

# Définition de l'infarctus du myocarde

## Nouveaux Concepts



**Johanne SILVAIN**

[joanne.silvain@aphp.fr](mailto:joanne.silvain@aphp.fr)

<sup>1</sup> Sorbonne Université

<sup>2</sup> ACTION Study Group

<sup>3</sup> INSERM UMRS 1166 ICAN

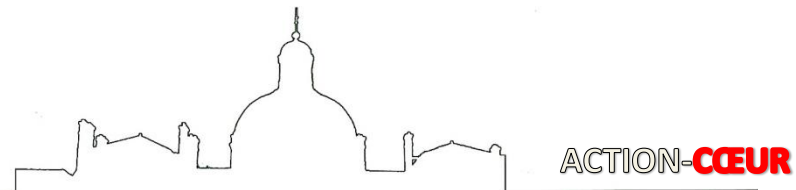
<sup>4</sup> Institut de Cardiologie (APHP)



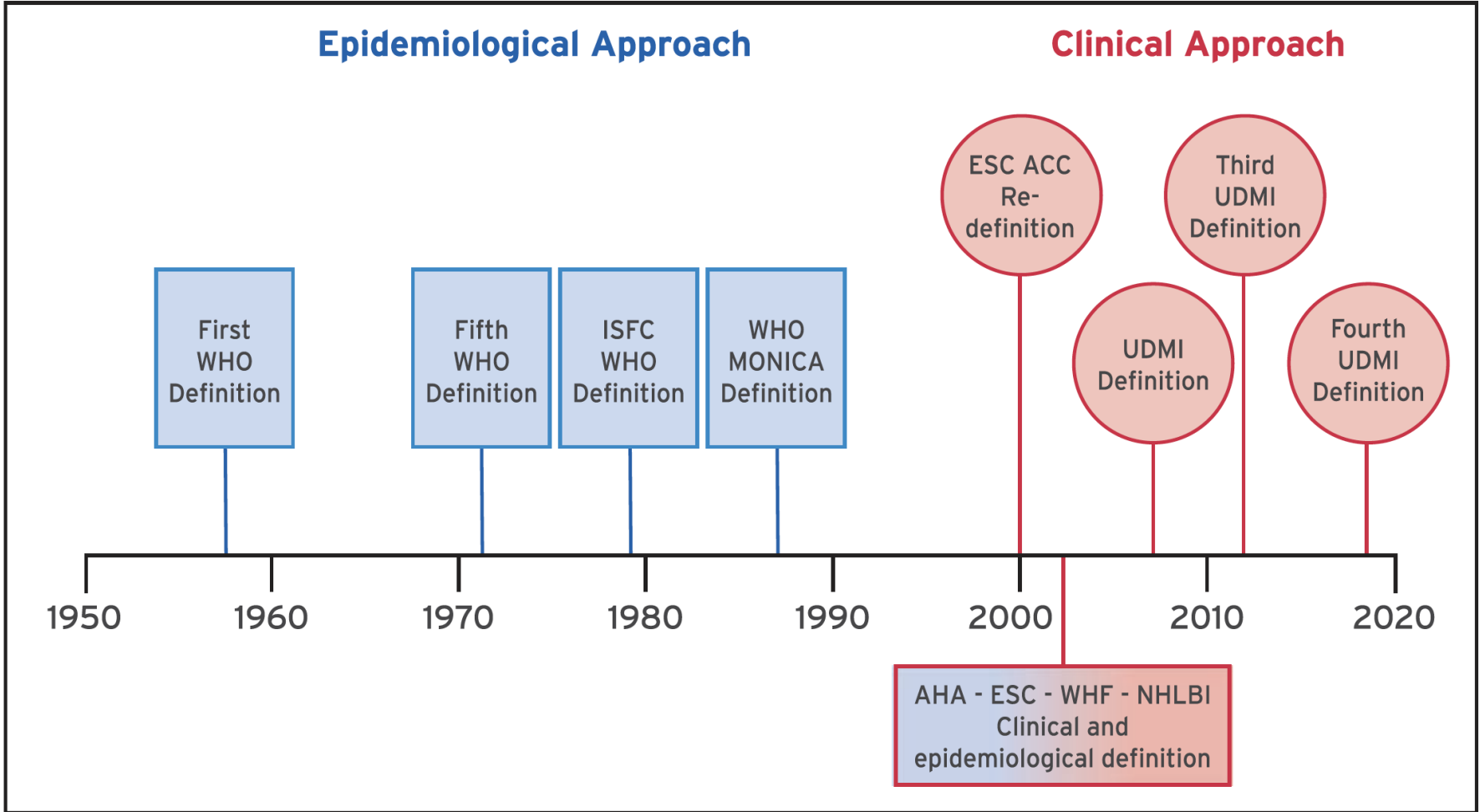
# Disclosures

## DISCLOSURE STATEMENT OF FINANCIAL INTEREST Johanne SILVAIN MD, PhD

**Consulting fees, Speaker honorariums or Travel support from**  
from Algorithim, Amed, Astra-Zeneca , Bayer, Boeringher Ingelheim,  
CLS Bering, Gilead Science, Sanofi-Aventis, Web MD  
Amgen, Astra-Zeneca and Saint-Jude Medical



# Historical Evolution of the definition of Myocardial Infarction



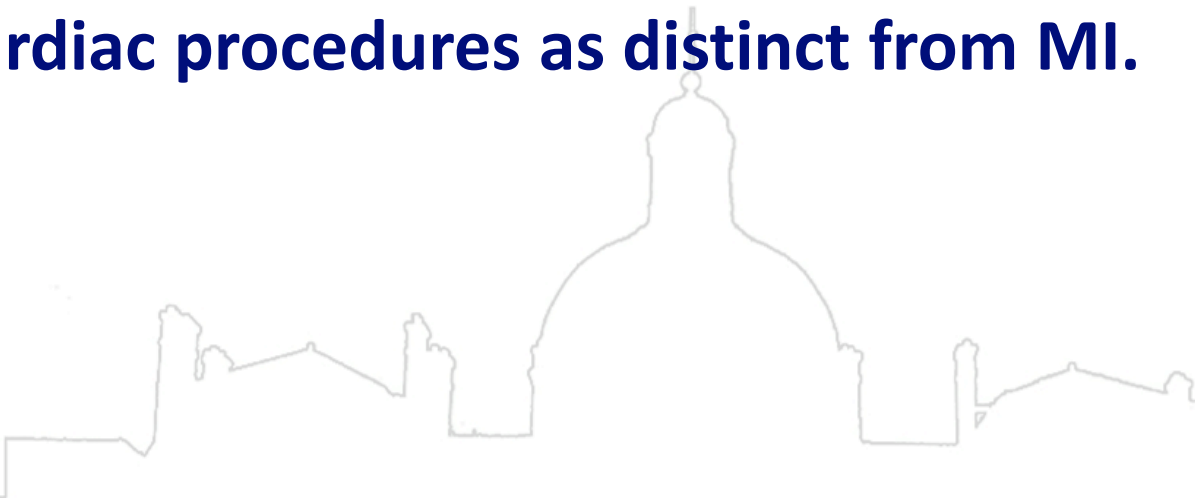
# What's new ?

What's new in the universal definition of myocardial infarction?
<p><b>New concepts</b></p> <ul style="list-style-type: none"> <li>• Differentiation of <u>myocardial infarction from myocardial injury</u>.</li> <li>• Highlighting <u>peri-procedural myocardial injury after cardiac and non-cardiac procedures</u> as discrete from myocardial infarction.</li> <li>• Consideration of electrical remodelling (cardiac memory) in assessing repolarization abnormalities with tachyarrhythmia, pacing, and rate-related conduction disturbances.</li> <li>• Use of cardiovascular magnetic resonance to define aetiology of myocardial injury.</li> <li>• Use of computed tomographic coronary angiography in suspected myocardial infarction.</li> </ul>
<p><b>Updated concepts</b></p> <ul style="list-style-type: none"> <li>• Type 1 myocardial infarction: Emphasis on the causal relationship of plaque disruption with coronary athero-thrombosis; <i>new Figure 3.</i></li> <li>• Type 2 myocardial infarction: Settings with oxygen demand and supply imbalance unrelated to acute coronary athero-thrombosis; <i>new Figures 4 and 5.</i></li> <li>• Type 2 myocardial infarction: Relevance of presence or absence of coronary artery disease to prognosis and therapy.</li> <li>• Differentiation of myocardial injury from type 2 myocardial infarction; <i>new Figure 6.</i></li> <li>• Type 3 myocardial infarction: Clarify why type 3 myocardial infarction is a useful category to differentiate from sudden cardiac death.</li> <li>• Types 4-5 myocardial infarction: Emphasis on distinction between procedure-related myocardial injury and procedure-related myocardial infarction.</li> <li>• Cardiac troponin: Analytical issues for cardiac troponins; <i>new Figure 7.</i></li> <li>• Emphasis on the benefits of high-sensitivity cardiac troponin assays.</li> <li>• Considerations relevant to the use of rapid rule-out and rule-in protocols for myocardial injury and myocardial infarction.</li> <li>• Issues related to specific diagnostic change ('delta') criteria for the use of cardiac troponins to detect or exclude acute myocardial injury.</li> <li>• Consideration of new non-rate-related right bundle branch block with specific repolarization patterns.</li> <li>• ST-segment elevation in lead aVR with specific repolarization patterns, as a STEMI equivalent.</li> <li>• ECG detection of myocardial ischaemia in patients with an implantable cardiac defibrillator or a pacemaker.</li> <li>• Enhanced role of imaging including cardiac magnetic resonance imaging for the diagnosis of myocardial infarction; <i>new Figure 8.</i></li> </ul>
<p><b>New sections</b></p> <ul style="list-style-type: none"> <li>• Takotsubo syndrome.</li> <li>• MINOCA.</li> <li>• Chronic kidney disease.</li> <li>• Atrial fibrillation.</li> <li>• Regulatory perspective on myocardial infarction.</li> <li>• Silent or unrecognized myocardial infarction.</li> </ul>

## What's new ?

**1/ Differentiation of MI from myocardial injury**

**2/ Highlighting periprocedural myocardial injury after cardiac procedures as distinct from MI.**



# What's new ?

## 1/ Differentiation of MI from myocardial injury



# Clinical Criteria of Myocardial Infarction

## Clinical Criteria for MI

The clinical definition of MI denotes the presence of acute myocardial injury detected by abnormal cardiac biomarkers in the setting of evidence of acute myocardial ischemia.

Acute **Myocardial Injury**

Acute **Myocardial Ischemia**

# Myocardial Injury



# Biomarker

High-Sensitivity assay for detection of Cardiac troponin I (cTnI) and T (cTnT)

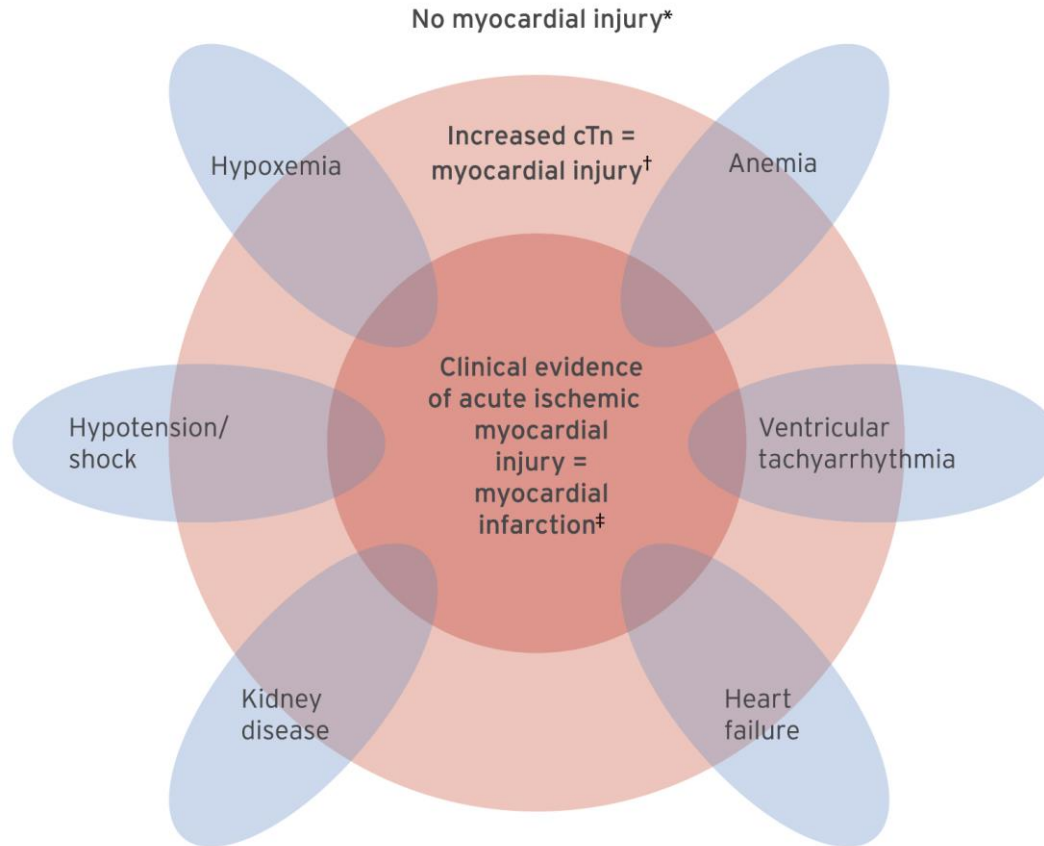
## Criteria for Myocardial Injury

Detection of an elevated cTn value above the 99th percentile URL is defined as myocardial injury. The injury is considered acute if there is a rise and/or fall of cTn values.

Chronic myocardial injury = persistently elevated cTn levels

# Mechanisms

Myocardial injury can be detected in clinical conditions associated with **nonischemic mechanisms** of myocardial injury as well



# Conditions associated with Myocardial Injury

Myocardial injury related to acute myocardial ischemia

Atherosclerotic plaque disruption with thrombosis

## Oxygen supply/demand imbalance

*Reduced myocardial perfusion, eg,*

- Coronary artery spasm, microvascular dysfunction
- Coronary embolism
- Coronary artery dissection
- Sustained bradyarrhythmia
- Hypotension or shock
- Respiratory failure
- Severe anemia

*Increased myocardial oxygen demand, eg,*

- Sustained tachyarrhythmia
- Severe hypertension with or without left ventricular hypertrophy

## Other causes myocardial Injury

*Cardiac conditions, eg,*

- Heart failure
- Myocarditis
- Cardiomyopathy (any type)
- Takotsubo syndrome
- Coronary revascularization procedure
- Cardiac procedure other than revascularization
- Catheter ablation
- Defibrillator shocks
- Cardiac contusion

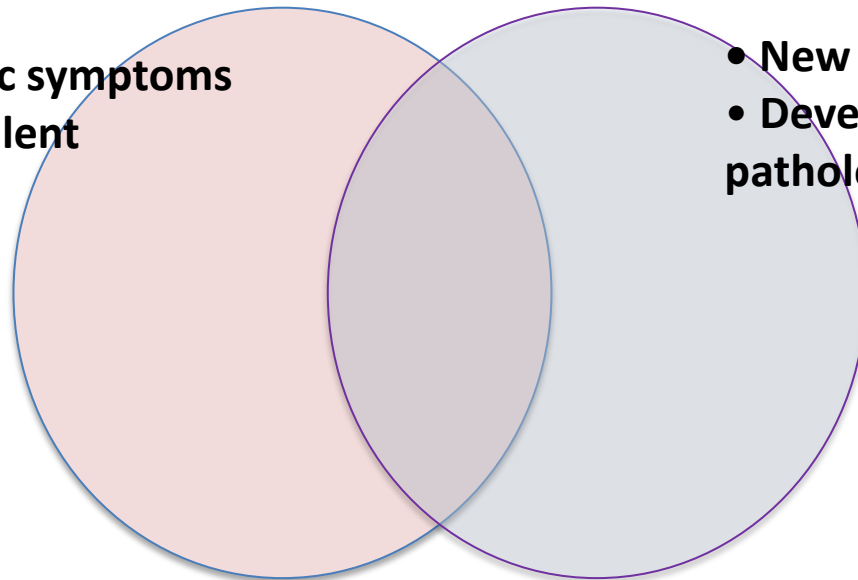
*Systemic conditions, eg,*

- Sepsis, infectious disease
- Chronic kidney disease
- Stroke, subarachnoid hemorrhage
- Pulmonary embolism, pulmonary hypertension
- Infiltrative diseases, eg, amyloidosis, sarcoidosis
- Chemotherapeutic agents
- Critically ill patients
- Strenuous exercise

# Myocardial Ischemia

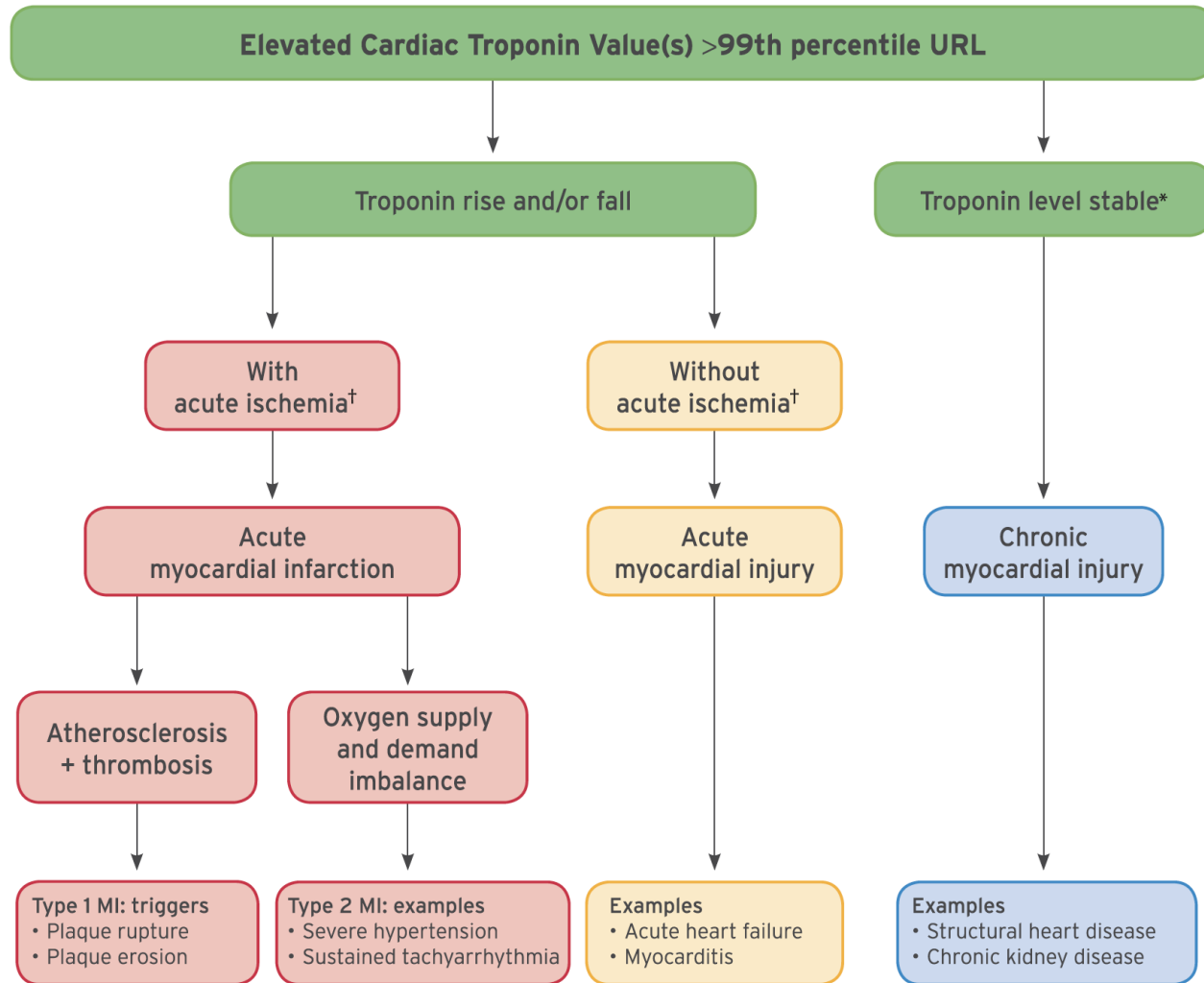
« *Ischemia denotes signs and/or symptoms of clinical myocardial ischemia* »

• **Ischemic symptoms**  
Or equivalent



• **New ischemic ECG changes**  
• **Development of new pathological Q waves**

# Myocardial Infarction or Injury



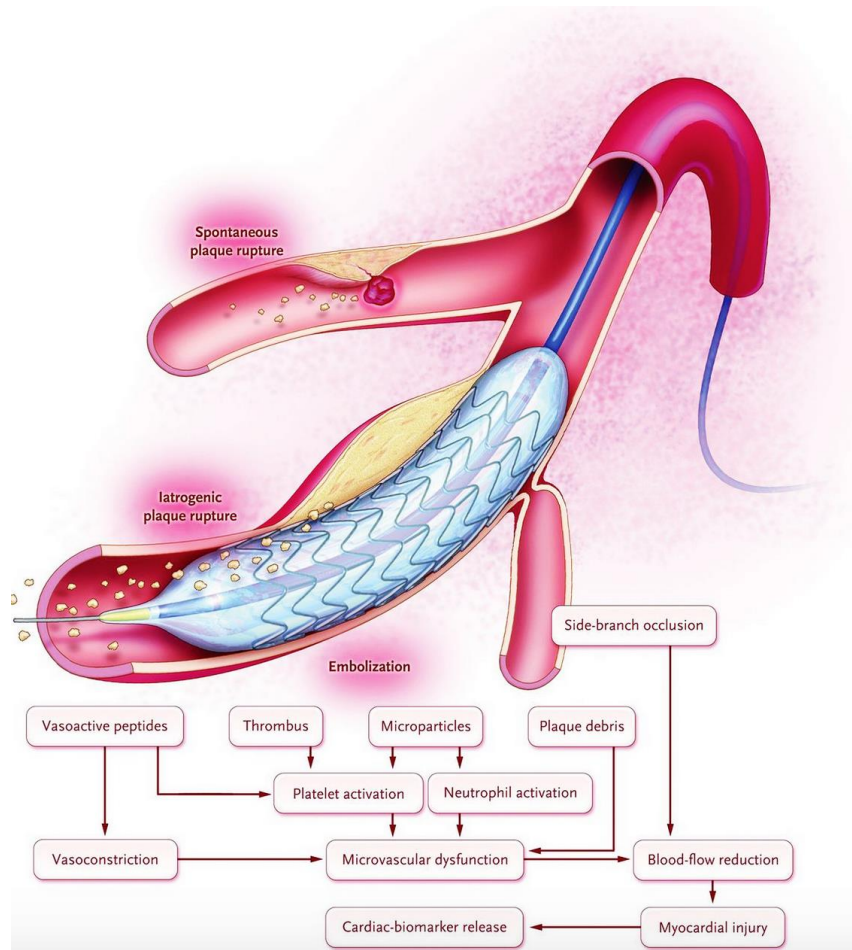
## What's new ?

1/ Differentiation of MI from myocardial injury

2/ Highlighting periprocedural myocardial injury after cardiac procedures as distinct from MI.



# CORONARY PROCEDURE-RELATED Myocardial Injury and Infarction



# Peri procedural (PCI) Myocardial

<b>Injury</b>	<b>Infarction*</b>
<b>In patients with normal baseline values (<math>\leq</math> 99th percentile URL)</b>	
Increases of cTn values ( $>$ 99th percentile URL)	Increases of cTn values <b><math>&gt;</math> 5 times the ULN</b>
<b>In patients with positive values (<math>&gt;</math> 99th percentile URL) stable (<math>\leq</math>20% variation) or falling</b>	
Rise of cTn values $>$ 20% of the baseline value	+ absolute post PCI <b><math>&gt;</math> 5 times the ULN</b>



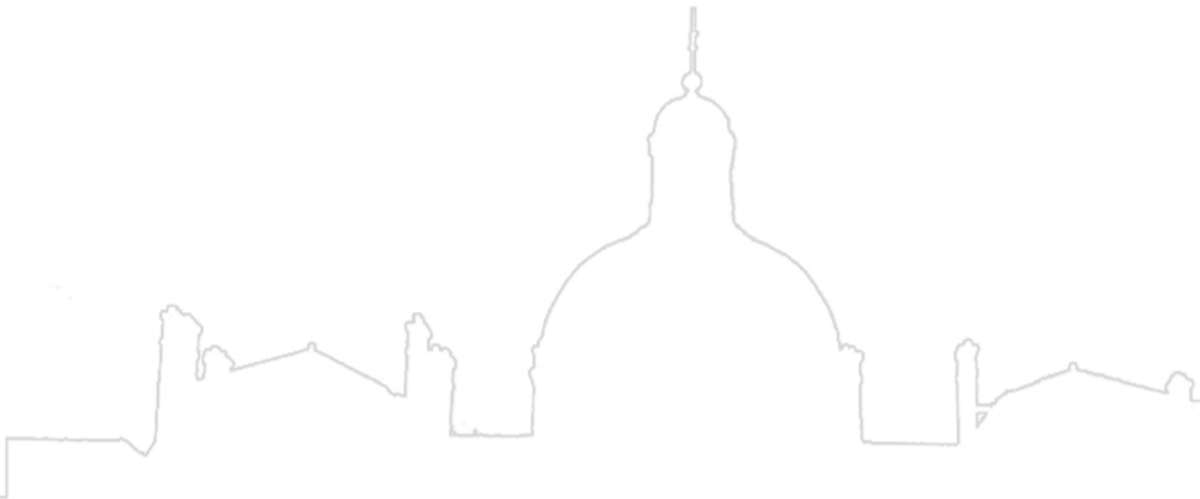
# \*additional criteria of Acute Myocardial Ischemia

- New ischemic ECG changes
- Development of new pathological Q waves

- Angiographic findings consistent with a **procedural flow-limiting complication** :
  - coronary dissection
  - occlusion of a major epicardial artery or a side branch
  - occlusion/thrombus
  - disruption of collateral flow
  - distal embolization

- **Imaging evidence of new loss of viable myocardium**
- **New regional wall motion abnormality** in a pattern consistent with an ischemic etiology

# What is the rate of events ?



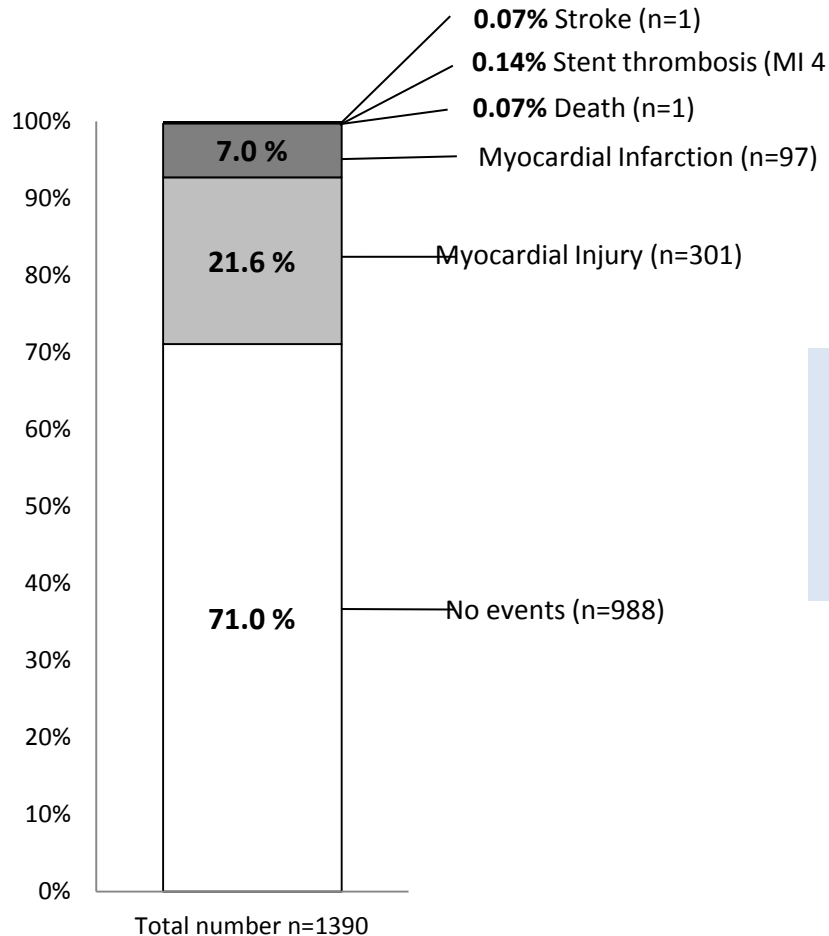
# Rate of MI type 4a and injury in post PCI

MI Type 4a or myocardial injury rates (2<sup>nd</sup> universal definition) in the literature

Authors	Journal	Years	n	MI Type 4a or myocardial injury (>3X 99th percentile)
<b>Collet al</b>	<b>New Engl J Med</b>	<b>2012</b>	<b>2500</b>	<b>29%</b>
Novacket al	Arch Intern Med	2012	4930	24%
Pervaizet al	Circulation CI	2012	3687	19%
Porto et al	Circulation CI	2012	50	42%
Feldman et al	Catheter Cardiovasc Inter	2011	22253 (MA)	26%/34%
Lee et al	Circ CVI	2011	131	24%
Kim et al	Int J Cardiol	2011	213	14%
Mangiacastra et al	JACC CardiovascInterv	2010	338	31%
Locca et al	JACC CardiovascInterv	2010	45	58%
Hoole et al	Coron Artery Dis	2010	243	27%
Nienhuis et al	Catheter Cardiovasc Inter	2008	15581 (MA)	33%
			<b>Average</b>	<b>30%</b>

# Real life events rate

n= 1390 Elective PCI (Troponin <0) at the Pitié-Salpêtrière Hospital in 2014-2015



## 29% events at 48hours

-**frequent (28.6%)** when considering PCI-related myonecrosis/myocardial injury  
-**rare (0.28%) but serious** when considering stent thrombosis, Q wave MI or stroke.

# Définition\*

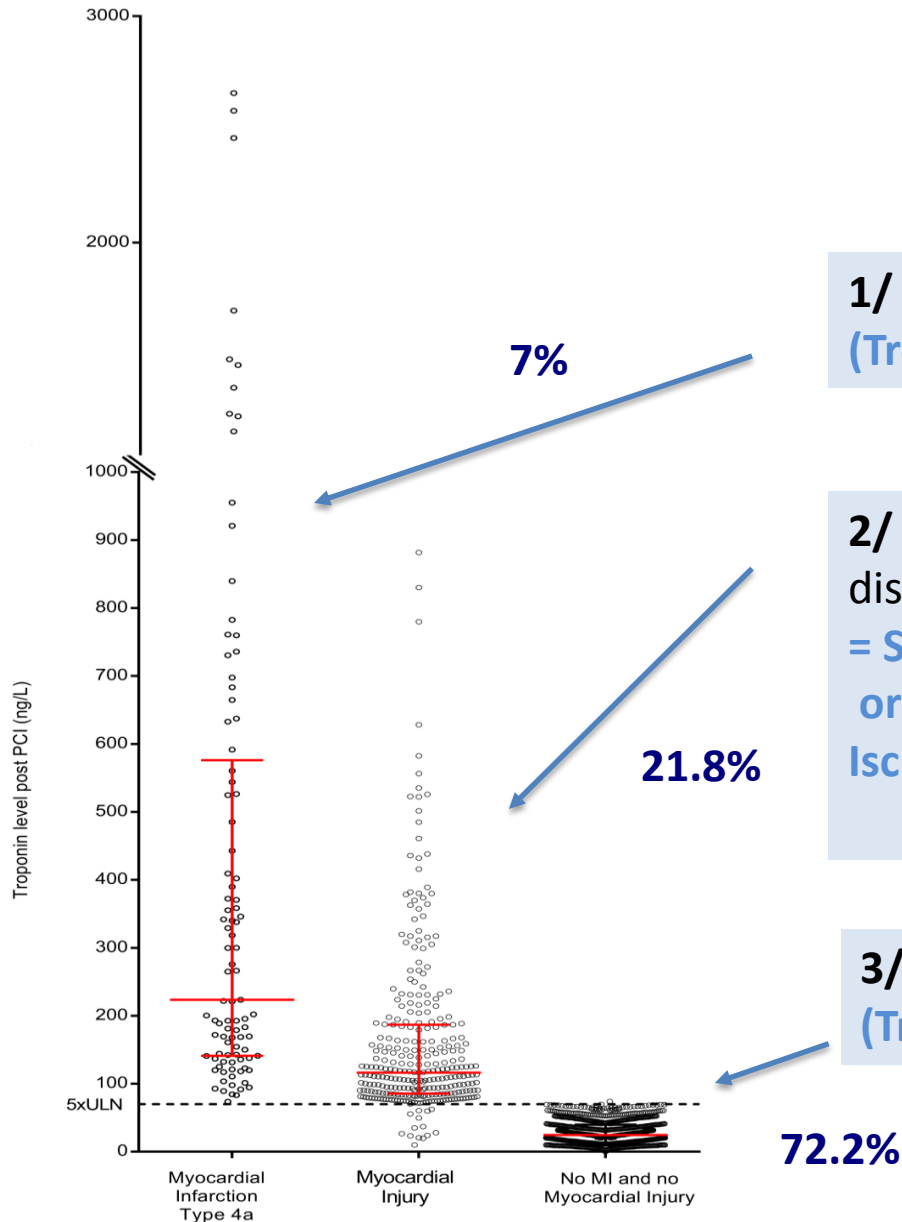
\*Third Universal definition

**1/ peri-procedural Myocardial Infarction type 4a  
(Troponin Elevation X5 ULN + Ischemic Criteria)**

**2/ myocardial injury at 48hours or earlier if discharge.**

**= Silent elevation of Troponin > 5xULN  
or  
Ischemic Criteria + Troponin < 5xULN**

**3/ No events  
(Troponin Elevation <5x ULN only)**

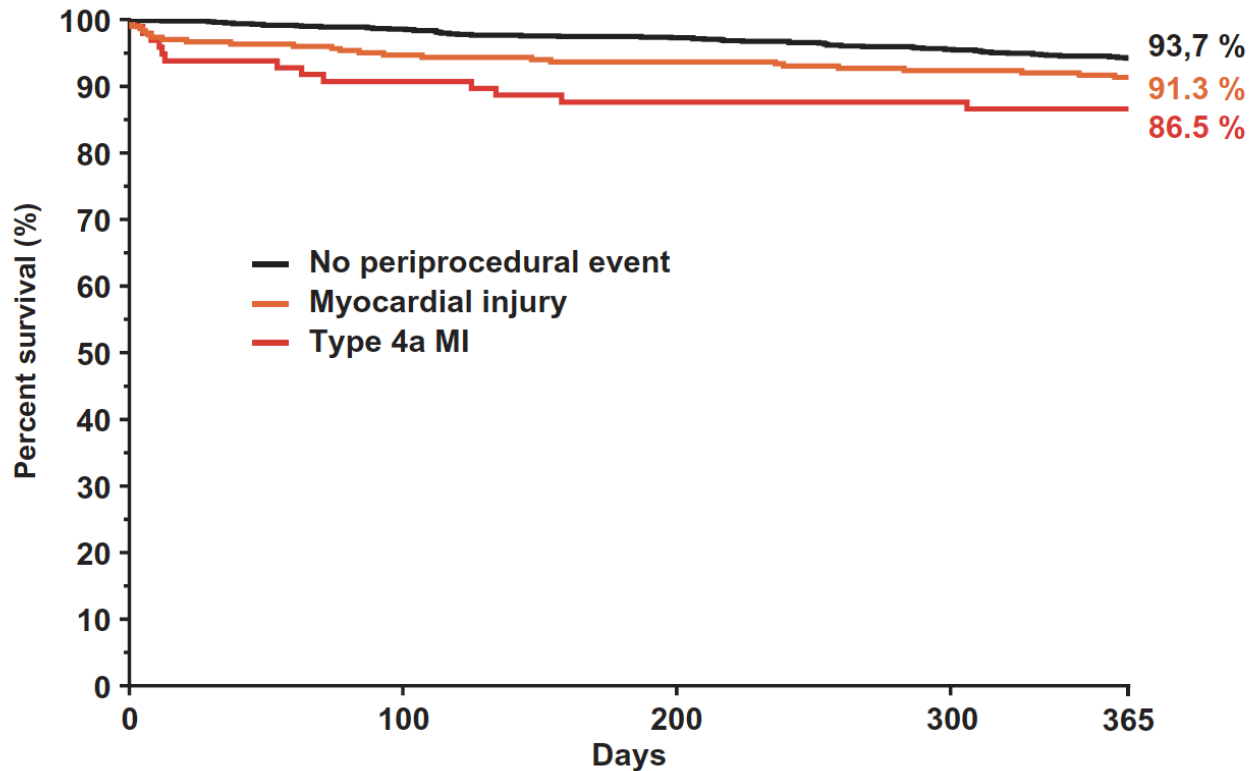


# What is the impact ?



# Impact on CV events

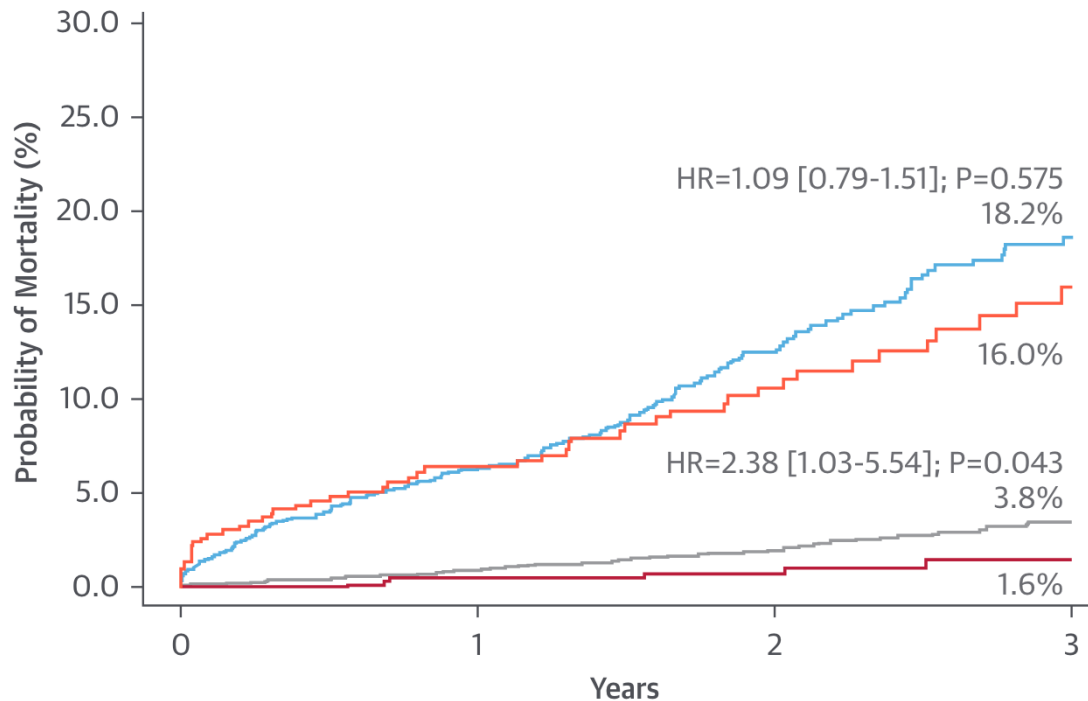
Event Free survival from ischemic events at one year



No. at risk	0	100	200	300	365
No periprocedural event	989	974	961	944	923
Myocardial Injury	301	286	283	279	275
Type 4a MI	97	88	86	85	81

# Impact on mortality

N= 5626 patients undergoing elective PCI



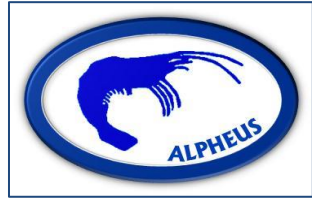
Troponin groups/patients at risk

Raised at baseline/further raised after PCI	1647	912	529	248
Raised at baseline/not raised after PCI	516	325	198	106
Not raised at baseline/raised after PCI	2721	1832	1142	588
Not raised at baseline/not raised after PCI	742	484	309	144

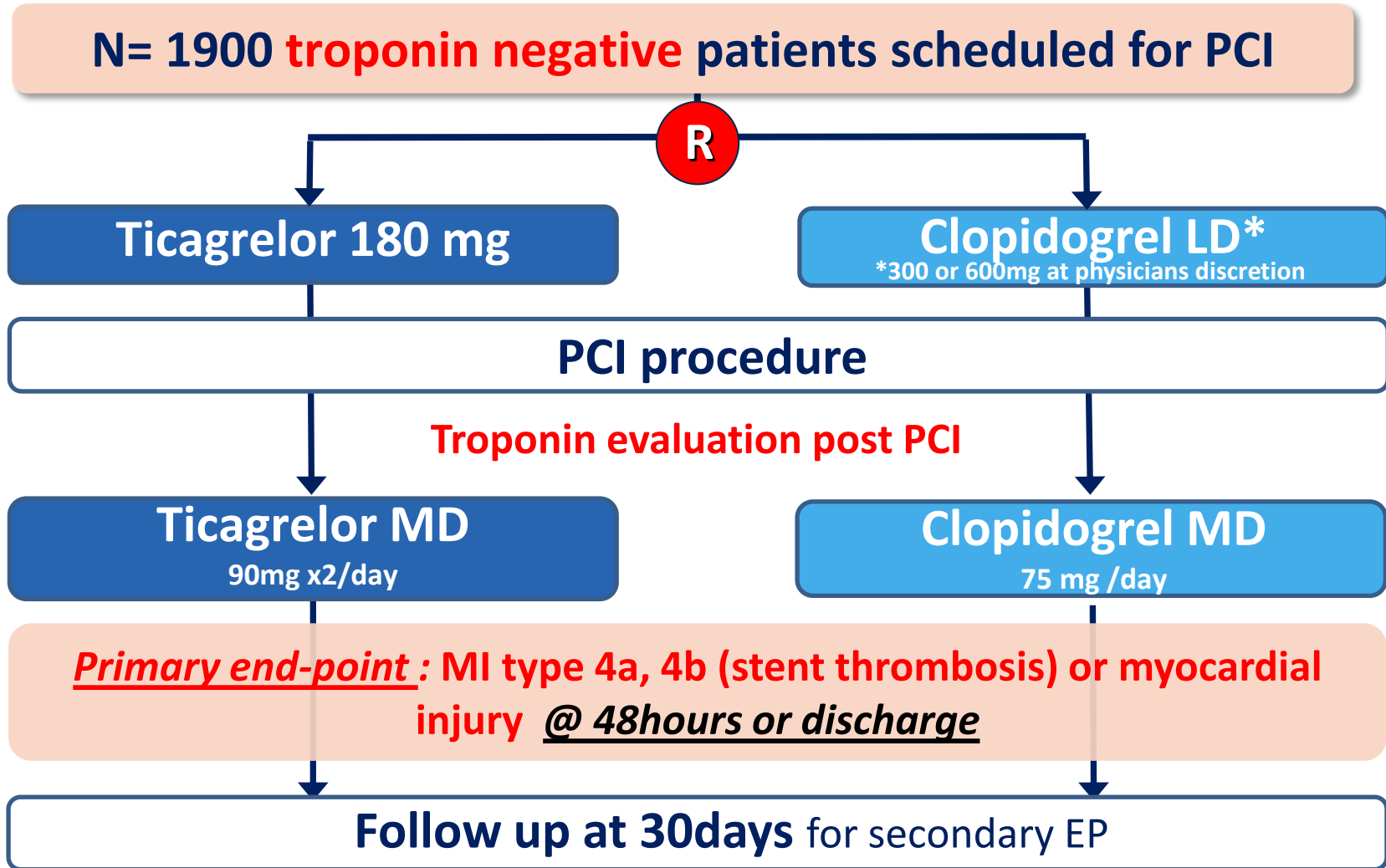


# Next step ?

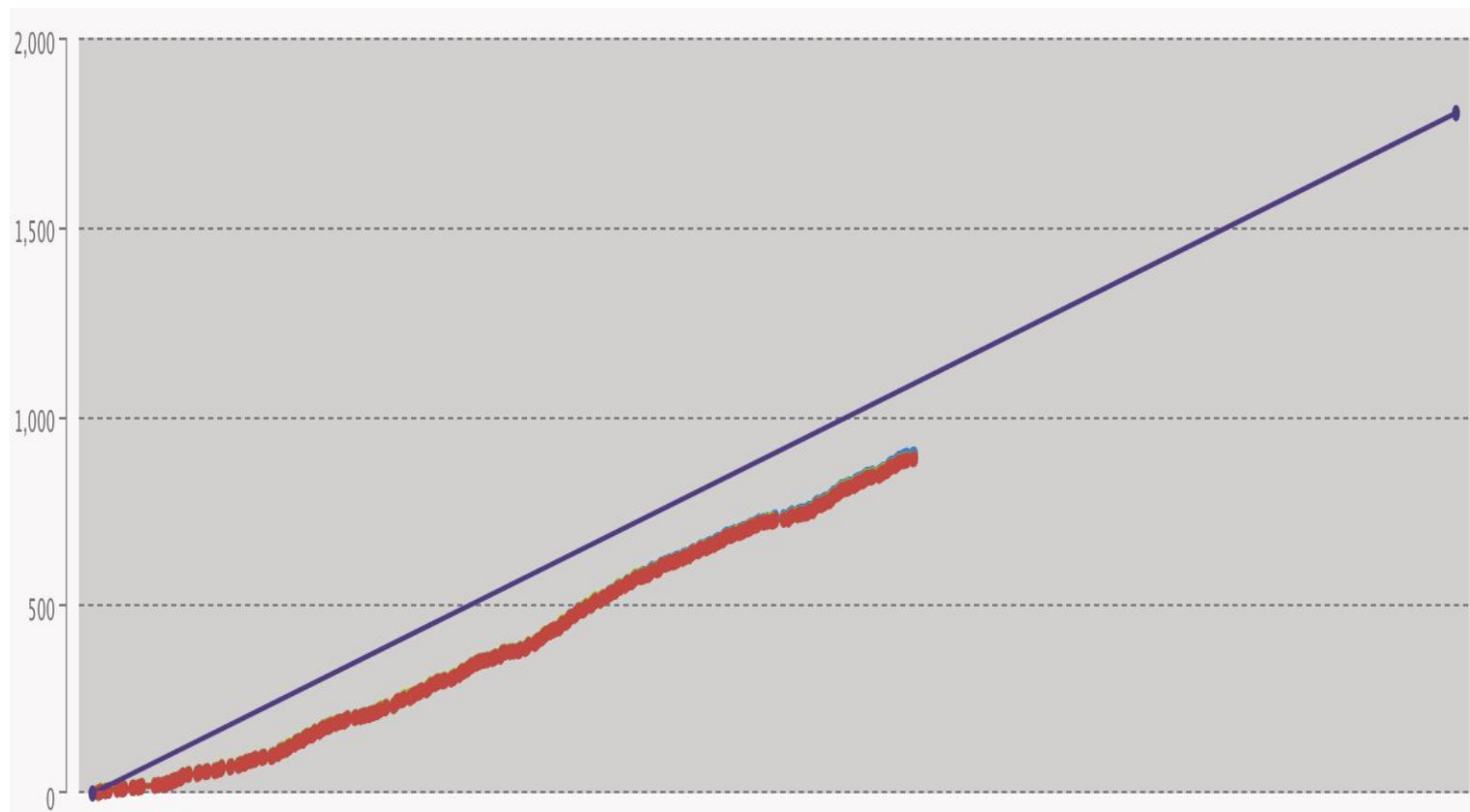




# ALPHEUS Trial



# 885 patients randomisés / 1900



## Bravo à tous les centres participants !

**Johanne SILVAIN**

[johanne.silvain@aphp.fr](mailto:johanne.silvain@aphp.fr)

<sup>1</sup> Sorbonne Université

<sup>2</sup> ACTION Study Group

<sup>3</sup> INSERM UMRS 1166 ICAN

<sup>4</sup> Institut de Cardiologie (APHP)



**Merci**



[www.action-cœur.org](http://www.action-cœur.org)

PITIE-SALPETRIERE UNIVERSITY HOSPITAL