LETTER TO THE EDITORS

Identifying very low-risk STEMI patients for early ICU discharge in the COVID-19 era

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Sirs:

Assessment of individual patient risk for short-term outcomes following acute ST-elevation myocardial infarction (STEMI) has focused on risk scores with high sensitivity to identify high-risk patients [1]. By contrast, there is a lack of uniformly accepted scores for predicting the absence of complications following primary percutaneous intervention (pPCI), and current guidelines still recommend admission in intensive care unit (ICU) during at least 24 h after symptoms onset in patients with uncomplicated STEMI [1–3]. Minimizing ICU admissions, particularly in the current COVID-19 era, is paramount for minimizing patient exposure and optimizing resource allocation [4–6].

We hypothesized whether in the era of regional pPCI reperfusion networks, uncomplicated STEMI patients remaining event-free following prompt TIMI 3 flow restoration, would facilitate early discharge from the ICU [7, 8]. The present study aimed to identify predictors of very low-risk STEMI patients following uncomplicated pPCI, and to assess the safety of an early ICU discharge strategy.

To test our hypothesis, we analyzed consecutive STEMI patients undergoing pPCI in our referral area (~850,000 inhabitants) arriving within 12 h after symptom onset, between 2012 and 2019 ($n = 2185$). Per protocol all patients received a loading dose of 300 mg of aspirin plus 600 mg of clopidogrel or 180 mg of ticagrelor or 60 mg of prasugrel before the procedure. We recorded in a prospective dedicated database clinical characteristics, peri-procedural complications including arrhythmias, Killip-Kimball class, reperfusion time, and procedural characteristics; 24-h ICU cardiac complications including ventricular fibrillation/tachycardia, A-V block or asystole, acute pulmonary edema, mechanical ventilation, shock, acute stent thrombosis and cardiac death; and 30-day cardiac death. Patients were divided in two cohorts: a derivation cohort ($n = 1492$; years 2012–2016) to identify independent very low-risk predictors; and a validation cohort ($n = 693$; years 2017–2019).

Univariate and multivariate logistic regression analysis were used to determine predictors of 24-h cardiac complications and 30-day cardiac death. Multivariate analysis included clinical and procedural predictors that exhibited a p value < 0.05 in the univariate analysis. First, multivariable-independent predictors allowed patient stratification in to very low-risk (odds ratio ≤ 0.85 for early cardiac complications and 30-day cardiac death) and other risk groups. Next, cardiac events beyond the first 6 h in the ICU were characterized in the very low-risk group. Finally, specificity to predict early cardiac complications and 30-day cardiac death in the very-low risk group was also assessed.

Derivation cohort independent predictors of very low-risk were age ≤ 75 years-old, absence of primary malignant arrhythmias during the first assistance, Killip-Kimball class I, radial access, absence of left main or three-vessel coronary disease, and successful angioplasty-stenting (defined as final TIMI 3 flow), as shown in Table 1. The same very low-risk predictors emerged in the validation cohort (data not presented).

In the derivation cohort, 144 of 1492 (9.7%) patients had a 24-h-cardiac event (21 patients with stent thrombosis); 50 (3.4%) suffered a 30-day cardiac death; and 638 (43%) met very-low risk criteria. In the very-low-risk group, seven patients (1.1%) had a 24-h-cardiac event, all

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Table 1 Univariate and multivariate analysis of predictors of very low-risk of 24-h cardiac events and 30-day cardiac death following primary percutaneous coronary intervention

Clinical and procedural predictors	No complication (n = 1348)	Complication (n = 144)	p	Early complication* [OR, 95% CI]	p	30-day cardiac death [OR, 95% CI]	p
Age ≤ 75 year old	1074 (80)	88 (61)	< 0.01	0.56 [0.37–0.84]	< 0.01	0.10 [0.04–0.20]	< 0.01
Female gender	296 (22)	41 (29)	010				
Diabetes mellitus	328 (24)	44 (31)	0.12				
Previous vascular disease (any)	274 (20)	43 (30)	0.01				
Anterior myocardial infarction	546 (41)	75 (52)	0.01				
Killip class I at presentation	1179 (88)	59 (41)	< 0.01	0.14 [0.10–0.22]	< 0.01	0.12 [0.06–0.26]	< 0.01
No arrhythmia first assistance[†]	180 (13)	59 (41)	< 0.01	0.32 [0.21–0.21]	< 0.01	0.36 [0.17–0.76]	< 0.01
Radial access	1320 (98)	125 (87)	< 0.01	0.50 [0.24–1.04]	0.06	0.18 [0.07–0.46]	< 0.01
No three vessel/LM disease	283 (21)	46 (32)	< 0.01	0.85 [0.56–1.30]	0.40	0.51 [0.25–1.00]	0.05
Stent implanted	1321 (98)	144 (100)	0.20				
Successful angioplasty-stenting[‡]	1263 (94)	121 (84)	< 0.01	0.42 [0.10–0.21]	< 0.01	0.16 [0.07–0.37]	< 0.01
Complete revascularization	519 (39)	46 (32)	0.16				
Reperfusion time (minutes)	191 (130–309)	181 (129–299)	0.60				
IIb/IIIa inhibitors use	547 (41)	50 (34)	0.36				
Dual antiplatelet load	1348 (100)	144 (100)	NA				
Baseline oral anticoagulation	44 (3)	12 (8)	0.02				
ICU cardiac predictors**							
LVEF < 40%	1166 (86)	77 (54)	< 0.001	NA		NA	
Creatinin clearance (ml/min)	92 (42)	68 (38)	< 0.001	NA		NA	

Values presented as n (%) or mean (SD) or median (Q1–Q3)

ICU intensive care unit, *NA* not assessed, *LM* left main, *LVEF* left ventricular ejection fraction

*Including 24-h cardiac death, malignant arrhythmias, severe heart failure, stent thrombosis/re-acute myocardial infarction

**Intensive Care Unit predictors were not included in the multivariate analysis

[†]Including atrial or ventricular fibrillation, ventricular tachycardia, A-V block or asystole appeared until the end of primary percutaneous coronary intervention procedure

[‡]Defined as final TIMI 3 flow without major procedural complications

due to stent thrombosis, one with concomitant ventricular fibrillation (specificity = 0.95, p < 0.01). No 30-day cardiac deaths were recorded in the very low-risk group (specificity = 1, p < 0.01).

In the validation cohort, 78 of 693 (11.3%) patients had a 24-h-cardiac event (16 of them stent thrombosis); 17 (2.5%) suffered a 30-day cardiac death; and 369 (53%) met criteria of very-low risk. In the very-low risk group, ten patients (2.7%) had a 24-h-cardiac event, nine due to stent thrombosis, (one with concomitant ventricular fibrillation) and one due to heart failure (patient with active hemolytic anemia complicated with systemic inflammatory syndrome) (specificity = 0.88, p < 0.01). No 30-day cardiac deaths were recorded in the very low-risk group (specificity = 1, p < 0.01).

The 6-h ICU cut-point analysis performed in the very-low risk group only revealed one stent thrombosis event beyond the 6 h (0.9 ‰), without other complications (specificity ≈ 1, p < 0.01).

This is the first study to focus on predictors of very low-risk of complications following STEMI in the pPCI reperfusion era. We found that younger patients with uncomplicated STEMI without complex coronary anatomy are highly likely to remain uncomplicated providing the infarct related artery is successfully opened via transradial pPCI. Importantly, the identified variables may be easily recorded upon completion of the pPCI procedure. Proper identification of such very low-risk patients should improve current post-procedural decision-making algorithms, including very early (within 6 h) patient transfer from the intensive care to a conventional ward, thus optimizing intensive care resources for other life-threatening pathologies.

Stent thrombosis is always concerning, and in this very-low risk stratification model, it was the least accurate event to predict; nevertheless, stent thrombosis usually manifests early post-pPCI. Indeed, only one patient presented stent thrombosis beyond 6 h after ICU admission. These data should be interpreted in the context of a regional pPCI reperfusion network that includes a high percentage of radial

access and stenting, and short reperfusion delay [2]. Nevertheless, pending confirmation in larger prospective studies, an early discharge strategy from the ICU within 6 h post-successful pPCI may be a reasonably safe option in almost half of STEMI patients.

References

1. Ibanez B, James S, Agewall S et al (2018) 2017 ESC guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: the task force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). Eur Heart J 39:119–177

2. Halkin A, Singh M, Nikolsky E et al (2005) Prediction of mortality after primary percutaneous coronary intervention for acute myocardial infarction: the CADILLAC risk score. J Am Coll Cardiol 45:1397–1405

3. De Luca G, Suryapranata H, van't Hof AW et al (2004) Prognostic assessment of patients with acute myocardial infarction treated with primary angioplasty: implications for early discharge. Circulation 109:2737–2743

4. Abdi S, Salarifar M, Mortazavi SH et al (2020) COVID-19 sends STEMI to quarantine!? Clin Res Cardiol. https://doi.org/10.1007/s00392-020-01664-3 **(Epub ahead of print)**

5. Grasselli G, Pesenti A, Cecconi M (2020) Critical case utilization for the COVID-19 outbreak in Lombardy, Italy. JAMA. https://doi.org/10.1001/jama.2020.4031 **(Epub ahead of print)**

6. Böhm M, Frey N, Giannitsis E, Sliwa K et al (2020) Coronavirus disease 2019 (COVID-19) and its implications for cardiovascular care: expert document from the German Cardiac Society and the World Heart Federation. Clin Res Cardiol. https://doi.org/10.1007/s00392-020-01656-3 **(Epub ahead of print)**

7. Kammler J, Kypta A, Hofmann R et al (2009) TIMI 3 flow after primary angioplasty is an important predictor for outcome in patients with acute myocardial infarction. Clin Res Cardiol 98(3):165–170

8. Zahler D, Lee-Rozenfeld K, Ravid D et al (2019) Relation of lowering door-to-balloon time and mortality in ST segment elevation myocardial infarction patients undergoing percutaneous coronary intervention. Clin Res Cardiol 108(9):1053–1058