



FORUM EUROPÉEN, CŒUR, EXERCICE & PRÉVENTION



Réadaptation Cardiaque et MINOCA: quel niveau de preuves?

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Conflits d'intérêts

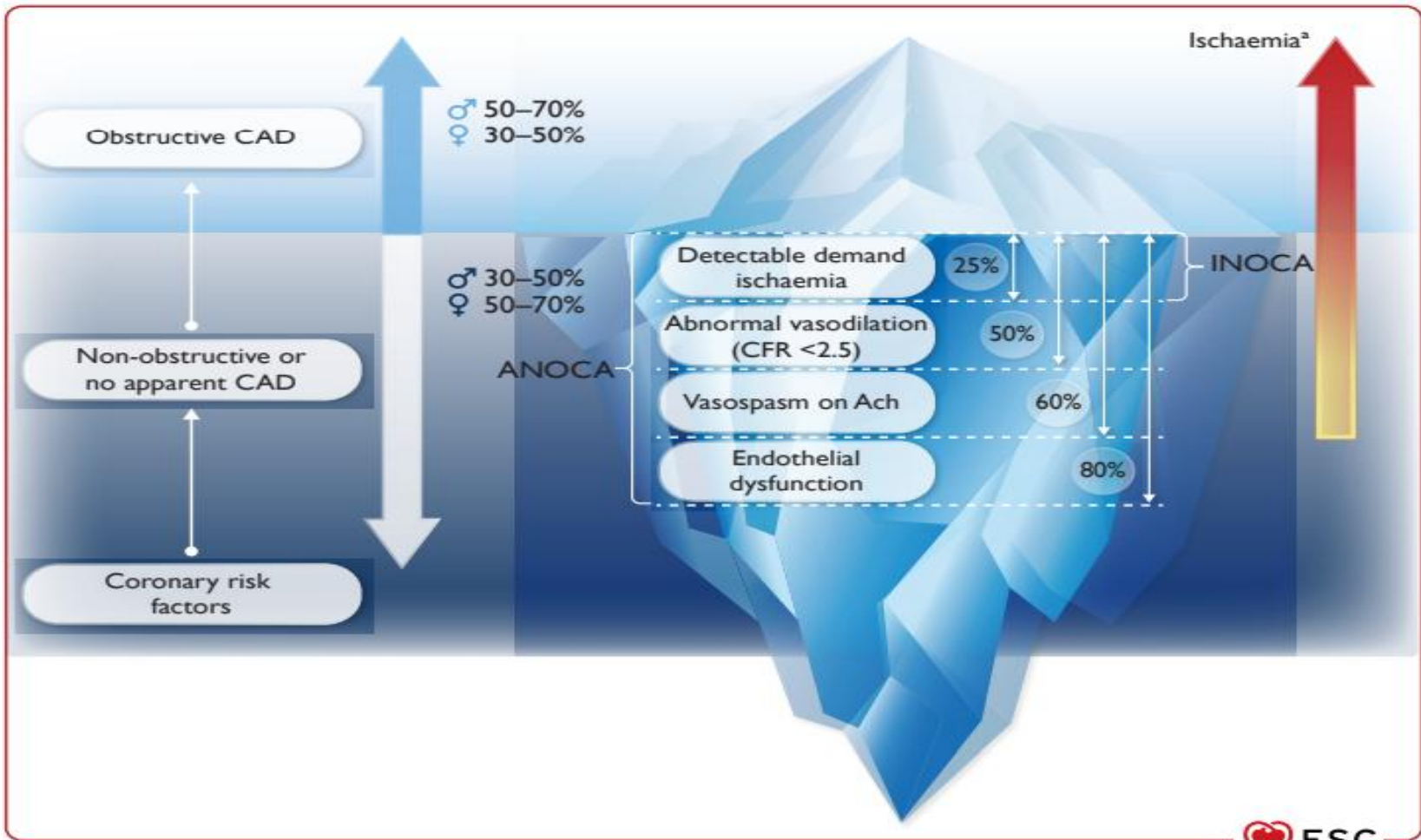
Aucun

NonObstructive Coronary Artery disease

Angina = ANOCA

Ischemic= INOCA

Myocardial Infarction= MINOCA



UNDERLYING CAUSES OF MINOCA

ATHEROSCLEROTIC CAUSES



- Plaque rupture
- Plaque erosion
- Calcific nodules

OTHER MECHANISMS



**Coronary
Microvascular
Dysfunction**

NONATHEROSCLEROTIC CAUSES



**SPONTANEOUS
CORONARY
ARTERY
DISSECTION**



EMBOLISM



VASOSPASM

NONISCHEMIC CAUSES/MIMICKERS



**TAKOTSUBO
CARDIOMYOPATHY**



MYOCARDITIS



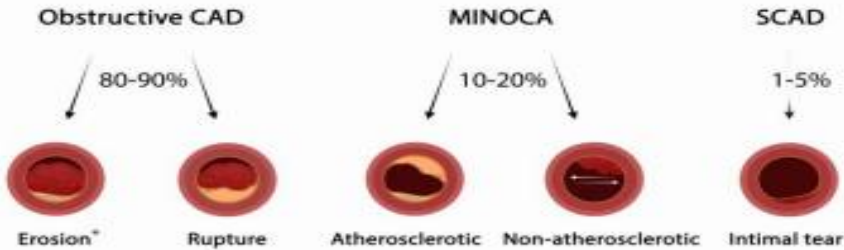
**SUPPLY-DEMAND
MISMATCH**

Premature acute coronary syndromes

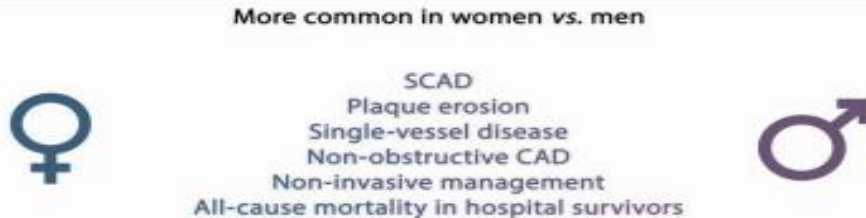
Risk factors



Causes

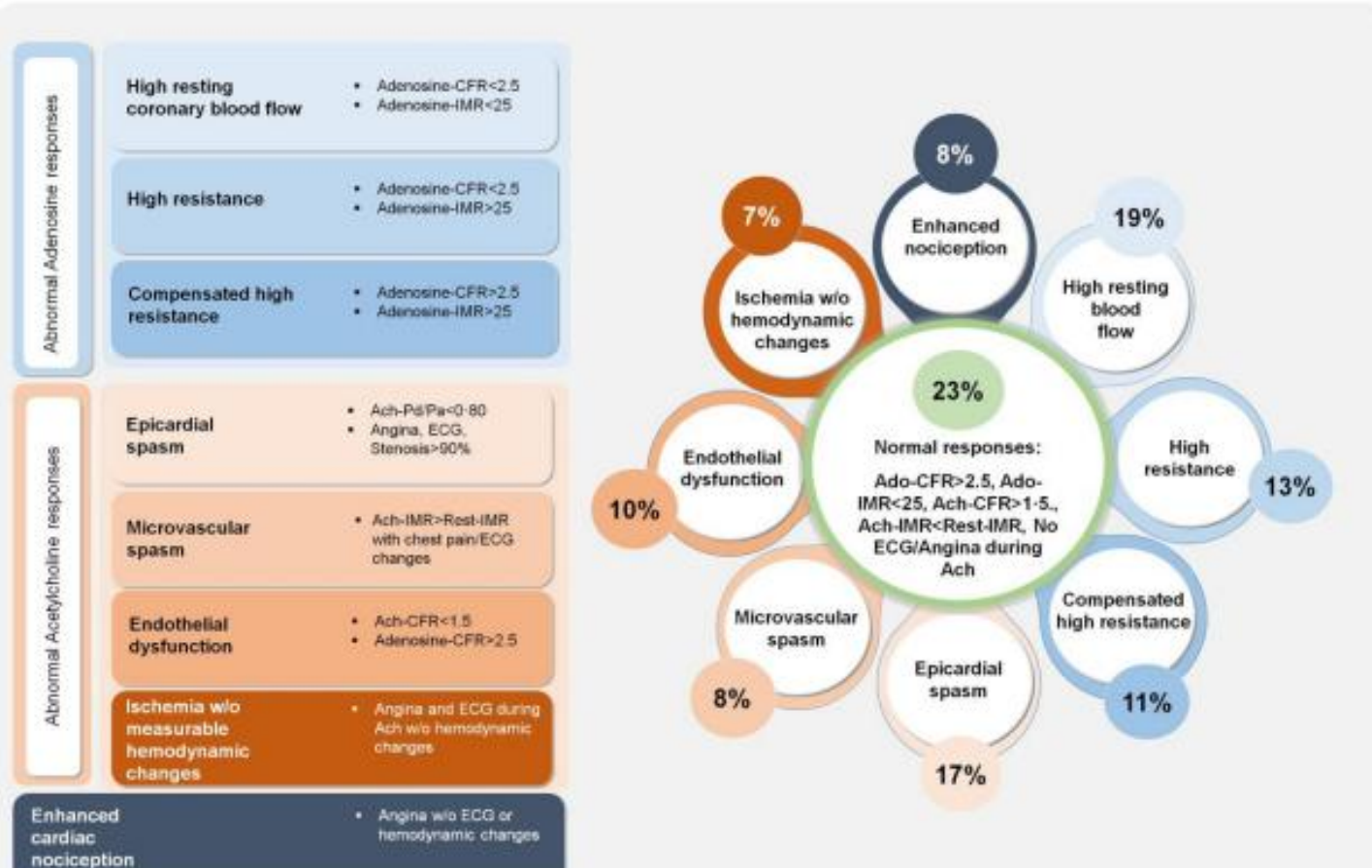


Sex differences

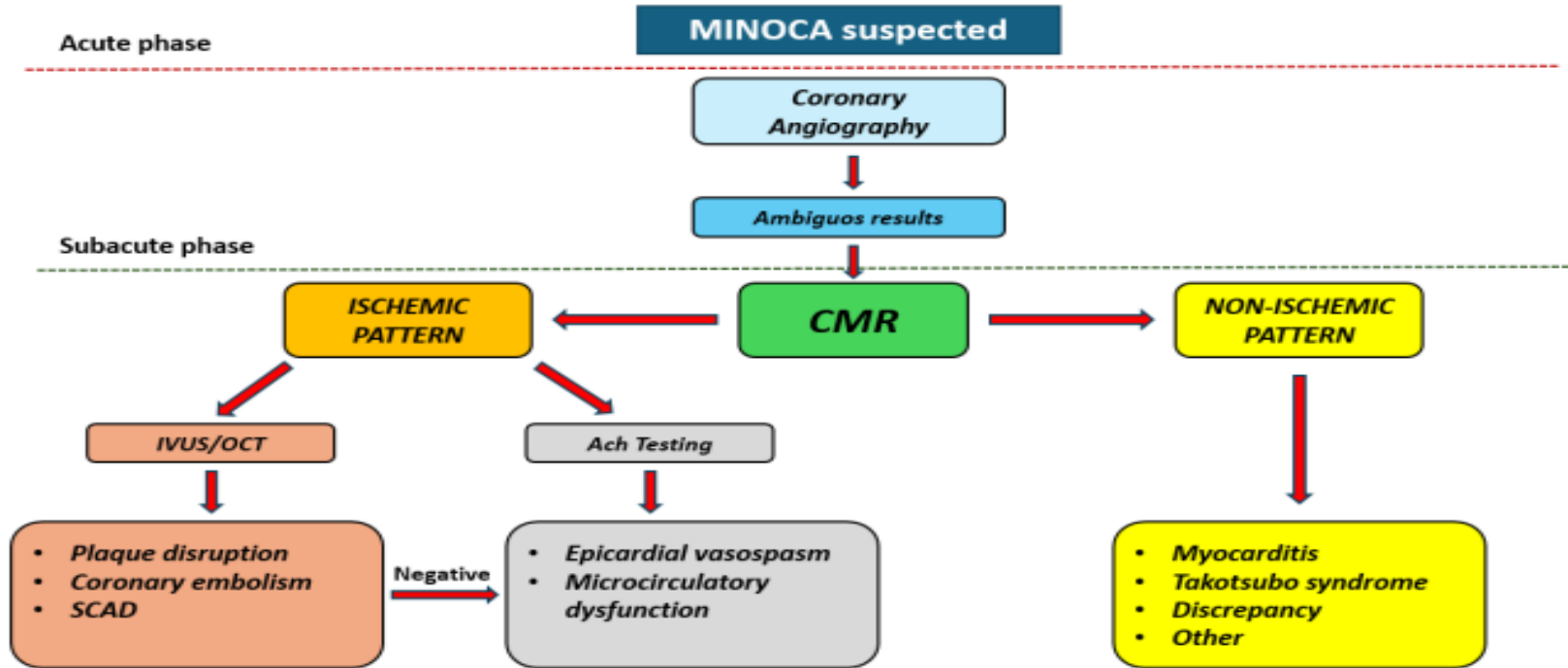


10 -20 % des SCA

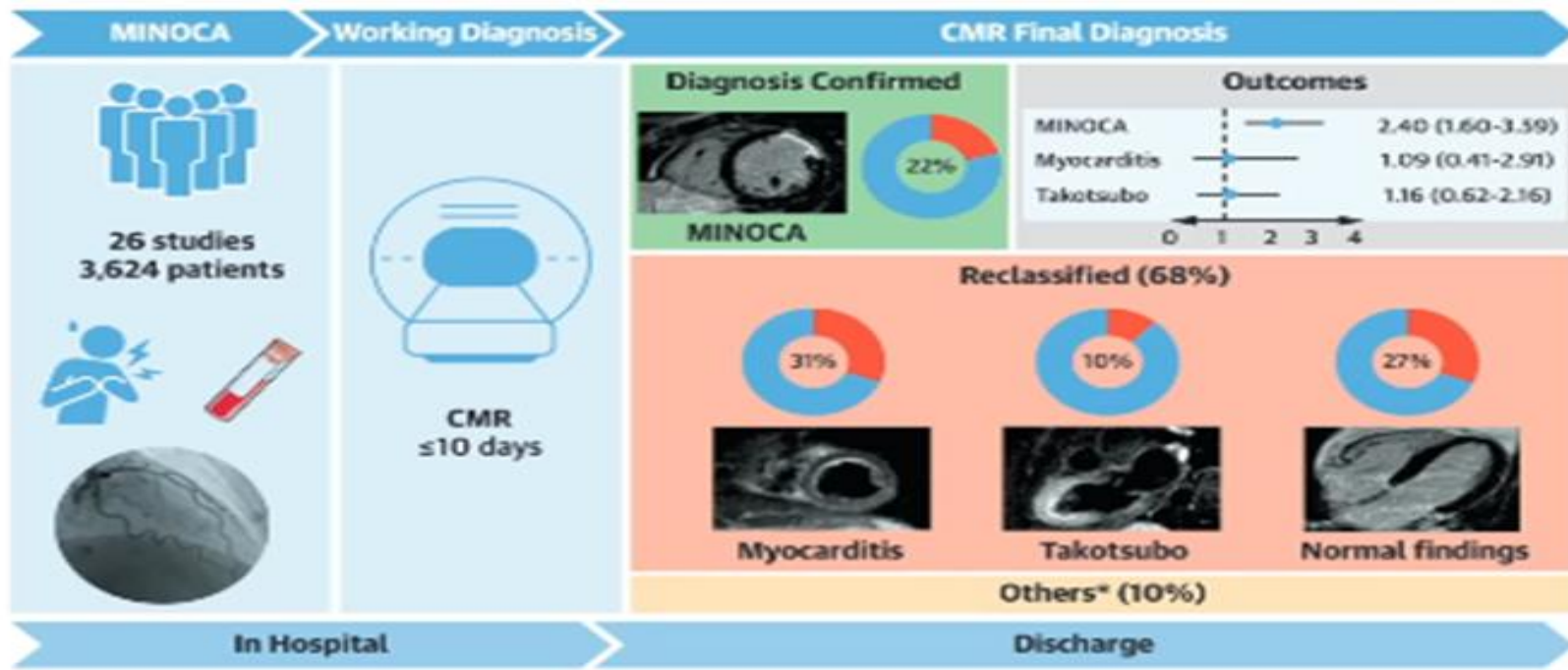
Endotypes of ANOCA



Suspicion MINOCA

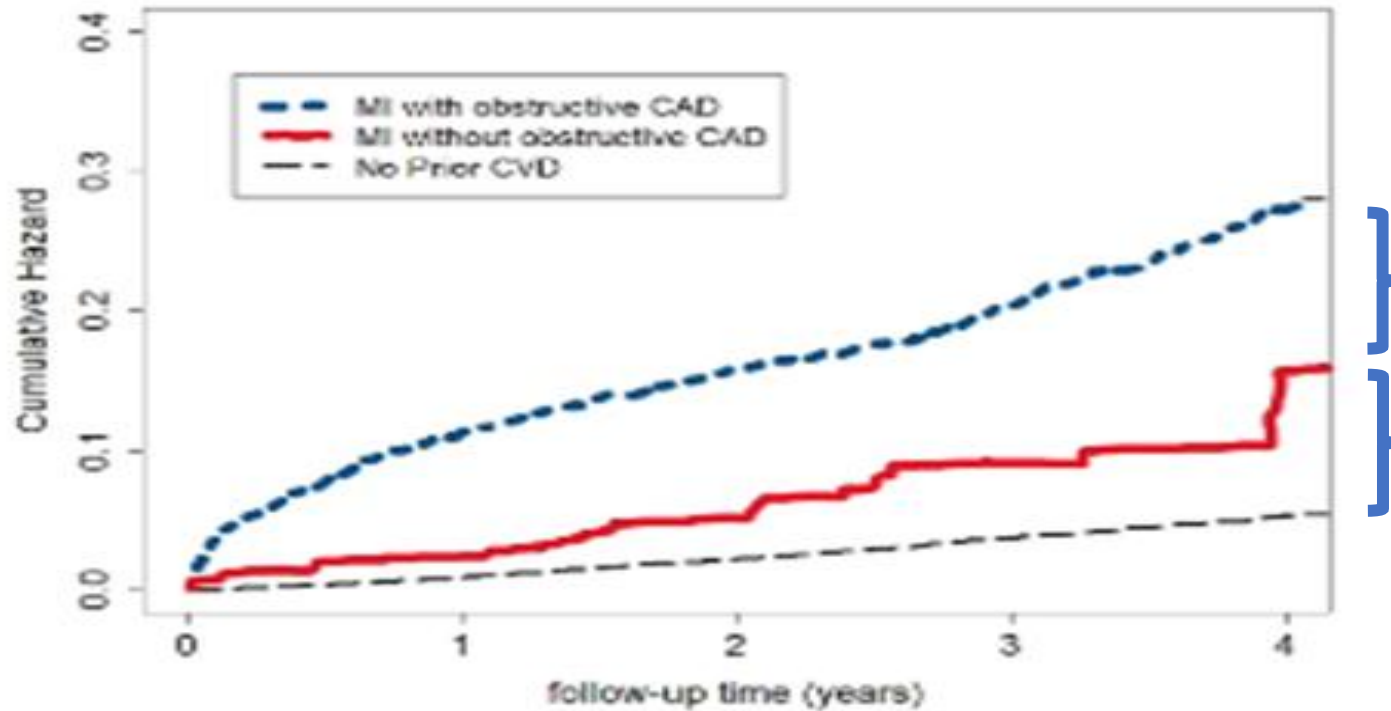


Pas de Dg = aggravation du pronostic



Mileva N, et al. J Am Coll Cardiol Img. 2023;16(3):376–389.

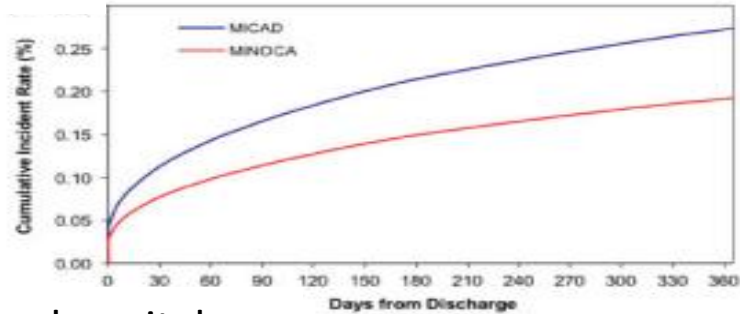
Mortality et MACE



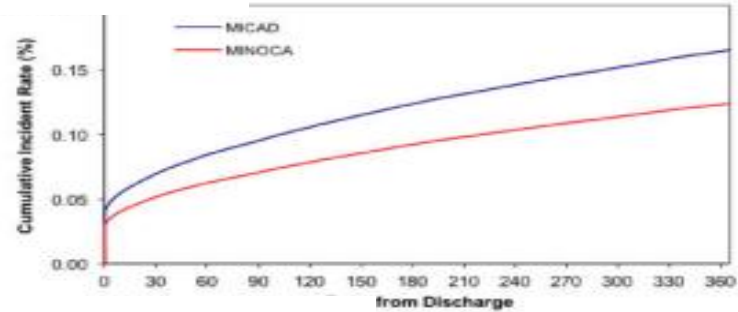
Barr PR; Heart Lung Circ. 2018;27(2):165-174.

276 522 patients SCA,
16 849 (5.9%) had MINOCA.

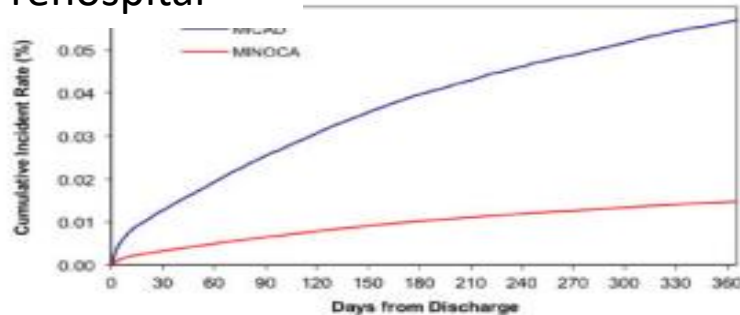
MACE



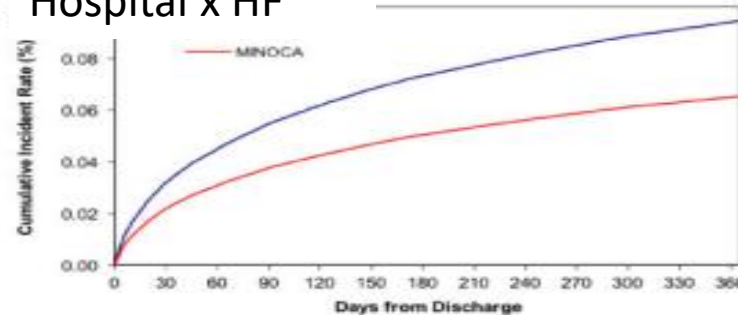
Mortality

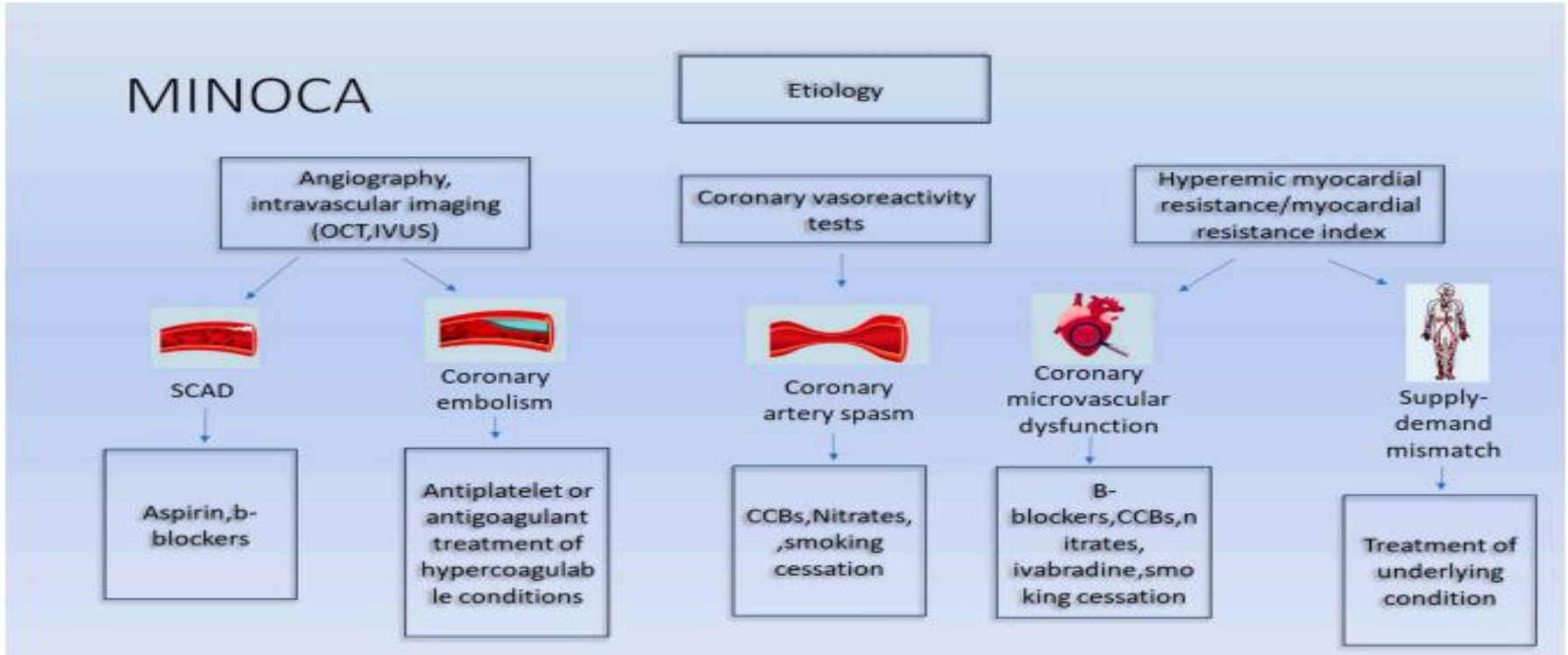


MI rehospital



Hospital x HF





MINOCA CAUSES AND TREATMENTS



SCAD:

- ASA
- DAPT
- BB
- ACEI*



EMBOLISM:

- Anticoagulation
- Interatrial shunt closure
- Specialty referral



PLAQUE RUPTURE:

- DAPT
- Statins
- BB?



CMD:

- Angina control (BB, CCB, nitrates, ranolazine)
- ACEI and statins*



VASOSPASM:

- CCB and/or nitrates



UNKNOWN CAUSE:

- ACEI
- Statins
- BB?

NONPHARMACOLOGICAL TREATMENTS



CARDIOVASCULAR REHABILITATION



CARDIOVASCULAR RISK FACTOR MANAGEMENT



PSYCHOSOCIAL SUPPORT

Rethinking False Positive Exercise
Electrocardiographic Stress
Tests by Assessing Coronary
Microvascular Function

A Positive Exercise ECG Stress Test



What is assumed

Absence of obstructive stenoses



40% false positive rates with coronary artery disease as the reference standard

What is new

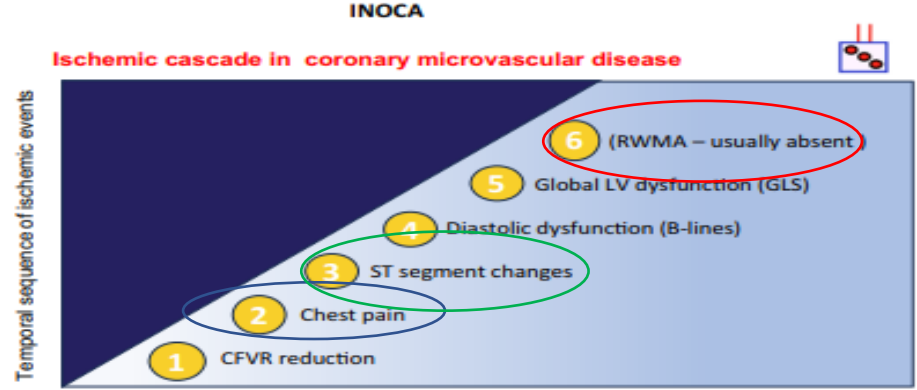
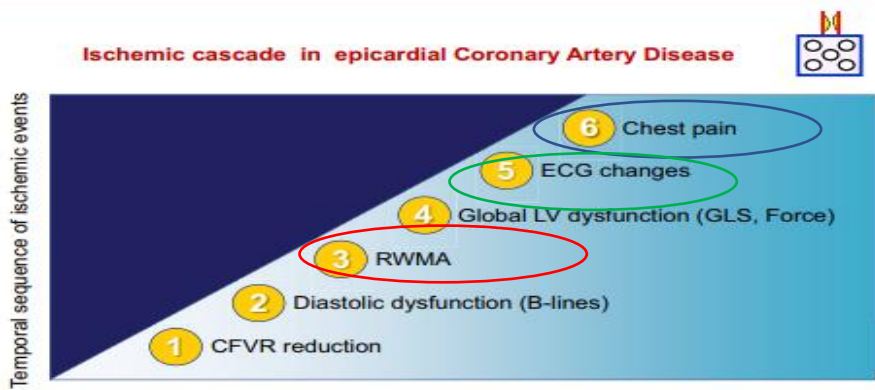


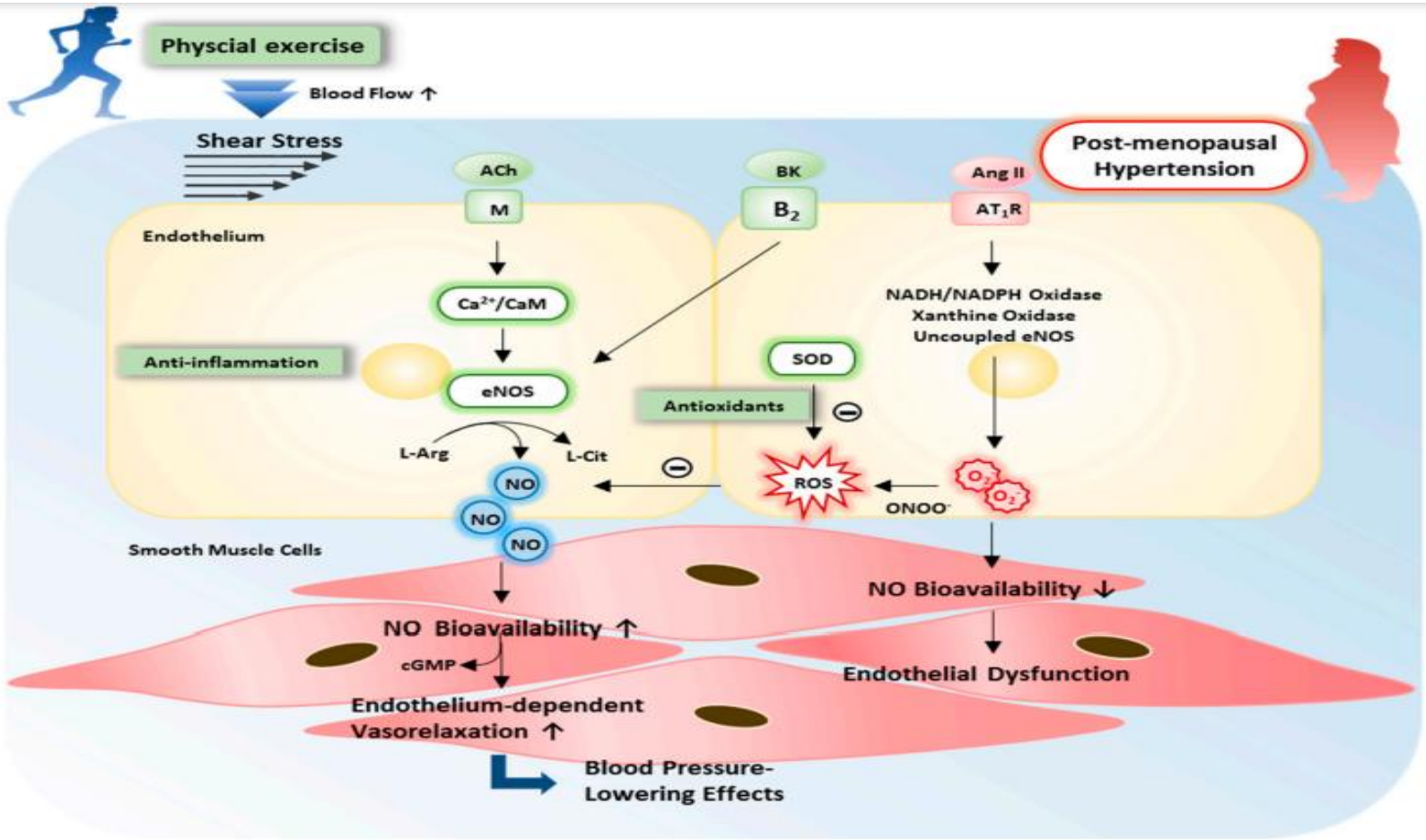
Highly specific for ischemic substrate when accounting for microvascular dysfunction

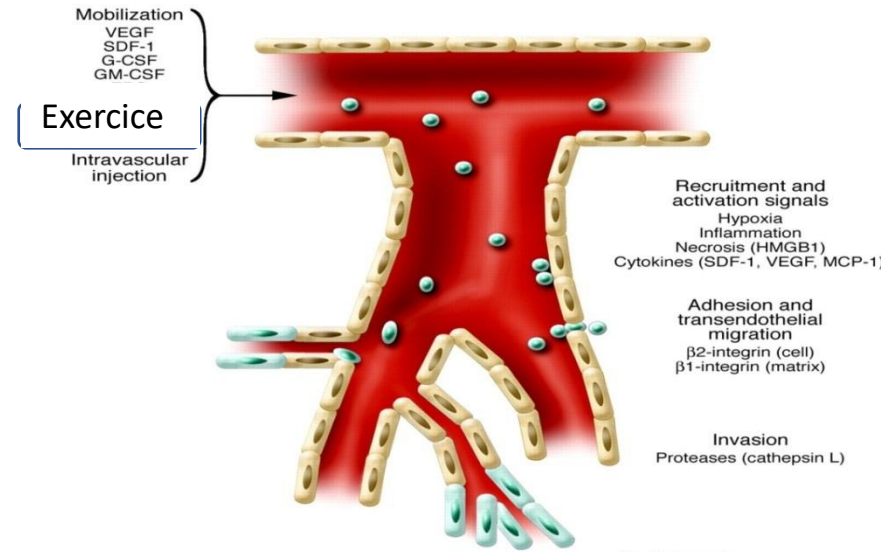
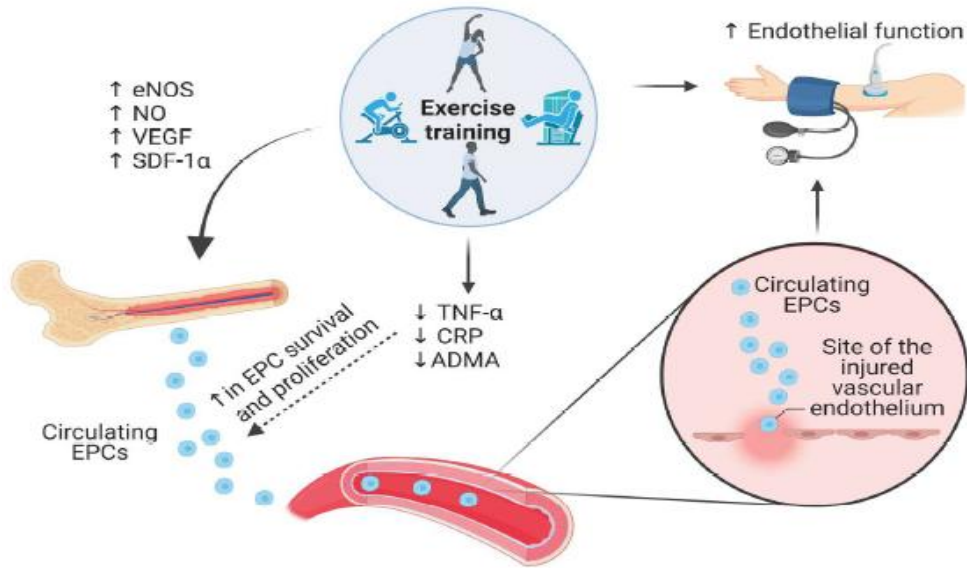
coronary flow velocity reserve



regional wall motion abnormality

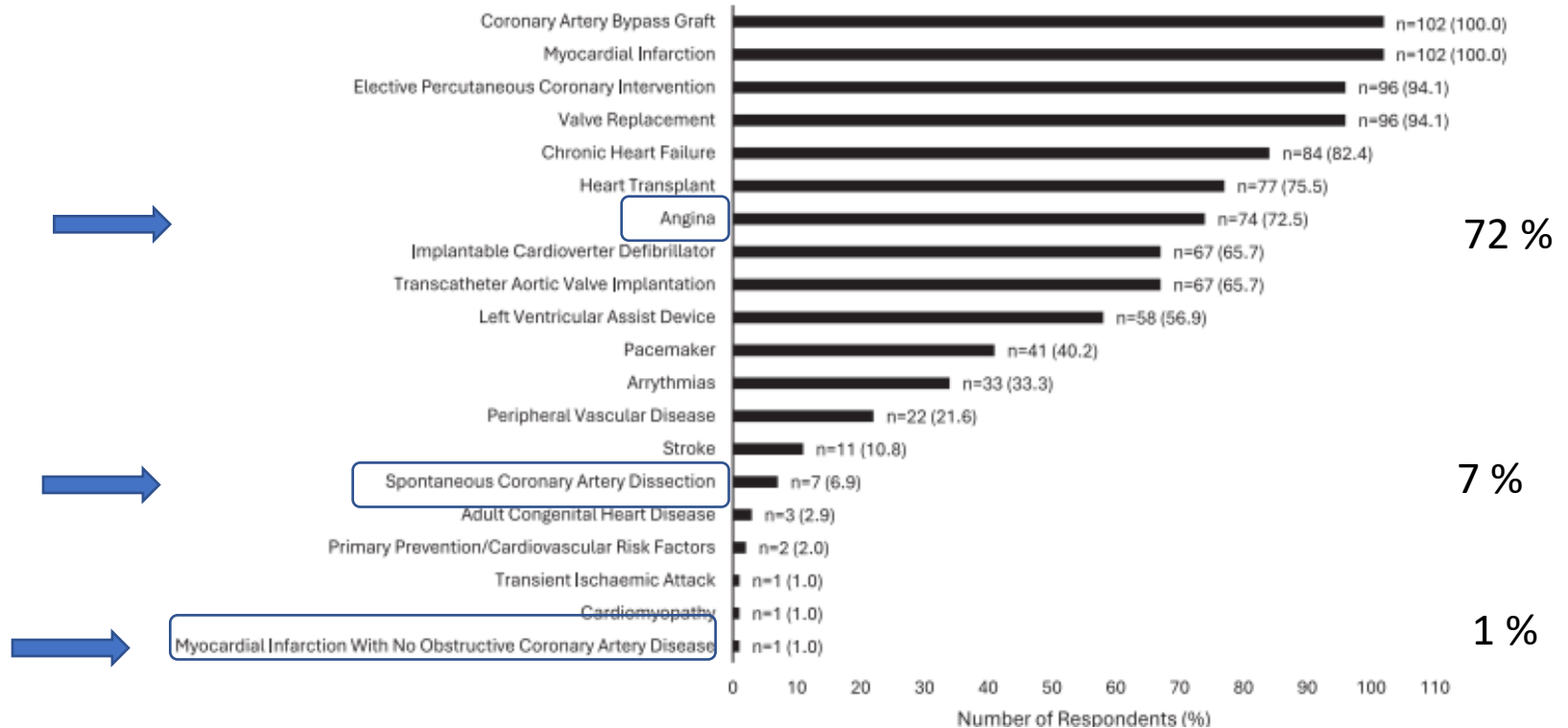






CR survey UK

114 Reponses / 931 professionnels de santé en Read Card



Physical Training in Syndrome X

Physical Training Counteracts Deconditioning and Pain in Syndrome X

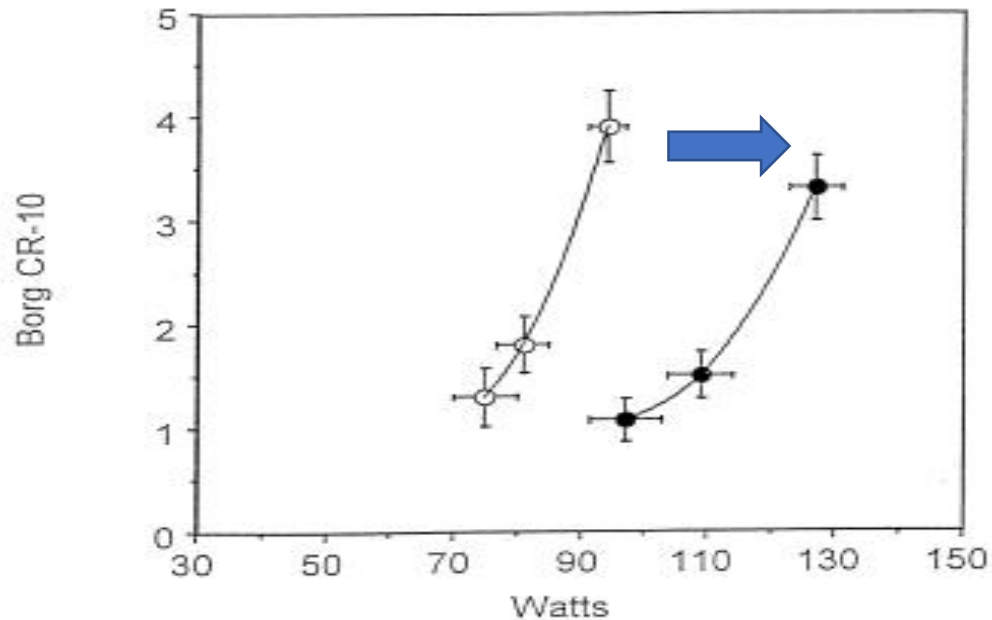


Figure 2. Pain response to increased workload in the training groups (A + B) before (open dots) and after training (solid dots).

Entraînement Physique

	n	programme	Results
Erikson (2000) R	26 femmes	8 semaines Relaxation + 8 ExT vs ExT vs control	↑ Delai de angor Améliore fon endothel ↑ Pic VO2 30%
Asbury (2008) R	64 femmes	8 semaines Ex vs relaxation	↑ QOL (HAD) ↑ Shuttle walk test + 29 %
Feizi (202) R	40 femmes	12 semaines Exercice T vs relaxation	↑ QOL
Carvalho (2015)	12 pts	12 semaines Ex T	↑ Pic VO2 14% ↑ Qol
Szot (2015)	55 femmes	12 semaines Ex T	↑ 24 % METs ↑ QOL
Tyni-Lenne (2020) R	24 femmes	8 semaines Ex ± relaxation	↑ Pic VO2 + 15 % ↑ QOL (2 gpes)
Rahmani (2020) R	30 pts	4 semaines Ex	↑ VO2 et pouls O2 Améliore FC récup
Bove (2020) R	56 femmes BMI > 25	24 semaines	↓ angor, poids et Lipides = réserve coronaire (echo)

Modalities and safety of cardiac rehabilitation in a population managed for spontaneous haematoma or coronary disruption: insights from the READAPT-DISCO study

Clément Nguyen Ngoc¹, Nicolas Combaret ², Hervé Douard³, Marc Bonnet⁴, Yann Valy⁵, Nicolas Méneveau⁶, Louis le Bivic⁷, Gilles Rioufol ^{8,9}, Grégoire Range¹⁰, Philippe Brunel¹¹, Brahim Harbaoui ^{12,13}, Benoît Lattuca¹⁴, Johanne Silvain¹⁵, Matthieu Godin¹⁶, Thibault Lhermusier ¹⁷, Arnaud Fluttaz¹⁸, Christophe Saint-Etienne¹⁹, Grégory Ducrocq^{20,21}, Hakim Benamer^{22,23,24}, Vincent Roule²⁵, Didier Bresson²⁶, Norbert Mayaud²⁷, Geraud Souteyrand², Julien Nardoux³, Pascal Motreff ², and Edouard Gerbaud ^{1,28*}

DISCO : 373 pts -> 101 pts en RC (50 ans, 91 % femmes, 27 % PCI)

Délai :42 js Durée : 4-8 semaines

Entraînement : MCT 71 % , Interval training 50 % , Renf muscul 19%

Intervention psychologique : 44 %

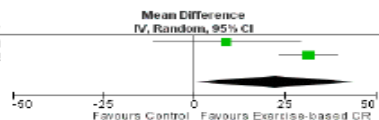
	Avant RC	Fin RC
Charge max (watts)	105 ± 30	128 ± 35
FC max (b/min)	120 ± 23	134 ± 20
VO2 pic (ml/kg/min)	22.3 ± 7	24.4 ± 6
FC SV1 (b/min)	94 ± 20	107 ± 22
SV1 (ml/kg/min)	16.7 ± 6	21.4 ± 17

Effects of cardiac rehabilitation on the severity of angina, health-related quality of life, and exercise capacity among adults living with microvascular angina: a systematic review and meta-analysis

SF-36 Physical role limitation domain

Study or Subgroup	Exercise-based CR			Control			Weight	Mean Difference IV, Random, 95% CI	Year
	Mean	SD	Total	Mean	SD	Total			
Asbury 2008	53.0	49.4	29	44.9	39.1	29	48.9%	9.08 [-11.48, 29.48]	2008
Feldt 2012	61.92	7.1	11	36.95	6.14	7	58.1%	31.50 [22.81, 39.55]	2012
Total (95% CI)	40			36			100.0%	22.34 [0.58, 44.10]	

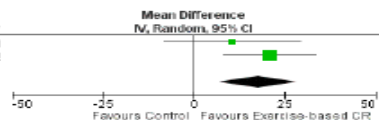
Heterogeneity: Tau² = 192.17; Chi² = 4.66, df = 1 (P = 0.04); I² = 75%
Test for overall effect: Z = 2.01 (P = 0.04)



SF-36 Emotional role limitation domain

Study or Subgroup	Exercise-based CR			Control			Weight	Mean Difference IV, Random, 95% CI	Year
	Mean	SD	Total	Mean	SD	Total			
Asbury 2008	79.4	34.1	29	69.9	39.7	29	31.4%	10.50 [-6.27, 29.27]	2008
Feldt 2012	50.75	10.17	11	29.78	15.1	7	68.6%	20.96 [6.29, 35.69]	2012
Total (95% CI)	40			36			100.0%	17.70 [7.18, 28.22]	

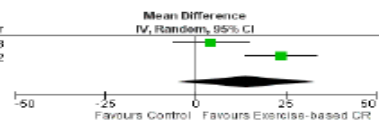
Heterogeneity: Tau² = 0.06; Chi² = 0.62, df = 1 (P = 0.36); I² = 0%
Test for overall effect: Z = 3.30 (P = 0.0010)



SF-36 Vitality domain

Study or Subgroup	Exercise-based CR			Control			Weight	Mean Difference IV, Random, 95% CI	Year
	Mean	SD	Total	Mean	SD	Total			
Asbury 2008	49.8	19.2	29	45.5	21.7	29	48.5%	4.30 [-6.25, 14.85]	2008
Feldt 2012	50.56	9.03	11	26.78	11.24	7	50.5%	23.78 [13.88, 33.67]	2012
Total (95% CI)	40			36			100.0%	14.13 [-4.96, 33.22]	

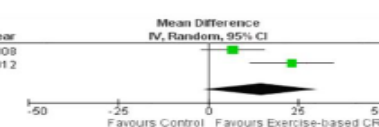
Heterogeneity: Tau² = 162.53; Chi² = 8.97, df = 1 (P = 0.008); I² = 86%
Test for overall effect: Z = 1.45 (P = 0.15)



SF-36 General health domain

Study or Subgroup	Exercise-based CR			Control			Weight	Mean Difference IV, Random, 95% CI	Year
	Mean	SD	Total	Mean	SD	Total			
Asbury 2008	57.6	17	29	51	17	29	53.1%	6.60 [-2.15, 15.35]	2008
Feldt 2012	56.06	9.38	11	32.73	14.31	7	46.9%	23.33 [11.37, 35.29]	2012
Total (95% CI)	40			36			100.0%	14.45 [-1.92, 30.81]	

Heterogeneity: Tau² = 111.35; Chi² = 4.89, df = 1 (P = 0.03); I² = 80%
Test for overall effect: Z = 1.73 (P = 0.08)



5 studies

Mean ages 51 -64 years

97.3% were women.

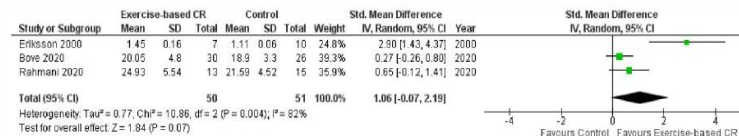


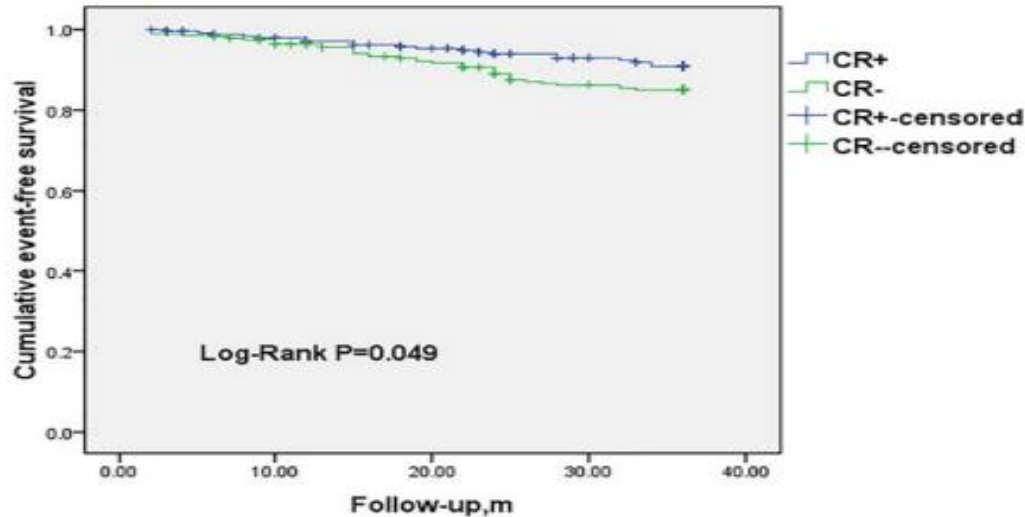
Figure 4 Comparison 1 exercise-based cardiac rehabilitation vs. control for microvascular angina, primary outcome 3 exercise capacity.

Read card longue durée à domicile

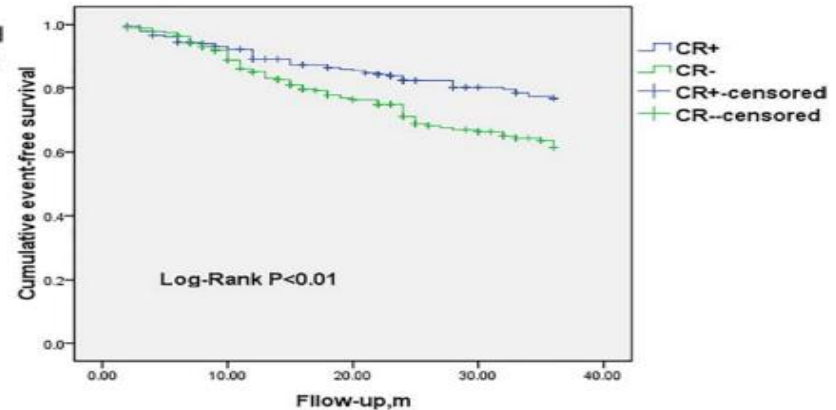
524 patients MINOCA , randomisés (CR+) vs (CR-)

CR+ = Entraînement (MCT à 65%–75% de FC au max de l'EE) 3/sem

All-cause mortality



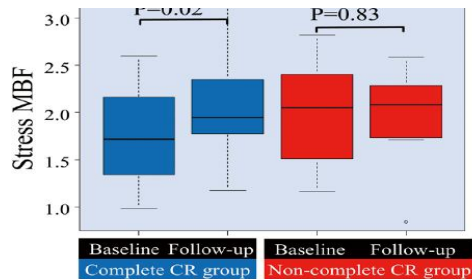
Major adverse cardiac events (MACE)



Clinical Effects of Supervised Cardiac Rehabilitation in Patients With Angina and Non-Obstructive Coronary Artery Disease and Impaired Myocardial Flow Reserve Assessed Using ^{13}N -Ammonia Positron Emission Tomography

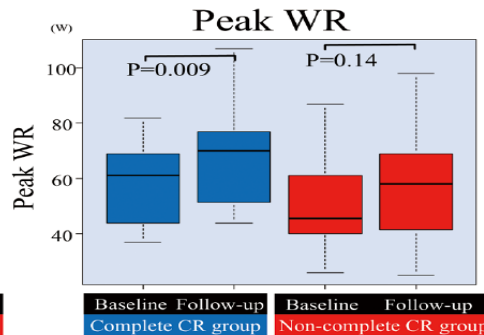
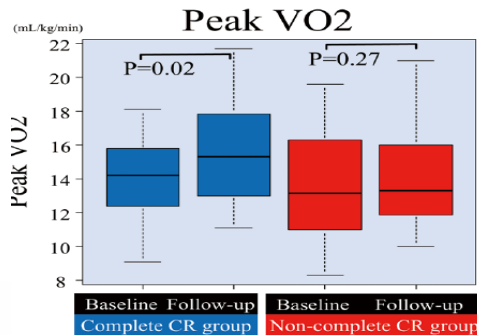
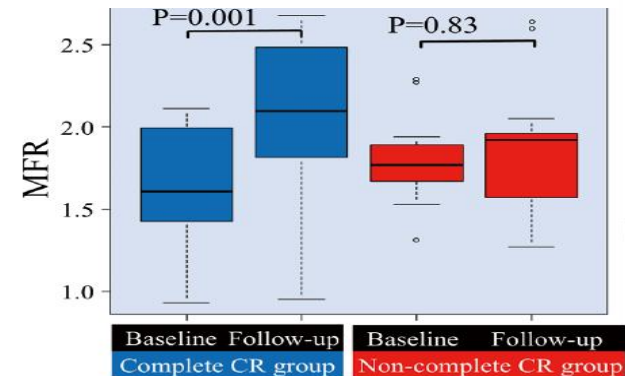
29 pts ANOCA, programme 16 RC (5 mois) complet, 13 incomplet

Stress Myocardial Blood Flow
























Test hyperhemie Petscan

Myocardial Flow Reserve



Clinical standards in angina and non-obstructive coronary arteries: A clinician and patient consensus

Setting	Community  Symptom awareness	Primary Care  Integrated care	Secondary Care  Coronary CTA	 Stress testing	 Coronary function	 Speciality clinics
Therapy and Care	 Clinical guidelines	 Lifestyle	 Cardiac rehabilitation	 Medical therapy	 Research	 Care plan
MDT	 Multidisciplinary care	 Physiotherapy	 Occupational therapy	 Psychology	 Social services	
Support Groups	 Care-takers, family, friends	 Patient forums	 Support groups	 Professional stakeholders		

Conclusions

La réadaptation cardiaque a toute sa place dans la prise en charge des coronaropathies non-épicardiques.

- Prise en charge globale : contrôle des FDR, psychologique, exercice
- L' exercice physique est un traitement de la dysfonction endothéliale

Toutefois, le niveau de preuves est très faible et nécessite des essais cliniques complémentaires

JOURNÉES NATIONALES DU **GERS-P**



**17/18
SEPT.
2026**

**CID DE
DEAUVILLE**



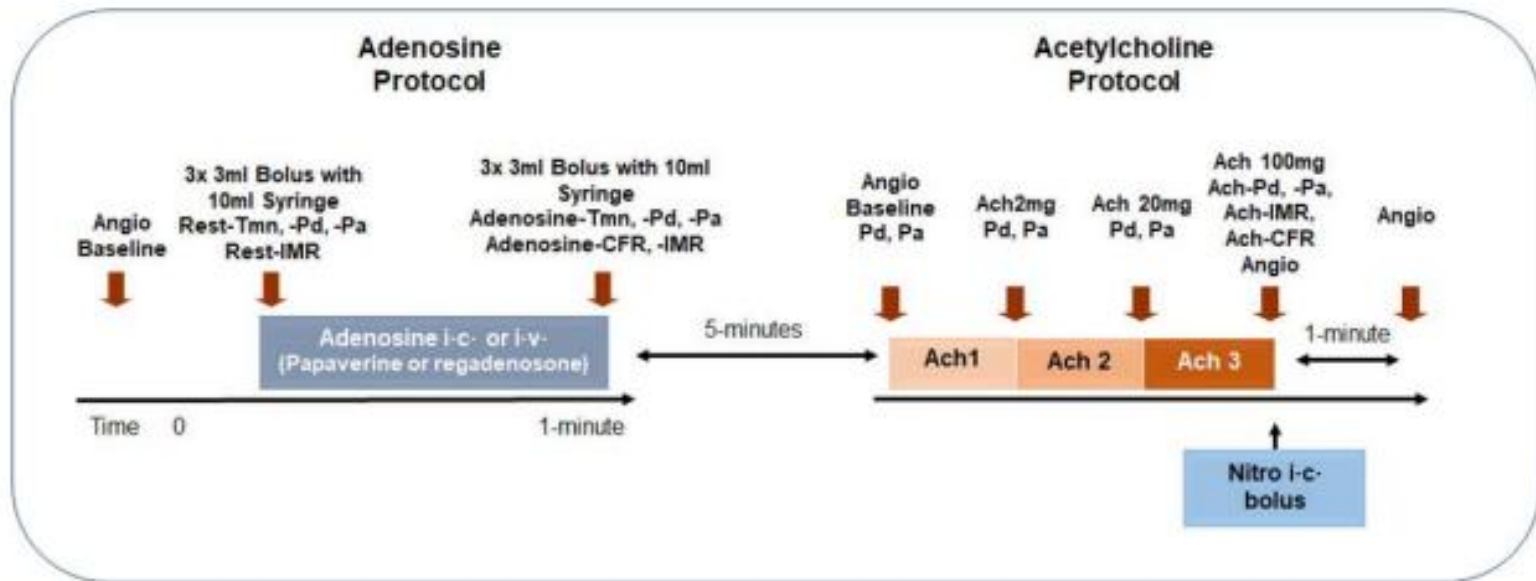


Figure 1 Protocol for the haemodynamic assessment. The protocol duration was approximately 9 min

Abnormal adenosine responses

- (1) Adenosine-CFR < 2.5 with adenosine-IMR < 25 (high resting coronary blood flow)
- (2) Adenosine-CFR < 2.5 with adenosine-IMR > 25 (high resistance)
- (3) Adenosine-CFR > 2.5 with adenosine-IMR > 25 in which compensation mechanisms are recruited to maintain CFR (compensated high resistance)

Abnormal acetylcholine responses

- (1) Acetylcholine-Pd/Pa < 0.80 and/or $>90\%$ coronary diameter reduction with ECG changes and angina during acetylcholine (epicardial spasm)
- (2) Acetylcholine-IMR $>$ rest-IMR (i.e. measurable evidence of increased microvascular resistance during acetylcholine) with ECG changes and angina during acetylcholine (microvascular spasm)
- (3) Acetylcholine-CFR < 1.5 with preserved Adenosine-CFR and no microvascular spasm impaired endotheliumdependent vasodilation)
- (4) Angina AND ischaemic ECG changes during acetylcholine without measurable haemodynamic abnormalities