

# Myocardial injury after non-cardiac surgery

P.J. Devereaux, MD, PhD

Director of Division of Perioperative Care , McMaster University

Associate Deputy Director of the Population Health Research Institute

Hamilton, Ontario, Canada

# Goals of presentation

- Prognostic relevance of troponin elevation after non-cardiac surgery
- Myocardial injury after noncardiac surgery (MINS)
  - diagnostic criteria
  - pathophysiology
  - management
- Should physicians obtain troponin measurements after non-cardiac surgery

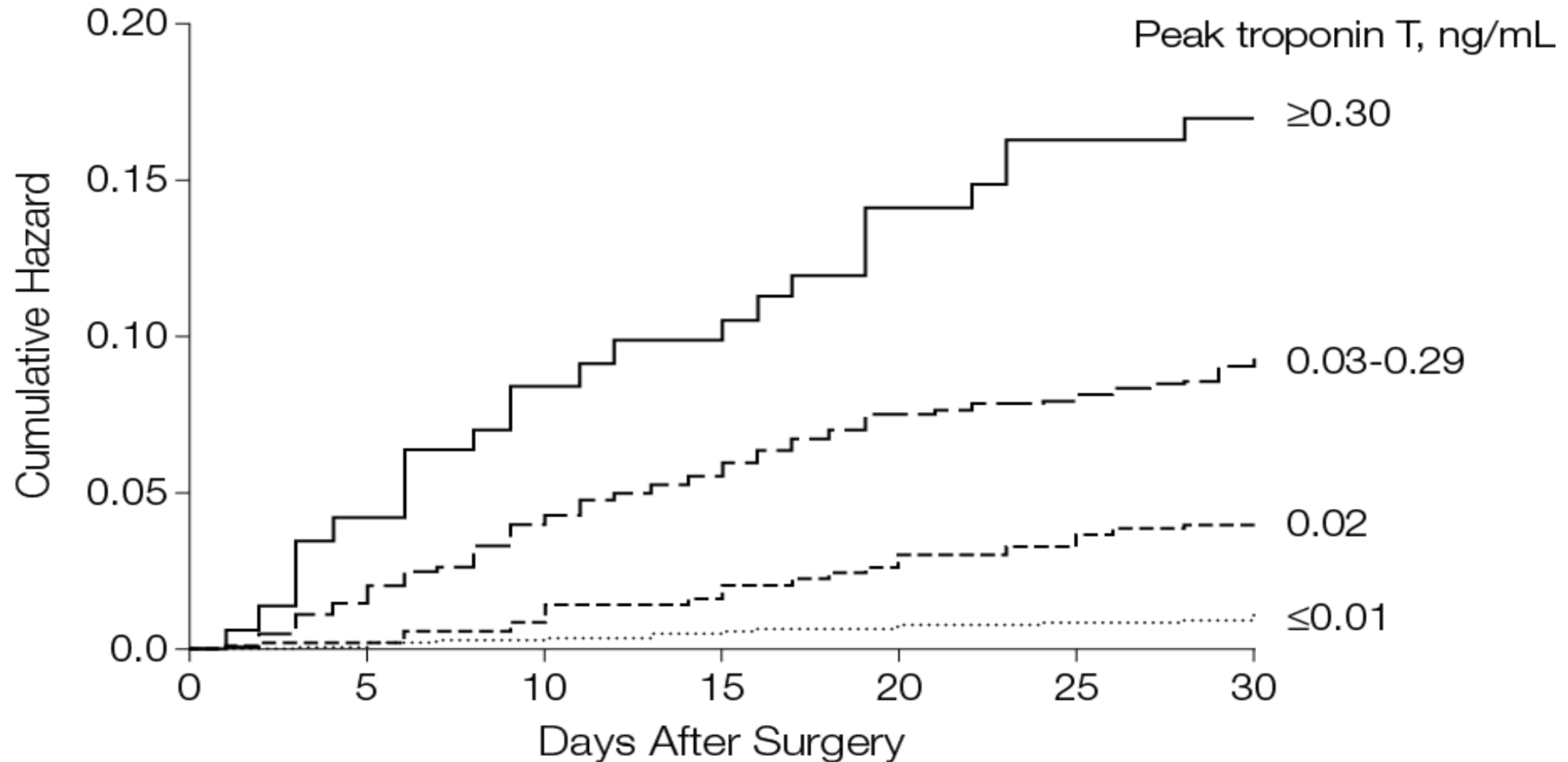
# Background

- >200 million major non-cardiac surgery annually
  - surgery can improve and prolong quality and duration of life
- Non-cardiac surgery also associated with
  - haemodynamic compromise, hypercoagulability, inflammation, sympathetic stimulation, and bleeding
    - all of which can predispose patients to ischaemic injuries
- Large prospective cohort studies of patients undergoing non-cardiac surgery have focused on myocardial injury and
  - informed prognostic relevance of perioperative troponin elevations

# VISION Study

- Primary objective – inform relationship between perioperative troponin measurements and 30-day mortality
- Prospective cohort study of representative sample of 40,004 patients
- Eligibility criteria
  - $\geq 45$  yrs underwent in-patient noncardiac surgery
- 28 centres in 14 countries
  - N + S America, Europe, Asia, Africa, Australia
- TnT measured 6-12 hours after surgery and daily for 3 days
- Iterative Cox proportional hazards models exploring if there were TnT thresholds that independently altered risk of 30-day mortality

# Association between non-high sensitivity troponin after noncardiac surgery and 30-day mortality



# Peak postoperative hsTnT thresholds associated with 30-day mortality

hsTnT thresholds (ng/L)	# of patients (%)	# of deaths (%)	aHR (95% CI)	P
<5	5318 (24)	6 (0.1)	1.00	-
5 to <14	8750 (40)	40 (0.5)	3.73 (1.58-8.82)	0.003
14 to <20	2530 (12)	29 (1)	9.11 (3.76-22.09)	<0.001
20 to <65	4049 (19)	123 (3.0)	23.63 (10.32-54.09)	<0.001
65 to <1000	1118 (5)	102 (9)	70.34 (30.60-161.71)	<0.001
≥1000	54 (0.2)	16 (30)	227.01 (87.35-589.92)	<0.001

# Elevated perioperative hsTnT

- Absolute hsTnT change  $\geq 5$  ng/L increased 30-day mortality
  - aHR, 4.69; 95% CI, 3.52-6.25
- Based on analyses defined elevated postop hsTnT
  - 20 to  $<65$  ng/L with change  $\geq 5$  ng/L or hsTnT  $\geq 65$  ng/L

# Myocardial injury after non-cardiac surgery (MINS)

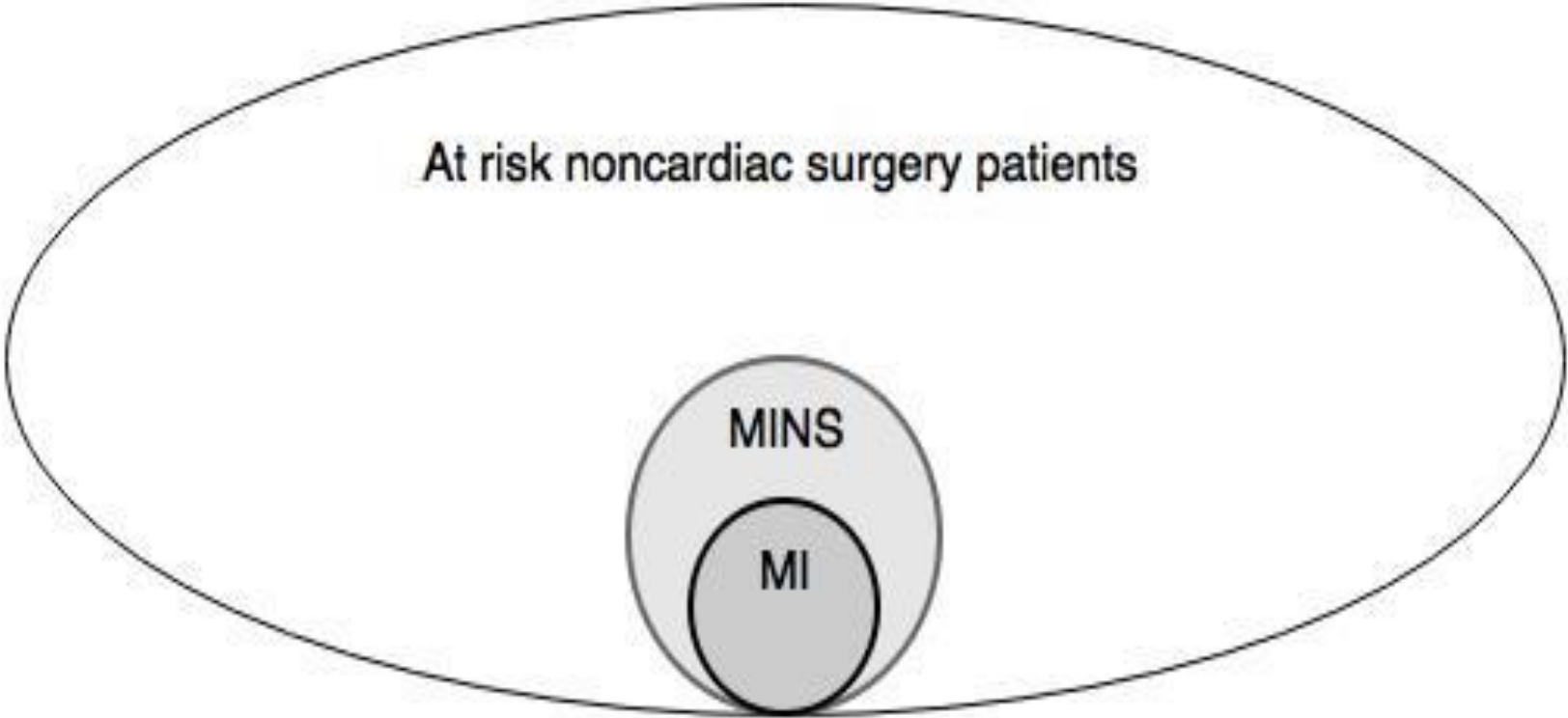
- Myocardial ischaemic injuries
  - leading cause of 30-day mortality after non-cardiac surgery
- Studies have demonstrated
  - substantial number of patients undergoing non-cardiac surgery sustain prognostically important ischaemic myocardial injuries that do not fulfill Universal Definition of MI
- Therefore, many perioperative researchers have focused on
  - myocardial injury after non-cardiac surgery (MINS), which includes MI and ischaemic myocardial injury that does not fulfill MI definition



# MINS diagnostic criteria

- Large cohort studies have established diagnostic criteria for MINS
  - through multivariable analyses that have demonstrated association between proposed diagnostic criteria and 30-day mortality
- Diagnostic criteria for MINS
  - elevated post-operative troponin measurement judged due to myocardial ischaemia (i.e., no evidence of non-ischaemic aetiology)
  - during or within 30 days after non-cardiac surgery and
  - without requirement of ischaemic feature
    - e.g., ischaemic symptom, ischaemic ECG finding

# Incidence of MINS and MI



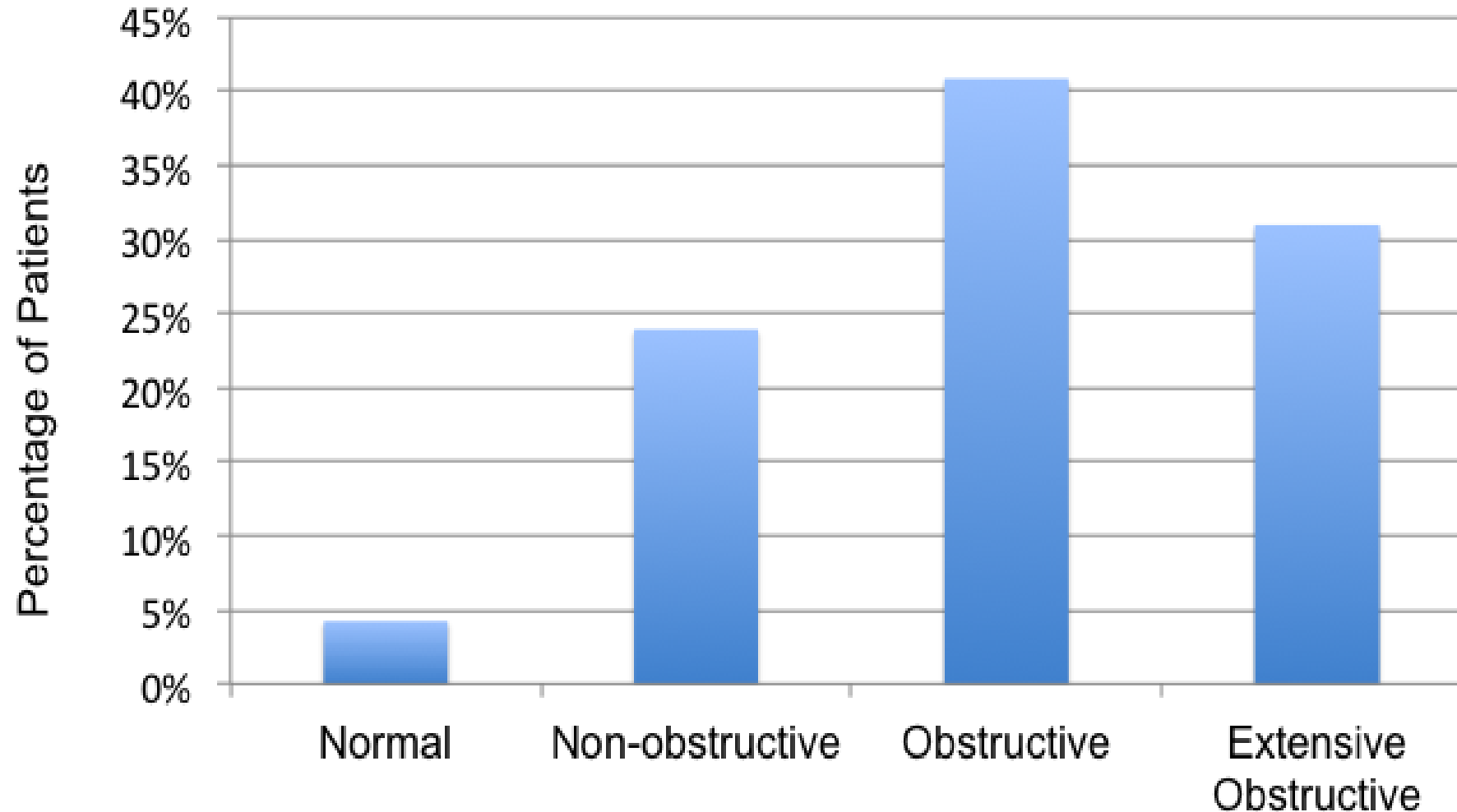
# Ischemic versus non-ischemic perioperative troponin elevations

- MINS does not include perioperative myocardial injury due to non-ischaemic aetiology (e.g., rapid AF, sepsis, PE)
- Adjudicators have assessed etiology of hsTn elevations in VISION and Swiss Studies
  - 11–14% of hsTn elevations after surgery were due to non-ischaemic aetiology
  - suggesting 86–89% of periop hsTn elevations are due to myocardial ischaemia

# OPTIMUS Study

- 30 patients with periop MI matched with 30 non-operative MI patients all underwent cath with optical coherence tomography
- 1 in 8 periop MIs demonstrated acute thrombus
- Culprit lesion demonstrated fibroatheroma in 60% of periop and 67% of non-operative MI patients
- Symptoms, ischemic ECG findings did not differentiate thrombotic from supply-demand mismatch

# Periop MI within 30 days of non-cardiac surgery and CAD on pre-op Coronary CTA



# Pathophysiology of MINS

- Although OPTIMUS and Coronary CTA Studies did not include patients with periop myocardial injury that did not fulfil Universal definition of MI
  - unlikely more of these myocardial injuries are due to thrombosis than periop MI
- Therefore data suggests MINS is due to ischemia
  - thrombosis (23–31%)
  - supply-demand mismatch (69-77%)
- Almost all of these patients had underlying CAD
- This shared pathophysiology that predisposes patients to future thrombotic events has potential to facilitate identifying effective therapeutic interventions

# Should you monitor perioperative troponins?

- VISION 93% of MINS occurred without ischemic symptoms and likely would have gone unrecognized without troponin monitoring
  - elevated postop hsTnT without ischemic feature associated with increased risk of 30-day mortality (aHR, 3.20; 95%, 2.37-4.32)
- POISE
  - 415 patients had MI - 2/3rds were asymptomatic
  - risk adjusted association with death at 30 days

Predictor	HR	95% CI
symptomatic MI	4.75	2.68-8.43
asymptomatic MI	4.00	2.65-6.06

# Conclusions

- Troponin elevation after non-cardiac surgery associated with increased risk of 30-day mortality and 2-year major vascular events
- Diagnostic criteria for MINS include
  - ischemic troponin elevation within 30 days after non-cardiac surgery, without need of ischaemic feature
- Pathophysiology of MINS
  - 69-77% supply-demand mismatch, 23–31% thrombosis, almost all have CAD
- Without periop troponin measurements
  - >90% of MINS and >50% of MIs will go undetected