MHIF FEATURED STUDY:
Tendyne MAC

DESCRIPTION:
Early feasibility study of the Tendyne Mitral Valve System in Mitral Annular Calcification. This is a multi-center study with 10 sites participating to enroll 30 patients total.

CRITERIA LIST/QUALIFICATIONS:

Inclusion
1) Symptomatic Severe MR; 2) MAC; 3) Noted to be Too High Risk for Surgery; 4) NYHA $\geq$ II

Exclusion
- Severe Stenosis not amenable to valvuloplasty
- LVEDD $>$ 7.0
- PAS $>$ 70 mmHg
- EF < 25%
- Prior MV Intervention
- Carotid Stenosis $>$ 70%
- LA or LV Thrombus
- CAD
- Severe TR
- COPD w/ Home O2

CONDITION:
Mitral Annular Calcification w/ Severe Symptomatic Mitral Regurgitation

NATIONAL PI:
Paul Sorajja, MD

RESEARCH CONTACT:
Karlee Gebhart, RN
Karlee.Gebhart@allina.com | 612-863-7821

SPONSOR:
Tendyne Holdings

OPEN AND ENROLLING:
Please Refer Patients!

MHIF is the top enroller with 4 patients implanted! Please help us keep the momentum going!
Minneapolis Heart Institute Foundation® Cardiovascular Grand Rounds

Title: Case Carousel

Speaker: Robert Fraser, MD, Cardiovascular Disease Fellow
Minneapolis Heart Institute® at Abbott Northwestern Hospital & Hennepin County Medical Center

Date: April 29, 2019
Time: 7:00 - 8:00 AM
Location: ANW Education Building, Watson Room

OBJECTIVES
At the completion of this activity, the participants should be able to:
1. Summarize the 2018 4th universal definition of myocardial infarction.
2. Summarize the WHO ICD-10 codes for elevated troponin.
3. Apply the 4th universal definition of MI and troponin-related ICD-10 codes to clinical practice.

ACCREDITATION
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Nurse - This activity has been designed to meet the Minnesota Board of Nursing continuing education requirements for 1.0 hours of credit. However, the nurse is responsible for determining whether this activity meets the requirements for acceptable continuing education.

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Moderator(s)/Speaker(s)
Dr. Robert Fraser has disclosed that he DOES NOT have any real or apparent conflicts with any commercial interest as it relates to presenting the content in this activity/course.
Planning Committee
Dr. Alex Campbell, Jake Cohen, Jane Fox, Dr. Mario Gössl, Dr. Kevin Harris, Dr. Kasia Hryniewicz, Rebecca Lindberg, Amy McMeans, Dr. Michael Miedema, Dr. JoEllyn Moore, Pamela Morley, Dr. Scott Sharkey, and Jolene Bell Makowesky have disclosed that they DO NOT have any real or apparent conflicts with any commercial interest as it relates to the planning of this activity/course. Dr. David Hurrell has disclosed the following relationship -Boston Scientific: Chair, Clinical Events Committee.

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Actelion Pharmaceutical Companies
of Johnson & Johnson

Portola Pharmaceuticals

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Each attendee at an activity is responsible for determining whether an activity meets their requirements for acceptable continuing education and should only claim those credits that he/she actually spent in the activity.

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PLEASE SAVE A COPY OF THIS Flier AS YOUR CERTIFICATE OF ATTENDANCE.

Signature: __________________________________________________________________________

My signature verifies that I have attended the above stated number of hours of the CME activity.

Allina Health - Learning & Development - 2925 Chicago Ave - MR 10701 - Minneapolis MN 55407
Case Carousel:

Troponinitis

Rob Fraser, MD
Cardiology Fellow

April 29, 2019

No Disclosures
29F

HPI: Acute shortness of breath

PMH - None
PSH - None
FMH - None
Social History - No tobacco

HR 135
BP 95/67
RR 22
SpO2 94%
What do we call the abnormal troponin?

A. NSTEMI
B. Type 2 MI
C. Myocardial injury
D. Myocardial necrosis
E. Demand ischemia
F. Elevated troponin
G. Troponinemia

And how will it be coded?
Objectives

• Review 2018 ACC/AHA/ESC 4th Universal Definition of Myocardial Infarction

• Review WHO ICD-10 codes for elevated troponin

• Apply 4th Universal Definition of MI and ICD-10 codes to clinical practice

ACC/AHA/ESC

A. NSTEMI
B. Type 2 MI
C. Myocardial injury
D. Myocardial necrosis
E. Demand ischemia
F. Elevated troponin
G. Troponinemia

ICD-10

A. NSTEMI
B. Type 2 MI
C. Myocardial injury
D. Myocardial necrosis
E. Demand ischemia
F. Elevated troponin
G. Troponinemia
Fourth Universal Definition of Myocardial Infarction (2018)

+ Troponin
(Rise or Fall)

Symptoms
EKG changes
Imaging changes
Angiographic findings

Myocardial Infarction

Myocardial Injury
29F with acute shortness of breath found to have PE

HR 135
BP 95/67
RR 22
SpO2 94% 3L
+ Troponin
(Rise/Fall)

Symptoms
EKG
Imaging
Cath

Myocardial Infarction

1. ASCVD
2. Non-ASCVD
3. SCD
4. PCI
5. CABG

Myocardial Injury
<table>
<thead>
<tr>
<th><strong>I21 AMI</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• I21.0 STEMI (Anterior)</td>
<td></td>
</tr>
<tr>
<td>• I21.1 STEMI (Inferior)</td>
<td></td>
</tr>
<tr>
<td>• I21.2 STEMI (Other wall)</td>
<td></td>
</tr>
<tr>
<td>• I21.3 STEMI (Unspecified)</td>
<td></td>
</tr>
<tr>
<td>• I21.4 NSTEMI</td>
<td></td>
</tr>
<tr>
<td>• I21.A1 Type 2 Myocardial Infarction</td>
<td></td>
</tr>
<tr>
<td>• I21.A9 Other Myocardial Infarction</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>R77 Other abnormalities of plasma proteins</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• R77.8 Other specified abnormalities of plasma proteins</td>
<td></td>
</tr>
</tbody>
</table>

WHO (2018) *The ICD-10: Clinical descriptions and diagnostic guidelines*
+ Troponin
(Rise/Fall)

Symptoms
EKG
Imaging
Cath

Myocardial
Infarction

Myocardial
Injury

1
ASCVD
STEMI I21.0-3
NSTEMI I21.4

2
Non-ASCVD
Type 2 MI I21.A1

3
SCD

4
PCI

5
CABG

Other Specified
Abnormal Blood
Protein R77.8

Elevated
Troponin

• Acute Myocardial Infarction
• Demand Ischemia
• Myocardial Necrosis
• Troponinemia
• Troponinitis

17F

HPI: Acute chest tightness

PMH
- Dilated NICM (EF 15%)
- Dual chamber ICD
- LBBB

PSH
- None

FMH
- Cardiomyopathy

Social History
- Unstable housing
- Tobacco use
Clinical Status

<table>
<thead>
<tr>
<th>Treated</th>
<th>Since 24-Apr-2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>VT</td>
<td>0</td>
</tr>
<tr>
<td>FVT</td>
<td>0</td>
</tr>
<tr>
<td>VT (Off)</td>
<td>0</td>
</tr>
<tr>
<td>AT/AF (Monitor)</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Monitored</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>VT (171-200 bpm)</td>
<td>0</td>
</tr>
<tr>
<td>VT-NS (&gt;4 beats, &gt;200 bpm)</td>
<td>0</td>
</tr>
<tr>
<td>High Rate-NS</td>
<td>0</td>
</tr>
<tr>
<td>SVT: VT/VF Rx Withheld</td>
<td>0</td>
</tr>
<tr>
<td>V. Oversensing-TWave Rx Withheld</td>
<td>0</td>
</tr>
<tr>
<td>AT/AF</td>
<td>0</td>
</tr>
<tr>
<td>Time in AT/AF</td>
<td>0.0 hr/day (0.0%)</td>
</tr>
</tbody>
</table>

Medical imaging with highlighted areas.
Coronary Embolism

+ Troponin (Rise/Fall)

Symptoms
EKG
Imaging
Cath

Myocardial Infarction

1 ASCVD
STEMI I21.0-3
NSTEMI I21.4

2 Non-ASCVD
Type 2 MI I21.A1

3 SCD
4 PCI
5 CABG

Other Specified Abnormal Blood Chemistry R77.8
Elevated Troponin

Myocardial Injury

Prevalence, Clinical Features, and Prognosis of Acute Myocardial Infarction Attributable to Coronary Artery Embolism

Toshihiko Shihara, MD; Shuji Kosakami, MD; Toru Negishi, MD; Tomotsu Takada, MD; Yoshiki Hatazumi, MD; Tomoki Koga, MD; Toshikazu Nakai, MD; Kazuhito Nakai, MD; Masaki Fujita, MD; Kazuaki Nagato, MD; Hiroshi Ishibashi, MD; Kyoko Tsuchida, MD; Yoshikazu Suzui, MD; Toshio Ogasawara, MD; Shintaro Yatabe, MD

Table 1. Proposed NCVC Criteria for the Clinical Diagnosis of Coronary Artery Embolism

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definite CE (n = 32)</td>
<td>Two or more major criteria (≥7) or one major criterion plus two or more minor criteria (≥12) or three minor criteria (≥6)</td>
</tr>
<tr>
<td>Probable CE (n = 20)</td>
<td>One major criterion plus one minor criterion (≥4) or two minor criteria (≥6)</td>
</tr>
</tbody>
</table>

Major criteria
- Angiographic evidence of coronary artery embolism and thrombosis without atherosclerotic components
- Concomitant coronary artery embolization at multiple sites
- Concomitant systemic embolization without left ventricular thrombus attributable to acute myocardial infarction

Minor criteria
- <25% stenosis on coronary angiography, except for the culprit lesion
- Evidence of an embolic source based on transthoracic echocardiography, transesophageal echocardiography, computed tomography, or MRI
- Presence of embolic risk factors: arterial fibrillation, cardiomyopathy, rheumatic valve disease, prosthetic heart valve, patent foramen ovale, atrial septal defect, history of cardiac surgery, infective endocarditis, or hypercoagulable state

Circulation. 2015;132(4)241-250
Type 2 MI

54M

HPI: Chest pain for 16 hours

PMH
- HTN
- Chronic pain

PSH
- None

FMH
- F: Heart disease

Social
- Active smoker
Acute Coronary Syndrome

+ Troponin
(Rise/Fall)

Symptoms
EKG
Imaging
Cath

Myocardial Infarction

Myocardial Injury

Other Specified Abnormal Blood Protein R77.8

Elevated Troponin

1 ASCVD
STEMI I21.0-3
NSTEMI I21.4

2 Non-ASCVD

3 SCD

4 PCI

5 CABG

Other MI I21.A9

27F

HPI: Motor vehicle accident

PMH
- None

PSH
- Tonsillectomy

FMH
- None

Social History
- Employed
- Non-smoker
Femur Fracture

+ Troponin
(Rise/Fall)

Symptoms
EKG
Imaging
Cath

Myocardial Infarction

1 ASCVD
STEMI I21.0-3
NSTEMI I21.4

2 Non-ASCVD
Type 2 MI I21.A1

3 SCD

4 PCI

5 CABG

Other Specified Abnormal Blood Protein R77.8
Elevated Troponin

Other MI I21.A9

Myocardial Injury

Circulation

ORIGINAL RESEARCH ARTICLE

Long-Term Outcomes in Patients With Type 2 Myocardial Infarction and Myocardial Injury

Major Adverse Cardiovascular Events
Non-Cardiovascular Death

Groups
Type 1 MI
Type 2 MI
Myocardial injury

Circ 2018;137(12):1236–1245
29F

HPI: Stuttering chest tightness for 6 hours

<table>
<thead>
<tr>
<th>PMH</th>
<th>PSH</th>
<th>FMH</th>
<th>Social History</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1P1</td>
<td>POD#7 s/p LTCS</td>
<td>None</td>
<td>Married</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Employed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Social ETOH</td>
</tr>
</tbody>
</table>
Spontaneous Dissection

+ Troponin
(Rise/Fall)

Symptoms
EKG
Imaging
Cath

Myocardial Infarction

1 ASCVD
STEMI I21.0-3
NSTEMI I21.4

2 Non-ASCVD
Type 2 MI I21.A1

3 SCD

4 PCI

5 CABG

Myocardial Injury

Other Specified Abnormal Blood Protein R77.8

Elevated Troponin

STATE-OF-THE-ART PAPER

Acute Myocardial Infarction Associated With Pregnancy
Asie Roth, MD,* Uni Elhayani, MD†
Tel Aviv, Israel; and Los Angeles, California

Coronary anatomy available, n (%) 96 (93)
Stenosis 41 (40)
Thrombus 8 (8)
Dissection 28 (27)
Spasm 2 (2)
Embolus 2 (2)
Normal 13 (13)

JACC 2008 52(3)171-180

Type 2 MI
43F

HPI: Severe sepsis due to streptococcal pneumonia, *pleuritic* chest pain hospital night 1

<table>
<thead>
<tr>
<th>PMH</th>
<th>PSH</th>
<th>FMH</th>
<th>Social</th>
</tr>
</thead>
<tbody>
<tr>
<td>HIV/AIDS</td>
<td>None</td>
<td>M: Sickle Cell Trait</td>
<td>Unstable housing</td>
</tr>
<tr>
<td>ETOH use disorder</td>
<td></td>
<td></td>
<td>Tobacco Use</td>
</tr>
<tr>
<td>Pancytopenia</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[Image of X-ray of chest]
The Case for Takotsubo Cardiomyopathy (Syndrome) as a Variant of Acute Myocardial Infarction

Scott W. Sharkey, Barry J. Maron and Robert A. Kloner

Originally published 20 Aug 2010 | https://doi.org/10.1161/CIRCULATIONAHA.110.035747 | Circulation: 2010;130:855–857

Natural History and Expansive Clinical Profile of Stress (Tako-Tsubo) Cardiomyopathy

Scott W. Sharkey, MD,* Denise C. Winderup, BA,* John R. Lesser, MD,* Martin S. Maron, MD;†
Robert G. Haeuser, MD,* Jennifer N. Lesser,* Timothy S. Haas, RN,* James S. Hodges, PhD,*
Barry J. Maron, MD*

Minneapolis, Minnesota, and Boston, Massachusetts

Figure 1: Ages at Stress Cardiomyopathy Presentation, by Sex

Ages at initial stress cardiomyopathy event, shown separately by sex.

JACC 2010 55(4)333-341
Spectrum and significance of electrocardiographic patterns, troponin levels, and thrombolysis in myocardial infarction frame count in patients with stress (tako-tsubo) cardiomyopathy and comparison to those in patients with ST-elevation anterior wall myocardial infarction.

Shayev BI², Lesser JJ, Morgan MJ, Panagl M, Maron MS, Maron BJ

**Mean Troponin**
- Admit 4.2 ng/mL
- Peak 8.4 ng/mL

Figure 1. Distribution of ECG patterns on admission in 59 patients with SC. MI = myocardial infarction.

*Am J Card 2008 101(12)1723-28*

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**Long-Term Prognosis of Patients With Takotsubo Syndrome**

*FIGURE 1 Long-Term Mortality of Takotsubo Syndrome Compared With ACS*

*JACC 2018 72(8) 874-882*
FIGURE 2 Short- and Long-Term Mortality of Different Triggering Groups

![Graph showing mortality rates for different triggering groups.]

### 52M

**HPI:** 2 chest pains

**PMH**
- ADPKD s/p LURT 1999
- CKD3
- HTN
- Dyslipidemia

**PSH**
- Bilateral nephrectomy
- Renal transplant

**FMH**
- F: ADPKD

**Social History**
- Married
- Employed

*JACC 2018 72(8) 874-882*
Aortic dissection causing coronary obstruction.
**Aortic Dissection**

+ Troponin (Rise/Fall)

Symptoms
- EKG
- Imaging
- Cath

Other Specified Abnormal Blood Protein E77.8

Myocardial Infarction

1. ASCVD
   - STEMI I21.0-3
   - NSTEMI I21.4

2. Non-ASCVD
   - Type 2 MI I21.A1

3. SCD

4. PCI

5. CABG

Myocardial Injury

Elevated Troponin

**Type 2 Myocardial Infarction**

JACC Review Topic of the Week

Yuli Sohn, MD, Alan S. Hsu, MD

Central Illustration: Diagnostic Approach for Patients with Suspected Acute Myocardial Infarction

JACC 2019 73(14)1846-60
Objectives

• Review 2018 ACC/AHA/ESC 4th Universal Definition of Myocardial Infarction

• Review WHO ICD-10 codes for elevated troponin

• Apply 4th Universal Definition of MI and ICD-10 codes to clinical practice
Thank You

Robert.Fraser@allina.com