Outcomes associated with small changes in normalrange cardiac markers

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Data collection

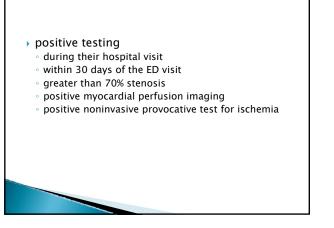
- Patients were included
- older than 18 years
- $^{\circ}$ suspected of having ACS
- $^{\circ}\,$ between June 1999 and August 2001
- 12-lead electrocardiogram (ECG) or cardiac biomarkers
- cardiac marker (troponin I, troponin T, or CK-MB) measured twice within 6 hours of presentation

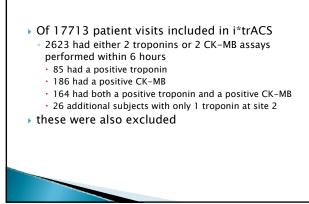
Predictor variables

- 15%: change in concentration of the institutional upper limit of normal was selected
- Patients was divided into 3 groups
 Decreasing cardiac markers>15%
 - stable markers: no absolute change greater than 15%
 increasing markers>15%

	CK-MB		Troponin	
	Institutional upper limit of normal	Minimum change not to be considered stable	Institutional upper limit of normal	Minimum change not to be considere stable
Site 1	3.50	0.53		
Site 2	5.80	0.87	0.25	0.04
Site 3	5.80	0.87	0.25	0.04
Site 4	5.80	0.87	0.25	0.04
Site 5	5.00	0.75	2.00	0.30
Site 6a"	7.00	1.05	0.20	0.03
Site 6b	5.00	0.75	1.50	0.23
Site 7	5.00	0.75	0.20	0.03
Site 8	8.00	1.20	2.00	0.30
Site 9	5.00	0.75	2.00	0.30

The institutional upper limit of normal for troponin was a factor of 10 lower than other sites; troponin levels at this site were not included in analysis.





	Change in 7	Troponin (n =	2021)	
	Decreasing	Stable	Increasing	
Age (y)	60.4 (15.7)	55.1 (14.6)	56.8 (15.3)	
Female	22 (59.5)	1016 (52.3)	15 (60.0)	2162 patient vi
Male	15 (40.5)	925 (47.7)	10 (40.0)	
White	20 (54.1)	822 (42.3)	12 (48.0)	were included,
African American	7 (18.9)	711 (36.6)	9 (36.0)	were merudea,
Other	10 (27.0)	408 (21.0)	4 (16.0)	2021 patient vi
Diabetes	8 (25.0)	404 (29.3)	10 (45.5)	2021 patient vi
Typertension	26 (81.3)	1031 (74.8)	17 (77.3)	had 2 troponin
Typerlipidemia	9 (28.1)	483 (35.1)	6 (27.3)	nau z troponin
Angina	11 (34.4)	217 (15.7)	7 (31.8)	26621/6
CAD	13 (40.6)	478 (34.7)	8 (36.4)	assays
CHF	2 (6.3)	156 (11.3)	3 (13.6)	
Current smoker	5 (27.8)	643 (46.8)	7 (41.2)	
Recent smoker	2(11.1)	135 (9.8)	4 (23.5)	
ECG diagnostic catego	CV			
Acute MI	0 (0.0)	13 (0.7)	0 (0.0)	
Acute ischemia	1 (2.8)	95 (5.2)	2 (8.7)	
Early repolarization	1 (2.8)	47 (2.6)	0 (0.0)	
Nondiagnostic	27 (75.0)	992 (54.7)	16 (69.6)	
Normal	7.0 (0.2)	665.0 (0.4)	5.0 (0.2)	
ACI-TIPI* (n = 1577)	35.9 (19.2)	27.6 (16.3)	33.0 (16.6)	
ACS	11 (29.7)	275 (14.2)	8 (32.0)	

	Change in C	K-MB (n=13	(11)
	Decreasing	Stable	Increasing
Age (y)	52.7 (13.5)	54.0 (14.6)	57.9 (16.8)
Female	33 (36.3)	601 (50.6)	18 (54.5)
Male	58 (63.7)	586 (49.4)	15 (45.5)
White	42 (46.2)	540 (45.5)	20 (60.6)
African American	43 (47.3)	515 (43.4)	11 (33.3)
Other	6 (6.6)	133 (11.2)	2 (6.1)
Diabetes	23 (33.8)	235 (28.6)	13 (54.2)
Hypertension	52 (76.5)	609 (74.0)	19 (79.2)
Hyperlipidemia	26 (38.2)	312 (37.9)	8 (33.3)
Angina	16 (23.5)	160 (19.4)	6 (25.0)
CAD	28 (41.2)	261 (31.7)	10 (41.7)
CHF	8 (11.8)	75 (9.1)	3 (12.5)
Current smoker	29 (44.6)	430 (48.0)	6 (25.0)
Recent smoker	8 (12.3)	87 (9.7)	5 (20.8)
ECG diagnostic categor	DV .		
Acute MI	0 (0.0)	6 (0.5)	0 (0.0)
Acute ischemia	4 (4.7)	53 (4.8)	2 (6.7)
Early repolarization	3 (3.5)	28 (2.5)	0 (0.0)
Nondiagnostic	50 (58.8)	605 (54.9)	20 (66.7)
Normal	28 (32.9)	410 (37.2)	8 (26.7)
ACI-TIPI* (n = 1125)	28.0 (17.0)	27.2 (16.1	28.2 (20.1
ACS	14 (15.4)	174 (14.6)	8 (24.2)

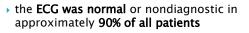
1311 patient visits had 2CK-MB assays

	Change i	n troponin			Change i	n CK-MB		
	Stable or decreasin	8	Increas	ing	Stable or decreasin	8	Increas	ing
	n	%	n	5	n	16	n	56
Positive testing	224	12.1	6	31.6	169	13.2	6	18.
Revascularization	70	3.8	4	21.1	49	3.8	3	9.
MI	27	1.5	0	0.0	15	1.2	1	3.
Death	7.	0,4	0	0.0	2	0.2	0	0.
noninvasive provocative t indicating revascularizatio	n. Myocardial in		ed based on d	scumented eviden	ice or a DRG cod	e of acute MI.		int cope
P 14								

creasing troponin	Versus stable	1.03	0.30-3.51
ncreasing troponin	troponin	3.59	1.40-9.21
Decreasing troponin	Versus stable	1.19	0.33-4.23
ncreasing troponin	troponin	4.81	1.60-14.46
ACI-TIPI		1.03	1.02-1.04
Decreasing CK-MB	Versus stable	1.06	0.59-1.92
Increasing CK-MB	CK-MB	1.87	0.83-4.20
Decreasing CK-MB	Versus stable	1.13	0.59-2.18
Increasing CK-MB	CK-MB		0.49-3.85
ACI-TIPI		1.03	1.02-1.05
creasing CK-MB	CK-MB nodels adjusted for p	1.37 1.03 robability	0.49-3.85 1.02-1.05 of ischemia

Discussion

- small changes in troponin not exceeding the institutional upper limit of normal are associated with increased risk of ACS
- a **decreasing troponin** did not portend ACS despite the fact that theoretically it could be the result of a resolving MI, which could also **be associated with ACS**
- Because the odds of adverse events are more than tripled when marker troponin was increasing, this suggests that even the smallest increases in troponin are clinically significant
- We found no differences between those with a stable CK-MB and those with either an increasing or decreasing CK-MB
- The significance of this finding is unclear but may reflect the lower specificity of CK-MB



 Small changes in troponin identify a cohort of patients at risk for ACS not otherwise detected by the ECG

Conclusions

- Any increase in troponin concentration within 6 hours of ED evaluation, is associated with an increased risk of ACS
- it will hopefully prompt further research into how patients, with troponin changes below the upper limit of normal, should be managed

