Postoperative myocardial injury is particularly prognostic toward predicting long-term mortality after non-cardiac surgery in patients classified as low-risk preoperatively.

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INTRODUCTION

- Myocardial injury even in asymptomatic symptoms is common after non-cardiac surgery, estimated to occur in ~12-20% of patients within 1-week of surgery, or up to 27 million patients globally each year[1-3].
- The VISION trial demonstrated that among 15,000 patients, troponin-T elevation within 3-days post-surgery was strongly associated with 2.4-10.5 fold rise in all-cause mortality at 30-days commensurate with magnitude of elevation.
- Additional studies[4,5], including a meta-analysis[6], have supported this idea that even a mild troponin (troponin-I or troponin-T) elevation above normal after non-cardiac surgery independently portends a high mortality risk (OR: 3.4) within the 1st year after surgery.
- Per ACC/AHA guidelines, evaluation of post-op troponin is a grade I recommendation when signs and symptoms of myocardial ischemia are present but is a grade IIb recommendation for routine screening[7].
- It has been suggested that high risk patients should be screened with a postoperative troponin measurement. Current preop risk stratification tools, such as RCRI and NSQIP, are designed for predicting risk in the immediate perioperative period and have only shown to have moderate discrimination toward 30-day risk[8,9].
- However, the role and performance of current preoperative risk assessments, RCRI and NSQIP, toward predicting postoperative troponin elevation and long-term mortality is unknown.

HYPOTHESIS/GOAL

We suspect that postoperative troponin elevation forebodes a high risk of all-cause mortality even in preoperatively low-risk patients.
Postoperative troponin screening might present an underutilized and efficient opportunity to help reclassify patients toward mitigating long-term mortality risk.

METHODS

- Single-center retrospective chart review analysis of patients that had a troponin drawn postoperatively from 2011 to 2016 at the MetroHealth Medical Center.
- Primary Endpoint: All-cause mortality up to one-year post-surgery.
- Patient data was de-identified by per institutional IRB protocol.
- The Ohio Department of Health provided official death records for those patients who were lost to follow up.

METHODS

- **Inclusion criteria:**
  1) Underwent non-cardiac surgery requiring an overnight hospital stay, a postoperative troponin-I drawn within 14 days of the index surgery 40-80 years of age.
  2) Determined to be at elevated risk for CVD: defined as either at least one major criteria or two minor criteria:
     a) Major criteria: history of documented CAD, diabetes mellitus, peripheral arterial disease (documented by ABI), ischemic stroke, current smoker
     b) Minor criteria: hypertension, hyperlipidemia (LDL>160 mg/dL) or current statin use, prior smoking history in the last decade, renal insufficiency (eGFR < 59 ml/min).
- **Exclusion criteria:**
  Pulmonary embolism, traumatic injury involving the chest cavity, or those who underwent neurosurgical intervention.

Analysis Methods

- Patients were determined to have troponin elevation if they had a troponin-I level of 2 times at or above the upper limit of normal at our lab, which is >0.08 ng/ml.
- Individual NSQIP and RCRI preoperative risk scores were calculated for each patient.
- Patients were classified as high-risk preoperatively if risk score determined >1% risk for MACE (RCRI) and mortality (NSQIP).
- Kaplan-Meier survival analysis and odds-ratio with sensitivity/specificity analysis were performed.

RESULTS

	Total Population		Negative Troponin		Positive Troponin		
	Number	%	Number	%	Number	%	p-value
Total	548		337	61.50	211	38.50	
Age (Mean)	64.05		64.18		63.85		0.70
Male	303	55.29	183	54.30	120	56.87	0.56
Female	245	44.71	154	45.70	91	43.13	0.56
HTN	419	76.46	274	81.31	145	68.72	0.7E-03
Known CAD	173	31.57	103	30.56	70	33.18	0.52
SMOKER	228	41.61	152	45.10	76	36.02	0.04
PVD	52	9.49	18	5.34	34	16.11	2.82E-05
CVA	49	8.94	30	8.90	19	9.00	0.97
HLD	291	53.10	204	60.53	87	41.23	1.05E-05
DM	200	36.50	127	37.69	73	34.60	0.46
CKD (GFR<59)	29	5.29	15	4.45	14	6.64	0.27
1yr Mortality	85	15.51	26	7.72	59	27.96	1.88E-10

Surgery Type	% of Total
Ortho	22.63
General surgery	24.64
Vascular	17.88
Spinal	14.78
ENT	4.20
Other	16.42

Table 1. Baseline characteristics of the study population. There was a fair representation of female patients, about 3/4 had hypertension, about ½ the patients were smoker or had hyperlipidemia, but only about 1/3 of the patients had diabetes, or known CAD and the majority did not have CKD. When subdivided based on troponin, the group with positive troponin had a higher proportion of patients with a known history of peripheral vascular disease (+10.8%) and significantly high 1-yr mortality (+20.24%) compared to the group of patients without post-op troponin elevation.

RESULTS

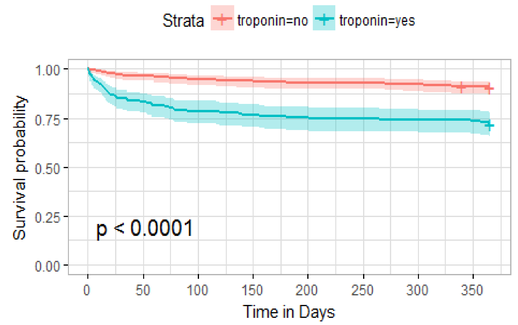

Figure 1: Kaplan-Meier Survival Curves for patients with and without postoperative troponin elevation. Consistent with previous reports, our Kaplan-Meier survival curves in Figure 1 clearly show that the MINS group (troponin) had increased mortality with separation of the curves within 30 days that stabilized after 6 months.

1yr Mortality				
	OR	95% CI	Sensitivity	Specificity
Trop High vs Low	3.90	2.44-6.33	0.66	0.67
RCRI High vs Low	1.57	0.97-2.45	0.39	0.71
NSQIP High vs Low	1.43	0.90-2.27	0.42	0.66

Table 2: 1yr Mortality in the population as associated with Troponin elevation or pre-op risk stratification tools. Elevated troponin portended a ~4 times higher risk of 1yr mortality with moderate sensitivity and specificity. Interestingly, higher preoperative risk per either risk stratifications tools (RCRI or NSQIP) did not portend a significantly higher 1yr mortality.

Troponin Elevation				
	OR	95% CI	Sensitivity	Specificity
RCRI High vs low	1.24	0.85-1.79	0.33	0.71
NSQIP High vs low	0.62	0.43-0.9	0.29	0.61

Table 3: Postoperative Troponin in the population as associated with pre-op risk stratification tools. Both risk-stratification tools had poor sensitivity and did not appropriately predicted postoperative troponin elevations

Association of post-op troponin elevation with 1-yr mortality across pre-op risk subclasses

R0: Low-risk RCRI R1: High-risk RCRI N0: Low-risk NSQIP N1: High Risk NSQIP

	Total: 548		High Trop		1 yr Mortality	
	Number	% of Total	Number	% within group	Number	% within group
R0	380	69.34	141	37.11	52	13.68
R1	168	30.66	70	41.67	33	19.64
N0	362	66.06	151	41.71	50	13.81
N1	186	33.94	60	32.26	35	18.82
R0N0	284	51.82	114	40.14	38	13.38

Table 4: Post-op troponin elevation and 1yr Mortality based on Pre-op risk stratification sub-classes. Majority of the study population (>2/3) was noted to be classified as low-risk preoperatively by either RCRI or NSQIP (R0 or N0) and about ½ of the patients were classified as low-risk by both RCRI and NSQIP (R0N0). There was a similar prevalence of post-op troponin elevation and no significance difference in mortality risk between the low and the high-risk groups for both risk tools.

1yr Mortality with Troponin Elevation vs without				
	OR	95% CI	Sensitivity	Specificity
R0	7.55	3.98 -15.22	0.76	0.70
R1	1.43	0.67 -3.02	0.49	0.60
N0	6.67	3.40-14.12	0.79	0.64
N1	2.42	1.16-5.03	0.47	0.73
R0N0	9.55	4.27-24.38	0.83	0.67

Table 5: Post-op troponin elevation prognosticates amplified risk of 1-yr mortality in the preoperatively low-risk groups compared to the general population. In R0N0 group (~1/2 of the study population), post-op troponin elevation was associated with a 10 times higher risk of 1yr mortality compared to 4 times in the overall study population, with an improved sensitivity while still maintaining moderate specificity. A similar trend was also noted with the individual pre-op low-risk subgroups: RCRI only (R0) and NSQIP only (N0).

CONCLUSIONS

- Our work adds to the growing body of evidence that patients with postoperative troponin elevations have clinically significant long-term all-cause mortality.
- This study demonstrates that currently used preoperative risk assessment tools, RCRI and NSQIP, by themselves were poor predictors of risk for postoperative troponin elevations or 1-yr mortality.
- Our results do however show that compared to the general population, post-op troponin elevation in patients classified as low-risk preoperatively by RCRI and NSQIP portended a markedly increased 1-yr mortality (10 times vs 4 times) with improved sensitivity of 0.83 and moderate specificity.
- These results support the use of postoperative troponin screening even in preoperatively low-risk patients with the appropriate cardiovascular risk factors to better identify patients with a high long-term mortality risk who might best benefit from further evaluation and risk mitigation strategies.

CLINICAL RELEVANCE

- The utility of risk stratification tools, with or without post-op troponin elevations, for prognosticating patients at high risk has been previously uncertain toward eventual management decisions and outcomes.
- Trials such as MANAGE[10] suggest a trend to improving CV outcomes with anti-thrombotic therapy and have also highlighted the poor utilization of primary prevention strategies such as aspirin and statin in these patients.
- Patients with “low-risk” pre-op likely stand to benefit from reclassifying their CV risk status with the identification of MINS through post-op troponin evaluation screening.

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