ANOCOR et sport : de la détection à la décision

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Club des Cardiologues du Sport

ANOCOR : de la détection à la décision

Pierre Aubry

Conflit d'intérêt potentiel : aucun

Club des Cardiologues du Sport

Modes de détection

Souffle/précordiagies/dyspnée/ECG anormal

Syncope/angor d'effort

Bilan systématique

Bilan arrêt cardiaque

Bilan d'aptitude

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Modes de détection

Souffle/précordiagies/dyspnée/ECG anormal

Syncope/angor d'effort

Bilan systématique

Bilan arrêt cardiaque

Bilan d'aptitude

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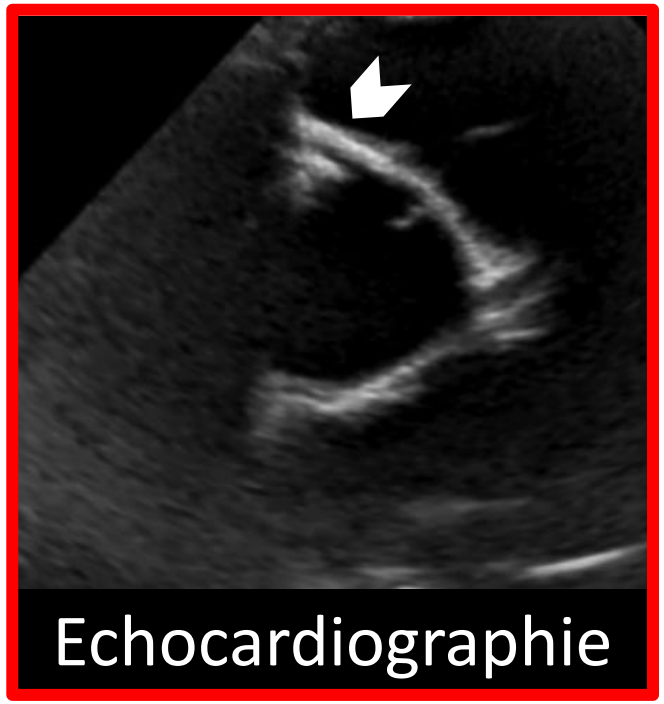
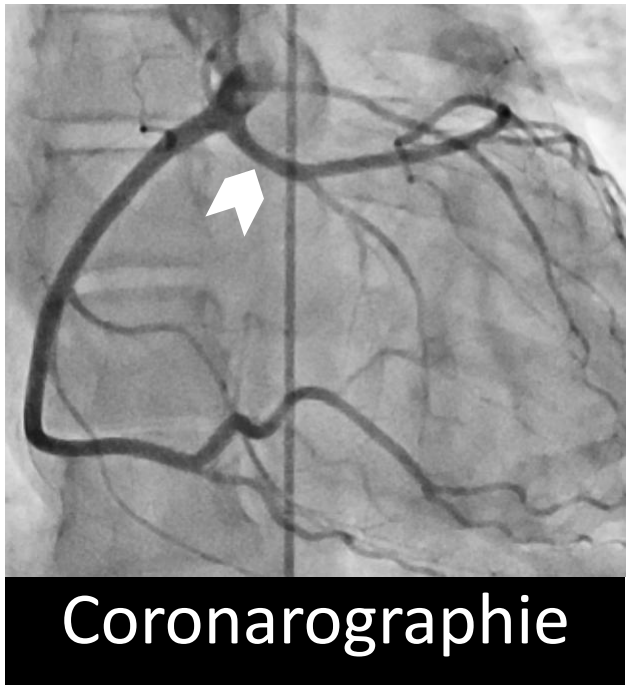
Prévalence selon le mode d'imagerie (toutes anomalies)



Echocardiographie

0.2%



Coronarographie

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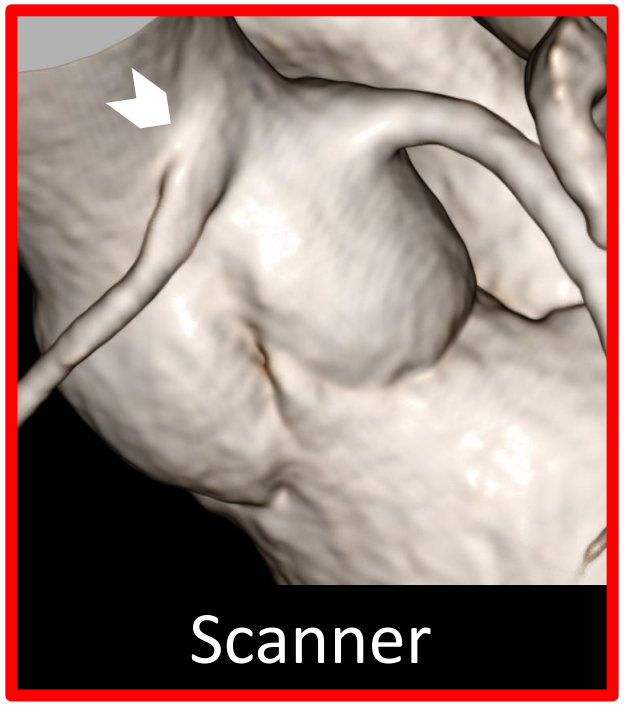

Scanner

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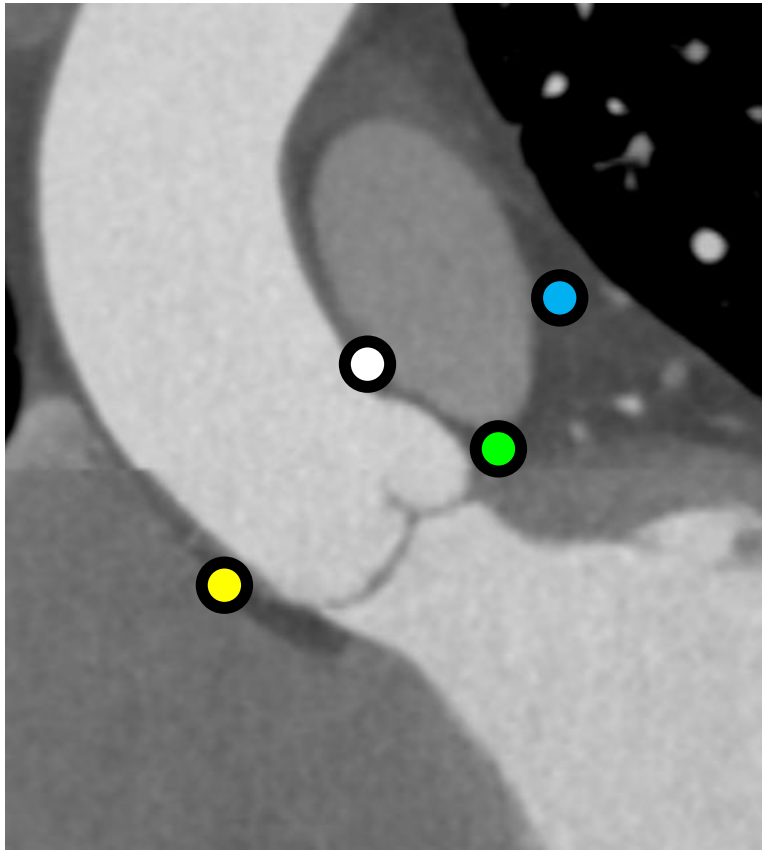
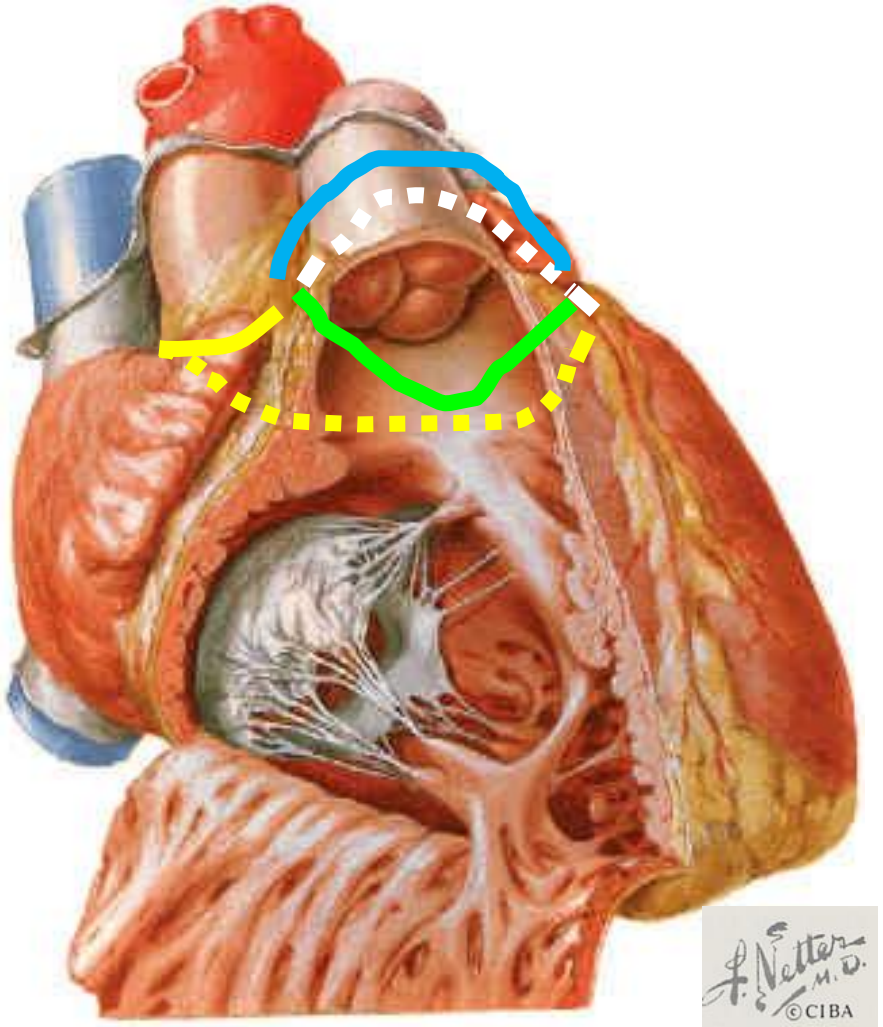
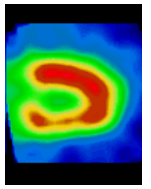
Classification anatomique par le trajet

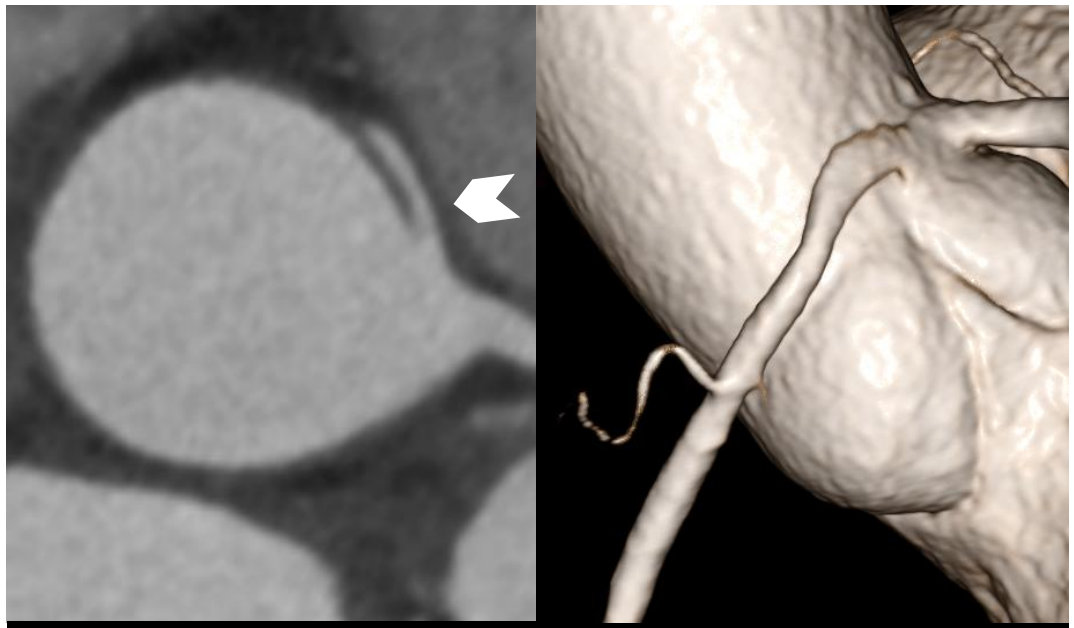
- Prépulmonaire
- Rétropulmonaire
- Interartériel
- Rétroaortique



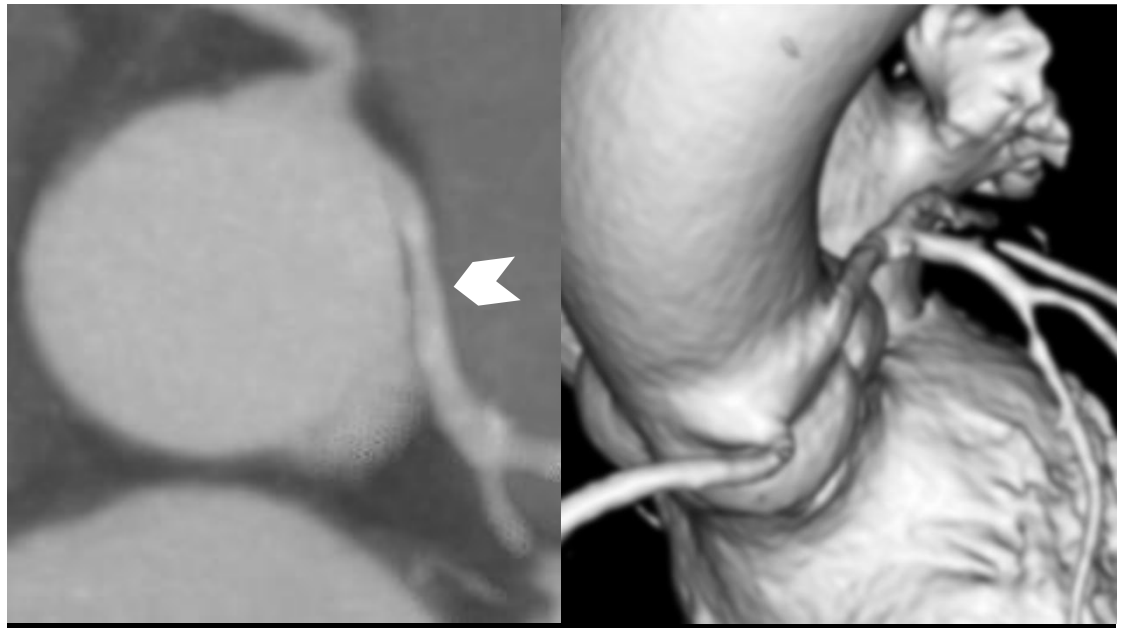


Anomalies de connexion coronaire à risque



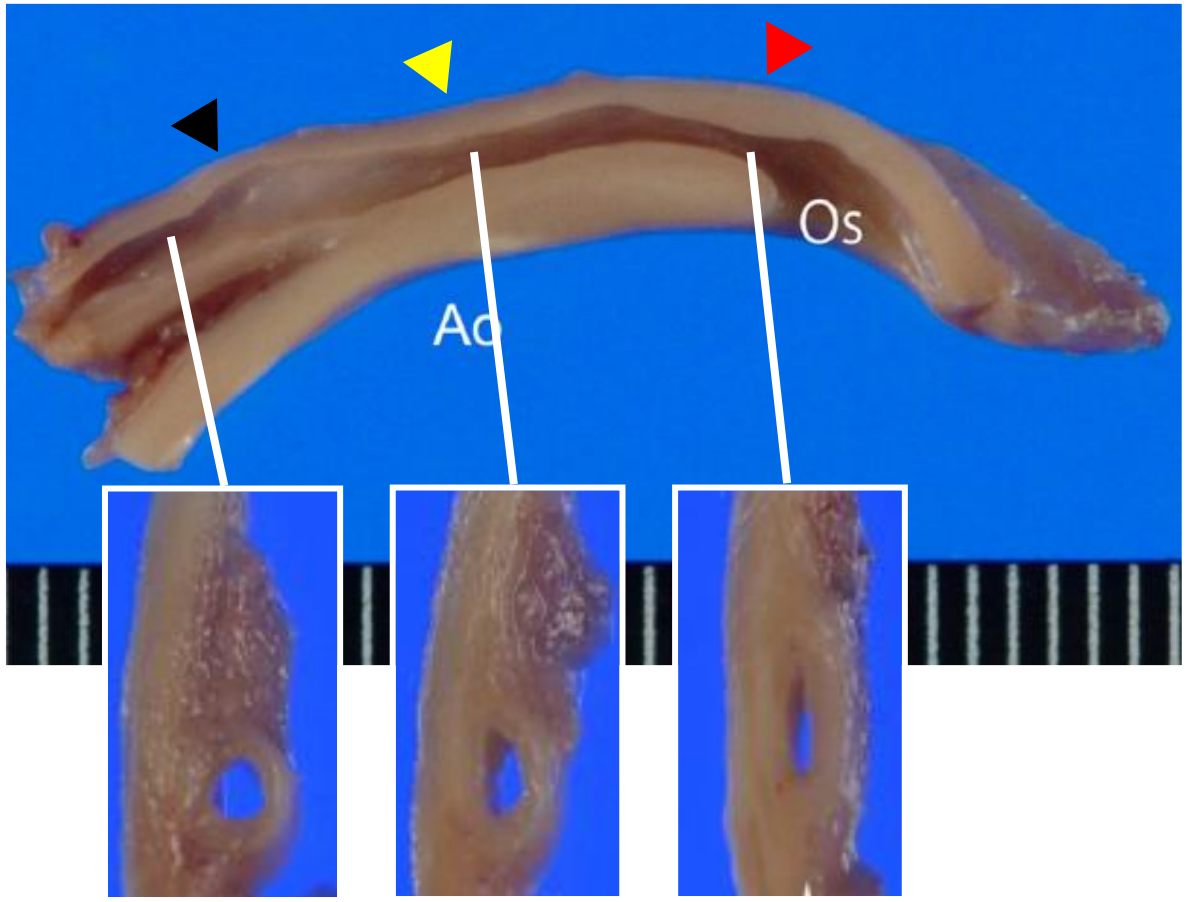


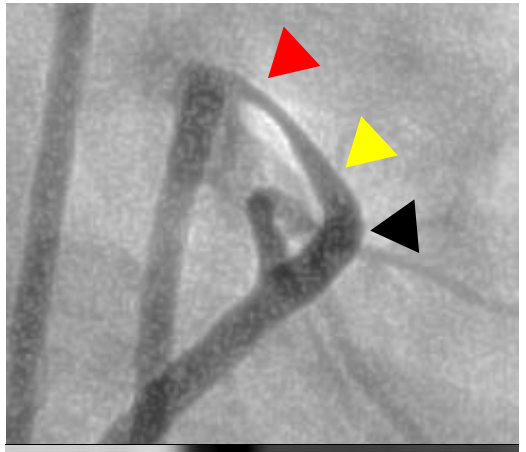
ANOCOR droite interartérielle

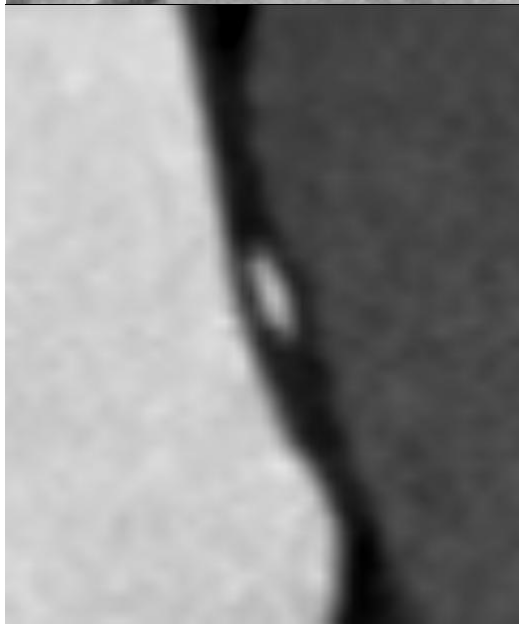


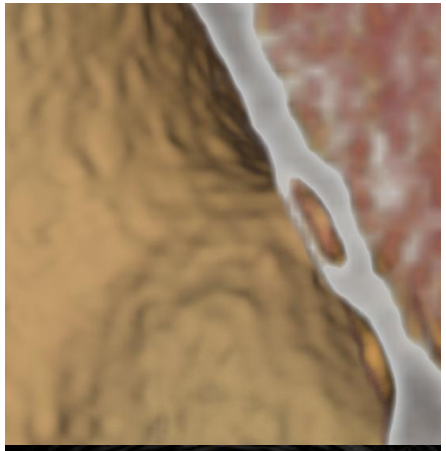
ANOCOR gauche interartérielle

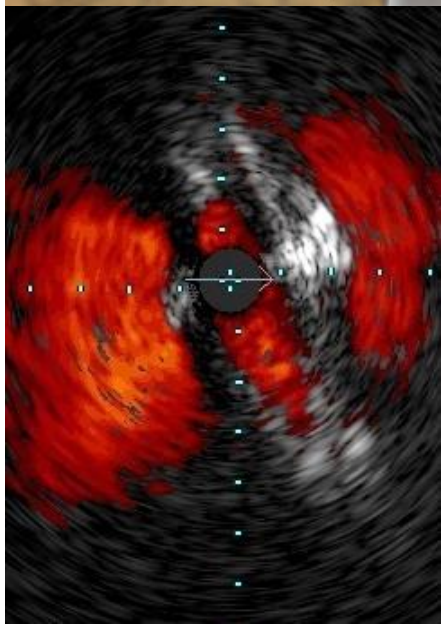
Trajet interartériel avec passage intramural aortique





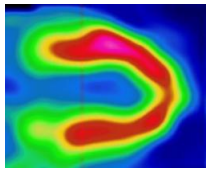




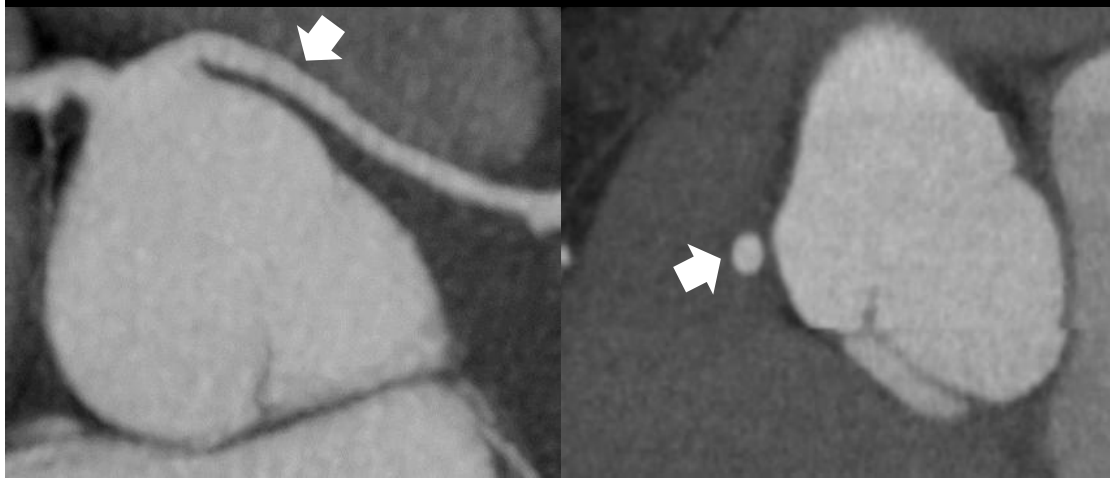


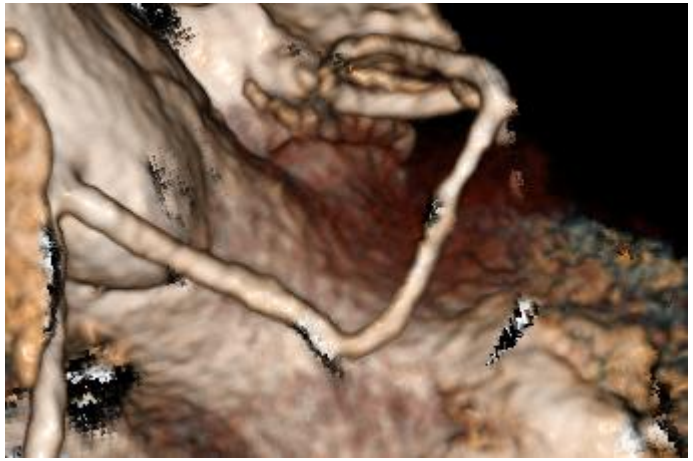
Hata Y et al. Cardiovasc Pathol. 2014.

Anomalie de connexion coronaire: très rarement à risque

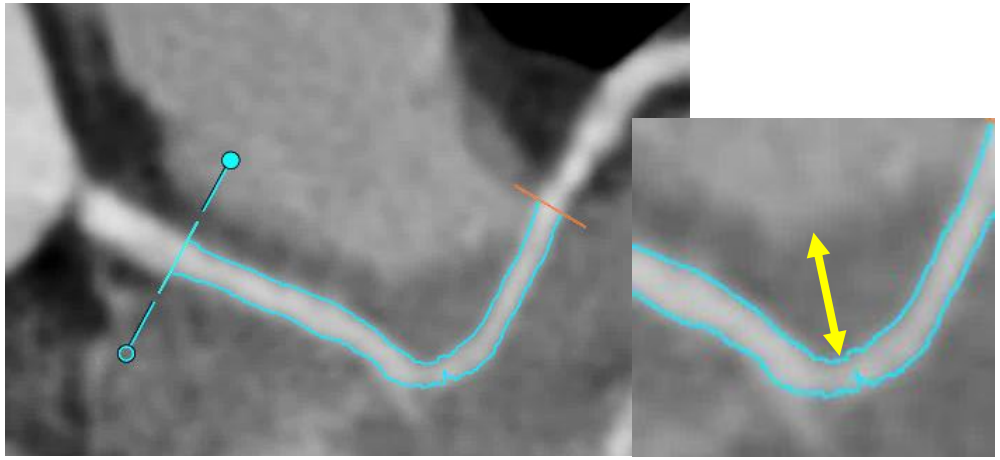


Tronc commun rétropulmonaire





Passage intramyocardique

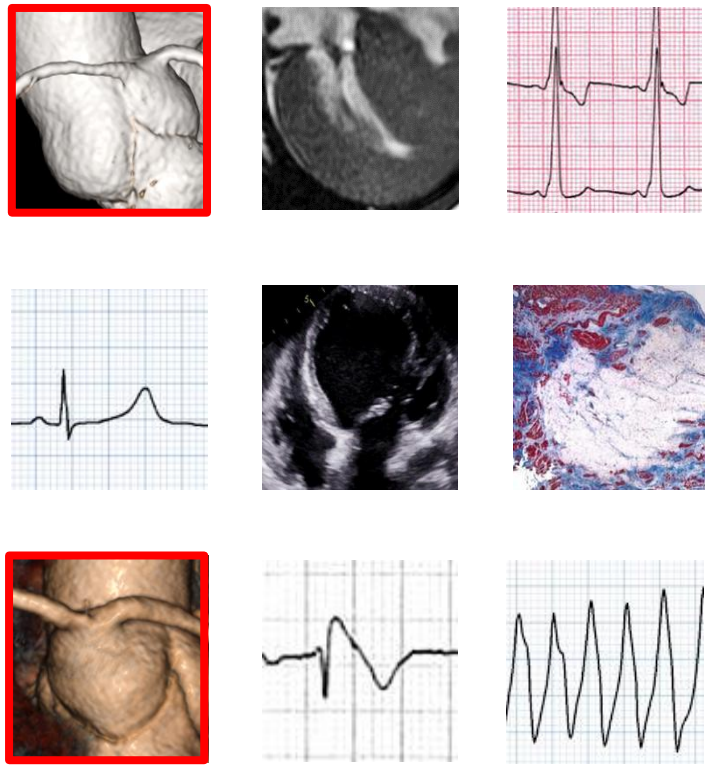


Anomalies de connexion coronaire non à risque

ANOCOR prépulmonaire

ANOCOR rétroaortique

Prévalence des anomalies congénitales à risque



Anomalie	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 l'anomalie en population générale (estimations)

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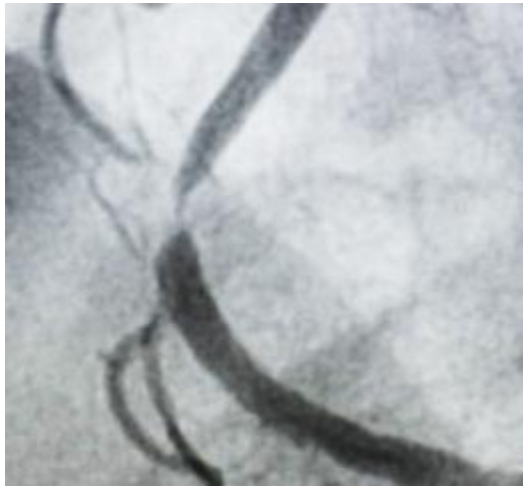
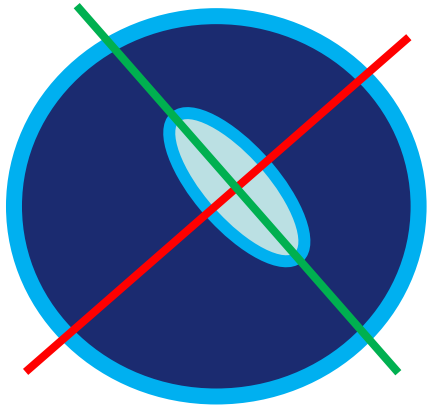
ANOCOR et ischémie myocardique

ATHEROME

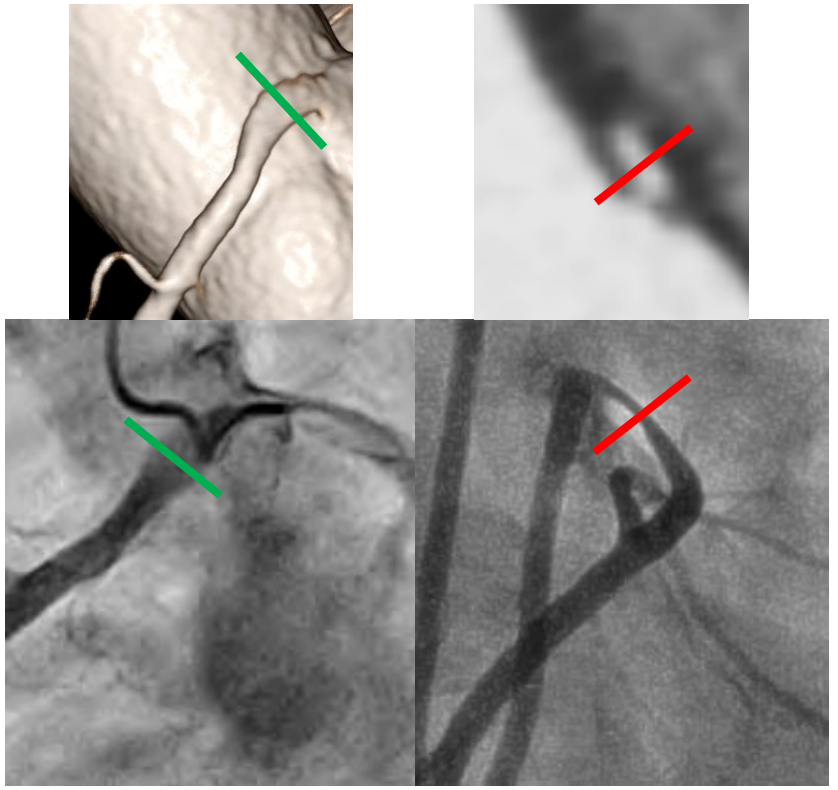


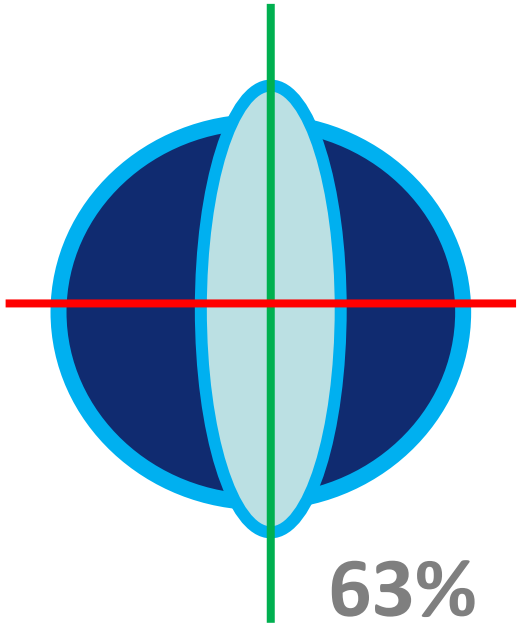


92%

Réduction de surface : > 70%

ANOCOR

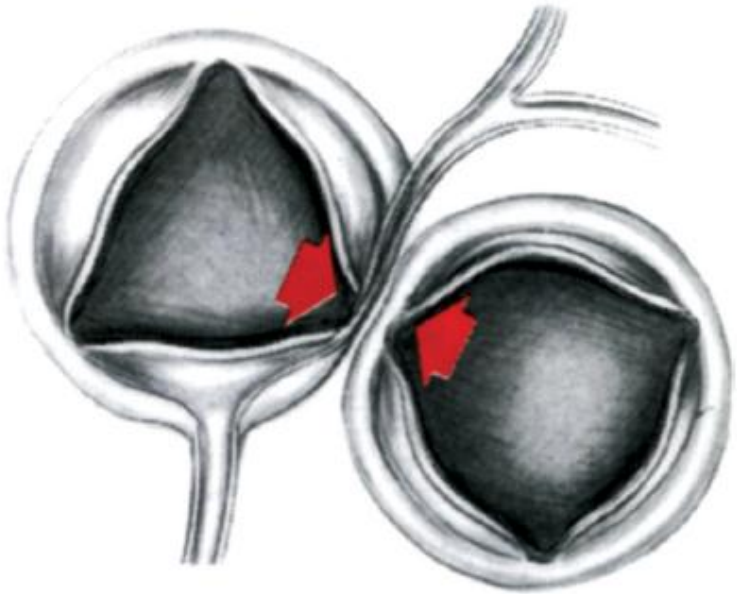




63%

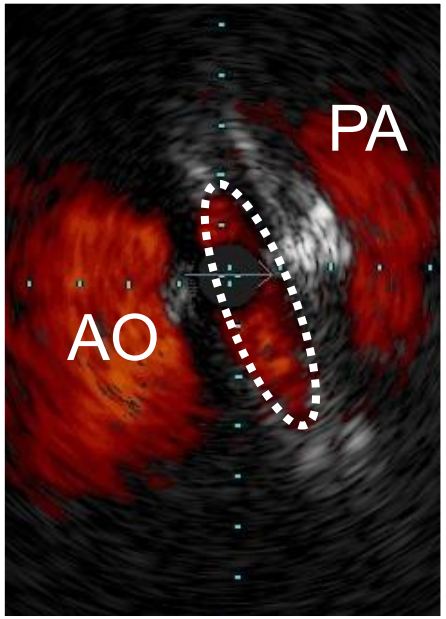
Réduction de surface : 35-70%

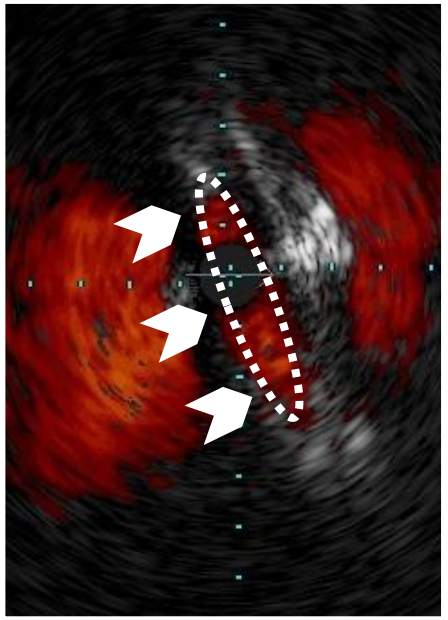
Mechanisms of myocardial ischemia



Raisky O, Vouhé P. EMC. 2007.

Fixed Component **Dynamic Component**





Exercise
Wall stress

35-70% Reduction in lumen area > 70%

Bigler MR et al. Front Cardiovasc Med. 2021.

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ANOCOR 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.

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Sudden cardiac death in athletes

1979

2022

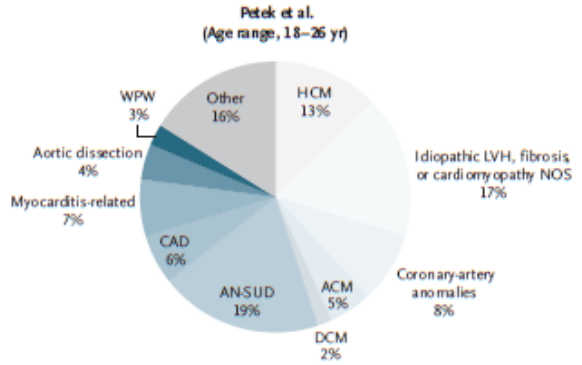
The NEW ENGLAND JOURNAL of MEDICINE

REVIEW ARTICLE

Sudden Cardiac Arrest in Athletes

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

Study	Country	Type of Cardiac Arrest or Death	Population	Age Range yr	No. of Cases	HCM %	Idiopathic LVH, Fibrosis, or Cardiomyopathy NOS %	Coronary-Artery Anomalies %	Arrhythmogenic Cardiomyopathy %	DCM %	AN-SUD %	CAD %	Myocarditis-Related %	Aortic Dissection %	Commotio Cordis %	Other %
Corrado et al.	Italy	SDC	Competitive athletes	12–35	46	2	0	13	26	2	2	22	11	2		20
Harmon et al.	U.S.	SDC	High-school athletes	14–18	50	14	26	8	2	0	18	6	14	0	0	12
Thiene et al.	Italy	SDC	Athletes	<40	75	5	0	16	27	0	11	23	4	0	0	15
Egger et al.	Many	SCA/D	Recreational, competitive, and elite soccer players	≤35	104	11	9	13	4	1		14	13	0	7	36
Peterson et al.	U.S.	SCA/D	Athletes	11–29	209	21	13	12	6	3	19	2	4	3	0	16
Finocchiaro et al.	U.K.	SDC	Athletes	18–35	128	3	12	9	8	3	52	1	0	0	5	7
Bohm et al.	Germany, France	EA-SCA/D	Recreational and competitive athletes	18–35	25	8	4	0	0	4	24	20	16	0	0	24
Petek et al.	U.S.	SDC	Competitive athletes	18–26	118	13	17	8	5	2	19	6	7	4	2	17
Total					755	12	11	10	8	2	20	8	6	1	2	20



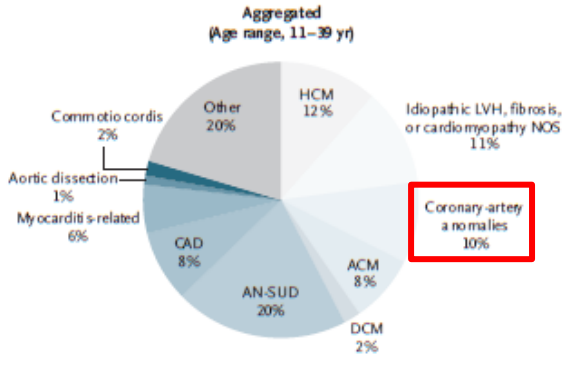


Figure 2. Cardiac Causes of Sudden Death in Athletes.

Only data from studies that included autopsy-negative, sudden, unexplained death (AN-SUD) among possible causes are shown. Data are from Bohm et al.,[36] Corrado et al.,[28] Egger et al.,[37] Finocchiaro et al.,[35] Harmon et al.,[22] Petek et al.,[27] Peterson et al.,[24] and Thiene et al.[38] ACM denotes arrhythmogenic cardiomyopathy, CAD coronary artery disease, DCM dilated cardiomyopathy, EA-SCA/D exercise-associated sudden cardiac arrest or death, HCM hypertrophic cardiomyopathy, LVH left ventricular hypertrophy, NOS not otherwise specified, SCA/D sudden cardiac arrest or death, SDC sudden death from cardiac causes, and WPW the Wolff–Parkinson–White syndrome.

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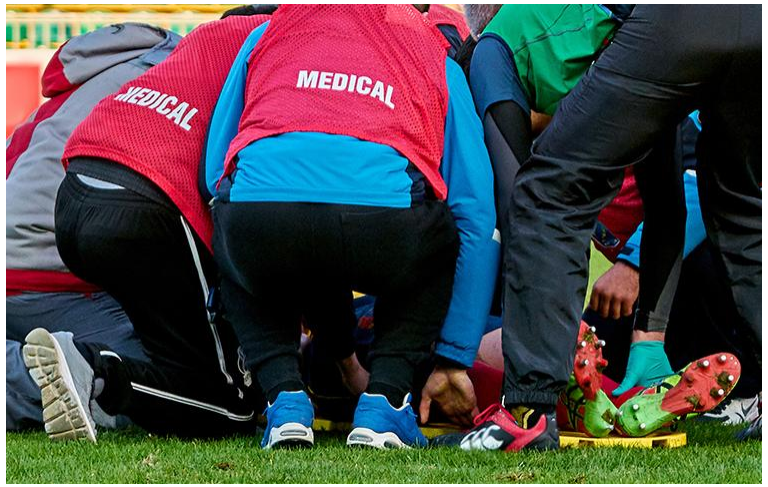
Incidence de la mort subite



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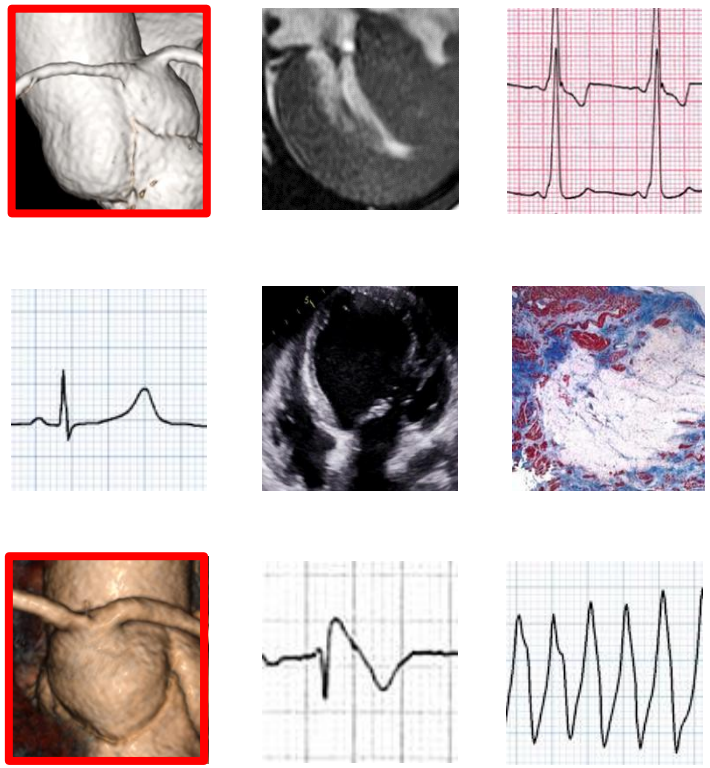
Anomalies congénitales à risque – Incidence de la mort subite



Anomalie	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)

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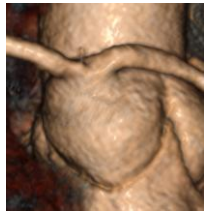
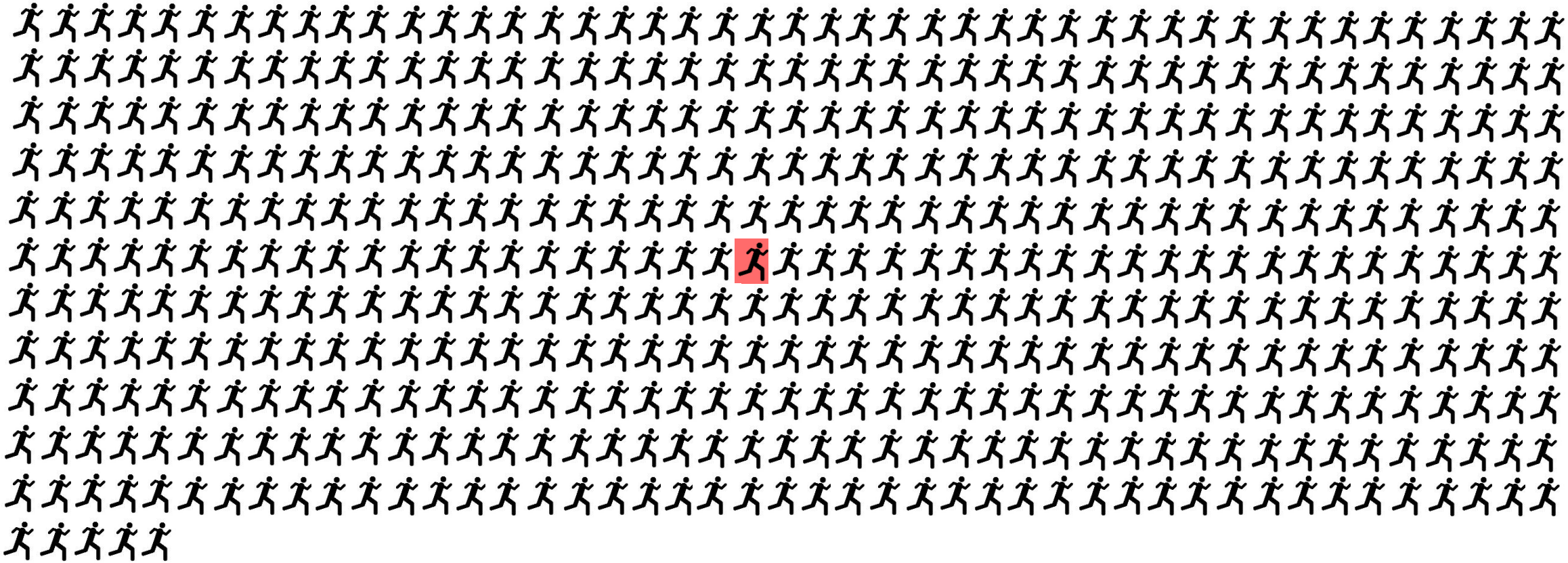
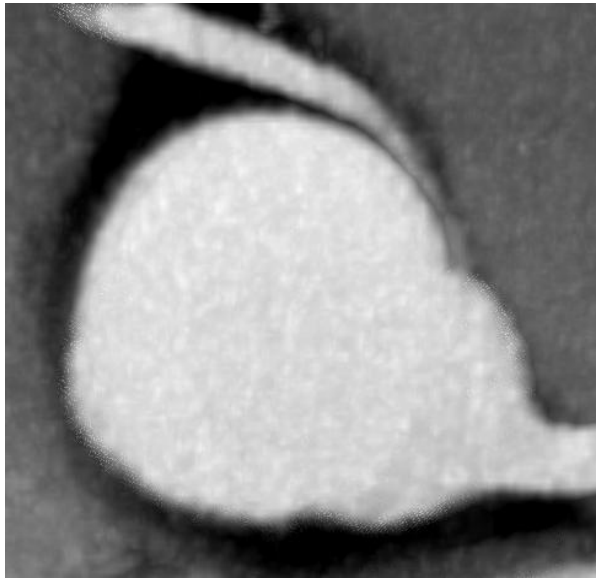


ANOCOR gauche – Incidence de la mort subite (0.2%)



Cause de la mort subite = fibrillation ventriculaire

Mr G.
32 ans



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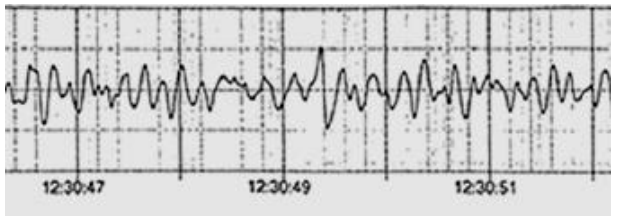
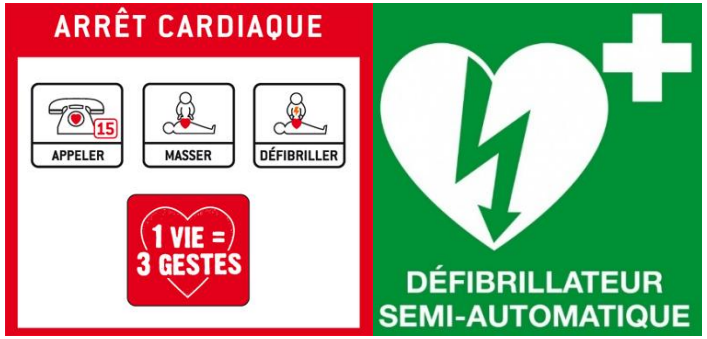
24/07/2024
12.56



Stratégie préventive : dépistage avant pratique sportive

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

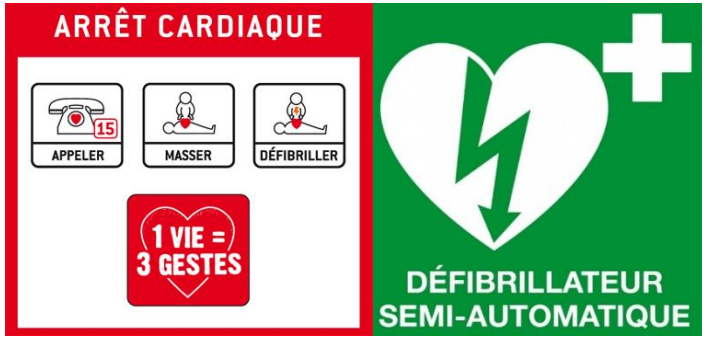


Club des Cardiologues du Sport

Stratégie préventive : dépistage avant pratique sportive

Incidence MS/AC

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



Taux de survie

Club des Cardiologues du Sport

Sudden cardiac arrest in athletes

Sports-related sudden cardiac arrest: a video analysis of presenting features, management and outcomes

Simone Ungaro [1], Thomas S Truglio,[2] Alessandro Zorzi,[1] Erik Ekker Solberg [1], Andrea Caniglia,[1] Nicole M Panhuyzen-Goedkoop [3,4] Merije Chukumerije,[5] Eloi Marijon,[6] Jonathan A Drezner [7]

Ungaro S, *et al*. *Br J Sports Med* 2026;**60**:20–27. doi:10.1136/bjsports-2025-110275

Table 4 Features of resuscitation and survival outcomes

	Total cases (N=48)	Survived	Deceased	P value
EMS on-site	36/48 (75%)	20/36 (56%)	16/36 (44%)	0.738
Pulse check	29/48 (60%)	19/29 (66%)	10/29 (34%)	0.051
Rescue breaths	16/48 (33%)	11/16 (69%)	5/16 (31%)	0.152
Chest compressions	22/48 (46%)	16/22 (73%)	6/22 (27%)	0.018
AED use	22/48 (46%)	19/22 (86%)	3/22 (14%)	<0001

AED, automated external defibrillator; EMS, emergency medical service.

« 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

Club des Cardiologues du Sport

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.

Club des Cardiologues du Sport

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

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)

ESC European Society of Cardiology

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.

AAOCA and competitive sports participation

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.*

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Specific clinical considerations
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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.*

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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 ?

Stratification du risque de mort subite

Risk calculator

UNAVAILABLE

HCM SCD risk calculator

1-2-3-LQTS-Risk

ARVC Risk Calculator

...

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Prévention secondaire

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. 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.

...

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

Baumgartner H et al. Eur Heart J. 2020.

Guidelines AAOCA

CLINICAL PRACTICE GUIDELINES

2025 ACC/AHA/HRS/ISACHD/SCAI Guideline for the Management of Adults With Congenital

4.5.1. Anomalous Aortic Origin of a Coronary Artery

Recommendations for Anomalous Aortic Origin of a Coronary Artery Referenced studies that support recommendations are summarized in the Evidence Table.

COR	LOE	Recommendations
Therapeutic		
1	B-NR	3. In adults with symptomatic AAOCA or diagnostic evidence consistent with myocardial ischemia attributable to the anomalous artery, surgery is recommended.[6]
2a	C-EO	4. In adults with asymptomatic anomalous origin of the left coronary artery, surgery is reasonable in the presence of high-risk anatomy.*
2b	B-NR	5. In asymptomatic adults with an AAOCA from the opposite sinus and without evidence of ischemia or evidence of compromised coronary perfusion, the benefit of surgery is not well established, and continued observation or surgery may be reasonable.[6–8]

*High-risk findings such as ostial or proximal stenosis, slit-like orifice, acute angle of takeoff, or intramural course.

Gurvitz M. et al. Circulation. 2026.

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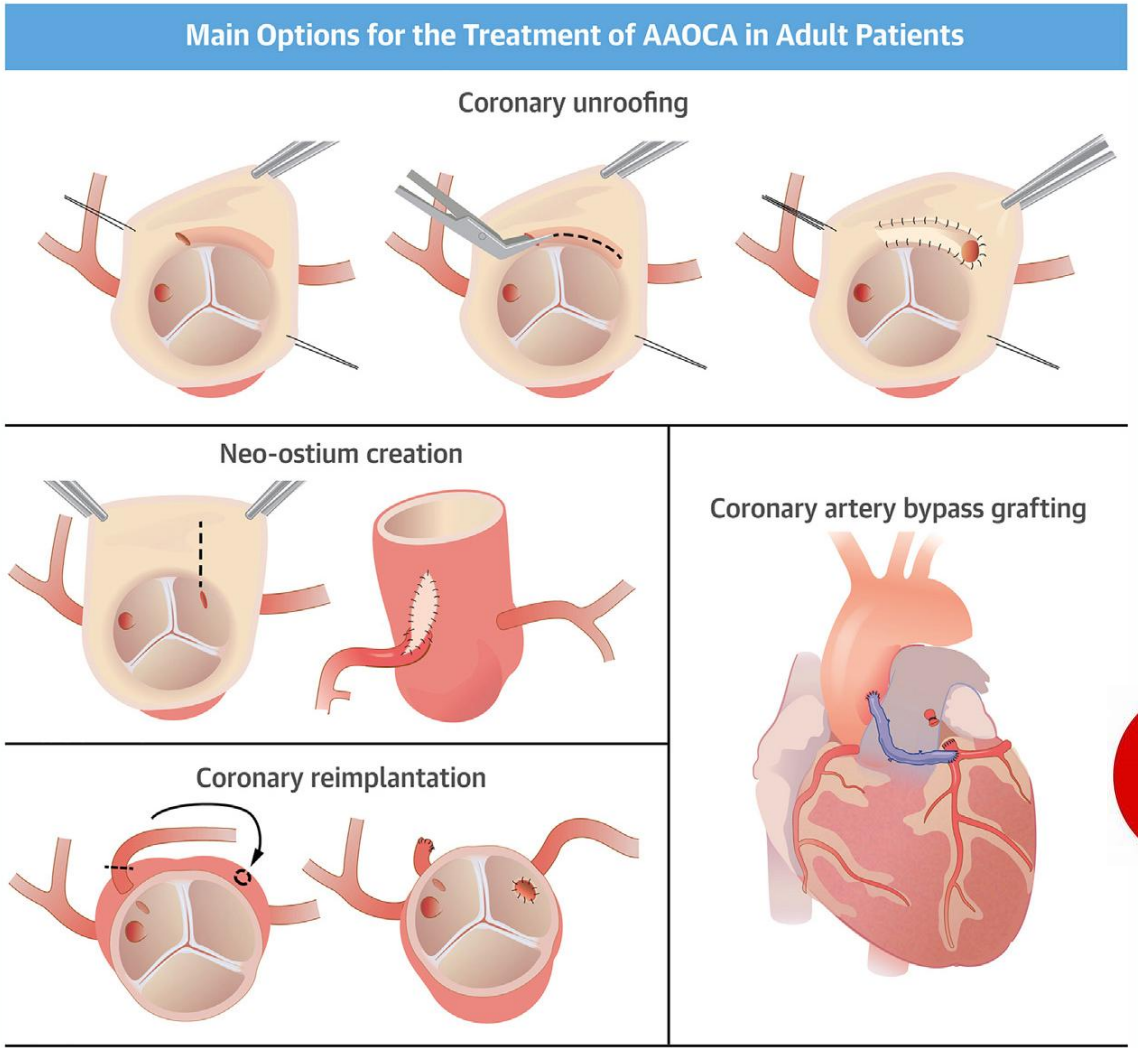
Principales indications de correction

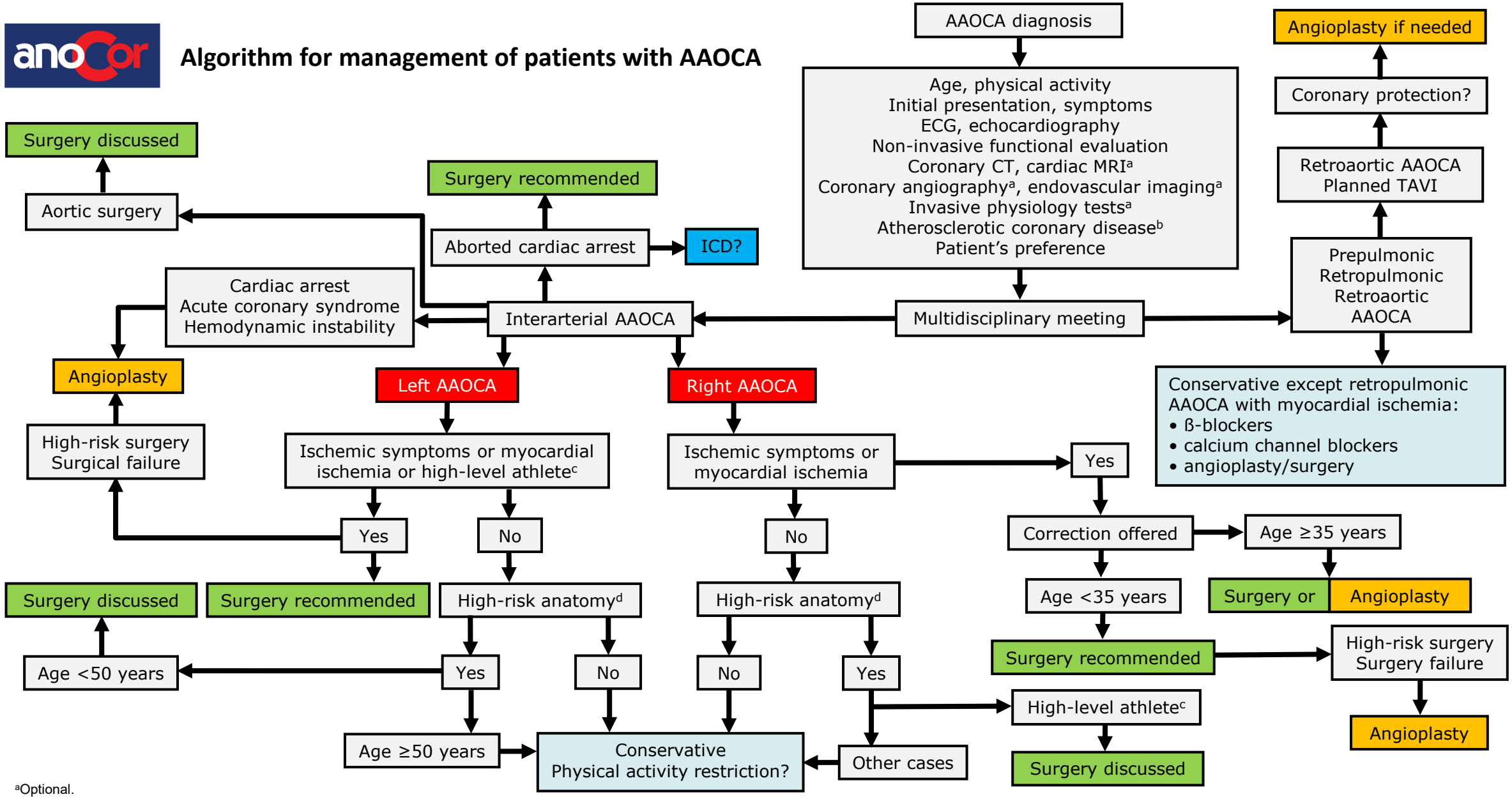
ANOCOR interartérielle avec **symptômes ischémiques et/ou ischémie myocardique**	**Correction est recommandée**	I
ANOCOR interartérielle gauche **asymptomatique et sans ischémie myocardique**	**Correction doit être discutée**	IIa
ANOCOR interartérielle droite asymptomatique, sans ischémie myocardique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

Techniques chirurgicales



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

Algorithm for management of patients with AAOCA



[a]Optional.
[b]Surgical technique adapted.
[c]Physical activity according to ESC guidelines.
[d]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.

ANOCOR : de la détection à la décision

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GROUPE HOSPITALIER BICHAT-CLAUDE BERNARD

Groupe de travail multidisciplinaire sur les anomalies coronaires congénitales

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