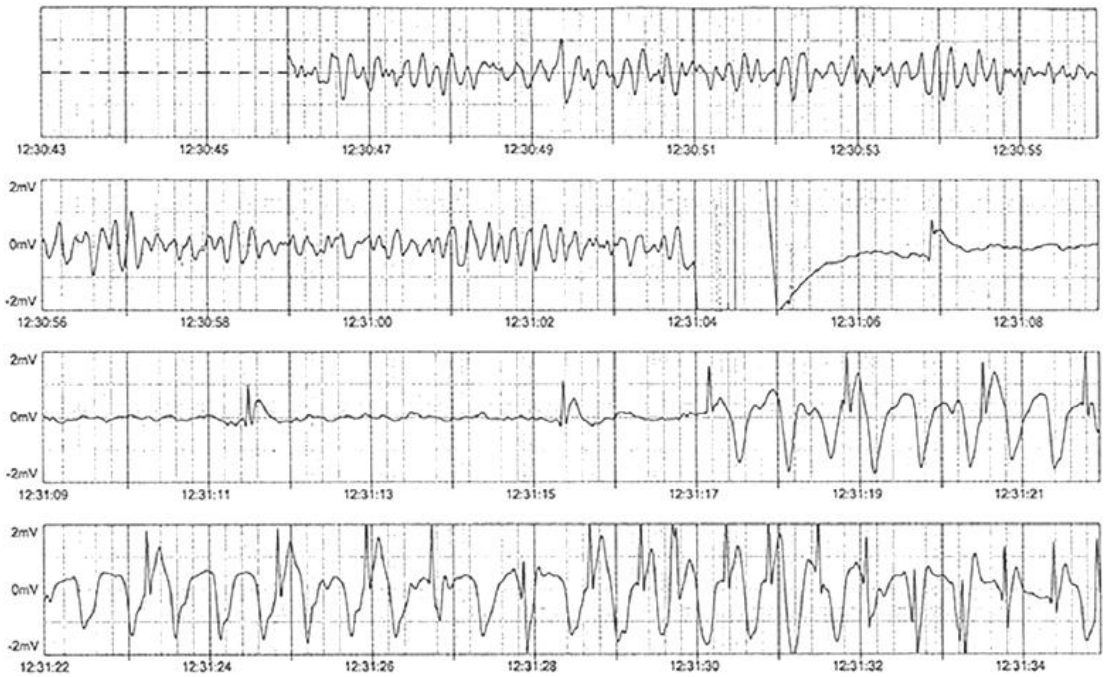
Mécanisme(s) de la mort subite

1990 Mort subite



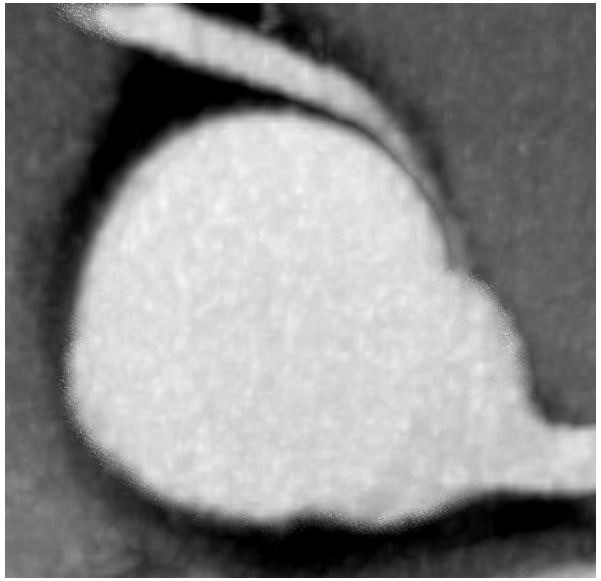
Corrado et al. Br Heart J. 1992.

2010 Arrêt cardiaque récupéré



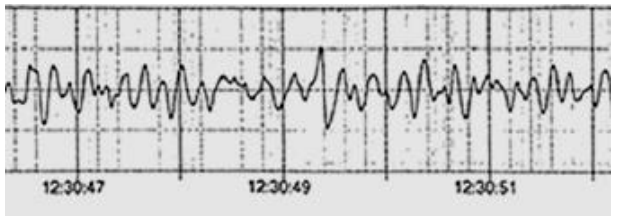
Cause de la mort subite = fibrillation ventriculaire

Mr G.
32 ans

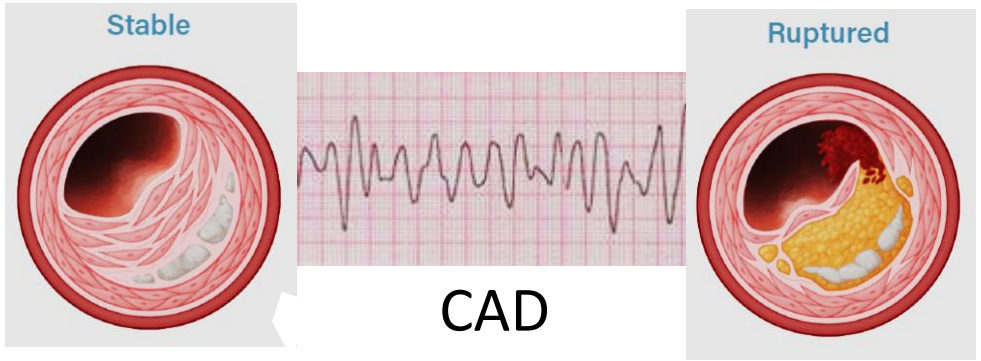


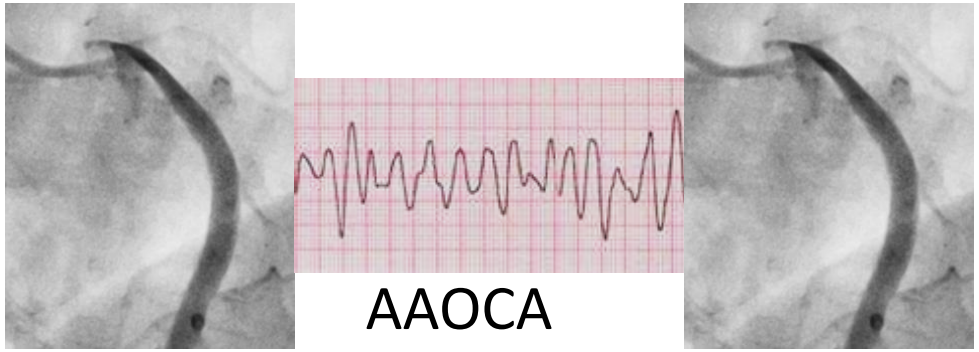
?

24/07/2024
12.56

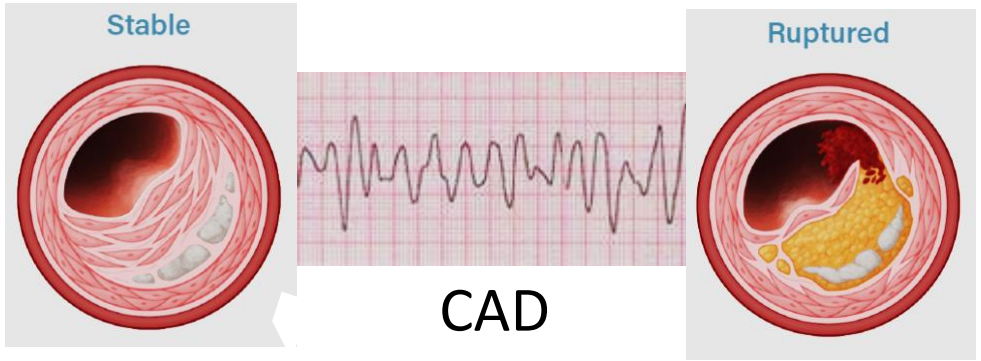


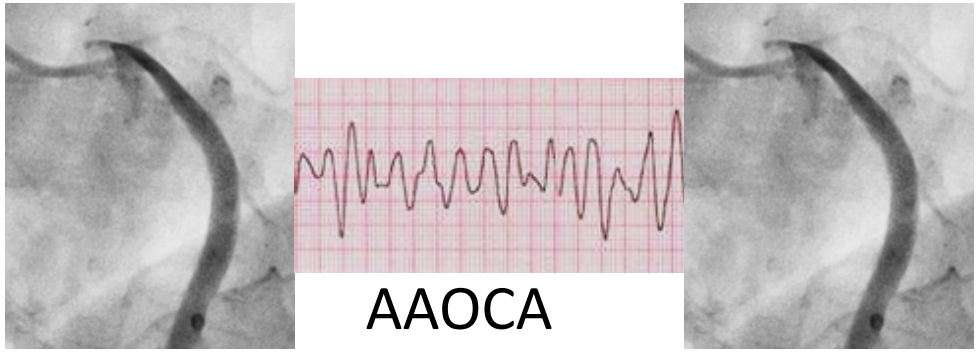
Mécanisme(s) de la fibrillation ventriculaire

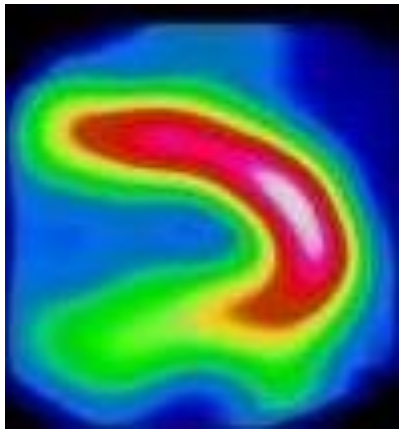


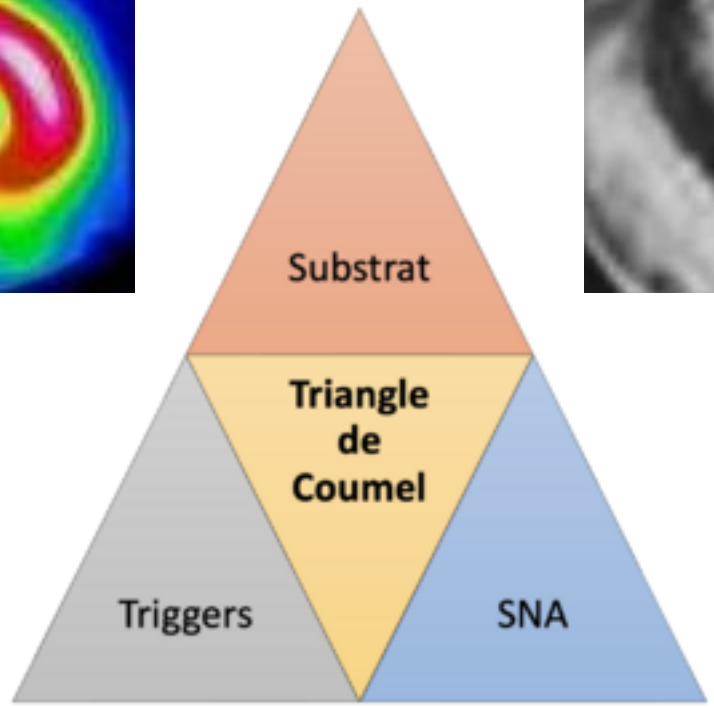


Mécanisme(s) de la fibrillation ventriculaire









Connexions aortiques anormales

3. Ce que l'on ne sait pas bien

- Mécanismes de la mort subite
- Score de risque de mort subite
- Dépistage chez le sportif
- Place de l'angioplastie

Stratification du risque de mort subite

HCM SCD risk calculator

Risk calculator

UNAVAILABLE

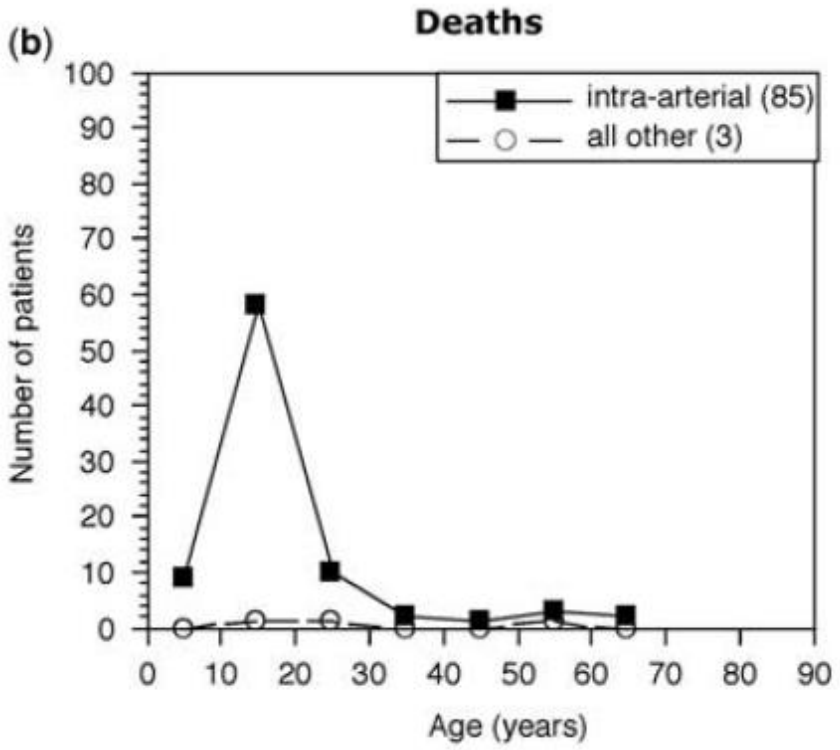
1-2-3-LQTS-Risk

ARVC Risk Calculator

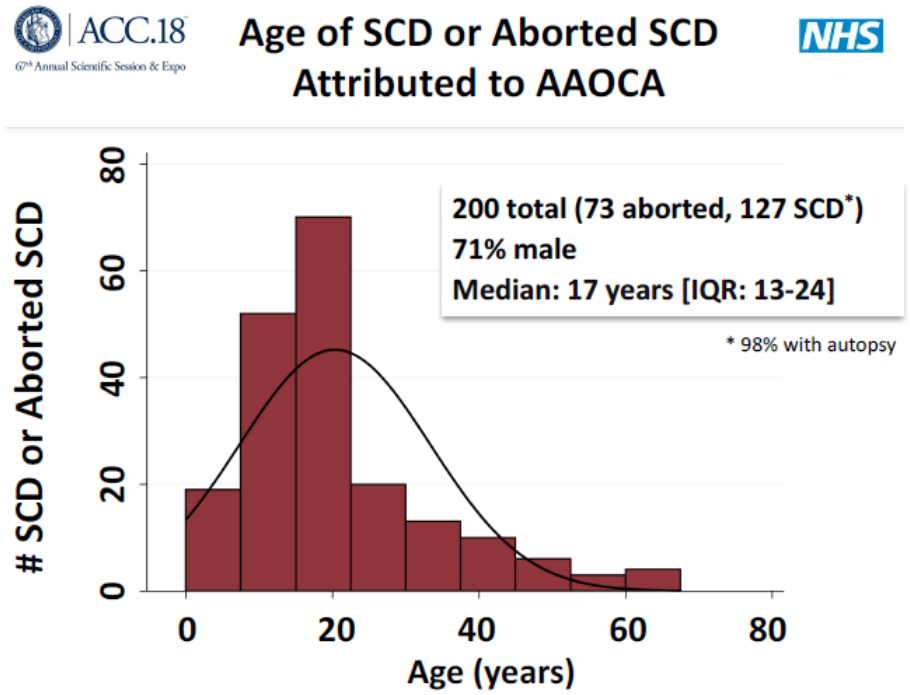
...

Stratification du risque de mort subite

Age distribution of SCD due to L-AAOCA



Hoffman JIE. Cardiol Young. 2014.



Shiwani H et al. ACC. 2018.

Connexions aortiques anormales

2. Ce que l'on sait plus ou moins bien

- Prévalence et mécanismes de l'ischémie myocardique
- Prévalence et incidence de la mort subite
- Recommandations sur la prise en charge
- Restriction sportive

Guidelines for cardiac arrest
Secondary prevention

ESC European Society of Cardiology
European Heart Journal (2022) **43**, 3997–4126
https://doi.org/10.1093/eurheartj/ehac262

ESC GUIDELINES

2022 ESC Guidelines for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death

Developed by the task force for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death of the European Society of Cardiology (ESC)

Endorsed by the Association for European Paediatric and Congenital Cardiology (AEPC)

Zeppenfeld K et al. Eur Heart J. 2022.

Recommendation Table 25 — Recommendations for sudden cardiac death prevention in patients with coronary anomalies

Recommendations	Class[a]	Level[b]
Treatment		
Surgery is recommended in patients with anomalous aortic origin of a coronary artery with CA, syncope suspected to be due to VAs, or angina when other causes have been excluded.[585,586,588]	I	C
Surgery should be considered in asymptomatic patients with anomalous aortic origin of a coronary artery and evidence of myocardial ischaemia or abnormal aortic origin of the left coronary artery with high-risk anatomy.[c,585,586,588]	IIa	C

CA, cardiac arrest; VA, ventricular arrhythmia.
[a]Class of recommendation.
[b]Level of evidence.
[c]High-risk anatomy is defined as interarterial course, slit-like shaped orifice, high orifice, acute-angle take-off, and intramural course and its length.

Guidelines for cardiac arrest
Secondary prevention

ESC European Society of Cardiology
European Heart Journal (2022) **43**, 3997–4126
https://doi.org/10.1093/eurheartj/ehac262

ESC GUIDELINES

2022 ESC Guidelines for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death

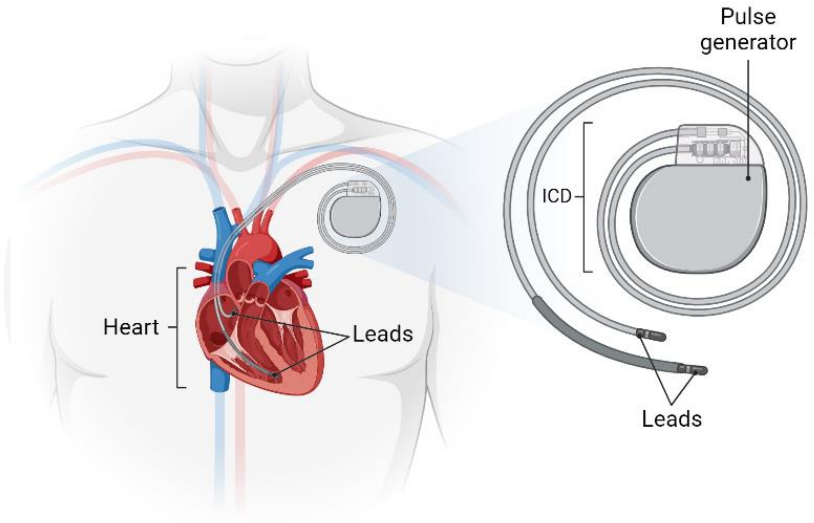
Developed by the task force for the management of patients with ventricular arrhythmias and the prevention of sudden cardiac death of the European Society of Cardiology (ESC)

Endorsed by the Association for European Paediatric and Congenital Cardiology (AEPC)

Zeppenfeld K et al. Eur Heart J. 2022.

?

Implantable Cardioverter Defibrillator (ICD)



No information

Guidelines

2018 AHA/ACC Guideline for the Management of Adults With Congenital Heart Disease: Executive Summary

COR	LOE	Recommendations
Therapeutic		
I	B-NR	1. Surgery is recommended for AAOCA from the left sinus or AAOCA from the right sinus for symptoms or diagnostic evidence consistent with coronary ischemia attributable to the anomalous coronary artery.[S4.4.5.2-1–S4.4.5.2-3]
IIa	C-LD	2. Surgery is reasonable for anomalous aortic origin of the left coronary artery from the right sinus in the absence of symptoms or ischemia.[S4.4.5.2-4–S4.4.5.2-6]
IIa	C-EO	3. Surgery for AAOCA is reasonable in the setting of ventricular arrhythmias.
IIb	B-NR	4. Surgery or continued observation may be reasonable for asymptomatic patients with an anomalous left coronary artery arising from the right sinus or right coronary artery arising from the left sinus without ischemia or anatomic or physiological evaluation suggesting potential for compromise of coronary perfusion (eg, intramural course, fish-mouth-shaped orifice, acute angle).[S4.4.5.2-4–S4.4.5.2-6]

Stout KK et al. Circulation. 2019.

2020 ESC Guidelines for the management of adult congenital heart disease

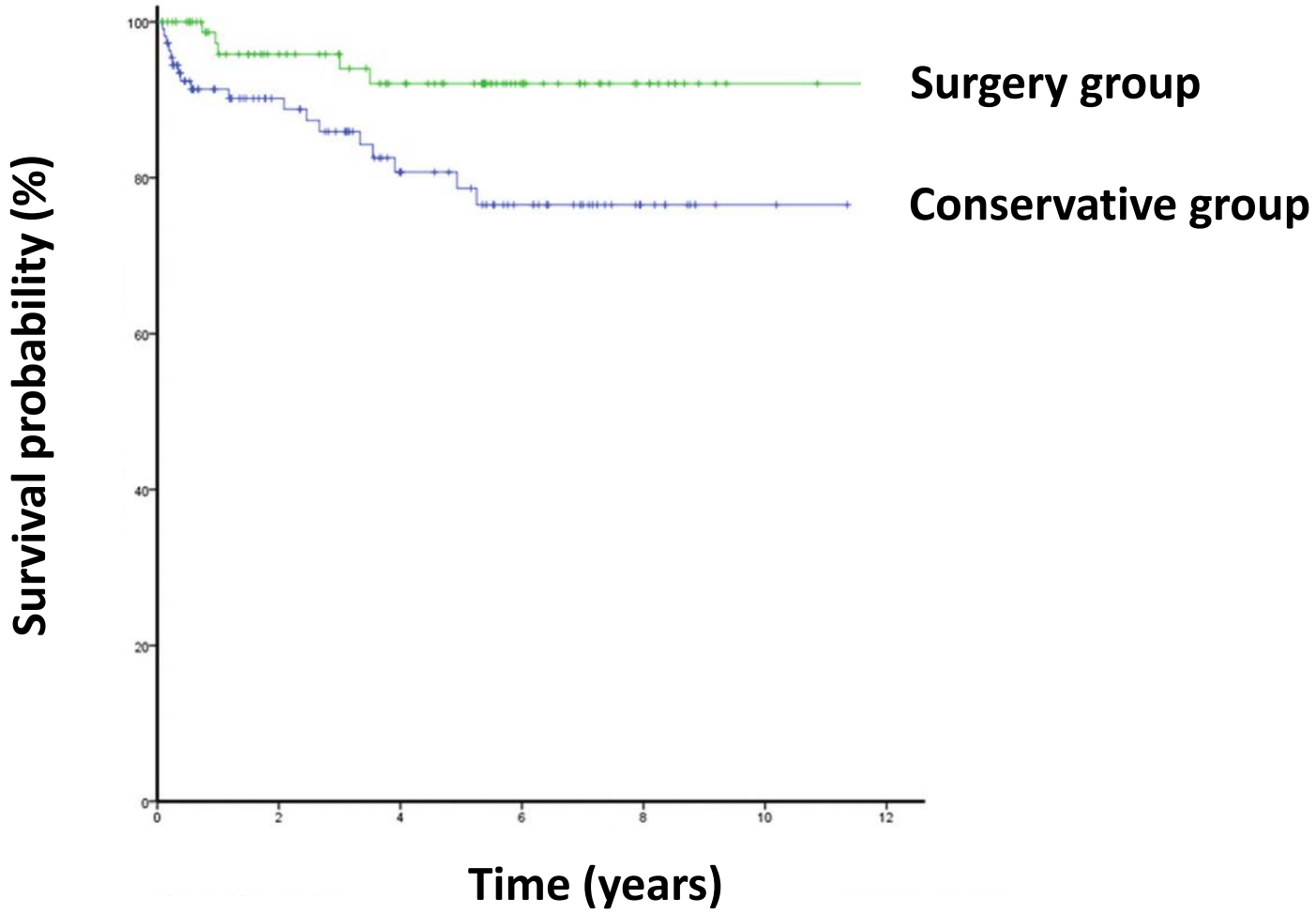
Anomalous aortic origin of the coronary artery		
Surgery is recommended for AAOCA in patients with typical angina symptoms who present with evidence of stress-induced myocardial ischaemia in a matching territory or high-risk anatomy.[c]	I	C
Surgery should be considered in *asymptomatic* patients with AAOCA (right or left) and evidence of myocardial ischaemia.	IIa	C
Surgery should be considered in *asymptomatic* patients with AAOLCA and no evidence of myocardial ischaemia but a high-risk anatomy.[c]	IIa	C
Surgery may be considered for symptomatic patients with AAOCA even if there is no evidence of myocardial ischaemia or high-risk anatomy.[c]	IIb	C
Surgery may be considered for *asymptomatic* patients with AAOLCA without myocardial ischaemia and without high-risk anatomy[c] when they present at young age (<35 years).	IIb	C
Surgery is not recommended for AAORCA in asymptomatic patients without myocardial ischaemia and without high-risk anatomy.[c]	III	C

Baumgartner H et al. Eur Heart J. 2020.

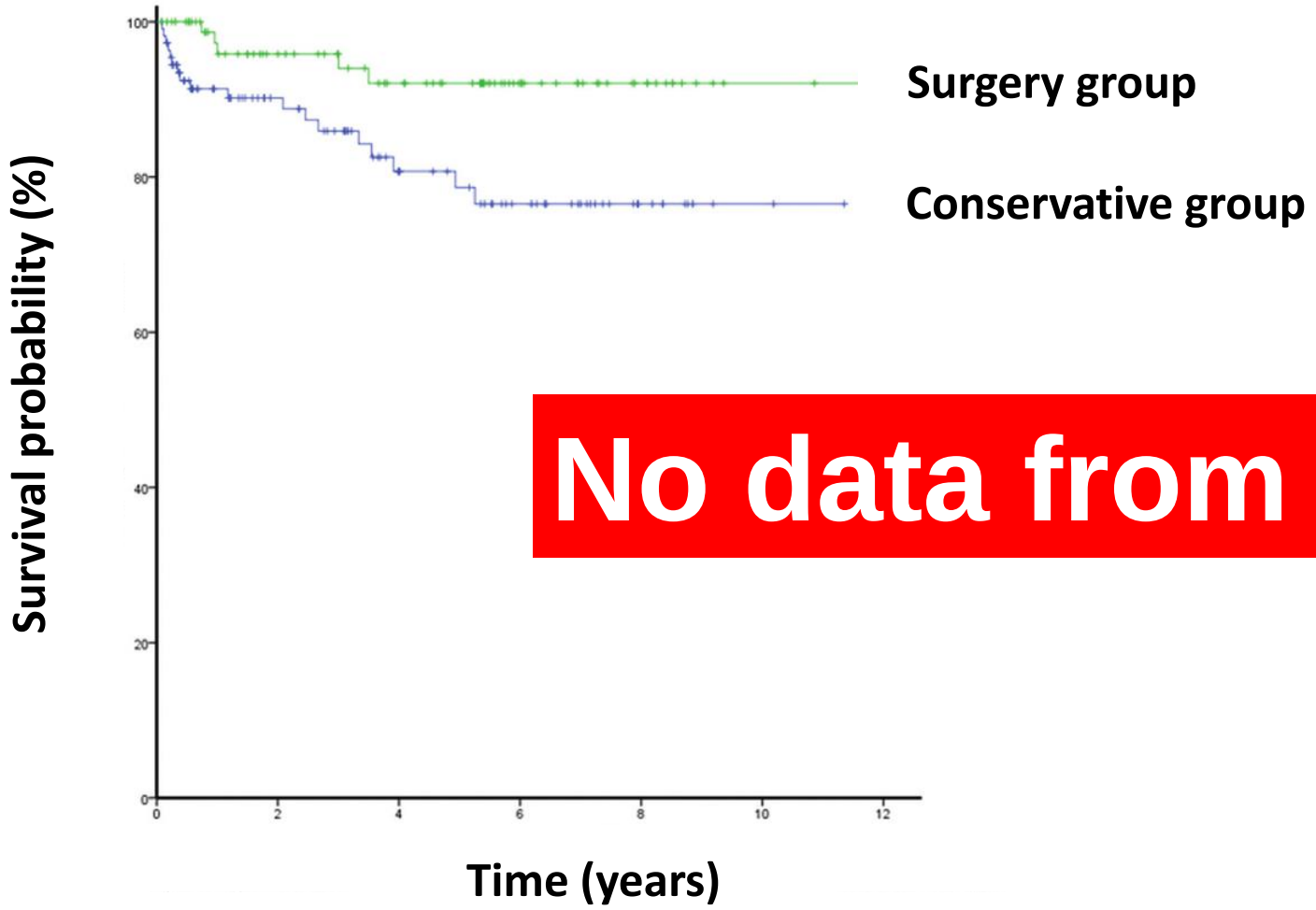
Principales indications de correction

ANOCOR interartérielle avec symptômes ischémiques et/ou ischémie myocardique	**Correction est recommandée**	I
ANOCOR interartérielle gauche asymptomatique et sans ischémie myocardique	**Correction doit être discutée**	IIa
ANOCOR interartérielle droite asymptomatique, sans ischémie myocardique et avec critères anatomiques de sévérité	**Correction peut se discuter dans de rares situations**	IIb

Surgical vs conservative therapy in AAOCA



Surgical vs conservative therapy in AAOCA



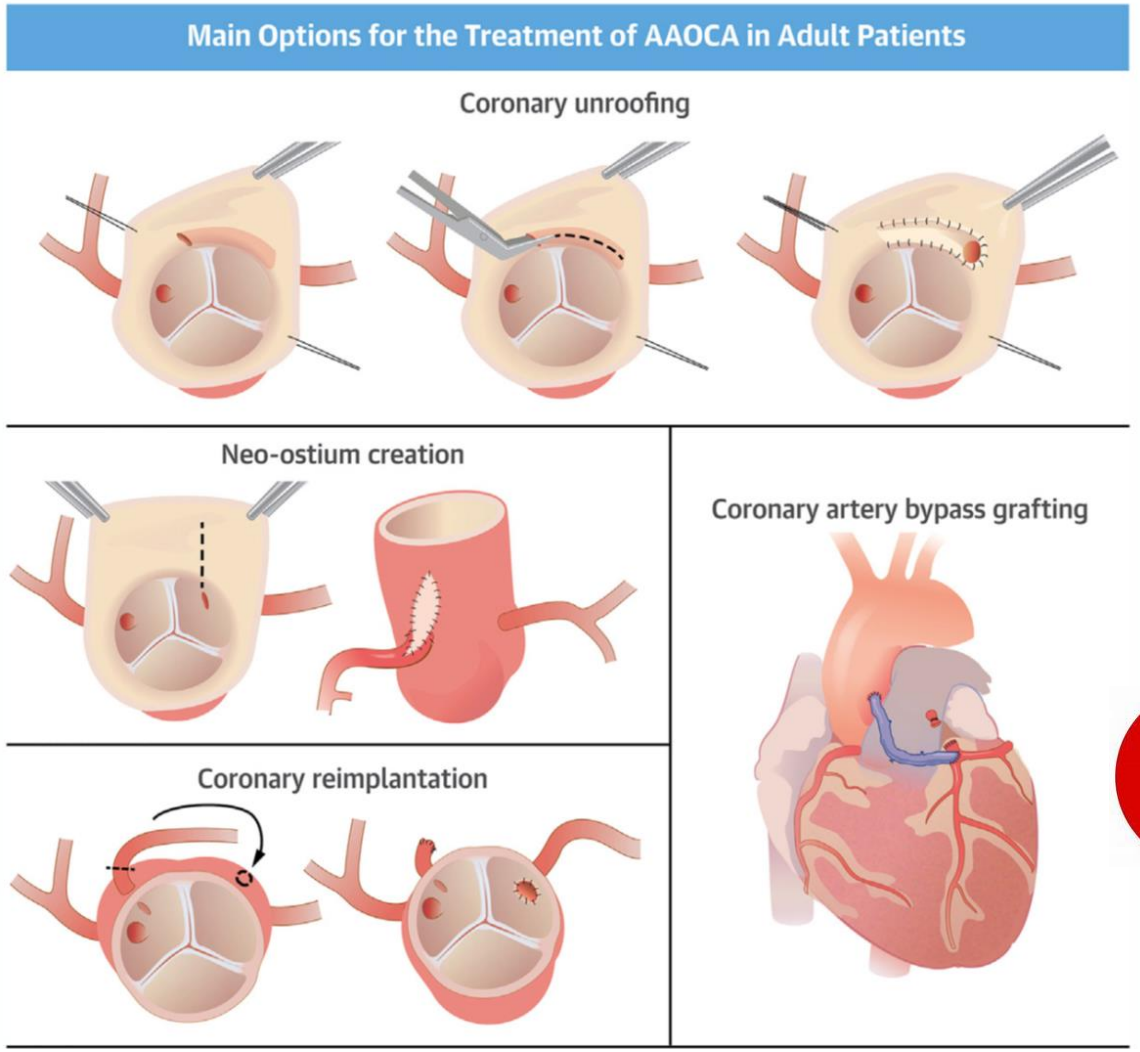
No data from RCT

Connexions aortiques anormales

1. Ce que l'on sait bien

- Prévalence des types anatomiques
- Risques selon l'anatomie
- Modes d'imagerie
- Techniques chirurgicales
- Maladie coronaire associée

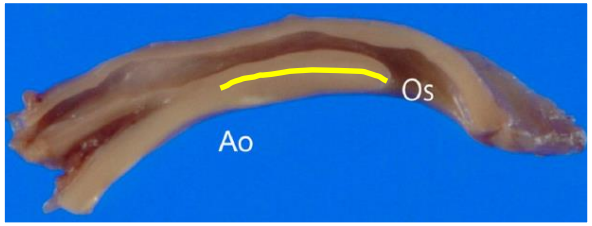
Techniques chirurgicales



Gaudino M. et al.
Ann Thorac Surg. 2023.

Techniques chirurgicales

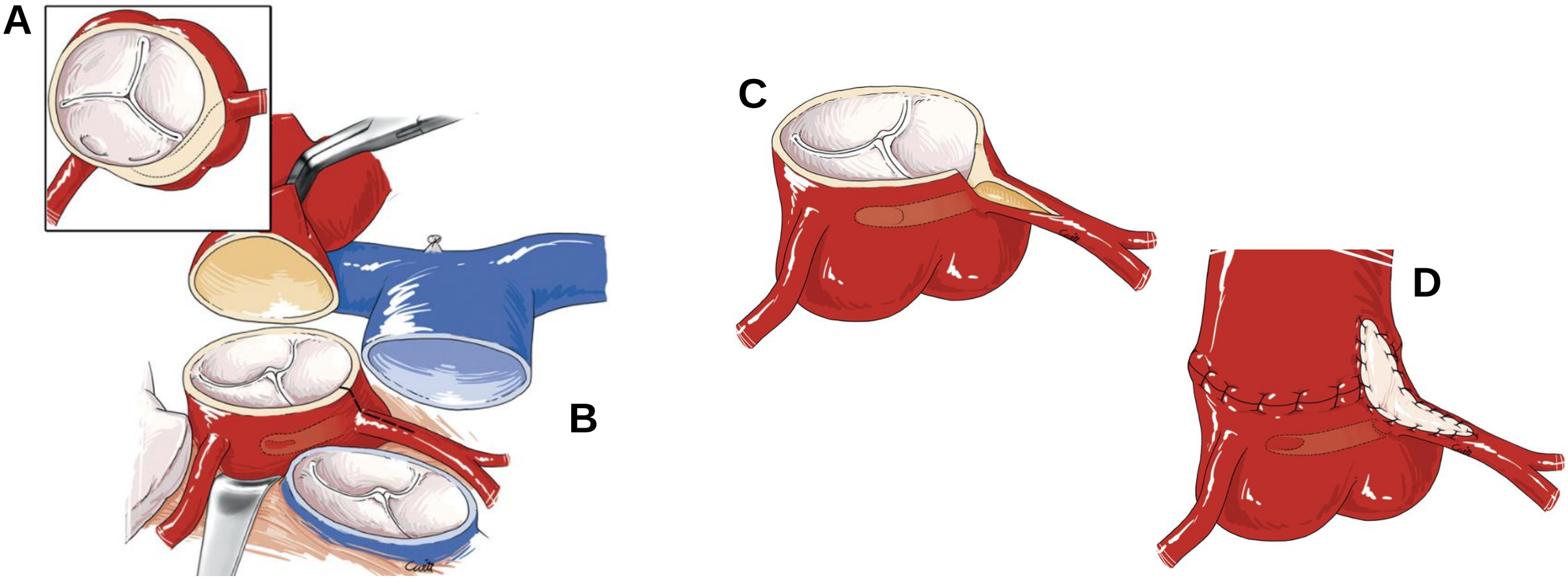
Unroofing technique



Molossi S et al. MD Cardiovasc J. 2019

Techniques chirurgicales

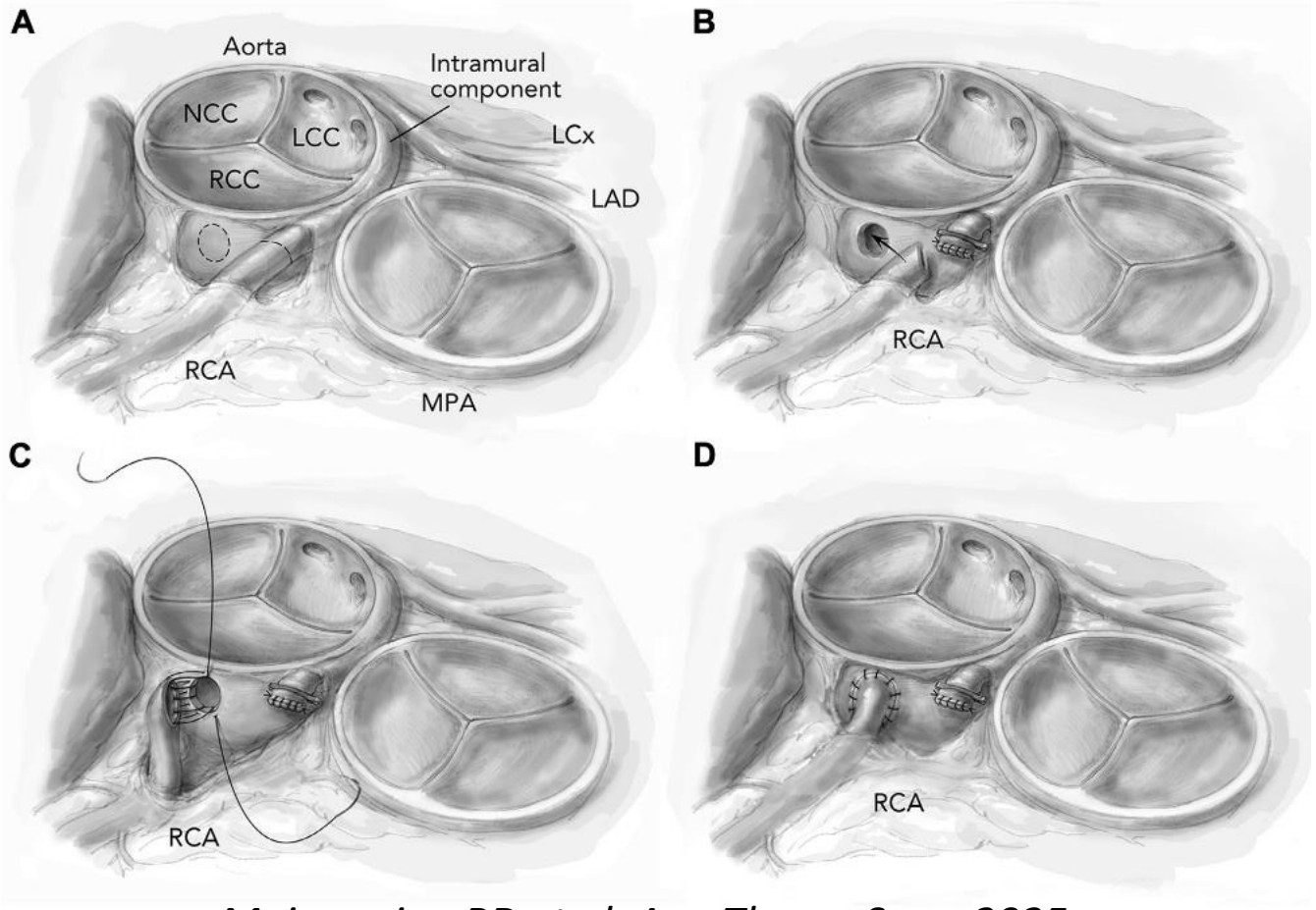
Création nouvel ostium

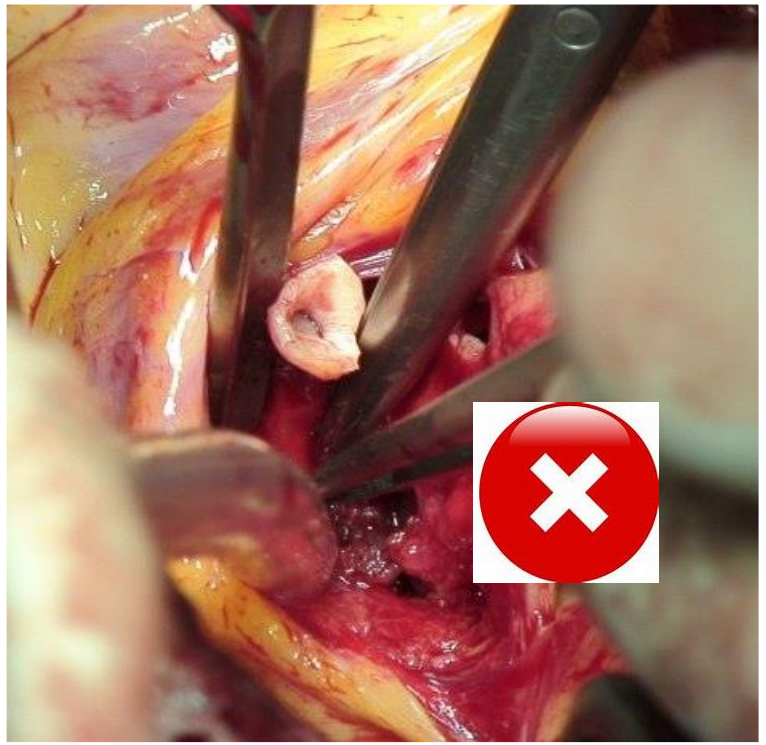


Vouhé P. Bulletin Académie Nationale Médecine. 2014.

Techniques chirurgicales

Réimplantation directe

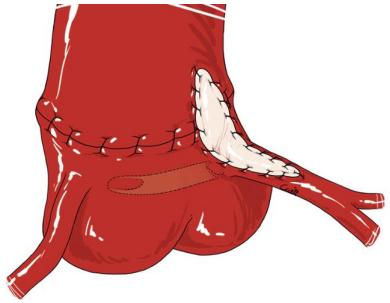




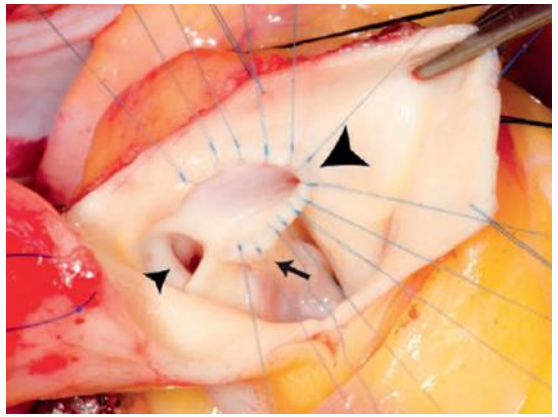
Mainwaring RD et al. Ann Thorac Surg. 2025.

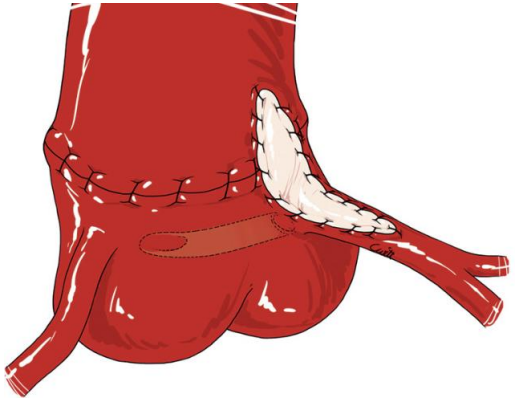
Techniques chirurgicales

Création nouvel ostium



Risques de la chirurgie





Mortalité hospitalière : 0-1%

Nouvelle intervention coronaire (PCI/chirurgie) : 3-10%

Padalino MA et al. Eur J Cardiothorac Surg. 2019.
Gaillard M et al. Eur J Cardio Thorac Surg. 2020.
Jegatheeswaran A et al. J Thorac Cardiovas Surg. 2020.
Pregaldini F et al. Eur J Cardiothorac Surg. 2023.
Mainwaring RD et al. Ann Thorac Surg. 2025.

Connexions aortiques anormales

3. Ce que l'on ne sait pas bien

- Mécanismes de la mort subite
- Score de risque de mort subite
- Dépistage chez le sportif
- Place de l'angioplastie

Causes of death in young athletes

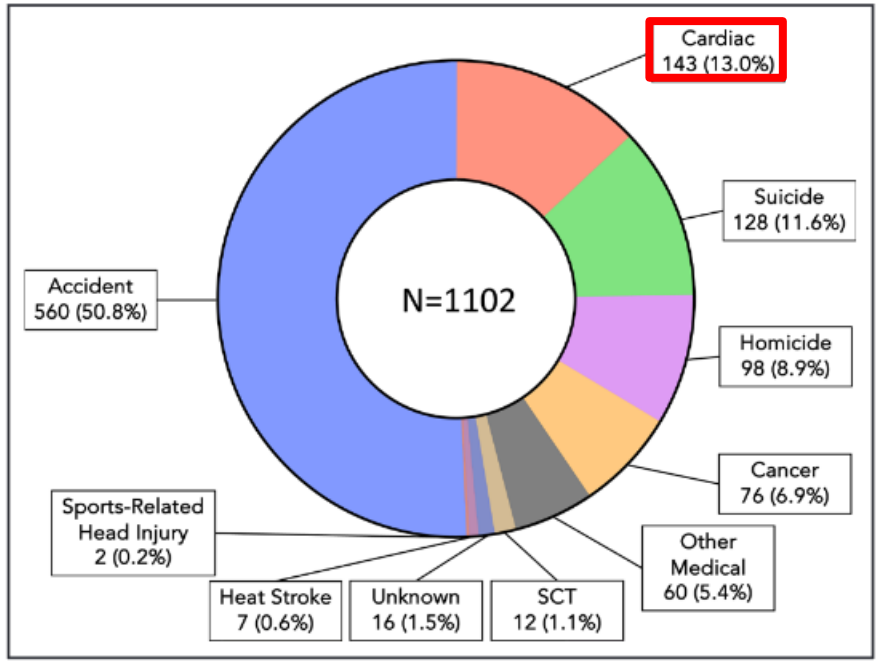


Figure 1. Causes of death among National Collegiate Athletic Association athletes (n=1102).
SCT indicates sickle cell trait.

Sudden cardiac death in young athletes

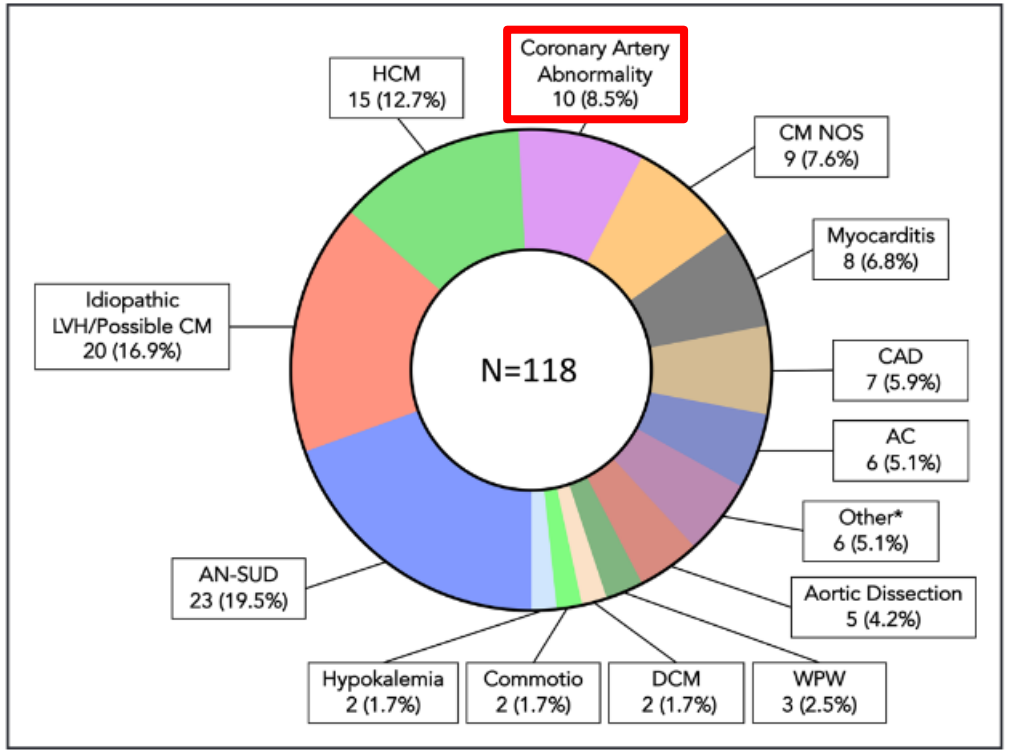
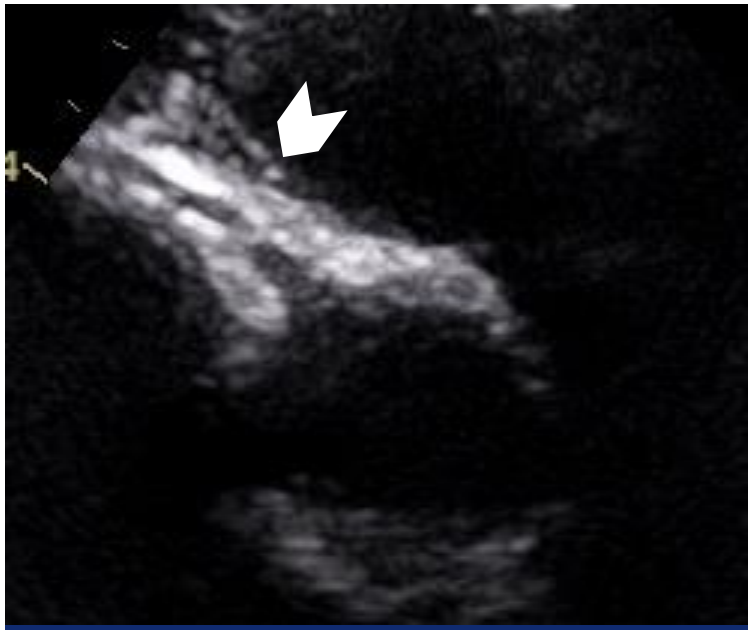


Figure 3. Causes of sudden cardiac death or findings on cardiac autopsy among National Collegiate Athletic Association athletes (n=118).
*Other: 1 each of long QT syndrome, complications of congenital heart disease, idiopathic left ventricular hypertrophy (LVH)/possible sickle cell trait, Kawasaki disease, complications after heart transplant, and sudden cardiac death in individual with pacemaker for idiopathic atrioventricular block. AC indicates arrhythmogenic cardiomyopathy; AN-SUD, autopsy-negative sudden unexplained death; CAD, coronary artery disease; CM, cardiomyopathy; DCM, dilated cardiomyopathy; HCM, hypertrophic cardiomyopathy; NOS, not otherwise specified; and WPW, Wolff-Parkinson-White syndrome.

Petek BJ et al. Circulation. 2024.

Faut-il dépister les ANOCOR chez le jeune sportif ?

Echocardiographie transthoracique



Connexion droite normale

Connexion droite anormale

Faut-il dépister les ANOCOR chez le jeune sportif ?

Exemple de dépistage d'une ANOCOR interartérielle

Prévalence : 3/1.000

Catégorie espoirs (12-15 ans) : 8.000 sportifs

Population testée : 2.000/an

Test : échocardiogramme transthoracique

Sensibilité : 90%

Spécificité : 90%

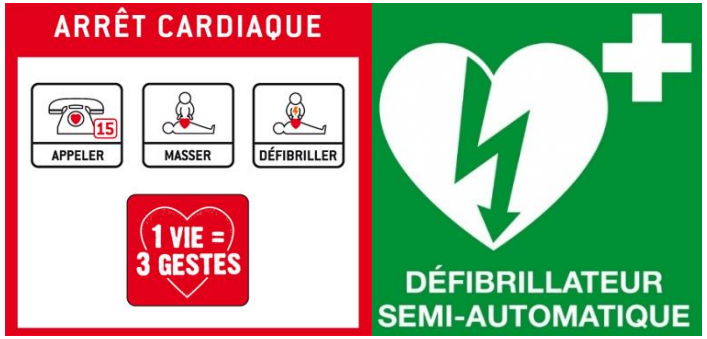
Nombre d'anomalies : 6

- 1 faux négatif
- 1.795 vrais négatifs

- 199 faux positifs
- 5 vrais positifs

Stratégie préventive : dépistage avant pratique sportive

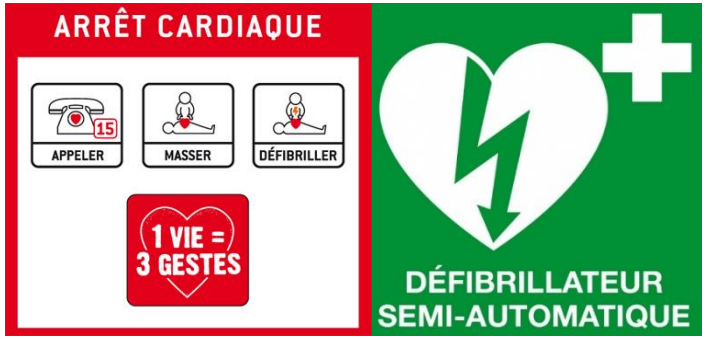
Stratégie réactive : prise en charge optimale de l’arrêt cardiaque



Stratégie préventive : dépistage avant pratique sportive

Incidence MS/AC

Stratégie réactive : prise en charge optimale de l'arrêt cardiaque



Taux de survie

Sudden cardiac arrest in athletes

The NEW ENGLAND JOURNAL of MEDICINE

REVIEW ARTICLE

Sudden Cardiac Arrest in Athletes

Rachel Lampert, M.D.,[1] and Kimberly G. Harmon, M.D.[2]

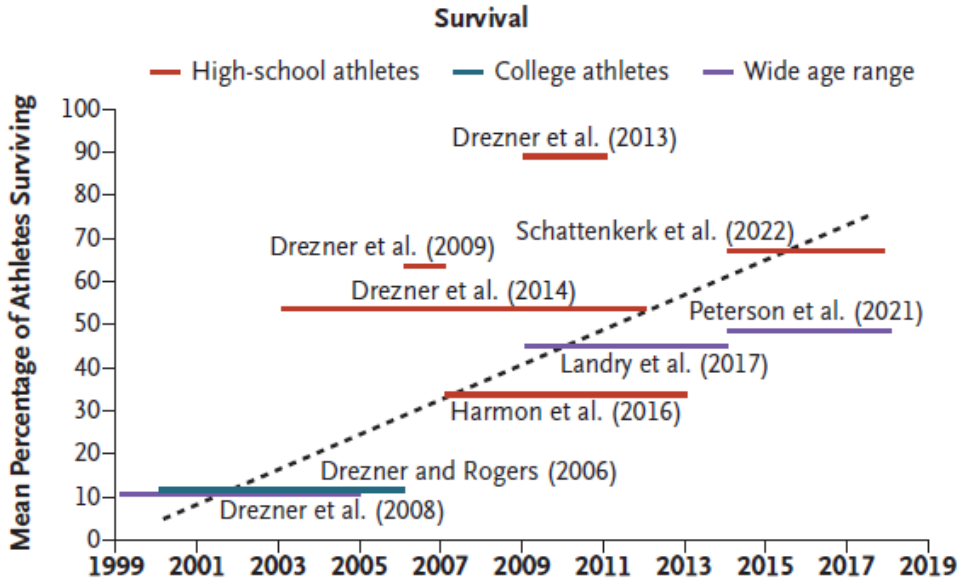


Figure 3. Survival after Sudden Cardiac Arrest in Young, Competitive Athletes in North America.

The horizontal lines represent the time frame of the studies. Data are from Drezner and Rogers,[50] Drezner et al.,[21,51-53] Harmon et al.,[22] Landry et al.,[54] Peterson et al.,[24] and Schattenkerk et al.[31] The dashed line provides a visual representation of the trajectory.

Faut-il dépister les ANOCOR chez le jeune sportif ?

Explorations Fonctionnelles Cardio-Vasculaires
Laboratoire d'échocardiographie
Echodoppler cardiaque transthoracique
Echographe : GE Vivid 9

Réalisé le 22/07/2021
M. né le : 01/01/2004
Motif : bilan d'aptitude sportive, précordialgies atypiques

Ventricule gauche non dilaté, non hypertrophié de fonction systolique normale et de cinétique homogène.
Profil et pressions de remplissage gauches normaux.
Pas de valvulopathie significative.
Aorte de taille normale.
Cavités droites non dilatées.
Pression artérielle pulmonaire systolique et pression de l'oreillette droite normales.
Pas d'épanchement péricardique.

Au total : examen dans les limites de la normale.

Faut-il dépister les ANOCOR chez le jeune sportif ?

Explorations Fonctionnelles Cardio-Vasculaires
Laboratoire d'échocardiographie
Echodoppler cardiaque transthoracique
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Aorte de taille normale.
Cavités droites non dilatées.
Pression artérielle pulmonaire systolique et pression de l'oreillette droite normales.
Pas d'épanchement péricardique.
Ostia coronaires visualisés en position normale.

Au total : examen dans les limites de la normale.

Connexions aortiques anormales

2. Ce que l'on sait plus ou moins bien

- Prévalence et mécanismes de l'ischémie myocardique
- Prévalence et incidence de la mort subite
- Recommandations sur la prise en charge
- Restriction sportive

Sudden cardiac death and exertional status

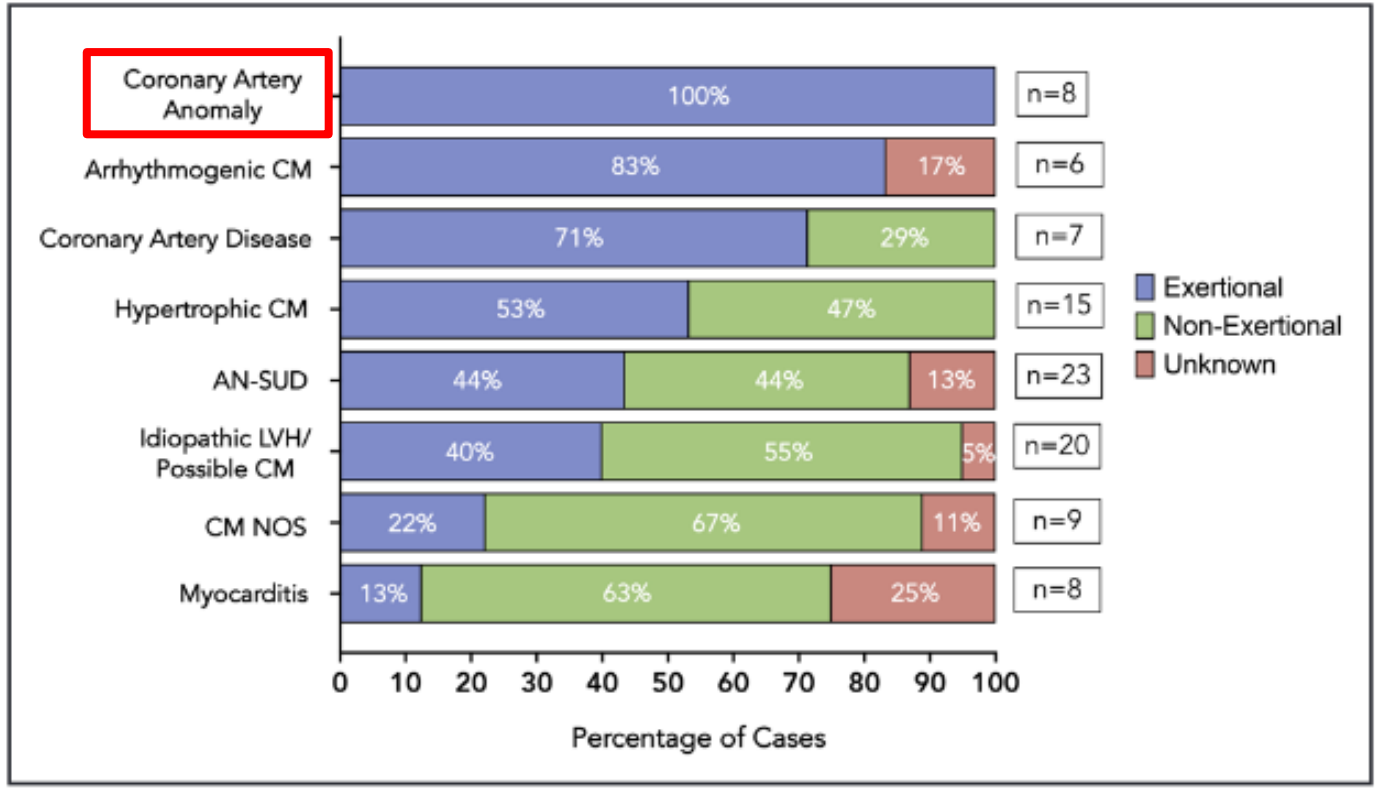


Figure 4. Exertional status at time of death by common causes of sudden cardiac death.
AN-SUD indicates autopsy-negative sudden unexplained death; CM, cardiomyopathy; LVH, left ventricular hypertrophy; NOS, not otherwise specified; and SCD, sudden cardiac death.

Petek BJ et al. Circulation. 2024

Restriction sportive

- Aucune
- Sur activité sportive d'intensité basse
- Sur activité sportive d'intensité moyenne
- Sur activité sportive d'intensité élevée
- Sur la pratique en compétition
- En attendant une correction de l'anomalie coronaire
- Après la correction de l'anomalie coronaire

Information éclairée du patient

Participation du patient à la décision

Pratique dans un environnement adapté

2019 Recommendations for participation in sports in athletes-patients with coronary artery disease

ESC European Society of Cardiology

Recommendations for participation in leisure time or competitive sports in athletes-patients with coronary artery disease: a position statement from the Sports Cardiology Section of the European Association of Preventive Cardiology (EAPC)

Mats Borjesson[1,2]*, Mikael Dellborg[3], Josef Niebauer[4], Andre LaGerche[5], Christian Schmied[6], Erik E. Solberg[7], Martin Halle[8], Emilio Adami[9], Alessandro Biffi[10], Francois Carré[11], Stefano Caselli[12,13], Michael Papadakis[14], Axel Pressler[15], Hanne Rasmusen[16], Luis Serratosa[17], Sanjay Sharma[18], Frank van Buuren[19], and Antonio Pelliccia[20]

- Specifically, in CAA originating from the wrong sinus, with acute angled take-off from the aorta and anomalous coursing between the aorta and the pulmonary artery, the risk for SCA/SCD is believed to be the highest. Strong consideration should be given to surgical correction of such an anomaly in symptomatic patients. Prior to successful correction, participation in high-intensity sport is discouraged. Level of recommendation: Class II, level of evidence C.

Borjesson M et al. Eur Heart J. 2019.

2020 Guidelines on sports cardiology and exercice in patients with cardiovascular disease

ESC European Society of Cardiology

2020 ESC Guidelines on sports cardiology and exercise in patients with cardiovascular disease

The Task Force on sports cardiology and exercise in patients with cardiovascular disease of the European Society of Cardiology (ESC)

Recommendations for exercise in young individuals/athletes with anomalous origins of coronary arteries

Recommendations	Class[a]	Level[b]
When considering sports activities, evaluation with imaging tests to identify high-risk patterns and an exercise stress test to check for ischaemia should be considered in individuals with AOCA.	IIa	C
In asymptomatic individuals with an anomalous coronary artery that does not course between the large vessels, does not have a slit-like orifice with reduced lumen and/or intramural course, competition may be considered, after adequate counselling on the risks, provided there is absence of inducible ischaemia.	IIb	C
After surgical repair of an AOCA, participation in all sports may be considered, at the earliest 3 months after surgery, if they are asymptomatic and there is no evidence of inducible myocardial ischaemia or complex cardiac arrhythmias during maximal exercise stress test.	IIb	C
Participation in most competitive sports with a moderate and high cardiovascular demand among individuals with AOCA with an acutely angled take-off or an anomalous course between the large vessels is not recommended.[c]	III	C

AOCA = anomalous origin of coronary arteries.
[a]Class of recommendation.
[b]Level of evidence.
[c]This recommendation applies whether the anomaly is identified as a consequence of symptoms or discovered incidentally, and in individuals <40 years of age.

Pelliccia A et al. Eur Heart J. 2020.

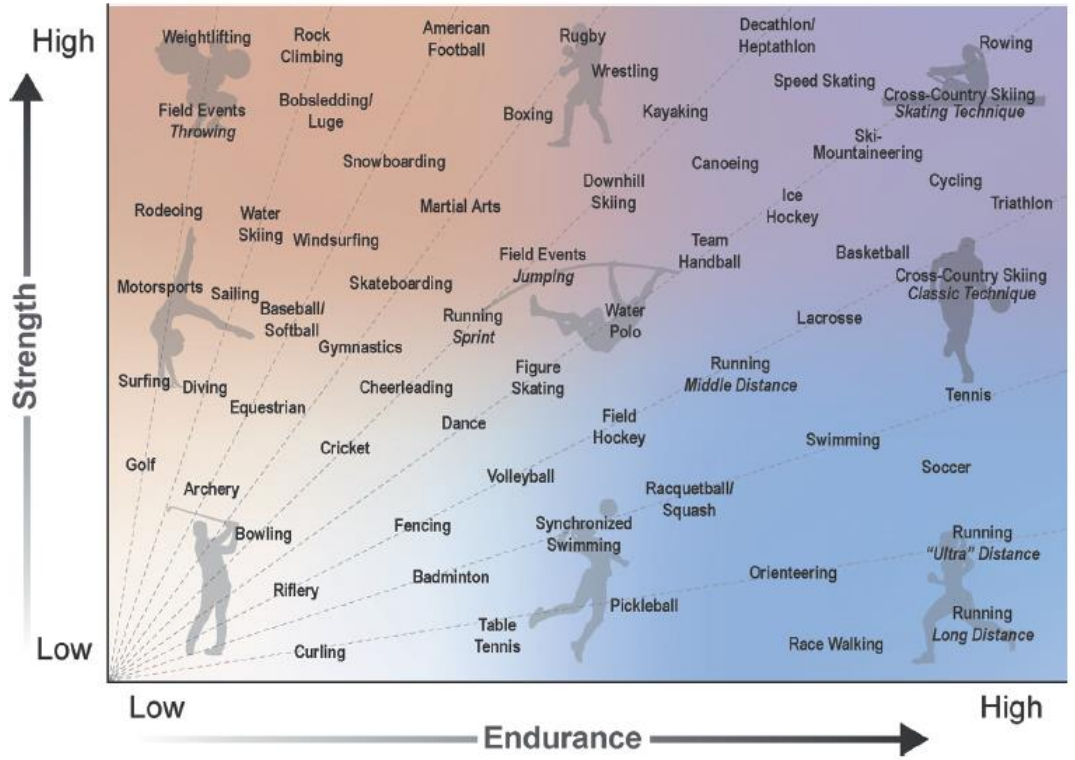
Restriction sportive

	Skill	Power	Mixed	Endurance
LOW	Golf (buggy)	Shot putting	Soccer (adapted)	Jogging
	Golf (18 holes walking)	(recreational)	Basketball (adapted)	Long distance walking
	Table tennis (double)	Discus (recreational)	Handball (adapted)	Swimming (recreational)
	Table tennis (single)	Alpine skiing	Volleyball	Speed walking
MEDIUM	Shooting	(recreational)	Tennis (double)	Mid/long distance running
	Curling	Short distance running	Ice-Hockey	Style dancing
	Bowling	Shot putting	Hockey	Cycling (road)
	Sailing	Discus	Rugby	Mid/long distance swimming
	Yachting	Alpine skiing	Fencing	Long distance skating
	Equestrian	Judo/karate	Tennis (single)	Pentathlon
		Weight lifting	Waterpolo	Rowing
		Wrestling	Soccer (competitive)	Canoeing
HIGH		Boxing	Basketball (competitive)	X-country skiing
			Handball (competitive)	Biathlon
				Triathlon

Low intensity · Medium intensity · High intensity

Pelliccia A et al. Eur Heart J. 2020.

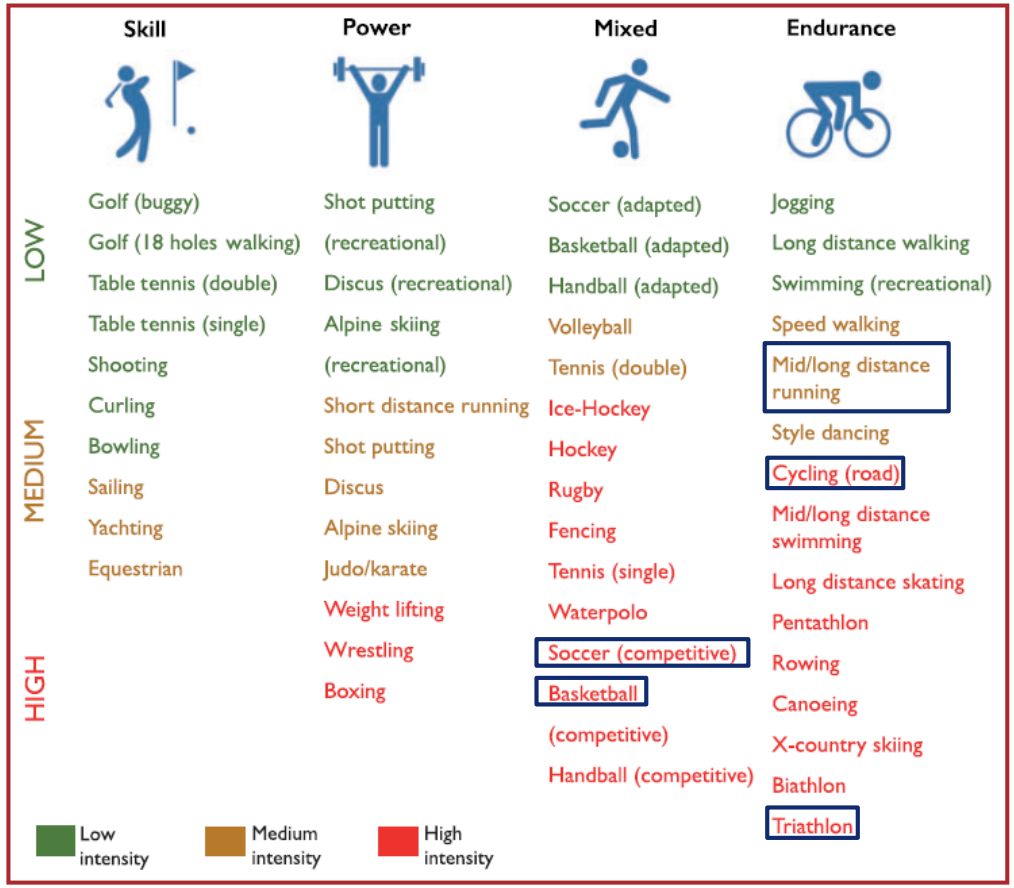
FIGURE 1 Updated Competitive Sports Participation Classification Schema Presented as a Continuum of Competitive Sports Participation Based on Relative Strength and Endurance Intensities



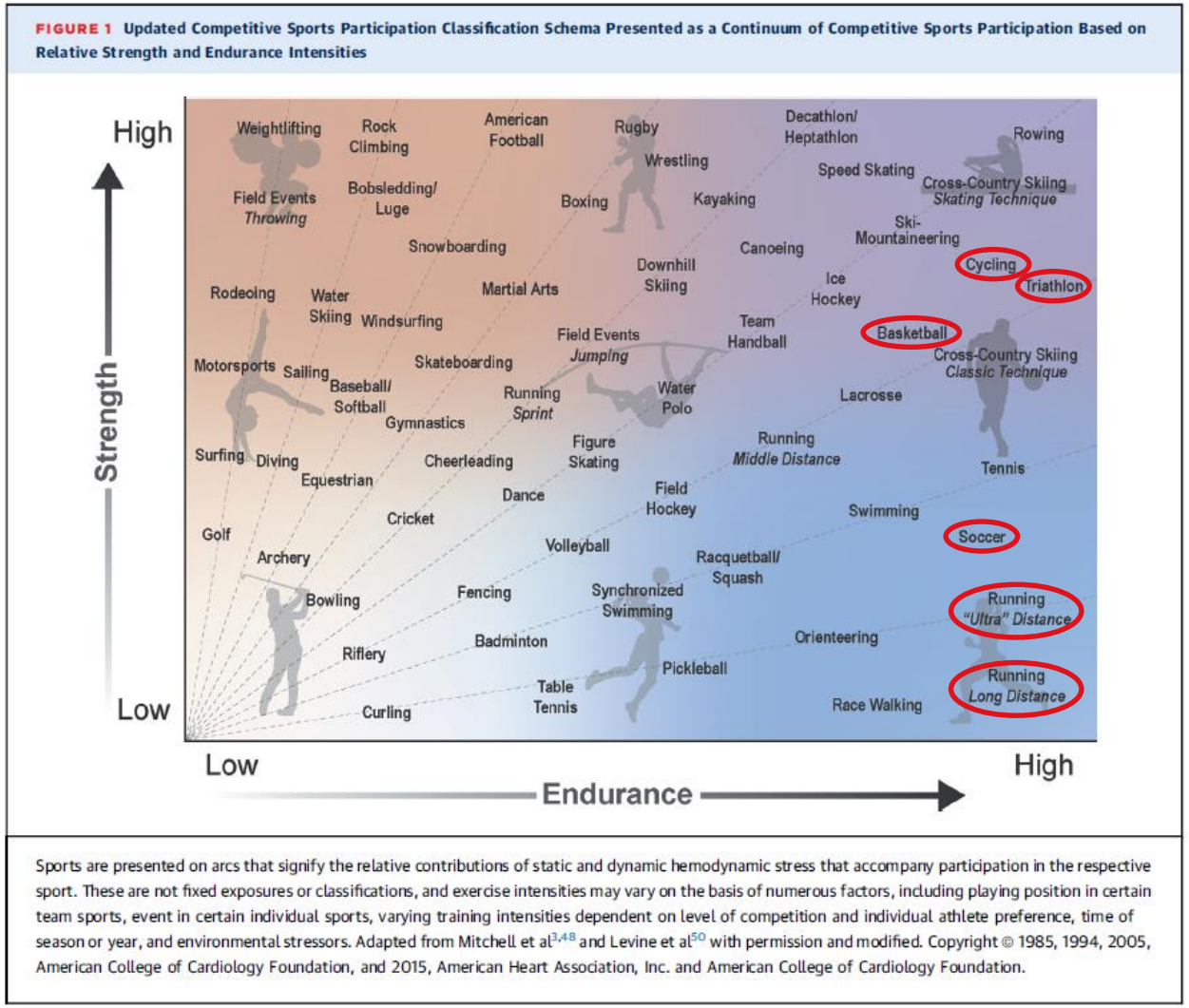
Sports are presented on arcs that signify the relative contributions of static and dynamic hemodynamic stress that accompany participation in the respective sport. These are not fixed exposures or classifications, and exercise intensities may vary on the basis of numerous factors, including playing position in certain team sports, event in certain individual sports, varying training intensities dependent on level of competition and individual athlete preference, time of season or year, and environmental stressors. Adapted from Mitchell et al[3,48] and Levine et al[50] with permission and modified.

Kim JH et al. JACC. 2025.

Restriction sportive



Pelliccia A et al. Eur Heart J. 2020.



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Kim JH et al. JACC. 2025.

Restriction sportive

Clinical Considerations for Competitive Sports Participation for Athletes With Cardiovascular Abnormalities

A Scientific Statement From the American Heart Association and American College of Cardiology

Kim JH et al. JACC. 2025.

TABLE 9 Clinical Considerations for Competitive Athletes With Coronary Artery Anomalies

Anomalous aortic origin of a coronary artery
Right AAOCA (interarterial)
Specific clinical considerations
Competitive athletes with interarterial right AAOCA should be assessed for symptoms suggestive of myocardial ischemia and inducible myocardial ischemia with provocative stress testing.*†‡§
It is reasonable to temporarily withhold or limit competitive sports participation during the initial clinical evaluation of interarterial right AAOCA.
Competitive athletes with interarterial right AAOCA should be considered for surgical intervention if there is evidence of inducible myocardial ischemia by testing or symptoms suggestive of ischemia.§
For competitive athletes with interarterial right AAOCA and no symptoms suggestive of myocardial ischemia and no evidence of inducible myocardial ischemia or complex ventricular arrhythmias, competitive sports participation is reasonable with SDM and longitudinal clinical surveillance.
For competitive athletes with interarterial right AAOCA who undergo surgical repair, resumption of competitive sports participation can proceed after complete sternal healing and testing showing no evidence of myocardial ischemia and no complex ventricular arrhythmias.*
Left AAOCA (interarterial)
Specific clinical considerations
Competitive athletes with interarterial left AAOCA should be considered for surgical intervention of this high-risk anatomic variant regardless of the initial clinical presentation or the results of an ischemia assessment. Competitive athletes should not participate in competitive sports if left unrepaired.
At the time of diagnosis, it is reasonable to assess competitive athletes with interarterial left AAOCA for the presence of myocardial fibrosis or scar to inform perioperative management and long-term prognosis.
For competitive athletes with interarterial left AAOCA who undergo surgical repair, resumption of competitive sports participation can proceed after complete sternal healing and testing showing no evidence of myocardial ischemia and no complex ventricular arrhythmias.*

Cas complexe à gérer

- Jeune sportif (football) de 15 ans
- Centre de formation (pôle espoirs)
- Echocardiogramme systématique
- Découverte ANOCOR droite avec trajet interartériel
- Pas de symptomatologie d'allure ischémique
- Pas d'ischémie myocardique documentée

Que lui proposer ?

Cas complexe à gérer

- Jeune sportif (football) de 15 ans
- Centre de formation (pôle espoirs)
- Echocardiogramme systématique
- Découverte ANOCOR droite avec trajet interartériel
- Pas de symptomatologie d'allure ischémique
- Pas d'ischémie myocardique documentée

Que lui proposer ?

- Pas de restriction sportive ?
- Restriction sur activité sportive d'intensité élevée ?
- Correction chirurgicale ?

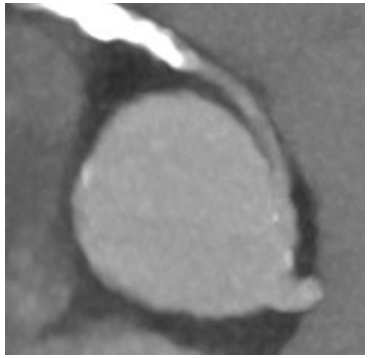
Connexions aortiques anormales

1. Ce que l'on sait assez bien

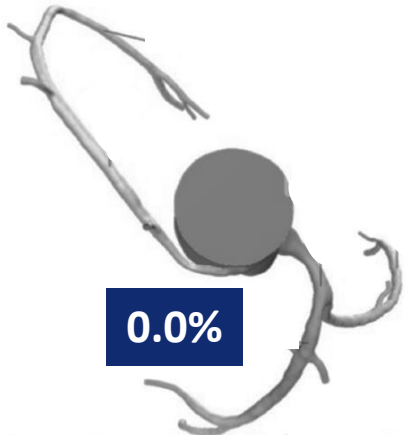
- Prévalence des types anatomiques
- Risques selon l'anatomie
- Modes d'imagerie
- Techniques chirurgicales
- Maladie coronaire associée

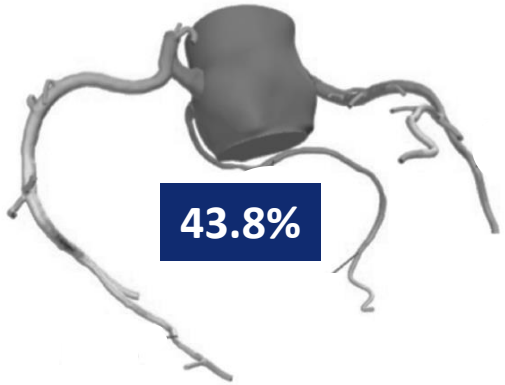
Prevalence and location of coronary artery disease (CAD) in AAOCA

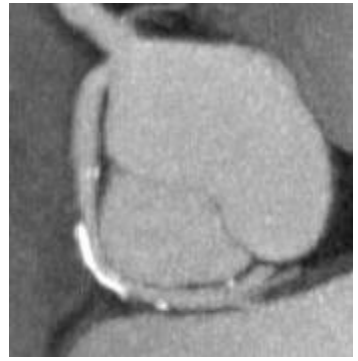
Ectopic courses (n=390)



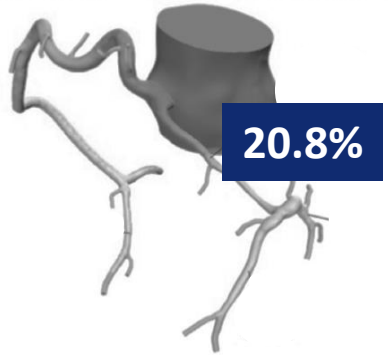
AAOCA (RCA)
with interarterial course
N = 122







AAOCA (Cx artery)
with retroaortic course
N = 219

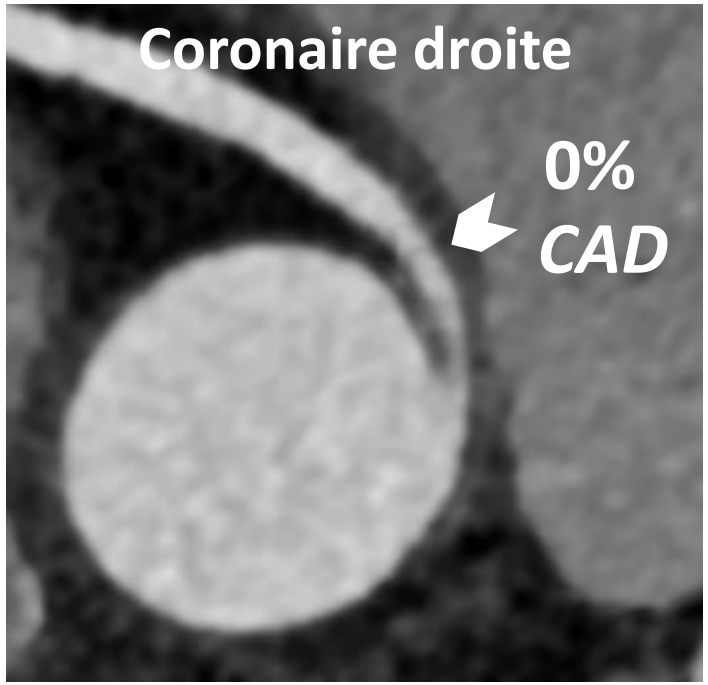


AAOCA (LM artery)
with subpulmonic course
N = 24

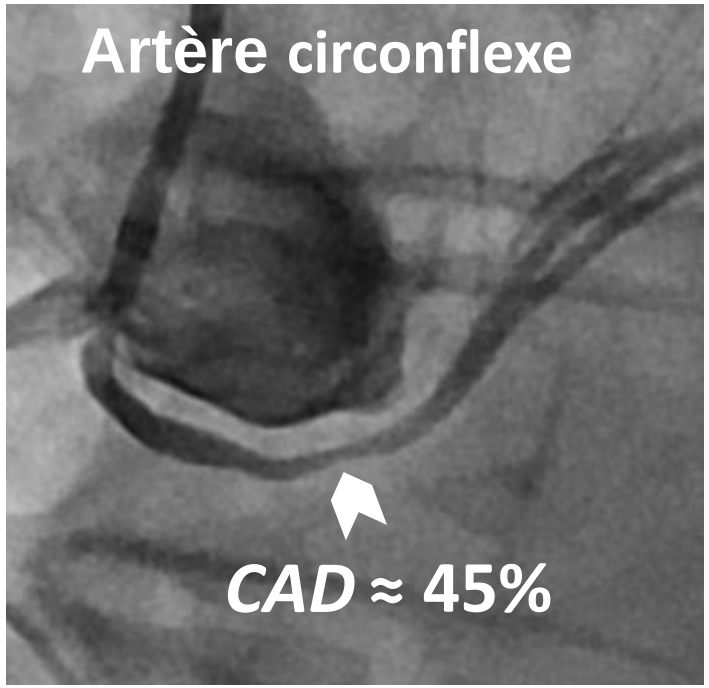
AAOCA (LM artery)
with prepulmonic course
N = 25

Zendjebil S et al. Cor Art Dis 2024

Prevalence and location of coronary artery disease (CAD) in AAOCA



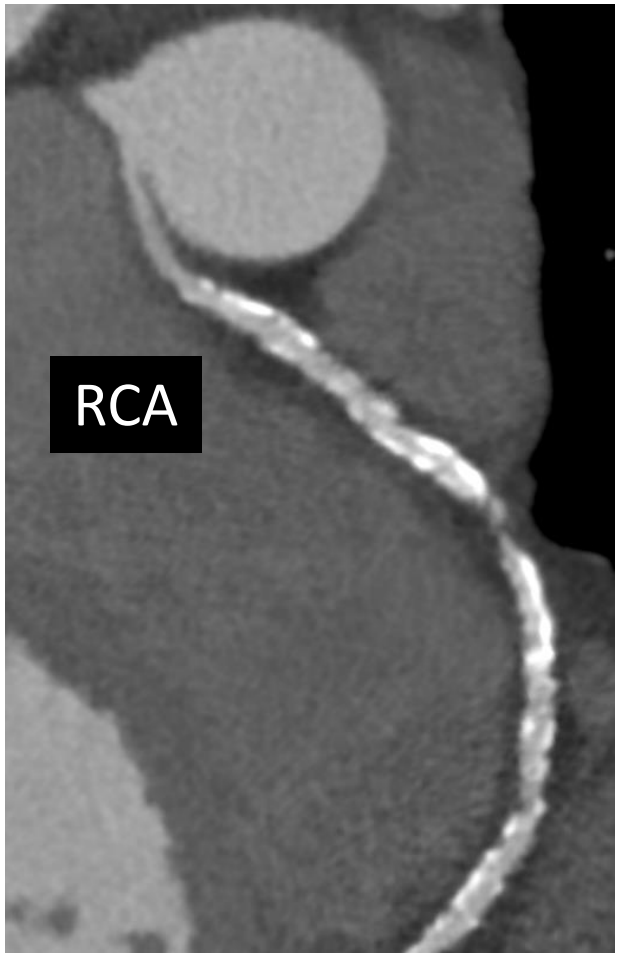
ANOCOR interartérielle

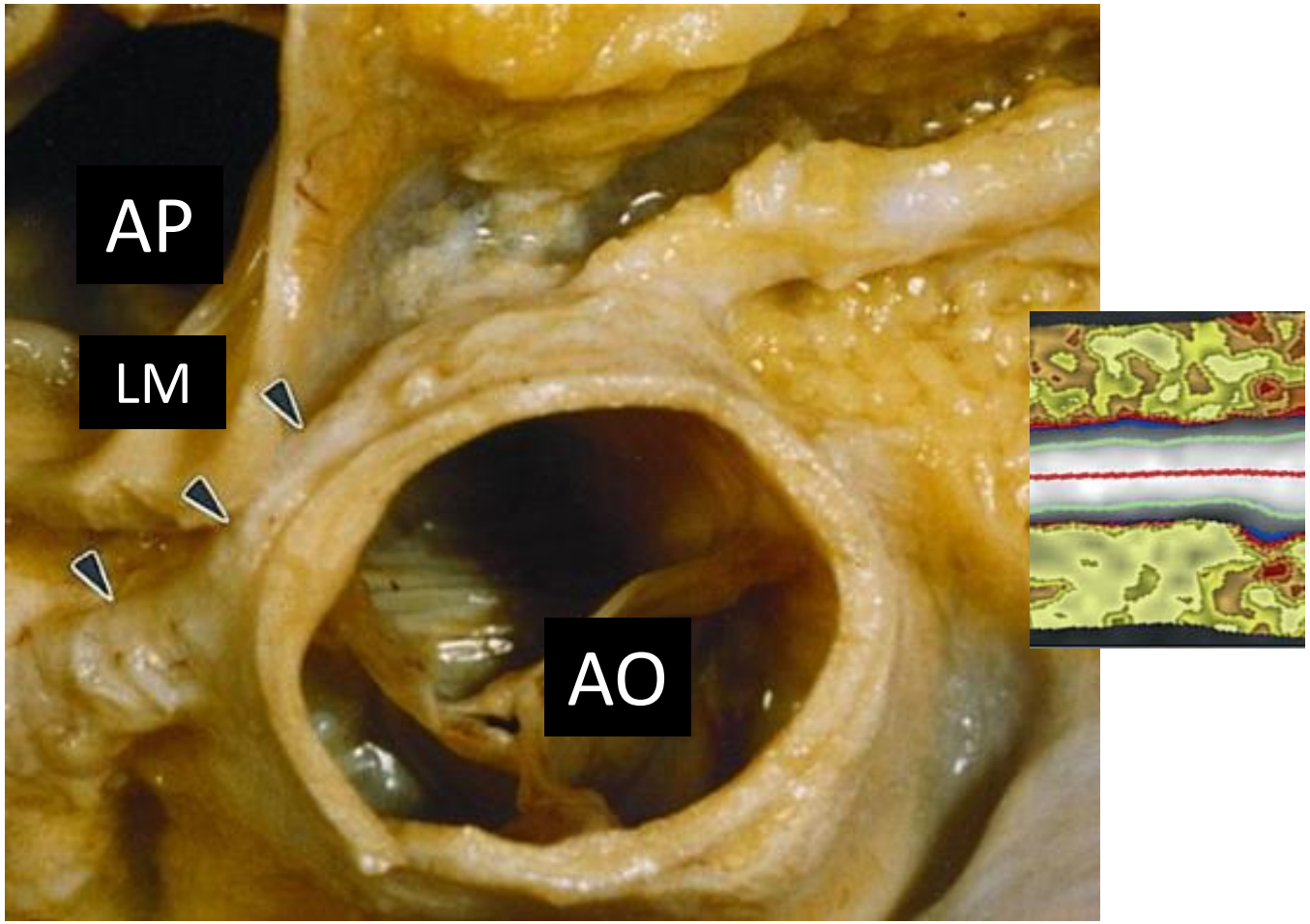


ANOCOR rétroaortique

Zendjebil S et al. Cor Art Dis. 2024.

Prevalence and location of coronary artery disease (CAD) in AAOCA





Connexions aortiques anormales

3. Ce que l'on ne sait pas bien

- Mécanismes de la mort subite
- Score de risque de mort subite
- Dépistage chez le sportif
- Place de l'angioplastie

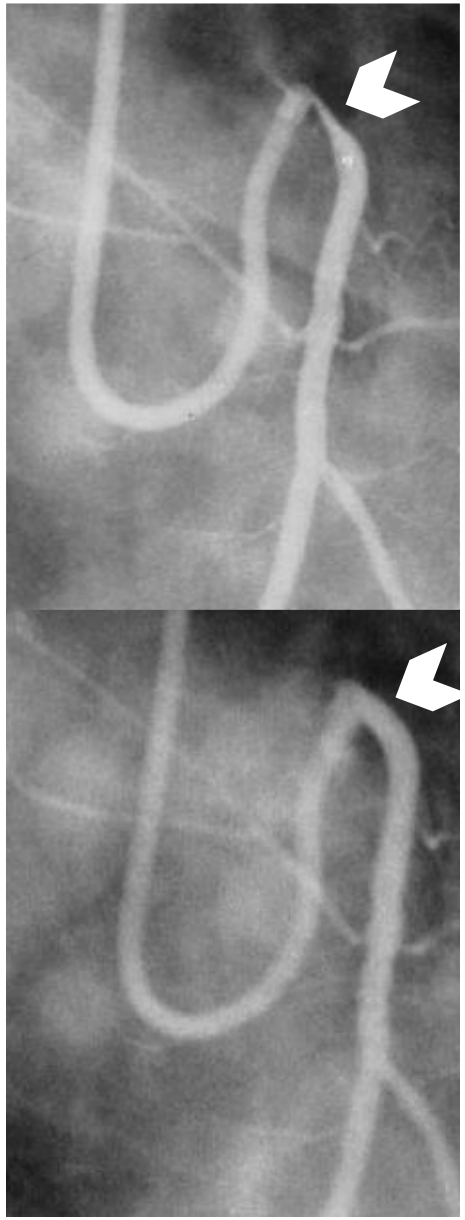
Angioplastie de novo

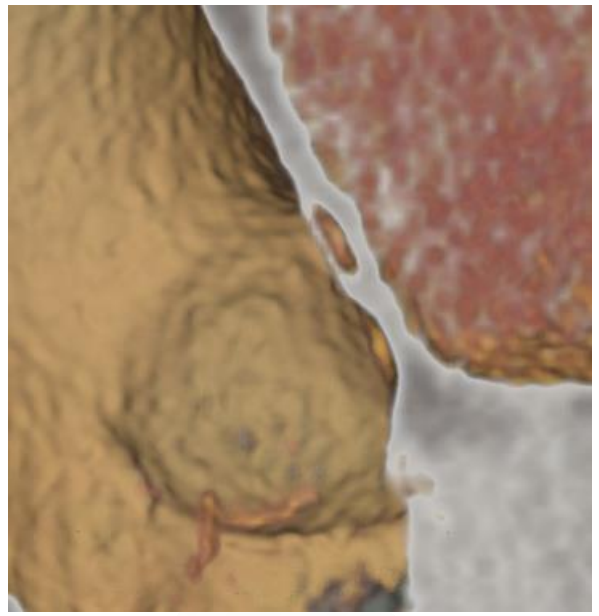
Six-Month Success of Intracoronary Stenting for Anomalous Coronary Arteries Associated With Myocardial Ischemia

Andrew J. Doorey, MD, Michael J. Pasquale, MD, James F. Lally, MD, Gary S. Mintz, MD, Erik Marshall, MD, and David A. Ramos, MD

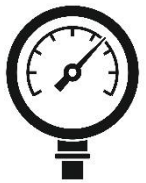
THE AMERICAN JOURNAL OF CARDIOLOGY® VOL. 86 SEPTEMBER 1, 2000

25 years ago





Φ 3.0/4.0 mm



16/24 bars

Angioplastie de novo

Six-Month Success of Intracoronary Stenting for Anomalous Coronary Arteries Associated With Myocardial Ischemia

Doorey AJ et al. Am J Cardiol. 2000.

N=14

Origin of the Right Coronary Artery from the Opposite Sinus of Valsalva in Adults: Characterization by Intravascular Ultrasonography at Baseline and After Stent Angioplasty

Angelini P et al. Cathet Cardio Interv. 2015.

N=42

Technical success and long-term outcomes after anomalous right coronary artery stenting with cardiac computed tomography angiography correlation

Darki A et al. Cathet Cardio Interv. 2020.

N=4

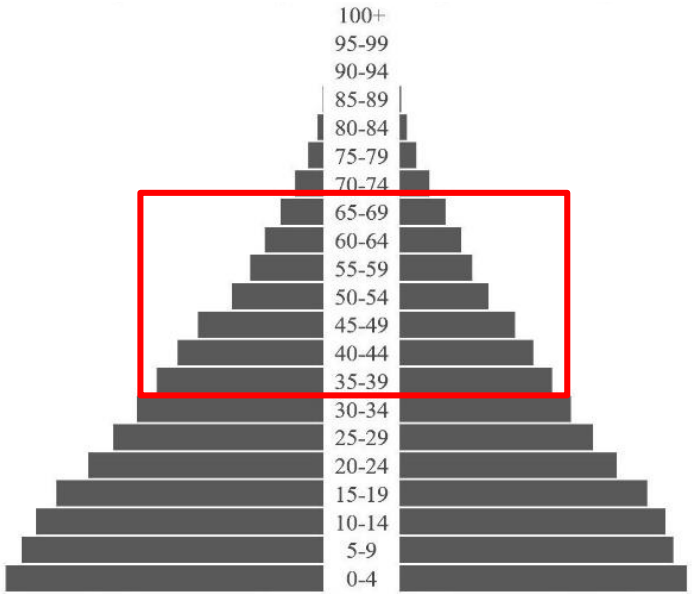
Place of Angioplasty for Coronary Artery Anomalies With Interarterial Course

Aubry P et al. Front Cardiovasc Med. 2021.

N=17

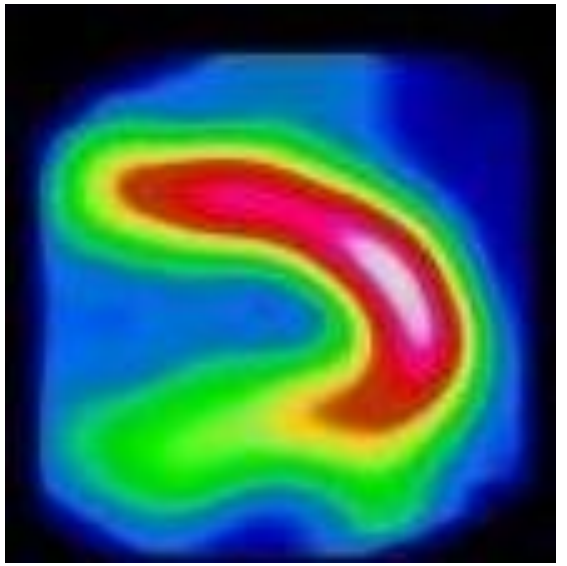
Angioplastie de novo

Symptômes

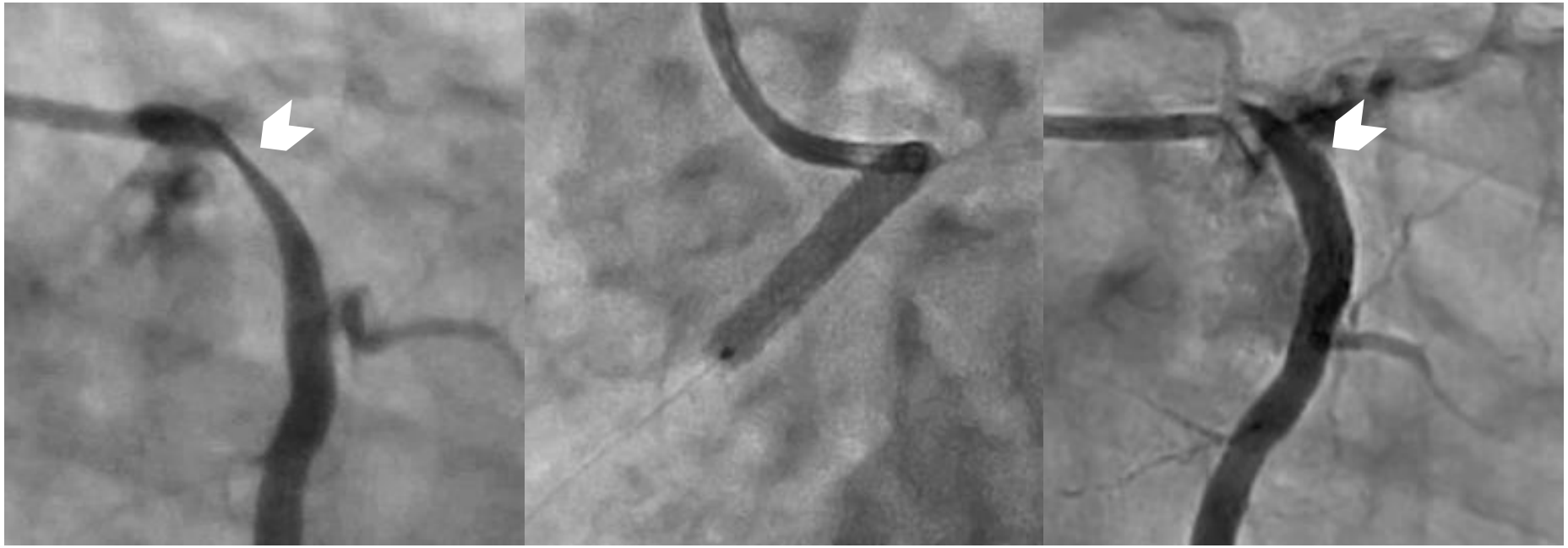


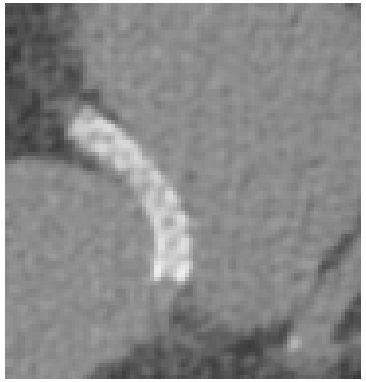
Population d'âge moyen

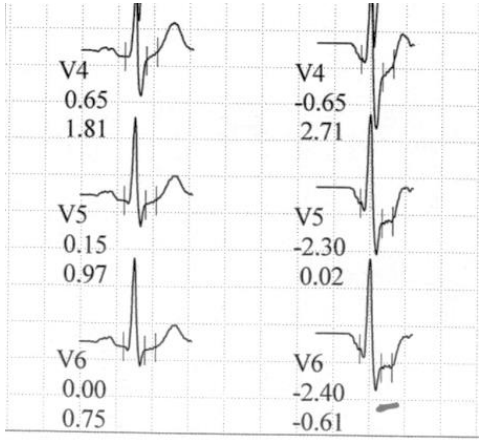
Ischémie



Angioplastie de novo

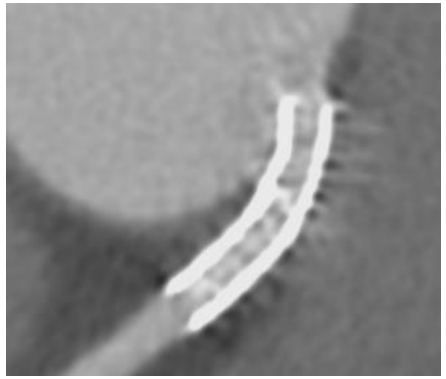


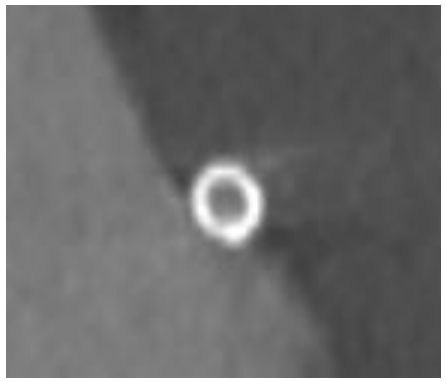




64 ans – vélo - lipothymie d'effort - ANOCOR droite - test d'effort +

Angioplastie de novo





- Cohortes plus larges
- Sécurité de la procédure
- Suivis plus prolongés
- Taux de resténose intrastent ?
- Taux de deformation du stent ?

Journal of the Society for Cardiovascular Angiography & Interventions 2 (2023) 100595

JSCAI

The official journal of the Society for Cardiovascular Angiography & Interventions

Comprehensive Review

Stent Angioplasty in Coronary Artery Anomalies With Intramural Course: When, Why, How, With What Results?

Paolo Angelini, MD *, Carlo Uribe, MD

The Texas Heart Institute Center for Cardiovascular Care, Houston, Texas

Next Guidelines for Adult CHD?

ICR3 Interventional Cardiology: Reviews, Research, Resources

EDITORIAL

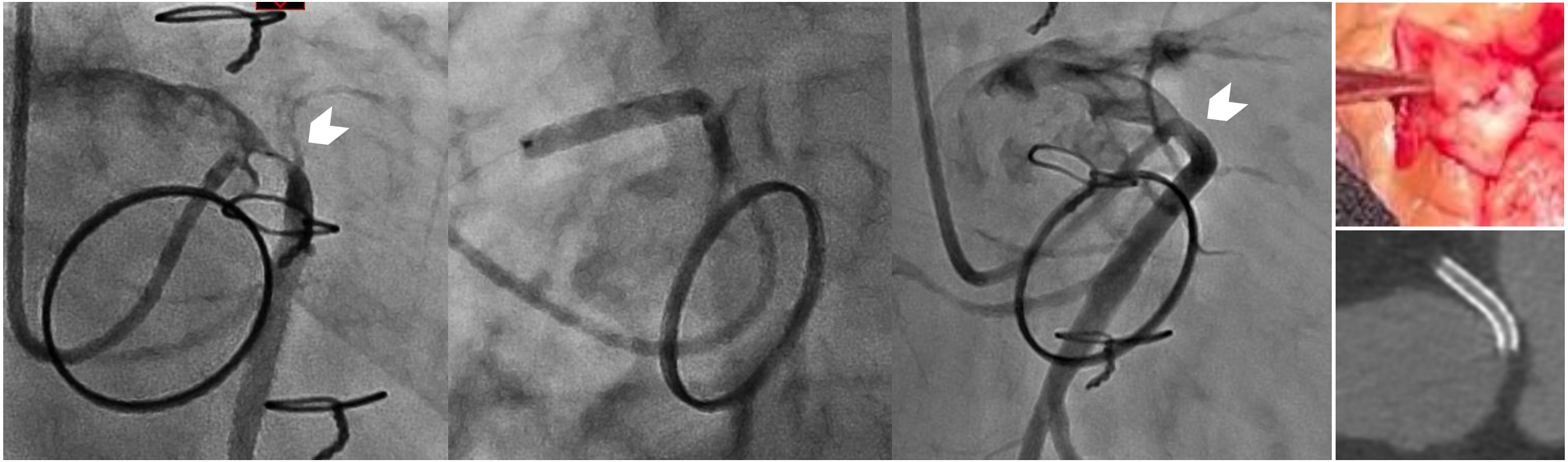
Coronary

Percutaneous Coronary Intervention in Anomalous Right Coronary Artery: Ready to Implement in Clinical Routine?

Anselm W Stark and Christoph Gräni

Department of Cardiology, Inselspital, Bern University Hospital, University of Bern, Bern, Switzerland

Angioplastie après chirurgie



Femme de 55 ans - ectasie aorte - ANOCOR droite - RVA + Bentall - réimplantation coronaire

Anomalies coronaires congénitales de l'adulte

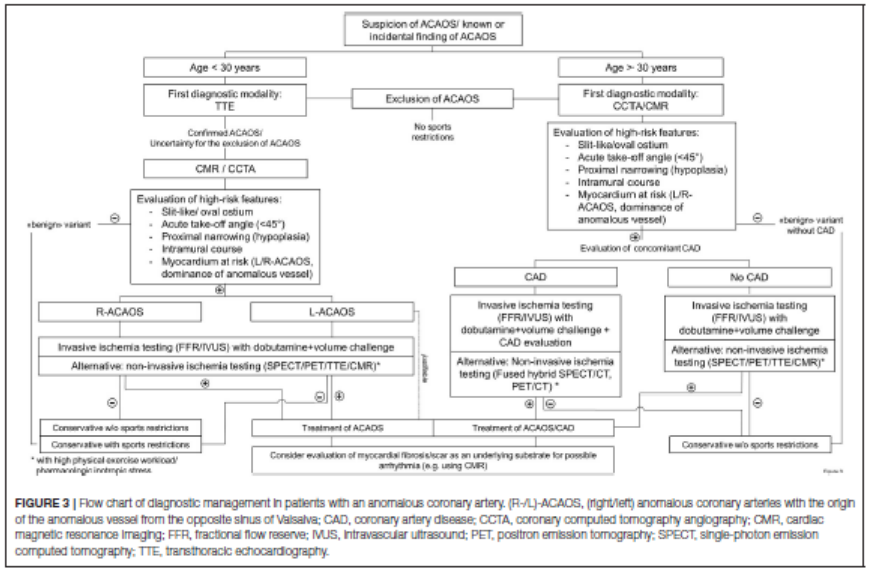


FIGURE 3 | Flow chart of diagnostic management in patients with an anomalous coronary artery. (R-/L)-ACAOS, (right/left) anomalous coronary arteries with the origin of the anomalous vessel from the opposite sinus of Valsalva; CAD, coronary artery disease; CCTA, coronary computed tomography angiography; CMR, cardiac magnetic resonance imaging; FFR, fractional flow reserve; IVUS, intravascular ultrasound; PET, positron emission tomography; SPECT, single-photon emission computed tomography; TTE, transthoracic echocardiography.

Bigler MR Front Cardiovasc Med 2021.

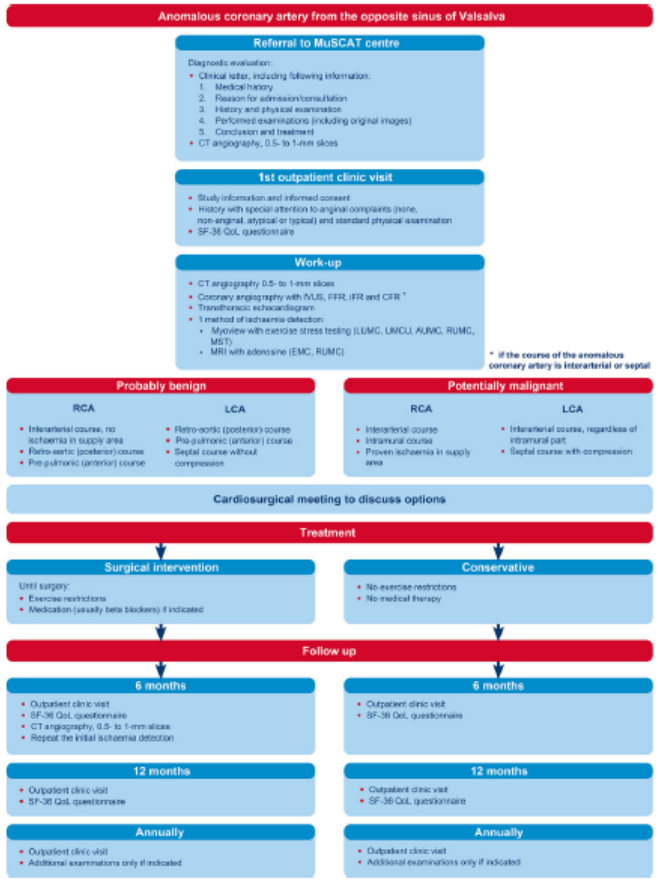


Fig. 2 Flowchart of study protocol. *IVUS* Intravascular ultrasound, *FFR* fractional flow reserve, *IFR* instantaneous wave-free ratio, *CFR* coronary flow reserve, *LUMC* Leiden University Medical Centre, *UMCU* University Medical Centre Utrecht, *AUMC* Amsterdam University Medical Centre, *EMC* Erasmus University Medical Centre, *RUMC* Radboud University Medical Centre, *MST* Medisch Spectrum Twente, *RCA* right coronary artery, *LCA* left coronary artery, *QoL* quality of life

Koppel CJ Neth Heart J 2022.

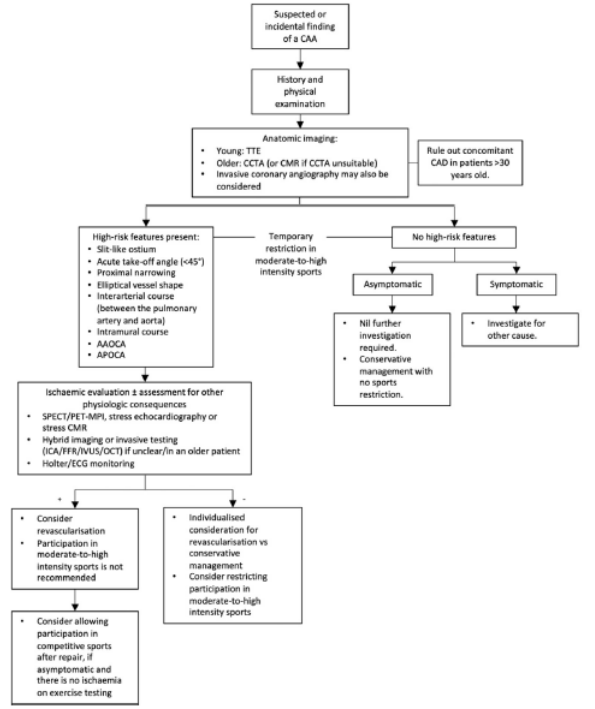
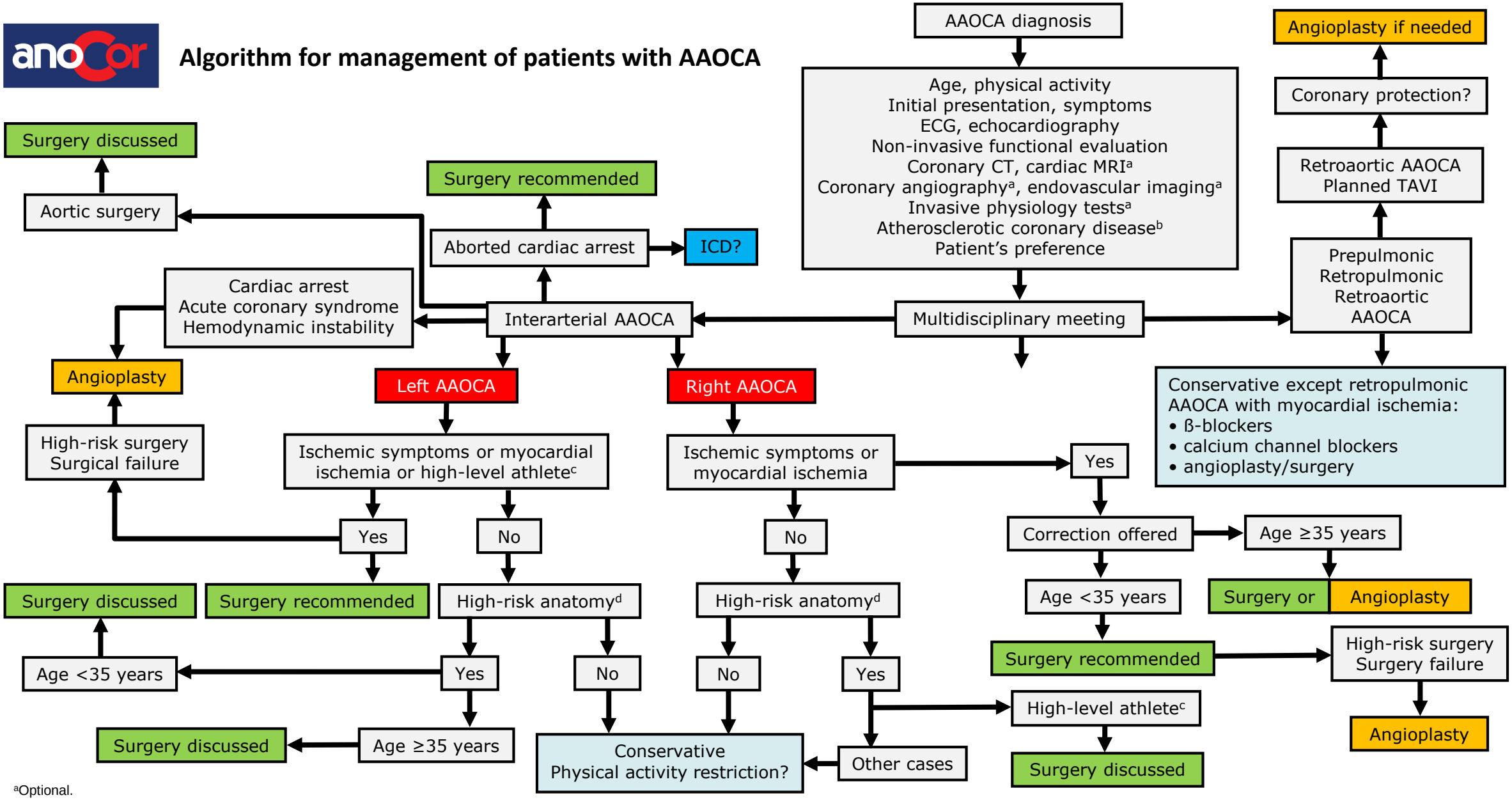


FIG 3. Proposed management algorithm for CAAs. APOCA, anomalous pulmonary origin of a coronary artery; AAOCA, anomalous aortic origin of a coronary artery; CAA, coronary artery anomaly; CAD, coronary artery disease; CCTA, coronary computed tomography angiography; CMR, cardiac magnetic resonance; ECG, electrocardiogram; MPI, myocardial perfusion imaging; SPECT, single-photon emission computed tomography; TTE, transthoracic echocardiogram. (Color version of figure is available online.)

Lau W Curr Probl Cardiol 2023.

Algorithm for management of patients with AAOCA



[a]Optional.
[b]Surgical technique adapted.
[c]Physical activity according to ESC guidelines.
[d]Takeoff angle ≤35, slit-like ostium, diameter reduction ≥50%, or intramural aortic passage.
AAOCA: Anomalous aortic origin of a coronary artery. ANOCOR: Anomalies coronaires congénitales. CT: Computed tomography. ECG: Electrocardiogram. ICD: Implantable cardioverter-defibrillator. MRI: Magnetic resonance imaging. TAVI: transcatheter aortic valve implantation.

https://www.anocor.fr

Groupe ANOCOR

Groupe de travail multidisciplinaire sur les anomalies coronaires congénitales

Contact : pcaubry@yahoo.fr

2010 - …

Pierre Aubry (Paris)	Cardiologie interventionnel
Olivier Boudvillain (Paris)	Cardiologie interventionnel
Patrick Dupouy (Melun)	Cardiologie interventionnel et imageur
Reza Farnoud (Paris)	Ingénieur de recherche clinique
Xavier Halna du Fretay (Saran)	Cardiologie interventionnel
Athanasios Koutsoukis (Le Plessis Robinson)	Cardiologie interventionnel
Jean-Pierre Laissy (Gonesse)	Radiologue
Phalla Ou (Paris)	Radiologue
Fouad Saadi (Paris)	Cardiologue imageur

Groupe ANOCOR

Groupe de travail multidisciplinaire sur les anomalies coronaires congénitales

Contact : pcaubry@yahoo.fr

2010 - …

Mode de fonctionnement

- Demande d'un cardiologue référent
- Récupération des éléments du dossier
- Analyse du dossier
- Avis adressé au cardiologue référent
- Consultation avec le patient (exceptionnelle)

Activité ≈ 1.750 dossiers (2010-2025) / **115** par an

Activité 2015 : **50** dossiers

Activité 2025 : **220** dossiers