

MINOCA

a case base discussion

DR. AFSANEH MOHAMMADI, MD

Interventional cardiologist

Cardiovascular Department of RAZAVI hospital

Mashhsad , Iran



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- ▶ Myocardial infarction with non-obstructive CAD (MINOCA) is clinically defined as acute myocardial infarction in the absence of ($\geq 50\%$ stenosis) obstructive CAD in any artery .
- ▶ **MINOCA is not a benign diagnosis**, with outcomes similar to those of patients with acute MI and obstructive coronary disease
- ▶ MINOCA occurs in **5–15% of patients**
- ▶ Factors associated with MINOCA include **female sex, younger age (<55 years), genetics and physiological stress.**
- ▶ one-third of patients have been reported to present with **suspected STEMI** within an emergency setting and the remaining majority as **NSTEMI**

Classification of MINOCA causes

Aetiology

Epicardial coronary artery disorder

Underlying Diagnosis

Atherosclerotic plaque rupture, ulceration, fissuring or erosion with non-obstructive or no coronary artery disease

Coronary artery dissection or aortic dissection with coronary extension with non-obstructive or no coronary artery disease

Oxygen supply–demand mismatch

Coronary artery vasospasm

Coronary artery embolism

Anaemia

Tachyarrhythmias or bradyarrhythmias

Hypotension or hypertension

Severe aortic valve disease

Respiratory failure

Endothelial dysfunction

Coronary microvascular dysfunction or spasm

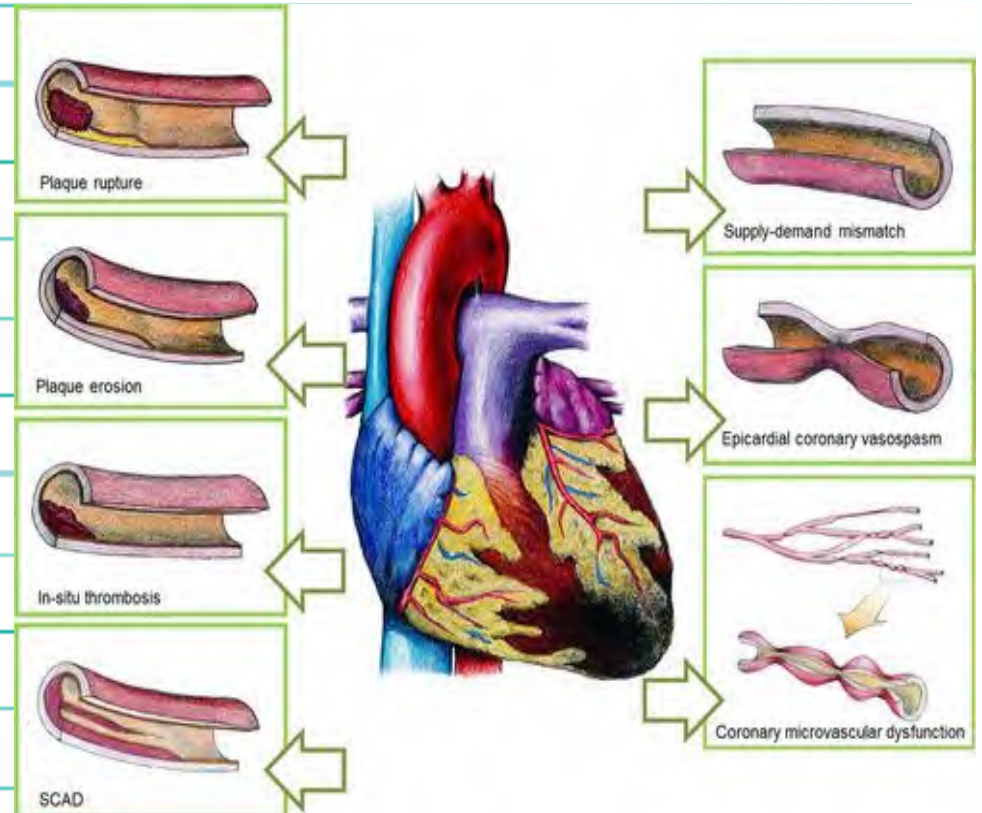
Other*

Myocarditis with or without pericarditis

Pulmonary embolism

Heart failure

Other systemic condition (e.g. sepsis)



Diagnosis and Evaluation of Patients with MINOCA

MINOCA

Universal definition of AMI +
Absent coronary stenosis $\geq 50\%$

Invasive Testing:

1. Intracoronary nitrates (Spasm)
2. LV Gram/Echo (Takotsubo)
3. IVUS/OCT (Plaque disruption)
4. Pressure wire (Microvascular dysfunction)
5. Provocative spasm testing (not during AMI)

Laboratory Testing:

1. Type-2 MI (Hb, CRP, SO₂)
2. D-Dimer (Pulmonary embolism)
3. Thrombophilia screening
4. BNP

MINOCA Confirmed:

- Type-2 MI
- Plaque Disruption
- Takotsubo
- Epicardial spasm or microvascular dysfunction
- Coronary Thromboembolism

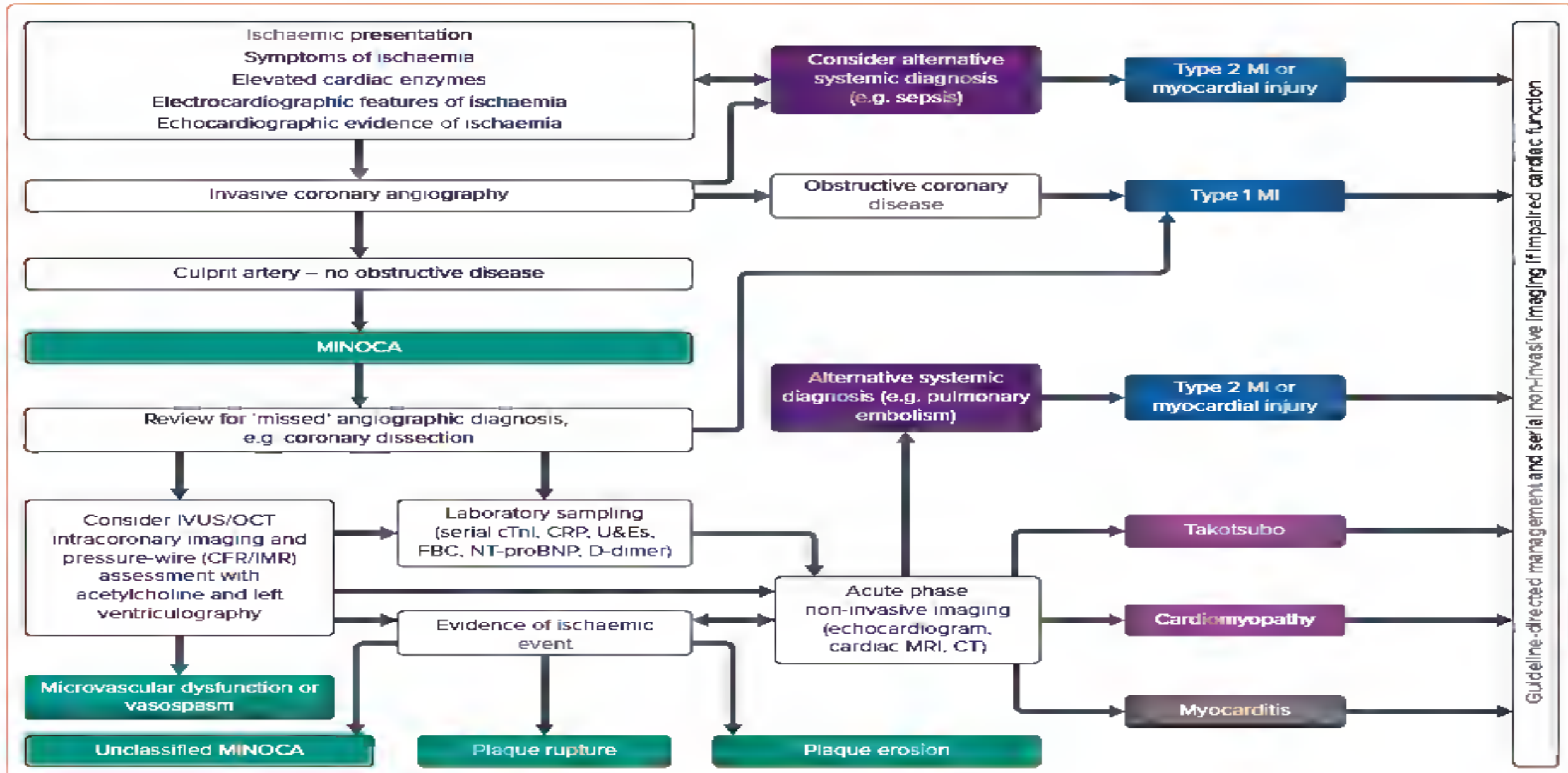
MINOCA NOT Confirmed:

- Cardiac MRI (LGE for myocarditis vs AMI)
- TEE (Cardiac source of embolization eg Left atrial appendage thrombus)

Echocardiography

- ▶ transthoracic echocardiography should be performed specifically assessing for the presence of **regional wall motion abnormalities, embolic sources, pericardial effusion and typical features of takotsubo syndrome.**
- ▶ Further echocardiographic assessment **for patent foramen ovale and atrial septal defect as embolic sources may be considered using transoesophageal or bubble contrast echocardiography.**

Figure 2: Diagnostic Pathway for MINOCA



CFR = coronary flow reserve; CRP = C-reactive protein; cTnI = cardiac troponin I; FBC = full blood count; IMR = index of microcirculatory resistance; IVUS = intravascular ultrasound; MINOCA = MI with no obstructive coronary artery disease; NT-proBNP = N-terminal pro B-type natriuretic peptide; OCT = optical coherence tomography; U&Es = urea and electrolytes.

Intra coronary imaging OCT & IVUS

- ▶ **‘missed’ obstructive disease or dissection** in addition to causes of type 1 MINOCA (**plaque rupture, erosion, ulceration, intraplaque haemorrhage**).
- ▶ Plaque erosion is more common in **women, smokers, patients with single-vessel disease, and younger patients with few risk factors for CAD**
- ▶ Atherosclerotic plaque disruption has been identified using IVUS in approximately **40% of cases of MINOCA**.

PLAQUE EROSION

Case 1-

A 58 Y man

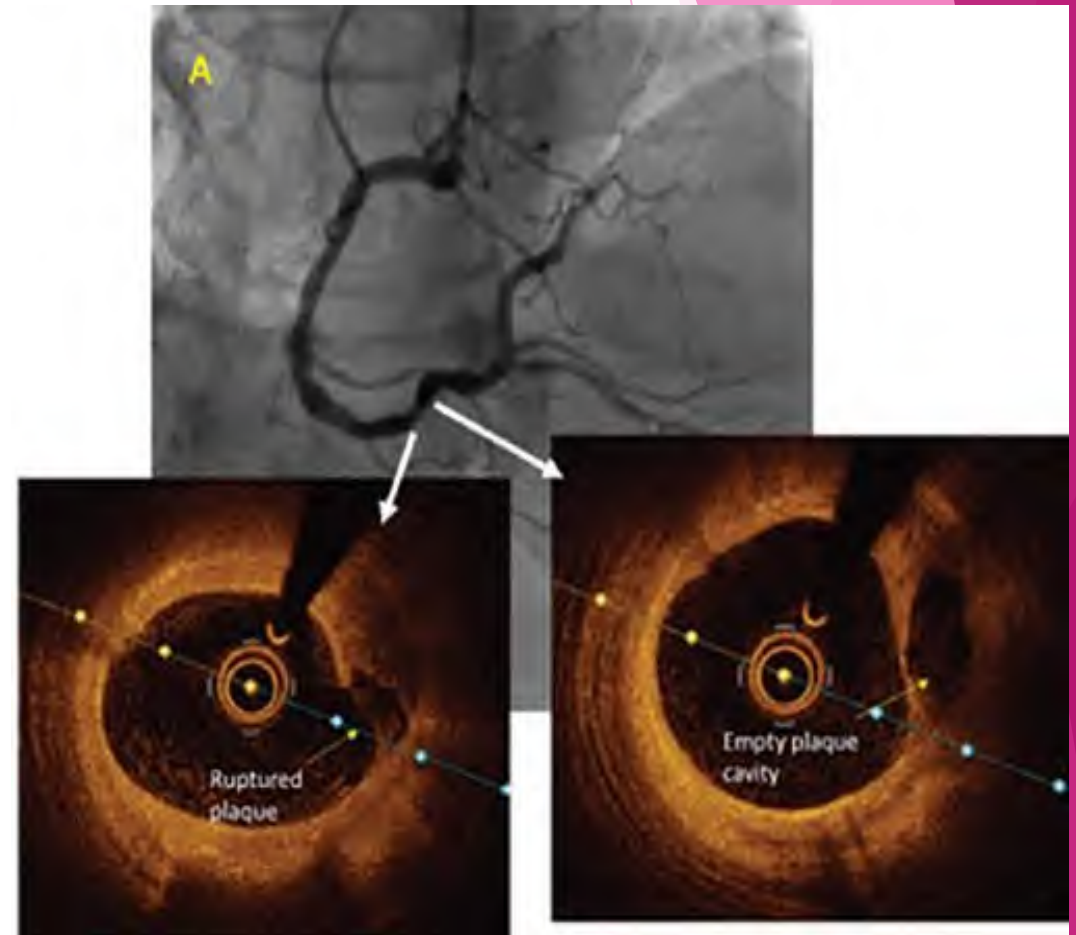
RF: HTN & HLP

Acute chest pain & inf MI IN ECG

ECHO: Inf wall hypokinesia

ICA: Multiple non significant lesions in RCA

OCT : plaque Rupture in RCA



Case 2 -

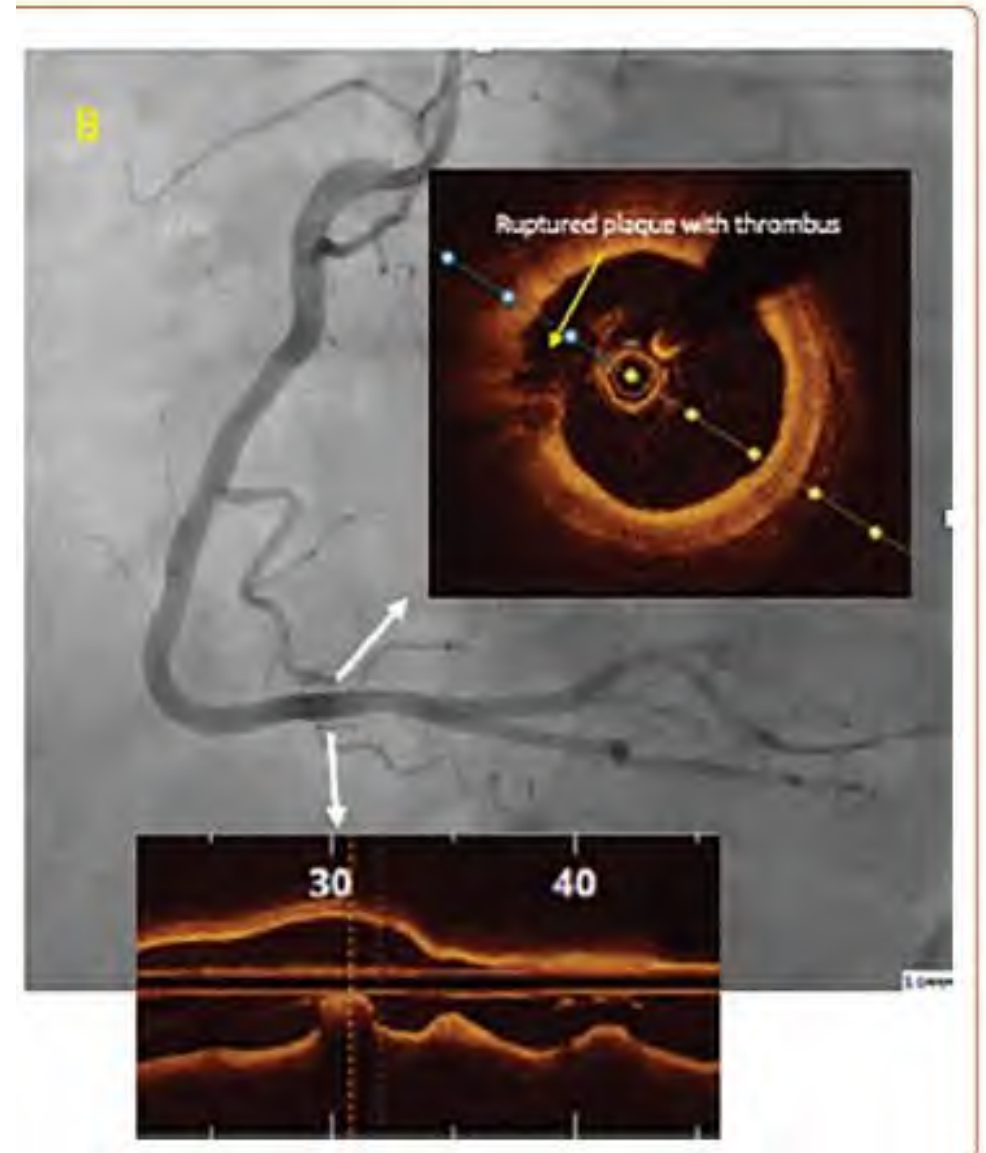
A 65 y man

RF: DM / HTN

Admitted with acute INF MI

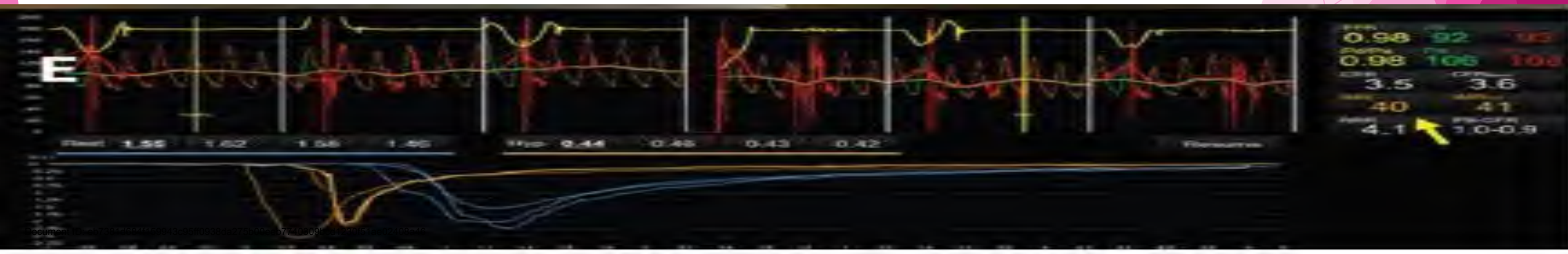
ICA : no sig lesion in RCA

OCT showed : Ruptured plaque in RCA



Coronary Microvascular dysfunction (CMD)

- ▶ **Coronary microvascular spasm**, is often an important etiology of angina that is often overlooked and undiagnosed.
- ▶ **Pressure wire** : Evaluation of coronary microvascular dysfunction and vasospasticity.
- ▶ These should be considered **once intracoronary imaging has ruled out** coronary dissection or plaque disruption or rupture.
- ▶ In order to evaluate for microvascular and vasospastic abnormalities, **coronary flow reserve (CFR; abnormal <2.0)** should be measured and the **index of microcirculatory resistance (IMR; abnormal ≥ 25)** calculated.



► Case 3-

A 55-year-old female

RF: HTN & HLP

PMH : migraine headaches & frequent rest typical angina

Admitted with NSTEMI

ECG demonstrated normal sinus rhythm with no Q-waves but nonspecific T wave abnormality.

ICA : non sig LAD lesion

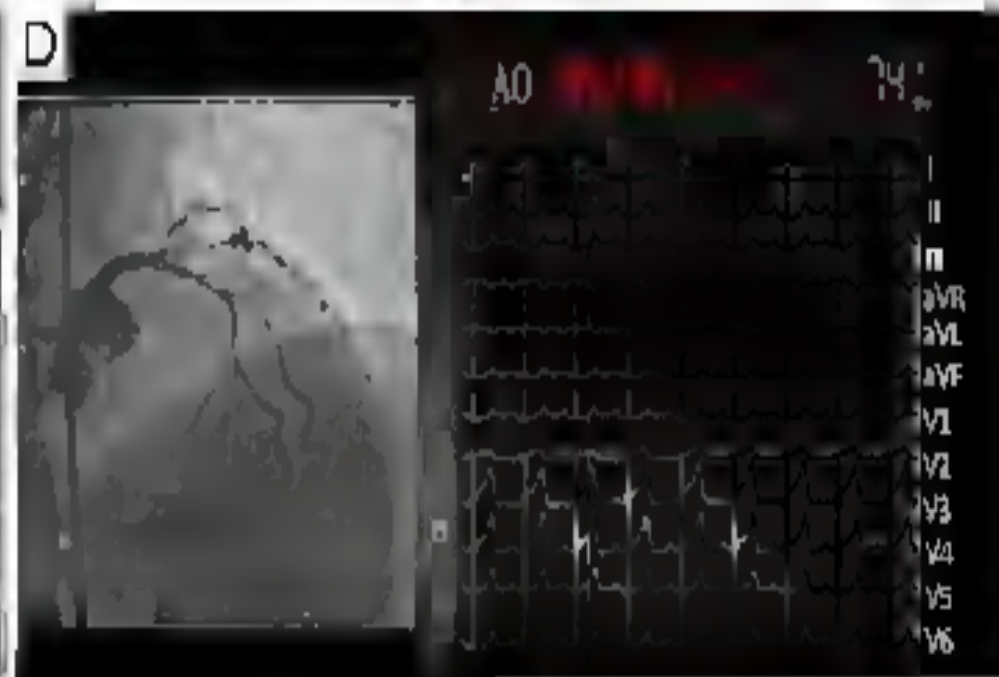
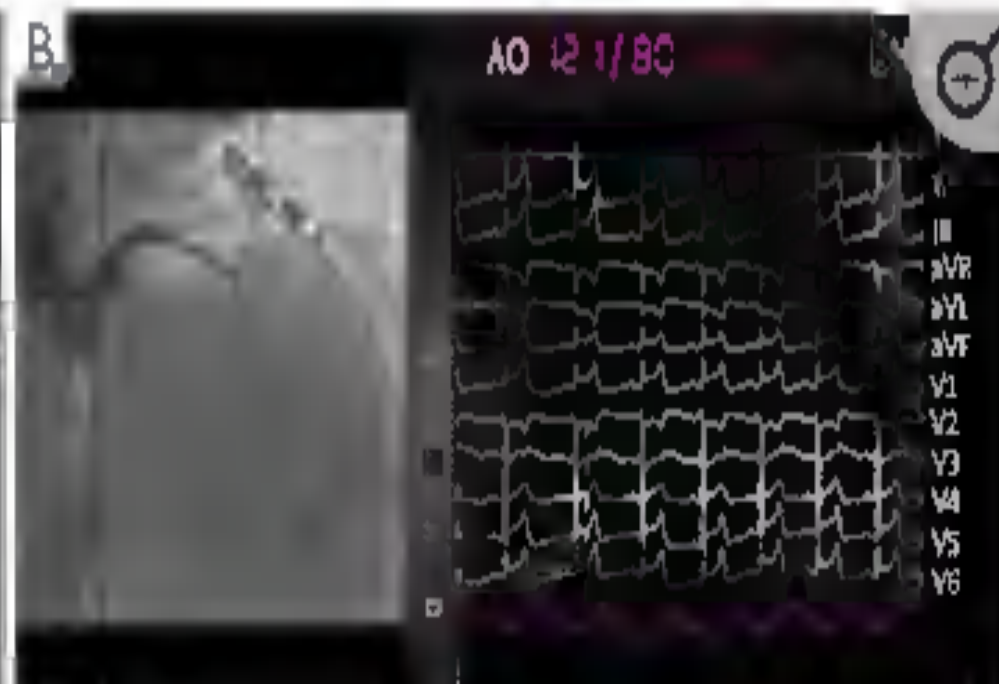
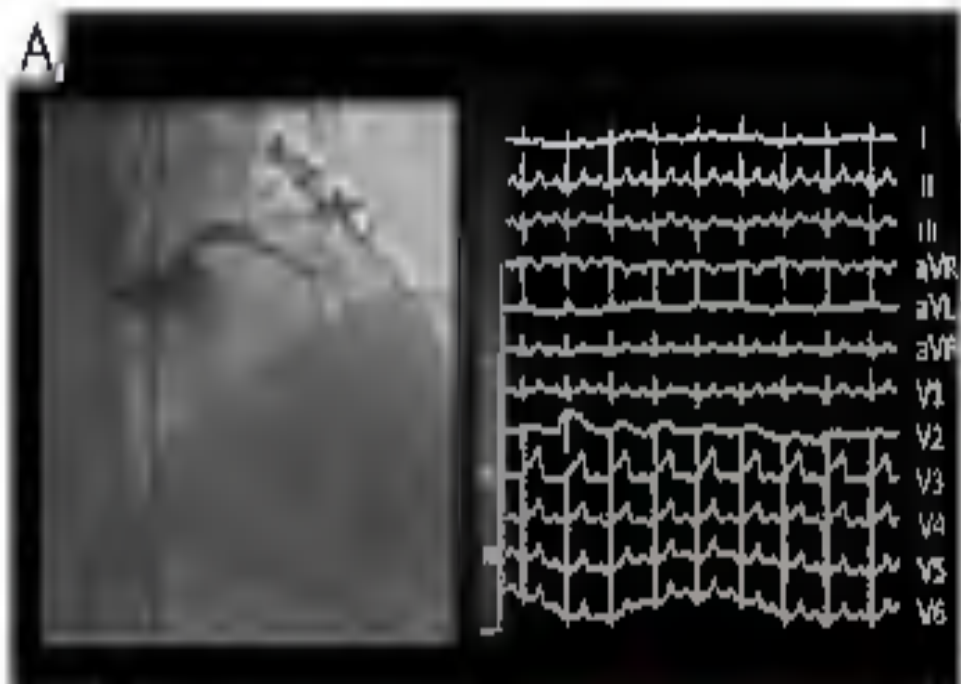
Echo : NL EF , NO RWMA

IVUS was unremarkable

Hypercoagulable workup was negative

The patient underwent **invasive CRT**

IC ACh showed abnormal endothelial-dependent **coronary microvascular dysfunction (CMD) and coronary microvascular vasospasm.**



Epicardial Coronary spasm (prinzmetal)

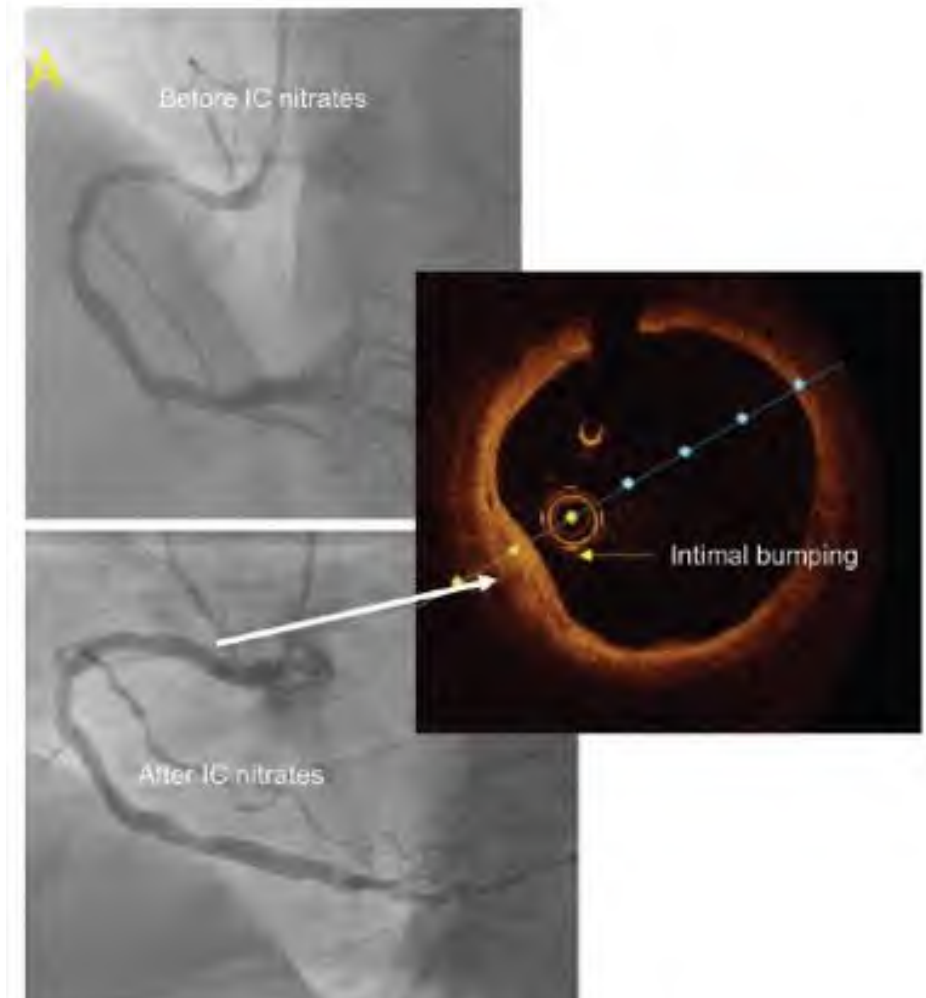
► Case 4-

A 48 y man

PMH: NSEMI 3 y ago with mild CAD & LGE in CMR diagnosed With MINOCA.

Admitted with acute INF MI , ICA showed severe stenosis Of proximal RCA resolved with IC TNG.

OCT was unremarkable.



- ▶ **Coronary vasospasm** can occur either in response to drugs or toxins (eg, cocaine, fluorouracil) that result in hyperreactivity of vascular smooth muscles or spontaneously because of disorders in coronary vasomotor tone.
- ▶ **Vasospastic angina** is a clinical disorder manifesting as rest angina associated with a dynamic ST-segment elevation pattern on ECG as a result of coronary artery spasm.

SCAD

► Case 5-

A 62 y lady

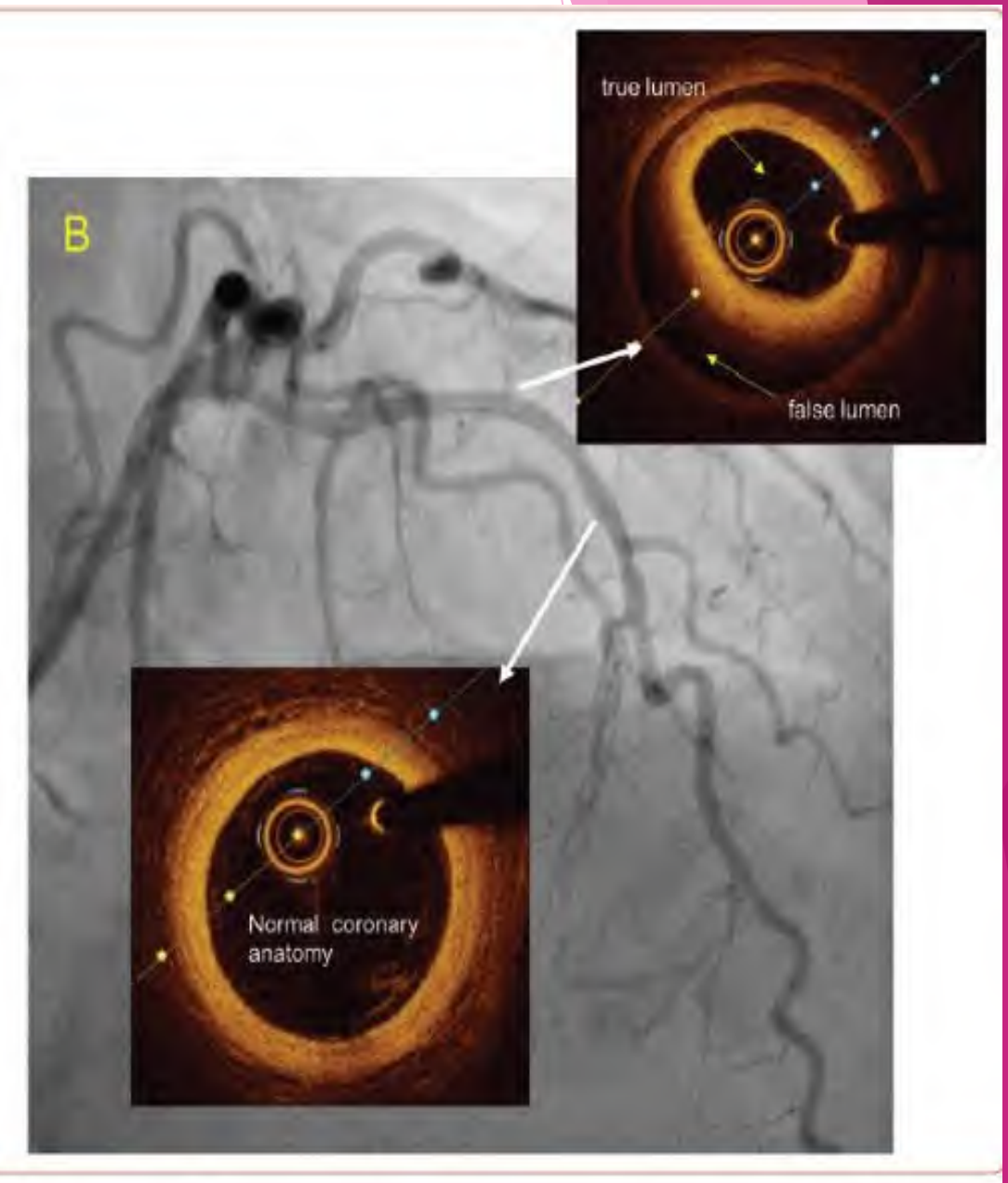
RF: HTN

Frequent typical chest pain , admitted with NSTEMI

Echo : ant wall hypokinesia

ICA showed mild LAD lesion & haziness in proximal

OCT releaved SCAD



Coronary Embolism/insitu Thrombosis

- ▶ **Hypercoagulable disorders** that result in coronary thrombosis can be divided into inherited and acquired causes.
- ▶ Acquired hypercoagulable states include thrombotic thrombocytopenic purpura (**TTP**), the **autoimmune disorder antiphospholipid syndrome**, **heparin-induced thrombocytopenia (HIT)**, and **myeloproliferative neoplasms**.
- ▶ In a systematic review examining the use of thrombophilia testing in MINOCA patients, **factor V Leiden or activated protein C resistance followed by protein C or S deficiency was most commonly observed** .
- ▶ It is reasonable to consider the inherited hypercoagulable states in patients with MINOCA, **especially in younger women**.

Supply-Demand Mismatch (Type 2 MI)

Case 6-

A 56-year-old male

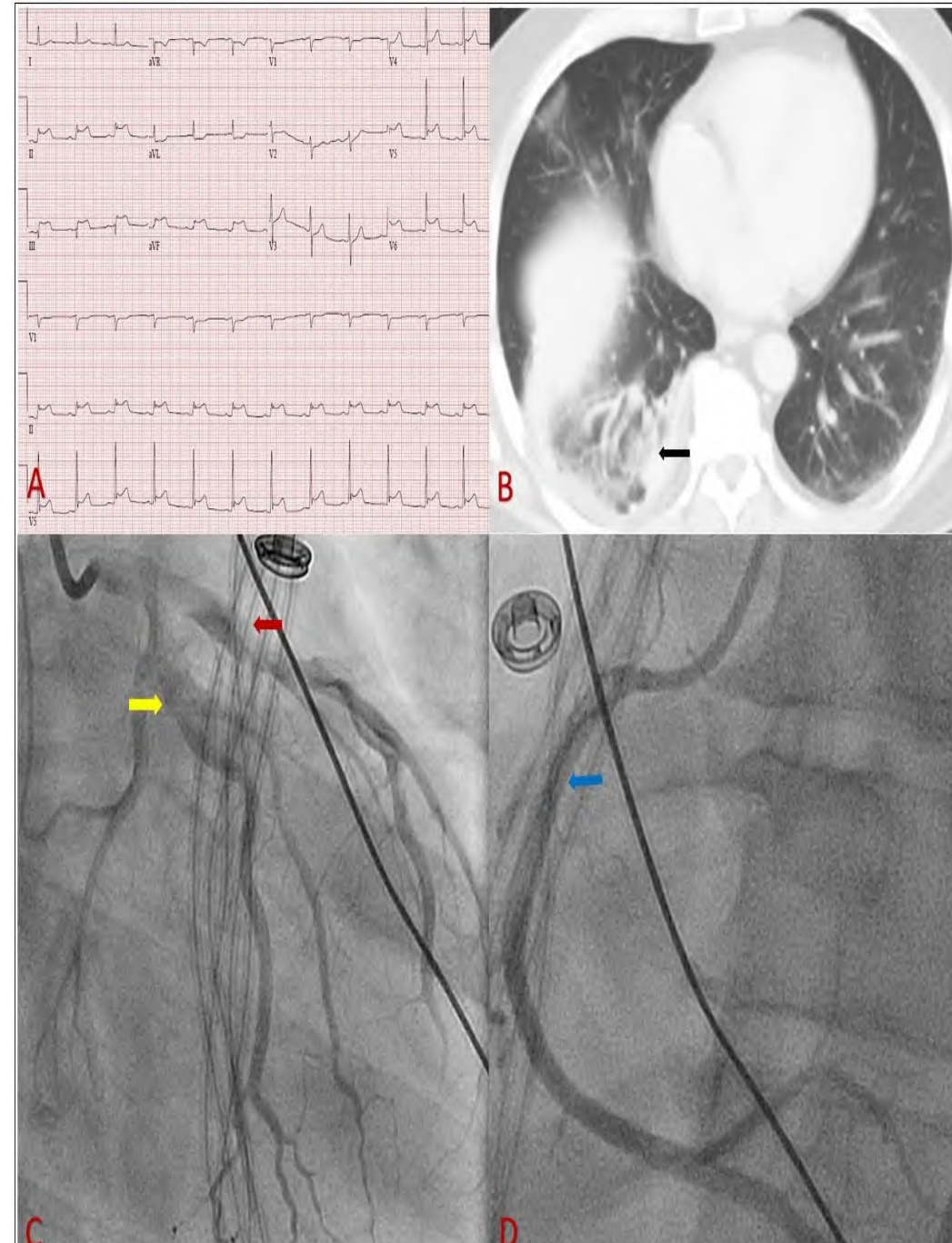
RF: HTN / HLP

Admitted with severe pneumonia with fever & hypoxemia

During hospitalization severe chest pain and rise of trop with
ECG changes of inf lateral wall MI , EF=35%

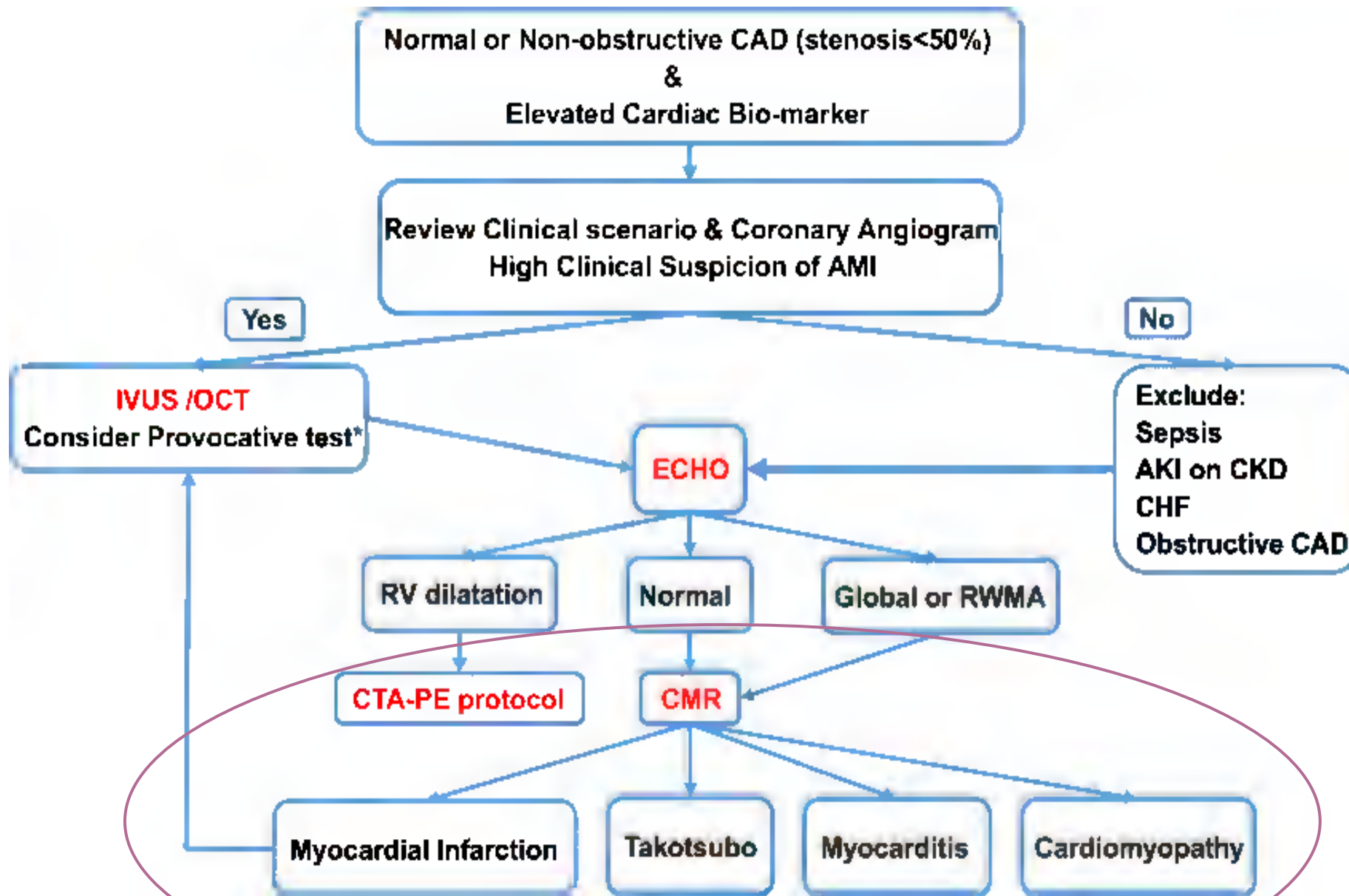
ICA showed no sig CAD

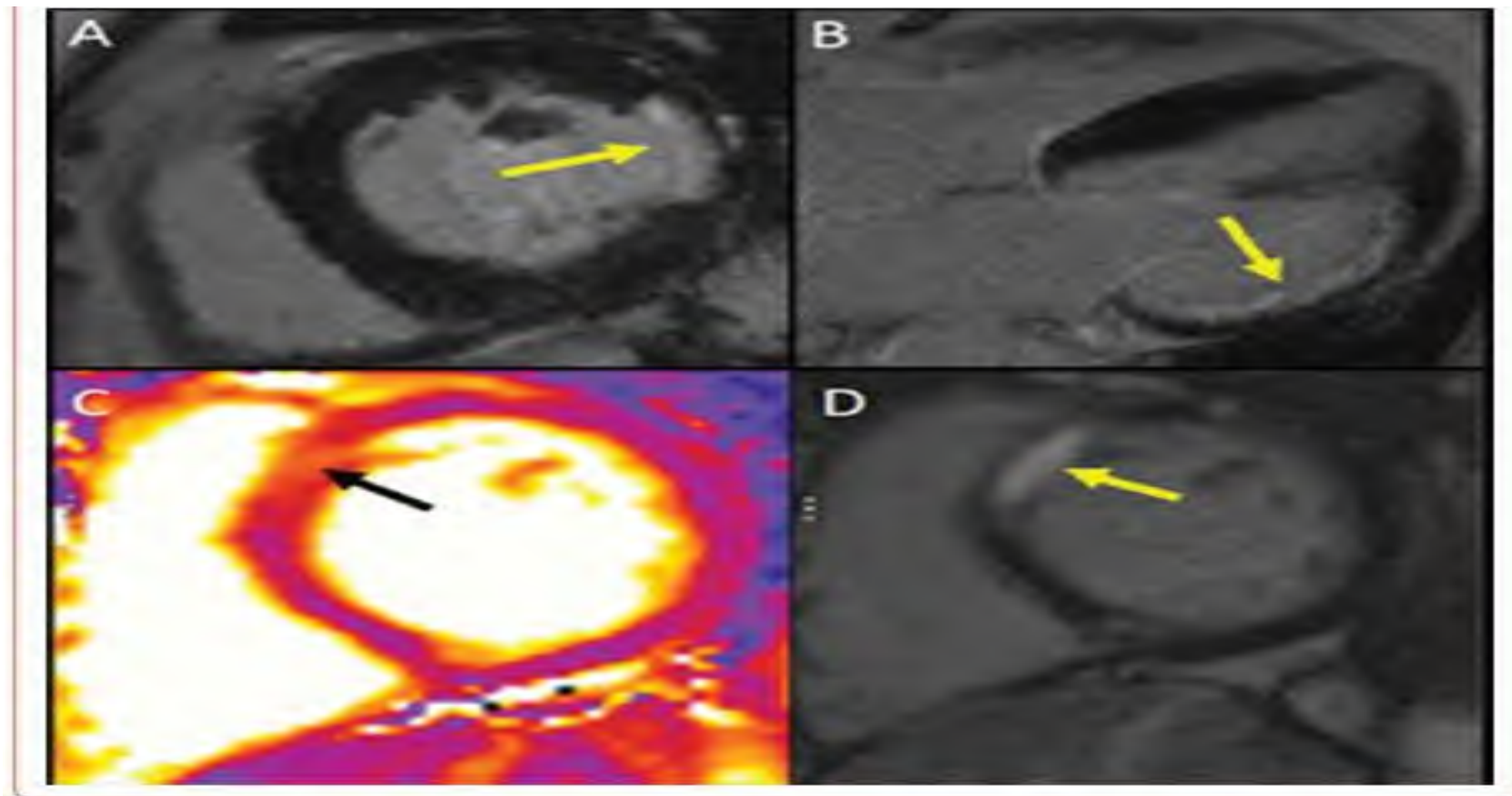
The patient was continued on antibiotics and discharged in stable
conditions, on dual antiplatelet therapy, follow up TTE in 2 weeks
revealed an improved EF of 60%.



Role of CMR

- ▶ **CMR** is an important diagnostic tool and is guideline recommended in all patients with MINOCA.
- ▶ If present on CMR, **late gadolinium enhancement (LGE)** localises the site of myocardial damage, and the pattern of distribution suggests the diagnosis.
- ▶ **Subendocardial or transmural enhancement** is typically of an ischaemic aetiology or hypereosinophilic syndrome. **Subepicardial enhancement** may be observed in myocarditis.
- ▶ **absence of late gadolinium enhancement** may be in keeping with microvascular dysfunction or a non-cardiac cause of the presentation.
- ▶ CMR should be performed **as soon as feasible** after identification of MINOCA.



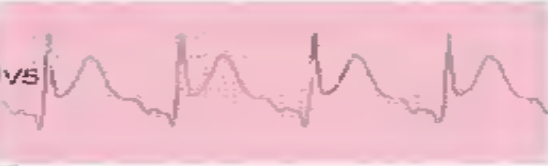


A, B: Images from a patient with limited MI. There is subendocardial late gadolinium enhancement (LGE) within the basal to mid-lateral wall (yellow arrows) in the short (A) and horizontal long (B) axis views. C, D: Images from a patient with acute myocarditis. There is an area of increased T2-weighted signal intensity (C; black arrow) in the basal anteroseptum suggestive of myocardial oedema that colocalises with an area of extensive LGE (D; yellow arrow). MINOCA = MI with non-obstructive coronary arteries.

Clinical Presentation
55-year old female presented with sudden onset of central chest pain for 2 hours.

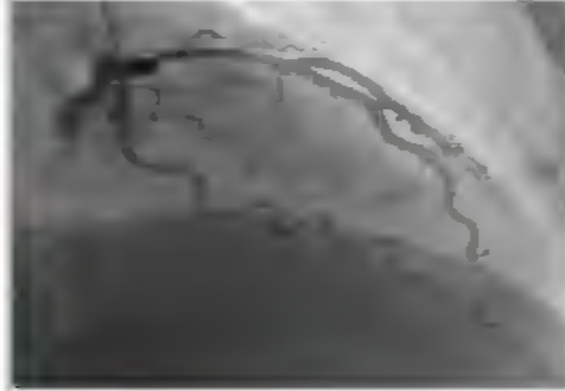
Troponin T (Reference Range <29ng/L)
Initial: 99 ng/L
6 Hours: 301 ng/L

ECG
ST elevation in V3-V5



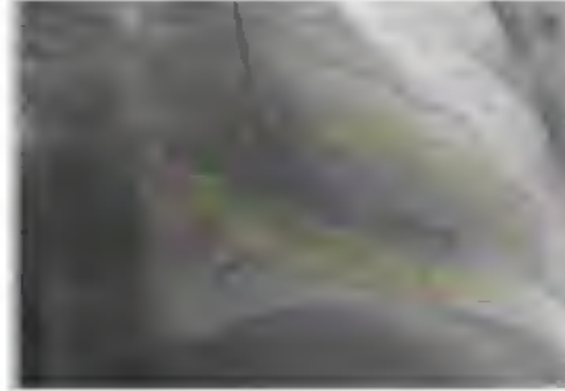
Coronary Angiography

No significant coronary stenosis



D-Dimer: Negative

Left Ventriculogram: Normal



1. Acute Myocardial Infarction

2. Non-Obstructive Coronary Arteries

3. No apparent cause for presentation

MINOCA - 'a working diagnosis'

Myocardial Infarction with Non-Obstructive Coronary Arteries

Differential diagnosis work up

Thrombophilia screen

No coagulation abnormalities detected

Cardiac Magnetic Resonance (CMR) imaging



Intravascular ultrasound imaging

Provocation spasm test

Final Diagnosis
Anterior Subendocardial Myocardial infarct

Subendocardial enhancement

CONCLUSIONS

- ▶ **MINOCA** is a distinct clinical diagnosis with many different pathophysiological causes.
- ▶ It is essential that healthcare professionals become familiar with this syndrome so that patients are appropriately identified and treated.
- ▶ The prognosis of patients presenting with MINOCA depends on the underlying cause and is currently under active investigation.

Thank you