

Rural Community Hospital Care NSTEMI/UA: Implications for Triage and Treatment

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Background/Introduction

Evidence has shown that predicting cardiovascular events is difficult. Myocardial infarction occurs in at least 50% of patients without hyperlipidemia and up to 20% in those without traditional risk factors [1-8]. When an acute coronary syndrome (ACS) occurs, three models for risk stratification have shown improved immediate clinical assessment as well as risk prediction for future morbidity and mortality [9-11]. Combinations of pharmacological agents and urgent revascularization are recommended for patients at high risk [12-16].

The time interval currently recommended for early intervention for intermediate and high TIMI (Thrombolysis in Myocardial Infarction) risk score patients with NSTEMI/UA (non-ST elevated MI/unstable angina) is 4 to 24. Physician uncertainty regarding the decision for intervention in patients with NSTEMI/UA disposition is reflected by data from Can Rapid risk stratification of Unstable Angina patients Suppress Adverse outcomes with Early implementation (CRUSADE) where less than half of 19,238 NSTEMI patients were transferred for revascularization, and less than 20% were sent within forty eight hours of presentation [17]. CRUSADE also showed a paradoxical risk: transfer relationship, with 41% of low risk patients and 12.5% of high risk patients transferred in the early period. Our goal was to assess six month readmission and mortality of transferred vs. non transferred patients with NSTEMI/UA who presented for initial treatment at their community hospital.

Methods

Acting as an independent review board (IRB), the Hancock County Aging Study approved this study. Electronic medical records (EMR) of all NSTEMI/UA patients, (ICD9 codes 411.1 and 410.7) treated from January 1, 2009 through December 31, 2009 were identified. Variables for the cohort were coded and retrospectively evaluated for cardiovascular risk. TIMI risk score for morbidity and mortality has widespread acceptance with predictive power for ACS. Patients' risk score was retrospectively determined examining the patient's status at the time of admission to the community hospital. NSTEMI/UA was defined in those patients who presented to the emergency room with symptoms of coronary insufficiency including back/chest pain or pressure, nausea, diaphoresis, or shortness of breath. These symptoms were considered acute coronary insufficiency and NSTEMI when they were associated with positive troponin ($T > 0.03$ ng/ml) and those troponin values varied according to the pattern of myocardial necrosis, with or without abnormal ST depression and T wave inversion. EKG interpretations were performed by experienced and credentialed board certified internists, with confirmatory review of all EKGs by the

author/principle investigator. Patients with STEMI (ST elevation myocardial infarction) ACS were excluded from the review, utilizing the standard electrocardiographic criteria for STEMI. Vital signs were defined on entry to the emergency room. Since cholesterol is an acute phase reactant, total cholesterol, HDL cholesterol, LDL cholesterol and triglycerides were defined by the last value in the record prior to admission with calculated ratios of total cholesterol/HDL cholesterol, non-HDL cholesterol, and triglyceride/HDL cholesterol. Other lab values determined at the time of admission include serial troponins, glucose, and creatinine. The original risk measures of TIMI and NCEP ATP III have three and five levels respectively. For statistical purposes the categorical covariants table for readmission and death combined Low and Intermediate categories to define a new TIMI variable, and also combined NCEP ATP III categories with a new model for NCEP ATP III.

Since the key outcome variables are categorical, we used binary logistic regression models to assess the association between the outcome variable and other risk covariates. These measures of association reported in the result section are odds ratio and the c-statistic. We also choose the p-value calculated from the Wald chi-squared test statistic to justify the significance of variables in the logistic regression models. Both parametric and non-parametric analysis of variance (ANOVA) procedures were used to assess the association between some categorical variables and continuous variables. Two p-values (based on parametric normal test and non-parametric Kruskal-Wallis ANOVA) are reported. The linear regression model was used to identify the potential significant association between TC/HDL ratio and other variables. All analyses were carried out using SAS® 9.2 (SAS Institute Inc).

Results

Seventy three patients were admitted with NSTEMI/UA to a community hospital from January 1, 2009 through December 31, 2009 (Table 1). Thirty seven patients (51.4%) were transported twenty six miles for urgent revascularization, and thirty two received PCI (Table 4). Less than 17% of transferred patients with NSTEMI/UA received PCI (percutaneous intervention) in under 36 hours. Twenty three (31.8%) of the entire cohort were over 80 years of age, and ten greater than 90 years. The mean age was 71.5 years, and the mean age at time of death was 85.2 years. Overall mortality was 18.0% in 6 months, 8.3% due to cardiac disease. Statistically significant associations with mortality occurred with age ($p=0.0037$), and systolic ($p=0.0008$) and diastolic ($p=0.001$) blood pressures (Table 2). Readmission had near statistical validity with TC/HDL ratio ($p=0.0644$). There was no association of TIMI or modified TIMI risk score with death or

readmission (Table 3). Statistically significant reduced mortality was associated with transfer for catheterization (p=0.0005) (Table 4). A follow up of three and one half years since the initial one year of analysis of NSTEMI/UA patients revealed 50.8 % of 445 admissions to the community hospital were transferred for cardiac intervention.

Variables TIMI	Original TIMI				Modified TIMI		
	Low 9	Intermed 33	High 31	p-value 42	Low-Mod	High 31	p-value
Age	60.5 (19.0)	69.5 (13.4)	77.2 (13.2)	0.0056 *(0.0121)	67.6 (15.0)	77.2 (13.2)	0.0059* (0.006)
Systolic	121 (15.1)	137 (26.1)	132 (33.4)	0.2908 (0.1794)	134 (25.0)	132 (33.4)	0.7961 (0.5806)
Diastolic	72 (12.2)	75 (11.4)	71 (16.1)	0.4686 (0.3010)	74 (11.5)	71 (16.1)	0.2518 (0.1561)
Pulse	87 (11.9)	77 (15.7)	87 (15.5)	0.027* (0.0192)	79 (15.4)	87 (15.5)	0.034* (0.0278)
TC	185 (33.6)	167 (34.6)	169 (42.8)	0.4261 (0.4616)	171 (35.0)	169 (42.8)	0.8705 (0.6472)
HDL-C	41 (16.5)	48 (15.3)	46 (15.2)	0.4614 (0.3925)	46 (15.6)	46 (15.2)	0.8840 (0.9111)
LDL-C	114 (35.5)	94 (27.6)	98(38.0)	0.2716(0.4003)	98 (30.2)	98 (38.0)	0.9610(0.7168)
TRIG	146 (75.7)	126 (83.1)	117 (61.5)	0.5878 (0.6262*)	131 (81.1)	117 (61.5)	0.4520 (0.6553)
Non-HDL	146 (41.0)	121 (35.4)	136 (40.4)	0.2283 (0.3079)	126 (37.6)	126 (40.4)	0.9973 (0.7082)
GLUCOSE	126 (44.7)	109 (25.1)	128 (37.7)	0.0624 (0.0594*)	113 (30.5)	128 (37.7)	0.0507 (0.0259*)
CREAT	1.01 (0.53)	1.47 (1.95)	1.34 (0.43)	0.6664 (0.0190*)	1.37 (1.75)	1.34 (0.43)	0.9191 (0.0130*)
TC -RATIO	5.29 (2.56)	3.72 (1.25)	3.98 (1.44)	0.039 (0.2021)	4.05 (1.71)	3.98 (1.44)	0.8341 (0.9644)
Trig-RATIO	4.45 (3.17)	3.06 (2.32)	2.97 (1.94)	0.2158 (0.4835)	3.36 (2.55)	2.97 (1.94)	0.4752(0.7845)

Table 1: ANOVA Summary – TIMI and Modified TIMI Risk Variables, Note: The p-value outside the parenthesis is based on the regular ANOVA while the non-parametric Kruskal-Wallis ANOVA based p-values that tests equal means across the TIMI risk levels using ranks is reported inside the parenthesis

Variables Outcomes	Readmission (YES vs. NO)				Death (YES vs. NO)			
	Odds Ratio	95% C.I.	p-value	c-statistic	Odds Ratio	95% C.I.	p-value	c-statistic
AGE	0.978	(0.941,1.015)	0.2407	0.595	1.089	(1.028,1.154)*	0.0037*	0.771
TC-RATIO	1.383	(0.981,1.949)	0.0644*	0.589	1.053	(0.735,1.507)	0.7794	0.567
Trig-RATIO	1.17	(0.927, 1.478)	0.1862	0.586	0.859	(0.656, 1.126)	0.2715	0.557
TC	1.007	(0.992,1.022)	0.379	0.566	1.001	(0.986,1.017)	0.9007	0.541
HDL-C	0.97	(0.929,1.013)	0.1665	0.614	0.998	(0.960,1.037)	0.9149	0.522
LDL-C	1.008	(0.997,1.019)	0.1768	0.555	1.001	(0.983,1.018)	0.9429	0.521
TRIG	1.004	(0.997,1.011)	0.2458	0.54	0.998	(0.990,1.007)	0.7283	0.522
NonHDL	1.008	(0.994,1.023)	0.2676	0.57	1.007	(0.992,1.022)	0.3649	0.592
Systolic	1.009	(0.990,1.029)	0.3469	0.536	0.934	(0.897,0.972)*	0.0008*	0.849
Diastolic	1.001	(0.960,1.044)	0.9469	0.472	0.882	(0.819,0.950)*	0.0010*	0.824
Pulse	1.026	(0.989,1.065)	0.1725	0.639	1.021	(0.983,1.060)	0.2887	0.606
Glucose	0.998	(0.981,1.015)	0.8181	0.505	0.995	(0.977,1.014)	0.599	0.502

CREAT	1.045	(0.712,1.532)	0.8234	0.632	1.076	(0.744,1.558)	0.6962	0.725
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Table 2: Summary of logistic regression models – Continuous covariates, Note: The 95% confidence intervals that do not include 1.0 are significant at level 0.05. Since the p-value for the global goodness-of-fit test of the simple logistic regression model is equivalent to the significant test of the variable, we suggest reporting significance of variable with p-value that is calculated based on Wald chi-square significance test.

Variables Outcomes	Readmission (YES v.s. NO)				Death (YES v.s. NO)			
	Odds Ratio	95% C.I.	p-value	c-statistic	Odds Ratio	95% C.I.	p-value	c-statistic
TIMI (orig.): High vs Low	0.84	(0.238,5.115)	0.8219		1.021	(0.172,6.070)		
Intermed vs Low	0.942	(0.159,5.584)	0.8647	0.517	0.625	(0.100,3.925)		
NCEP (orig.)	NA	NA	NA	NA	NA	NA		
TIMI (mod.): High v.s. Low-Mod	0.88	(0.277, 2.797)	0.8285	0.516	1.458	(0.453,4.696)		
NCEP(mod.): High v.s. Very High	0.221	(0.043,1.149)	0.0317*		1.389	(0.404,4.776)		
Mod v.s. Very High	1.597	(0.411,6.206)	0.08	0.682	0.321	(0.035,2.953)		
TIME2PCI : >24hrs v.s. <24hrs	0.5	(0.076,3.305)	0.4719	0.549	NA	NA		
Coumadin: Not Use v.s. Use	0.549	(0.124,2.440)	0.4037	0.54	0.941	(0.177,5.011)		
LMWH Not Use v.s. Use	0.484	(0.097,2.408)	0.3751	0.554	0.965	(0.234,3.982)		
UFH Not Use v.s. Use	1.037	(0.107,10.02)	0.9752	0.501	NA	NA		
CLOPIDOGREL: Not Use v.s. Use	0.333	(0.104,1.070)	0.0649	0.629	1.282	(0.357,4.605)		
ASA Not Use v.s. Use	0.305	(0.036,2.574)	0.2754	0.561	1.516	(0.352,6.530)		
STATIN Not Use v.s. Use	0.147	(0.018,1.199)	0.0734	0.63	1.63	(0.471,5.633)		
ACE_ARB: Not Use v.s. Use	2.083	(0.593,7.321)	0.2524	0.582	2.889	(0.730,11.44)		
BETA: Not Use v.s. Use	0.274	(0.033,2.295)	0.2324	0.57	2.222	(0.571,8.654)		
CCB : Not Use v.s. Use	0.522	(0.150,1.816)	0.3067	0.563	1.414	(0.278,4.675)		
GLUCOSE : <126 v.s. >126	0.829	(0.245,2.79)	0.7623	0.52	0.729	(0.213,2.492)		
TROPONIN: Neg v.s. Pos	0.536	(0.163,1.762)	0.3042	0.575	0.264	(0.067,1.043)		
EKG: Neg v.s. Pos	0.698	(0.205, 2.372)	0.5642	0.537	0.415	(0.123,1.400)		
TABACCO: Not Use v.s. Use	0.523	(0.159, 1.717)	0.2855	0.571	0.96	(0.291,0.166)		
INSULIN: Not Use v.s. Use	0.168X	(0.009,3.056)X	0.1889T	NA	1.071	(0.201,5.717)		
Gender: Female v.s. Male	0.711	(0.228,2.220)	0.5571	0.543	0.975	(0.329,2.893)		

Table 3: Summary of logistic regression models – Categorical covariates, Note: 1. NA is used due to small number of patients in at least one of the categories in the variable. 2. X Since there were no readmitted patients using Insulin in this cohort, the regular odds ratio is not available (based on logistic regression). We used the amended estimator of the odds ratio and the associated confidence interval. 3. T The p-value for testing independence is based on Fisher’s Exact test.

	TIMI			DEATH		READMISSION	
	High	Int.med	Low	Yes	No	Yes	No
CATH	16	17	4	2	39	12	31
NO-CATH	16	15	4	11	19	5	18
p-value	≈ 1.0			0.0005*		0.7692	

Odds Ratio	NAA	OR=0.084, CI(0.008, 0.434)B	OR=1.38, CI (0.375, 5.868)B
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Table 4: Fisher’s exact tests for association between CATH and TIMI, DEATH as well as READMISSION, Notes: * indicates significance at level 0.05, ^A OR are not defined for a 3-by-2 contingency table, ^B confidence level is 95%.

Discussion

Our findings suggest that there is a variability in care and non-adherence to guidelines for patients admitted to a community hospital with non-ST elevated MI/unstable angina. There were delays in both transfer and timing of percutaneous intervention. These findings were mirrored by the multi-center CRUSADE study of 19,238 patients. Percutaneous intervention in our study did reduce mortality at six months, but had no impact on readmission rates. In addition our medication review noted that glycoprotein IIb/IIIa therapy was chosen for only 4.1% of all patients (3 of 73). Currently eptifibatide is approved by the FDA for non-ST elevated MI/unstable angina, whether or not percutaneous intervention is performed.

Physicians strive to comply with guidelines and appropriate utilization of services, yet are challenged by different therapies and recommendations for optimal treatments of non-ST elevated MI/UA. In a community of 1000 residents, eight of nine patients who require hospitalization are admitted to community hospitals, and not teaching institutions [18]. Knowing the importance of collaboration and a team approach in providing care, we suggest a prospective study using a model similar to that of Project Leonardo [19]. This multi centered study utilized nurse care managers and current software to improve patient care. Adapting this model to acute coronary syndromes in community hospitals would also predictably serve to improve outcomes.

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