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Fourth Universal Definition of Myocardial Infarction (2018)

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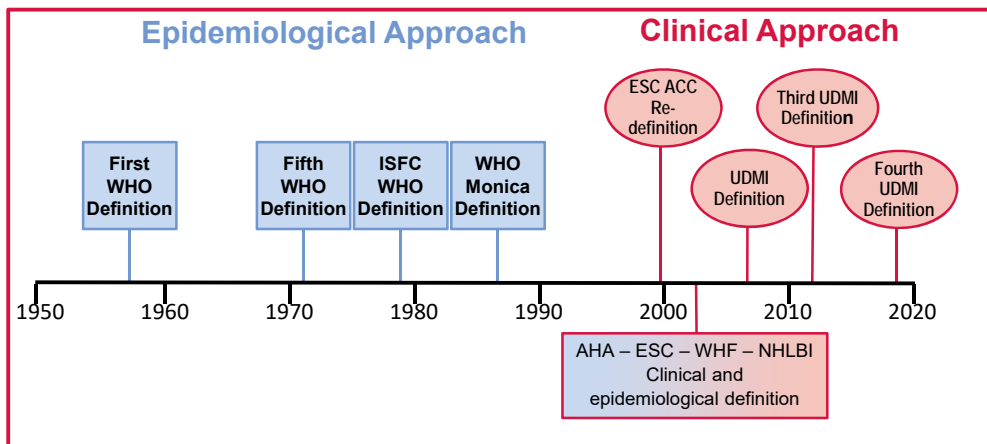
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EXPERT CONSENSUS DOCUMENT

Fourth universal definition of myocardial infarction (2018)

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History of Documents on the Definition of Myocardial Infarction



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What's New about the Universal Definition of Myocardial Infarction? (1)

New concepts

- **Differentiation of myocardial infarction from myocardial injury; new Figure 2.**
- Highlighting peri-procedural myocardial injury after cardiac and non-cardiac procedures as discrete from myocardial infarction.
- Consideration of electrical remodelling (cardiac memory) in assessing repolarization abnormalities with tachyarrhythmia, pacing, and rate-related conduction disturbances.
- Use of cardiovascular magnetic resonance to define aetiology of myocardial injury.
- Use of computed tomographic coronary angiography in suspected myocardial infarction.

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Spectrum of Myocardial Injury, ranging from no Injury to Myocardial Infarction

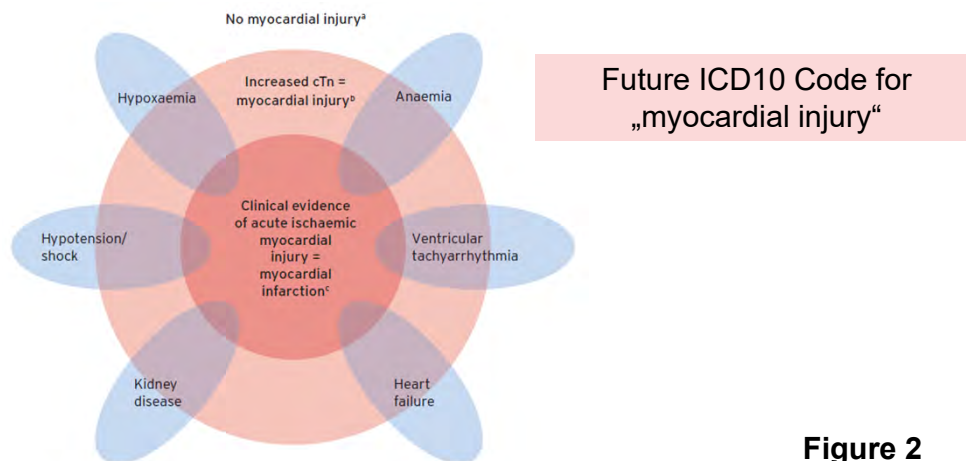


Figure 2

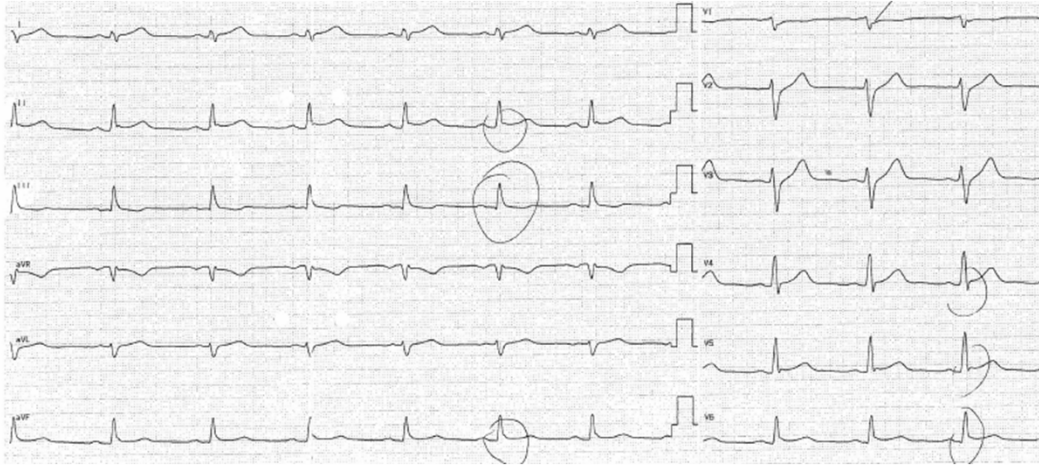
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Case vignette 1

- 36 years old male
- Since a couple of days heavy diarrhea, no bleeding
- This morning chest pain, radiation to the right arm for 4-5 hours. Patient presents himself in the ED painfree approx. 8 hours after the index event
- History: Ex-smoker, 15py; hypercholesterolemia, statin medication
- POC troponin T **1100ng/L [N: <17; cutoff < 30]**; copeptin **9.14pmol/L [N: < 10]**
- Acute echo: No regional wall abnormalities, but global EF slightly reduced (by eye ball assessment, not quantified)

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ECG



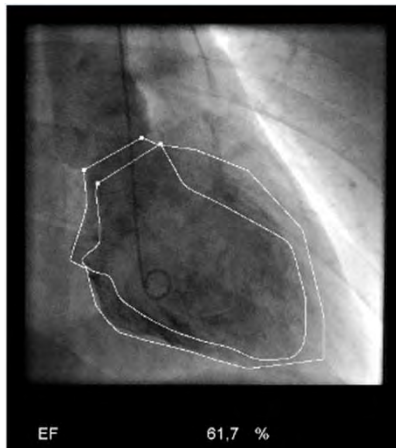
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Coronary angiography: No CAD, no occlusion



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LV angiography: Normal LV function



MRI: Signs of acute myocarditis

Myocardial injury

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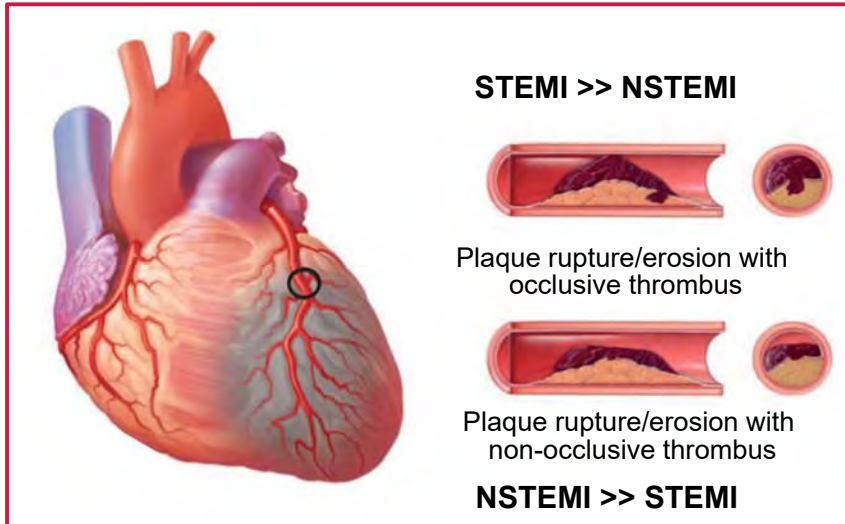
What's New about the Universal Definition of Myocardial Infarction? (2)

Updated concepts

- Type 1 myocardial infarction: Emphasis on the causal relationship of plaque disruption with coronary athero-thrombosis; new *Figure 3*.
- Type 2 myocardial infarction: Settings with oxygen demand and supply imbalance unrelated to acute coronary athero-thrombosis; new *Figures 4 and 5*.
- Type 2 myocardial infarction: Relevance of presence or absence of coronary artery disease. Differentiation of myocardial injury from Type 2 myocardial infarction; new *Figure 6*.
- Type 3 myocardial infarction: Clarify why Type 3 myocardial infarction is a useful category to differentiate from sudden cardiac death.

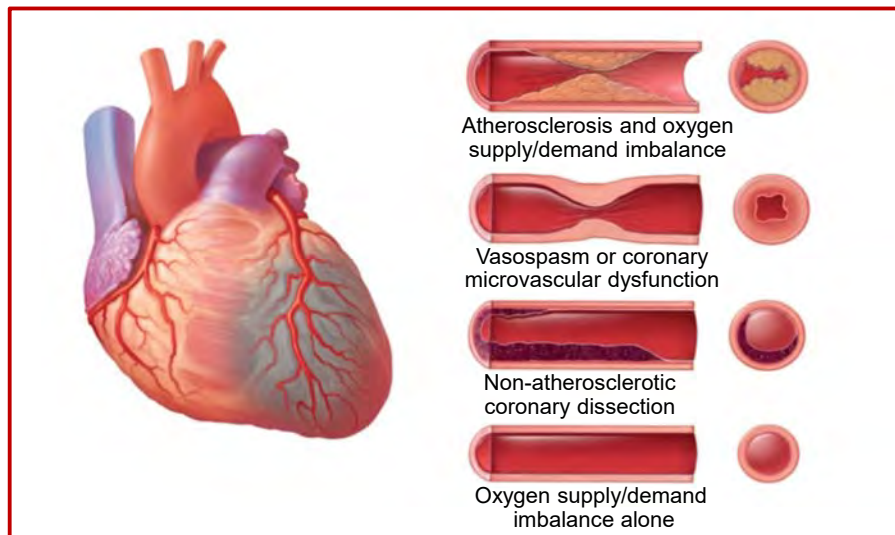
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Myocardial Infarction Type 1



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Myocardial Infarction Type 2



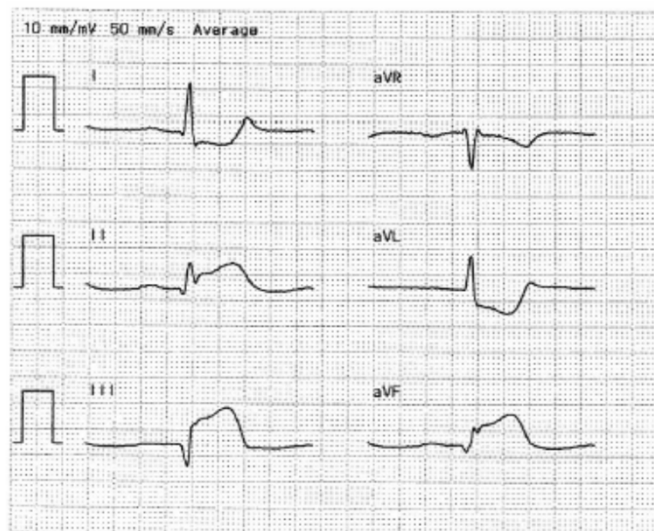
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Case vignette 2

- 64 years old male
- Since 3 hours heavy chest pain, radiation in the left arm, left shoulder and the back
- Cold sweating, dyspnea
- Presents himself walking in the ED

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EKG



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Coronary angiography und PCI



Type 1 MI, STEMI

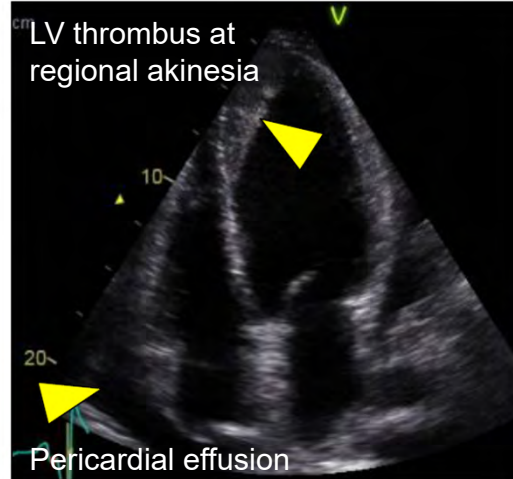
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Case vignette 3

- 36 years old male
- After a fall on a trampolin, pain in the left shoulder and arm. After orthopedic consultation and normal x-ray of the left shoulder, prescription of pain killer (ibuprofen)
- 2 weeks later presentation in the ED with fatigue, fever and respiratory modulated chest pain

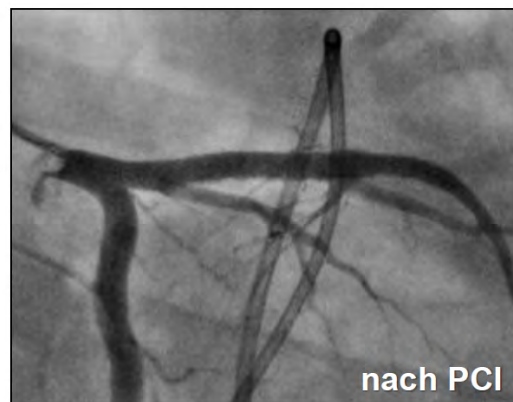
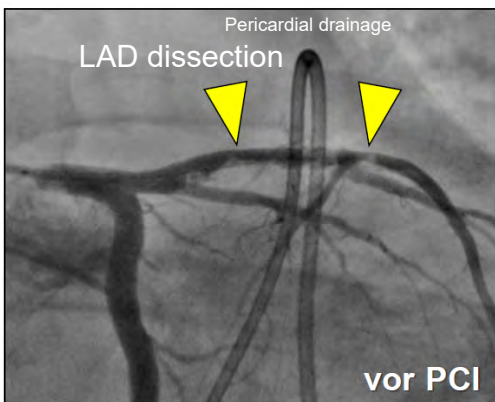
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Primary diagnostics: chest X-ray and echo



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Coronary angiography: none atherosclerotic (OCT) LAD dissection

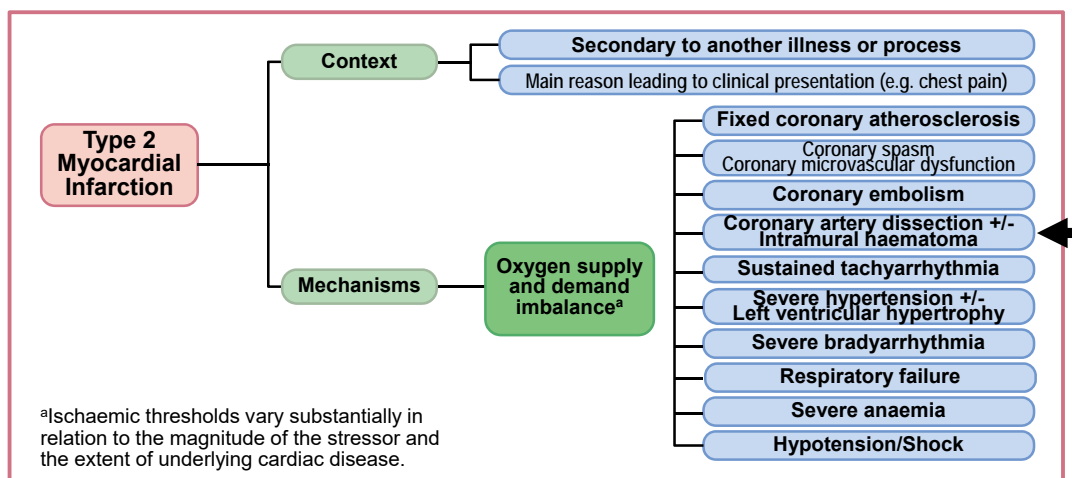


Dreger H, Haug M, Möckel M, DÄB 2018 in press

Type 2 MI

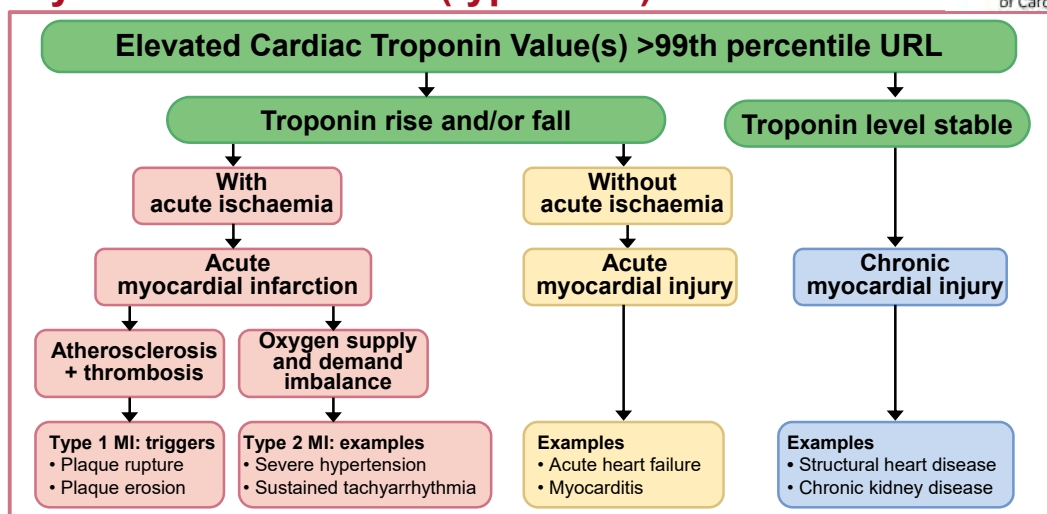
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Framework for Type 2 MI considering Context and Mechanisms attributable to Acute Myocardial Ischaemia



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A Model for interpreting Myocardial Injury and Myocardial Infarction (type 1 + 2)



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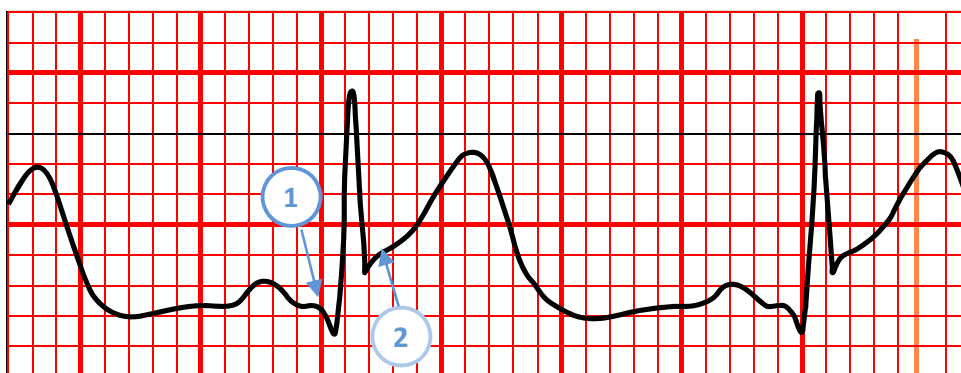
What's New about the Universal Definition of Myocardial Infarction? (3)

Updated concepts (*Contd*)

- Consideration of new non-rate related right bundle branch block with specific repolarization patterns.
- Determination of the magnitude of the ST-segment shift with the onset of the QRS serving as the reference point; new *Figure 8*.
- ST-segment elevation in lead aVR with specific repolarization patterns, as a STEMI equivalent.
- ECG detection of myocardial ischaemia in patients with an implantable cardiac defibrillator or a pacemaker.
- Enhanced role of imaging including cardiac magnetic resonance imaging for the diagnosis of myocardial infarction; new *Figure 9*.

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How to assess ST-segment elevation



Arrow 1 indicates the onset of the Q wave. Arrow 2 Indicates the onset of the ST-segment or J-point. The difference between points 1 and 2 denotes the magnitude of the ST-segment elevation

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Electrocardiographic Changes* suggestive of Acute Myocardial Ischaemia

ST-elevation

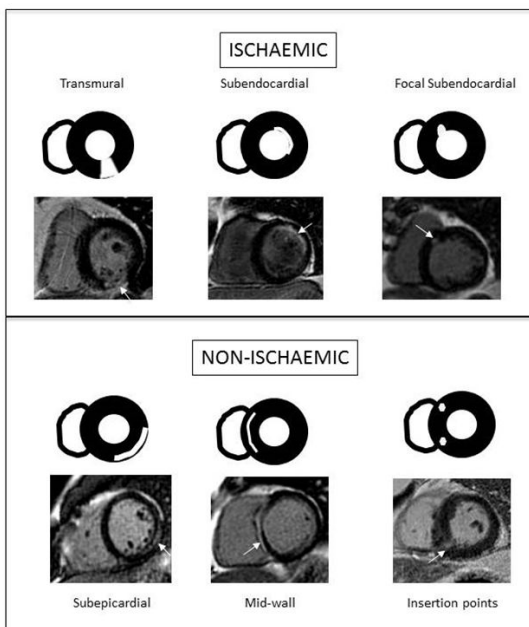
New ST-elevation at the J-point in two contiguous leads with the cut points: ≥ 1 mm in all leads other than leads V_2-V_3 where the following cut points apply: ≥ 2 mm in men ≥ 40 years; ≥ 2.5 mm in men < 40 years, or ≥ 1.5 mm in women regardless of age.

ST-depression and T wave changes

New horizontal or down-sloping ST-depression ≥ 0.5 mm in two contiguous leads and/or T inversion > 1 mm in two contiguous leads with prominent R wave or R/S ratio > 1 .

*in absence of left ventricular hypertrophy and bundle branch block

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Cardiac Magnetic Resonance Images

Gadolinium-based contrasts wash out from myocardium with increased extracellular space such as fibrosis, thus enhancing areas of scar (white arrows).

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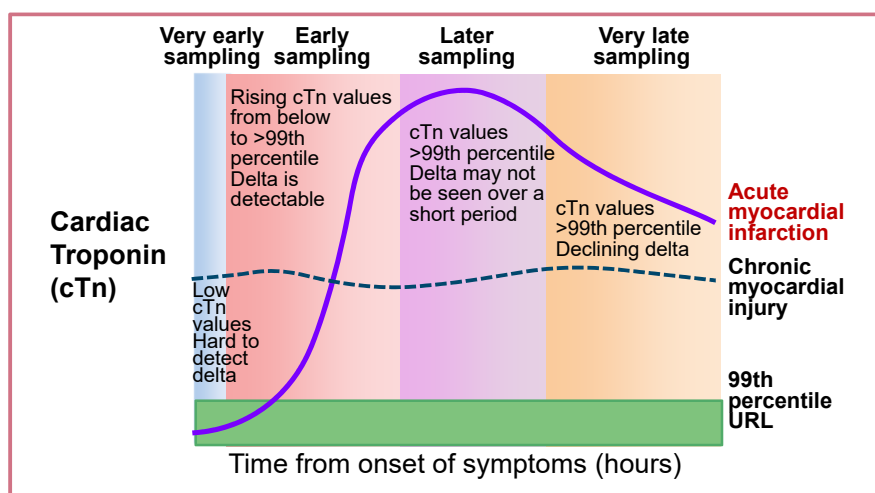
What's New about the Universal Definition of Myocardial Infarction? (4)

Updated concepts (Contd)

- Types 4-5 myocardial infarction: Emphasis on distinction between procedure-related myocardial injury and procedure-related myocardial infarction.
- Cardiac troponin: Analytic issues for cardiac troponins; new *Figure 7*.
- Emphasis on the benefits of high-sensitivity cardiac troponin assays.
- Considerations relevant to the use of rapid rule-out and rule-in protocols for myocardial injury and myocardial infarction.
- Issues related to specific diagnostic change ("delta") criteria for the use of cardiac troponins to detect or exclude acute myocardial injury.

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Conceptual Illustration of Troponin Kinetics after Acute Myocardial Injury and Infarction



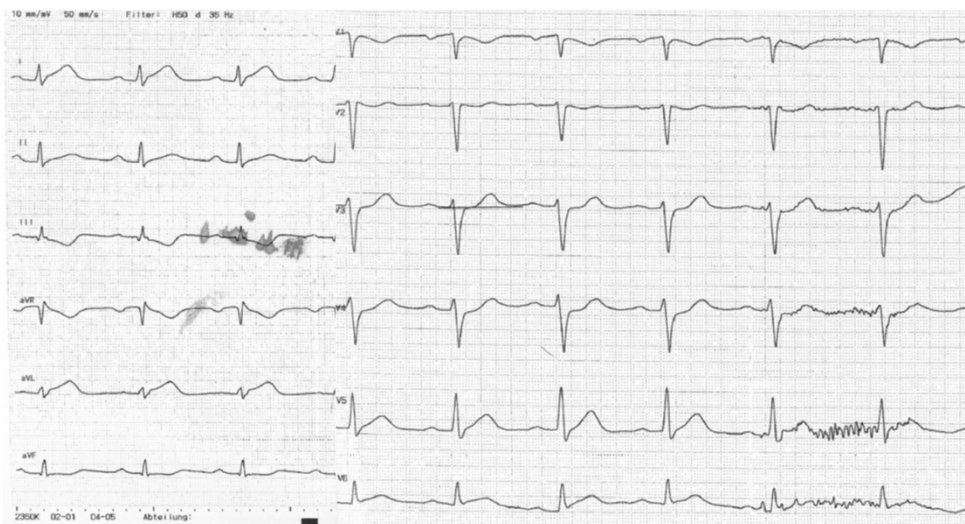
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Case vignette 4

- 38 years old male, moderate chest pain
- Diabetes mellitus, alcohol abuse
- Patient reports, that he takes no actual medication and a coronary angiography 3 weeks ago was „o.k.“

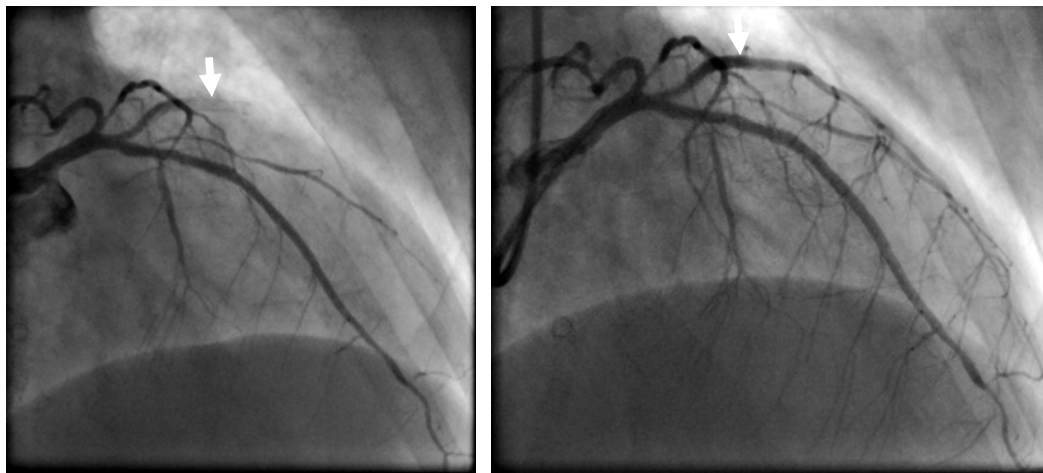
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EKG



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Coronary angiography and PCI



**Type 4b = subacute
stent thrombosis (D1)**

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What's New about the Universal Definition of Myocardial Infarction? (5)

New sections

- Takotsubo syndrome.
- MINOCA (myocardial infarction with non-obstructive coronary arteries).
- Chronic kidney disease.
- Atrial fibrillation.
- Regulatory perspective on myocardial infarction.
- Silent or unrecognized myocardial infarction.

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Type 4 & 5

Criteria for coronary procedure-related myocardial infarction (Types 4 and 5 MI)

- Percutaneous coronary intervention (PCI) related MI is termed Type 4a MI.
- Coronary artery bypass grafting (CABG) related MI is termed Type 5 MI.
- Coronary procedure-related MI ≤ 48 hours after the index procedure is arbitrarily defined by an elevation of cTn values >5 times for Type 4a MI and >10 times for Type 5 MI of the 99th percentile URL in patients with normal baseline values.

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Type 4 & 5

Criteria for coronary procedure-related myocardial infarction (Types 4 and 5 MI) (Contd)

- New ischaemic ECG changes (this criterion is related to Type 4a MI only).
- Development of new pathological Q waves.
- Imaging evidence of new loss of viable myocardium or new regional wall motion abnormality in a pattern consistent with an ischaemic aetiology.
- Angiographic findings consistent with a procedural flow-limiting complication such as coronary dissection, occlusion of a major epicardial artery or graft, side-branch occlusion-thrombus, disruption of collateral flow or distal embolization.

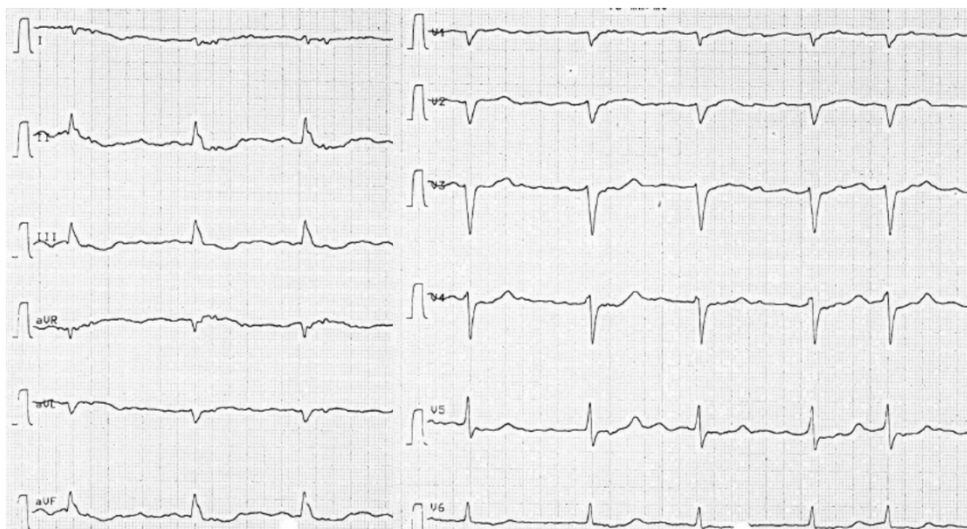
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Case vignette 5

- 78 years old male
- Patient was sent to the ED by his family physician; known lower back pain, currently worse and obstipation since a couple of days; severe abdominal pain despite 2 times daily intake of tramadol; no chest pain, no dyspnea, no palpitations, no syncope
- History: COPD, atrial fibrillation, lung carcinoma (>10 years before, curative surgery and radiochemotherapy), mitral regurgitation
- Vitals: BP 155/85mmHg, HR 102/min, RR 16/min, peripheral oxygen saturation 100%
- Medication: Digitalis, verapamil, rivaroxaban
- Initial POC troponin T: 16ng/L (N: < 17, cutoff 30)
- Hs troponin T 116ng/L (after 6h), 117ng/L (after 10h)
(atypical sampling interval due to presentation with abdominal pain and no chest discomfort)

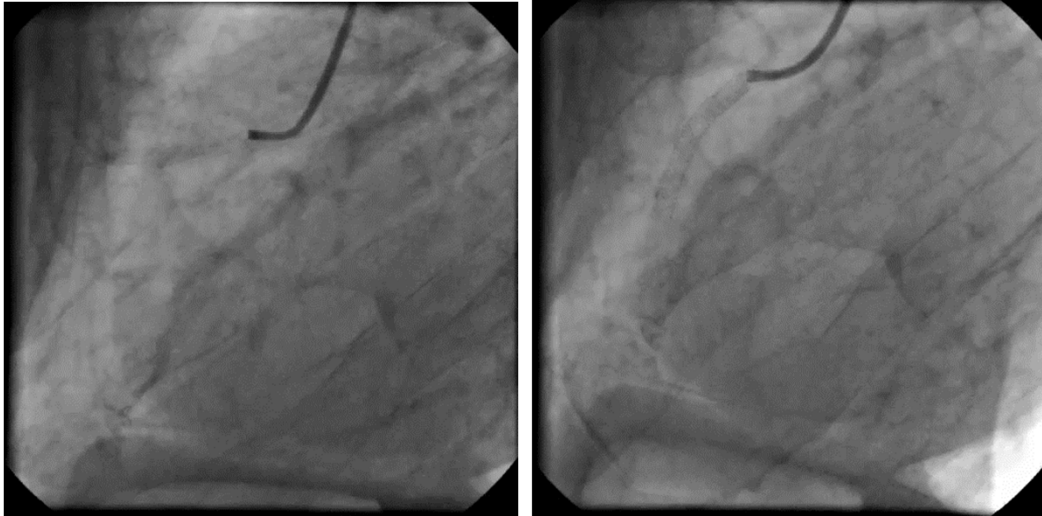
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EKG



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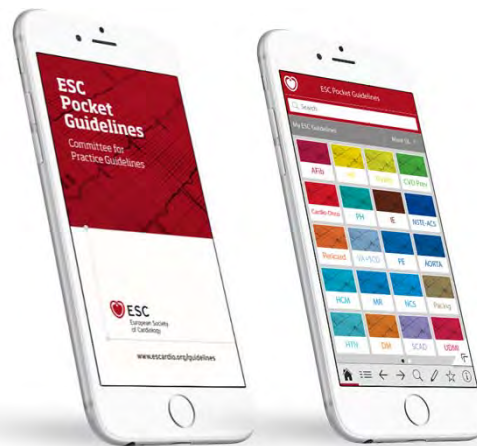
Koronarangiographie und PCI: Lesion RCA



Type 1 MI, NSTEMI

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Pocket-Guideline und App



More information on www.escardio.org/guidelines

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Summary („highlights“)

- „Myocardial Injury“ more precisely defined, future ICD 10 code
- Prior concepts better specified
- New type 4c infarction = troponin rise with coronary restenosis after PCI
- New imaging techniques (cMRI und CTA) adopted
- Better definition of type 2 infarction and differentiation from injury
- ECG-criteria
- Still high complexity, further work needed for practical implementation

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