Temporal Trends in the Characteristics, Management and Outcomes of Patients With Acute Coronary Syndrome According to Their Killip Class

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Based on the historical Killip Classification, higher Killip class is associated with increased mortality in patients with acute coronary syndrome (ACS), yet data on current prognosis are lacking. We sought to examine temporal trends in the management and outcomes of patients admitted with an ACS by Killip class and to assess its contemporary prognostic value. Time-dependent analysis (early-period 2000 to 2008 vs late-period 2010 to 2016) in patients with lower (=1) and higher (≥2) Killip classes in a national ACS survey. Clinical outcomes included 30d MACE (death, myocardial infarction, stroke, unstable angina, stent thrombosis, urgent revascularization) and 1-year mortality. Included were 9,736 and 5,288 patients in the early and late time-periods of which 18.5% and 11.5% were categorized as higher Killip class, respectively (p <0.001). Baseline co-morbidities (diabetes, hypertension, dyslipidemia) were more prevalent in the late versus early time periods in both study groups (p <0.001). Rates of 30d MACE decreased in both Killip classes (p <0.001), yet 1-year mortality decreased only in patients with lower Killip class (p = 0.02), and remained extremely high (30%) in patients with higher Killip class (p = 0.75). Killip class was a significant independent predictor for 1-year mortality, both in the early (adjusted hazard ratio 3.23, confidence interval 2.8, 3.7) and late (adjusted hazard ratio 4.13, confidence interval 3.21, 5.32) time periods. In conclusion, even in the current era, patients presenting with ACS and higher Killip class have poor 1-year survival. Efforts should focus on improving the adherence to guideline-recommended therapies. The Killip classification system is still a reliable prognostic tool. **(Am J Cardiol 2019;124:1862−1868)**

The Killip-Kimball Classification, developed in the pre-thrombolytic era, is based on a bedside physical assessment of left ventricular dysfunction in patients presenting with acute myocardial infarction (AMI).[1] Worsening Killip class is independently associated with increased mortality among patients with AMI.[1] This classification system is still acknowledged and recommended nowadays by Society Guidelines for the evaluation of patients presenting with AMI.[2,3] However, data regarding the prognosis of patients with higher versus lower Killip class in the current era and its contemporary yield for risk stratification are limited. Therefore, we examined temporal trends in the characteristics, treatment and outcomes of patients with higher versus lower Killip class admitted with acute coronary syndrome (ACS).

Methods

The population of the current study is comprised of consecutive admitted ACS patients included in the Acute Coronary Syndrome Israeli Survey (ACSIS) between 2000 and 2016. In brief, ACSIS is a 2-month nationwide survey conducted biennially, which prospectively collects data from all ACS admissions in all 25 intensive care units and cardiology wards operating in Israel. Informed consent was obtained from each patient. The study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki and data collection was approved at each hospital by the Institutional Ethics Review Committee. Prespecified, standard forms were used to record demographic, clinical data, management, and outcome during the index hospitalization and subsequent follow-up. Definitions of type of ACS (acute ST-elevation myocardial infarction [STEMI] versus non-ST-elevation myocardial infarction [NSTEMI] vs unstable angina) were based on prespecified criteria according to accepted definitions in the specific survey period.[1,4-6]

Patients' Killip class was determined clinically by the treating physician upon admission based on the following classification: Class I—no evidence of heart failure; class II—findings consistent with mild to moderate heart failure, such as jugular venous distention or lung rales or an S3 on heart auscultation; class III-overt pulmonary edema and

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class IV cardiogenic shock.[1] Patients' management was at the discretion of the attending physicians.

We performed a time-dependent analysis of patients with higher (II-IV) versus lower (I) Killip class. Survey years were divided to early (2000 to 2008) and late (2010 to 2016) time-periods. The endpoints in the study included 30-day and 1-year mortality and the composite of major cardiac adverse events at 30 days (30d MACE), which included recurrent MI, all-cause mortality, stent thrombosis, and urgent revascularization. In-hospital and 30-day outcome data were ascertained by hospital chart review, telephone contact, and clinical follow-up data. Mortality data during hospitalization and at 30 days and at 1-year were determined for all patients from hospital charts and by matching identification numbers of patients with the Israeli National Population Register.

All data were compared by Killip class status, using chi-squared analysis for categorical variables and Mann-Whitney U test for non-normal distributed continuous variables. The cumulative probabilities of 1-year mortality are graphically displayed according to the method of Kaplan and Meier, with comparison of cumulative events by the log-rank test. Multivariate analysis for 1-year mortality was carried out using Cox proportional hazards regression modeling. Different sets of variables were tested, and the final set was chosen by stepwise selection of step-AIC (Akaike Information Criterion). To reduce bias between the two study groups, a propensity score matching was performed for patients with higher Killip class (724 early period, 362 late period), and for patients with lower Killip class (2734 early period, 1367 late period). A one-to-two matching was conducted, based on statistical significant differences between the groups of early versus late period with a caliper of 0.09. All analyses were performed by the IACT using R software (R Development Core Team, version 3.4.2, Vienna, Austria). A 2-sided p-value <0.05 was used for declaring statistical significance

Results

The study cohort included 9,736 and 5,288 ACS patients in the early and late time-periods, respectively, of which 1801 (18.5%) and 603 (11.5%) patients had a higher Killip class, respectively. During the entire study follow-up period (2000 to 2016) (Supplementary Table 1), patients with higher versus lower Killip class were older (median age 73 years), more commonly female, and with higher burden of cardiovascular co-morbidities, including diabetes mellitus, hypertension, chronic kidney disease, previous peripheral vascular disease, and previous stroke.

The baseline characteristics of patients categorized by their Killip class in the study time periods are presented in Table 1. Patients with lower Killip class in the late versus early period had increased rates of cardiovascular co-morbidities. Nevertheless, patients with lower Killip class in the current era were more likely to undergo coronary angiography and PCI during hospitalization and to be discharged with guideline-recommended medications.

Patients with higher Killip class in both time periods had similar rates of ST-elevation on electrocardiogram (40%) and a comparable left ventricular systolic dysfunction by echocardiography (median estimated ejection fraction 35%). Nevertheless, patients with a higher Killip class in the late versus early period were more likely to have diabetes mellitus, dyslipidemia, hypertension and renal failure and were less likely to present with typical chest pain. Among patients with higher Killip class, the utilization of guideline-recommended medication at discharge was more common in the late time-period. However, patients with a higher Killip class were still undertreated with guideline-recommended therapies (e.g., antiplatelets, statins, coronary angiography and PCI) as compared with patients with lower Killip class, both in the early and late time periods (Table 1).

In both the higher and lower Killip class groups in the late versus early time periods, the rates of recurrent AMI during hospitalization decreased, whereas the rates of major bleeding increased (Table 2). In the late versus early time periods, patients with lower Killip classes demonstrated a decrease in the rates of high-degree atrioventricular block and both atrial and ventricular arrhythmias.

Short- and long-term outcomes were worse in patients presenting with higher versus lower Killip class in both time periods (Table 3). The rate of 30-day MACE decreased in the late versus early time periods in both the lower and higher Killip class groups, whereas the rate of 1-year mortality improved over the years only in patients with lower Killip class (Figure 1). In fact, nearly a third of the patients in the higher Killip class group died within the first year of their index admission, regardless of their ACS status in both time periods (Supplementary Table 2, Supplementary Table 3). These results remained consistent even after the exclusion of patients with unstable angina from the analysis (Supplementary Table 4). Furthermore, when further stratifying the higher Killip Class group to the different Killip subclasses, no improvement was observed in the 1-year survival of patients categorized as either Killip class II, Killip class III, or Killip class IV (Table 4). In order to overcome potential bias related to patients' baseline comorbidities, 2 propensity score matched analyses were performed, one for patients with lower Killip class and the other for patients with higher Killip class (Supplementary Table 5 and Supplementary Table 6). Upon propensity matching the results were qualitatively similar (Table 5).

Multivariate analysis demonstrated that Killip class is a significant independent predictor for 1-year mortality in patients admitted with ACS both in the early (Hazard ratio 3.23, confidence interval 2.8, 3.7) and the late (Hazard ratio 4.13, confidence interval 3.21, 5.32) time periods. Other predictors for 1-year mortality included age, previous peripheral vascular disease, and other characteristics (Supplementary Figure 1). Importantly, each Killip class within the higher Killip class group was associated with an escalating increased 1-year mortality (Figure 2).

Discussion

This study based on a national ACS registry, demonstrates important insights concerning the contemporary utilization of the Killip-Kimball classification in patients admitted with an ACS. First, both short- and long-term outcomes have improved over the last 2 decades in

Table 1
Characteristics of patients with lower Killip class compared with patients with higher Killip classes according to the time-period analyzed

Variable	Early period (2000-2008)			Late period (2010-2016)			Temporal comparison	
	Killip class I (n=7,935)	Killip class II-IV (n=1801)	p-value	Killip class I (n=4,675)	Killip Class II-IV (n=613)	p-value	p-value Killip class I	p-value Killip class II-IV
Age (years)	61 (53, 72)	73 (64, 80)	<0.001	63 (54, 72)	72 (63, 81)	<0.001	<0.001	0.629
Males	6243 (78%)	1190 (66%)	<0.001	3702 (79%)	417 (68%)	<0.001	0.512	0.404
Body mass index (kg/m^2)	27 (25, 30)	27 (24, 30)	0.104	27 (25, 30)	27 (24, 31)	0.918	<0.001	0.015
Diabetes mellitus	2380 (30%)	850 (48%)	<0.001	1744 (37%)	341 (56%)	<0.001	<0.001	<0.001
Hypertension	4122 (52%)	1197 (67%)	<0.001	2969 (64%)	492 (81%)	<0.001	<0.001	<0.001
Dyslipidemia	4765 (60%)	933 (53%)	<0.001	3458 (74%)	468 (77%)	0.141	<0.001	<0.001
Peripheral artery disease	606 (8%)	272 (15%)	<0.001	272 (6%)	107 (18%)	<0.001	<0.001	0.198
Past smoker	1461 (19%)	304 (17%)	0.164	1004 (22%)	168 (28%)	0.001	<0.001	<0.001
Current smoker	3049 (39%)	416 (23%)	<0.001	1004 (40%)	168 (28%)	<0.001	0.100	0.026
Family history of coronary artery disease	1911 (25%)	201 (12%)	<0.001	1334 (33%)	91 (19%)	<0.001	<0.001	<0.001
Prior chronic kidney disease	580 (7%)	415 (23%)	<0.001	462 (10%)	177 (29%)	<0.001	<0.001	0.005
Prior myocardial infarction	2103 (27%)	716 (40%)	<0.001	1477 (32%)	256 (44%)	<0.001	<0.001	0.098
Past cerebrovascular accident or transient ischemic attack	493 (6%)	278 (16%)	<0.001	329 (7%)	104 (17%)	<0.001	0.091	0.424
Any malignancy	178 (4%)	78 (7%)	<0.001	165 (5%)	34 (9%)	0.008	0.001	0.143
Presentation on admission								
Typical chest pain	5178 (66%)	542 (30%)	<0.001	2968 (64%)	99 (16%)	<0.001	<0.001	<0.001
Time from symptom onset to first medical contact (min)	87 (30, 210)	70 (30,180)	0.003	90 (37, 210)	63 (20, 181)	<0.001	0.203	0.137
Heart rate (beats per minute)	76 (66, 89)	91 (75,108)	<0.001	76 (67, 88)	90 (75, 108)	<0.001	0.796	0.428
Systolic blood pressure (mm Hg)	140 (123,160)	140 (115,163)	0.006	140 (125, 159)	139 (115, 163)	0.064	0.707	0.807
Diastolic blood pressure (mm Hg)	80 (70, 90)	80 (67, 92)	<0.001	80 (70, 90)	79 (65, 90)	<0.001	0.271	0.077
ST-elevation myocardial infarction	3908 (49%)	828 (46%)	<0.001	1928 (41%)	259 (42%)	<0.001	<0.001	0.316
Non ST-elevation myocardial infarction	2449 (31%)	780 (43%)		2043 (44%)	314 (51%)			
Unstable angina pectoris	1574 (20%)	190 (11%)		704 (15%)	40 (7%)			
Hemoglobin (g/dL)	13.7 (13, 15)	12.6 (11, 14)	<0.001	14 (13, 15)	12.6 (11, 14)	<0.001	<0.001	0.224
Peak troponin T (ng/ml)	0.43 (0.09, 1.85)	0.91 (0.27, 3.4)	<0.001	1.00 (0.13, 10.09)	1.68 (0.38, 9)	<0.001	<0.001	<0.001
Estimated glomerular filtration rate (ml/min) *	77 (62, 92)	54 (37, 71)	<0.001	79 (63, 94)	52 (33, 70)	<0.001	<0.001	0.040
Left ventricular ejection fraction (%)	50 (40, 59)	35 (30, 45)	<0.001	50 (41, 60)	37 (30, 45)	<0.001	0.004	0.951
Management								
Door to needle time (min)	67 (37, 110)	78 (49, 119)	0.262	60 (31, 94)	80 (36, 131)	0.001	0.004	0.832
Primary reperfusion	2505 (32%)	482 (27%)	<0.001	1537 (33%)	189 (31%)	0.332	0.134	0.059
Coronary angiography	6184 (78%)	1054 (59%)	<0.001	4341 (93%)	465 (76%)	<0.001	<0.001	<0.001
Percutaneous coronary intervention	4654 (59%)	706 (39%)	<0.001	3426 (73%)	342 (56%)	<0.001	<0.001	<0.001
Coronary artery bypass graft (%)	413 (5%)	123 (7%)	0.007	145 (3%)	25 (4%)	0.243	<0.001	0.017
Number of coronary arteries narrowed								
1	1401 (34%)	121 (18%)	<0.001	1475 (34%)	108 (23%)	<0.001	0.870	0.038
0	197 (5%)	13 (2%)	<0.001	201 (5%)	15 (3%)	0.180	0.832	0.236
Discharge medications								
Aspirin	7422 (95%)	1440 (86%)	<0.001	4474 (96%)	507 (87%)	<0.001	<0.001	0.406
Clopidogrel	4967 (64%)	741 (45%)	<0.001	2474 (53%)	332 (57%)	0.102	<0.001	<0.001
Dual anti-platelet treatment	4827 (62%)	697 (42%)	<0.001	3952 (85%)	422 (72%)	<0.001	<0.001	<0.001
Beta blockers	6273 (81%)	1155 (69%)	<0.001	3662 (80%)	455 (79%)	0.607	0.963	<0.001
Angiotensin converting enzyme inhibitor or angiotensin receptor blocker	5437 (69%)	1200 (68%)	0.665	3630 (78%)	400 (65%)	<0.001	<0.001	0.187
Mineralocorticoid receptor antagonists	199 (4%)	146 (15%)	<0.001	186 (6%)	95 (22%)	<0.001	<0.001	0.003
Statins	6246 (80%)	1058 (64%)	<0.001	4411 (96%)	488 (85%)	<0.001	<0.001	<0.001
Hospitalization duration (days)	5 (4, 7)	7 (5, 11)	<0.001	4 (3, 5)	6 (4, 10)	<0.001	<0.001	<0.001
Cardiac care unit stay (days)	4 (3, 6)	5 (3, 7)	<0.001	3 (2, 5)	4 (3, 7)	<0.001	<0.001	0.207

* eGFR is calculated based on the Cockcroft Gault formula.

patients with Killip Class I despite their increasing burden of co-morbidities. Second, patients with Killip Class II-IV experienced a decrease in 30-day MACE, yet their 1-year morality during the last 2 decades has not improved and remained extremely high (more than 30%). Third, patients with ACS and a higher Killip class are undertreated with guideline recommended medical and interventional therapies. Fourth, Killip class remains an independent predictor of mortality in the current era.

Table 2
In-hospital complications in patients with lower Killip class compared with patients with higher Killip classes according to the time-period analyzed

Variable	Early period (2000-2008)			Late period (2009-2016)			Temporal comparison	
	Killip class I (n = 7935)	Killip class II-IV (n = 1801)	p Value	Killip class I (n = 4675)	Killip class II-IV (n = 613)	p Value	p Value Killip class I	p Value Killip class II-IV
Recurrent myocardial infarction	122 (1.5%)	46 (2.6%)	0.004	40 (0.9%)	5 (0.8%)	1.000	0.001	0.014
Acute kidney injury	282 (3.6%)	362 (20%)	<0.001	154 (3.3%)	123 (20%)	<0.001	0.453	0.993
Bleeding (TIMI major)	67 (0.8%)	34 (1.9%)	<0.001	58 (1.2%)	32 (5.2%)	<0.001	0.039	<0.001
Pericarditis	64 (0.8%)	11 (0.6%)	0.484	22 (0.5%)	2 (0.3%)	0.857	0.035	0.603
Ventricular septal rupture	9 (0.1%)	7 (0.4%)	0.022	3 (0.1%)	2 (0.3%)	0.198	0.567	1.000
New onset atrial fibrillation	328 (4.1%)	266 (14.8%)	<0.001	154 (3.3%)	75 (12.3%)	<0.001	0.019	0.130
Sustained ventricular tachycardia	97 (1.2%)	66 (3.7%)	<0.001	41 (0.9%)	24 (3.9%)	<0.001	0.084	0.892
Primary ventricular fibrillation	146 (1.8%)	66 (3.7%)	<0.001	48 (1.0%)	29 (4.7%)	<0.001	<0.001	0.304
Secondary ventricular fibrillation	43 (0.5%)	43 (2.4%)	<0.001	21 (0.4%)	10 (1.6%)	0.001	0.556	0.334
High degree atrio-ventricular block	176 (2.2%)	94 (5.3%)	<0.001	64 (1.4%)	25 (4.1%)	<0.001	0.001	0.287

Table 3
Unadjusted mortality and MACE* of patients with lower versus higher Killip class categorized by time period

Variable	Early period			Late period			Temporal comparison	
	Killip class I (n = 7935)	Killip class II-IV (n = 1801)	p Value	Killip class I (n = 4675)	Killip class II-IV (132)	p Value	p Value Killip class I	p Value Killip class II-IV
MACE 30 days	1173 (15%)	546 (30%)	<0.001	391 (8%)	132 (22%)	<0.001	<0.001	<0.001
Mortality, 30 days	224 (2.8%)	327 (18%)	<0.001	89 (1.9%)	103 (17%)	<0.001	0.002	0.534
Mortality, 1 year	480 (6.1%)	558 (31%)	<0.001	234 (5.1%)	181 (30%)	<0.001	0.018	0.752

* MACE—all-cause mortality/Re-MI/CVA/ST thrombosis/urgent revascularization.

The Killip-Kimball Classification which was developed in the prethrombolytic era in AMI patients has been validated in various subgroups including patients presenting with ACS and non-ST-elevation AMI,[7,8] patients treated with thrombolytic agents[9] and patients treated with PCI.[10] In the GRACE risk score model, Killip class was the most important predictor of mortality.[6] However, the majority of these reports rely on older data in patients who were not treated according to contemporary ACS guideline-recommendations. Here, we demonstrate the prognostic value of

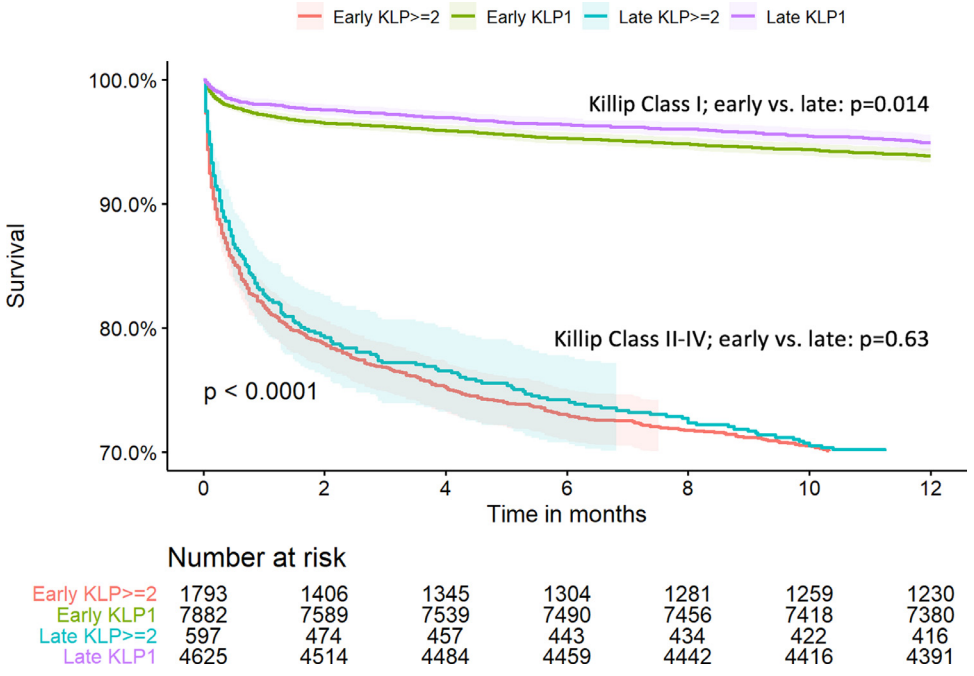

Figure 1. Kaplan-Meier curve of 1-year survival of patients with lower Killip class (I) compared with patients with higher Killip classes (II-IV) in the early (2000 to 2008) and late (2010 to 2016) time periods.

Table 4
Rates of 30-day MACE and 1-year mortality according to the different Killip classes categorized by time periods

Killip class	Killip class I		Killip class II		Killip class III		Killip class IV	
Period	Early	Late	Early	Late	Early	Late	Early	Late
30-day MACE	1173 (15%)	391 (8%)	267 (25%)	55 (16%)	195 (34%)	35 (20%)	84 (54%)	42 (46%)
p-value	<0.001		<0.001		<0.001		0.325	
1-year mortality	480 (6%)	234 (5%)	263 (25%)	81 (25%)	199 (34%)	56 (32%)	96 (61%)	44 (49%)
p Value	0.018		0.95		0.58		0.080	

*MACE−−all-cause mortality/Re-MI/CVA/ST thrombosis/urgent re-vascularization.

the Killip risk stratification system in a broad, heterogeneous and large-scale population. Our results show that a higher Killip class, even in the current era, is predictive of 1-year mortality and worse outcome over the entire higher Killip class spectrum.

Incidence of heart failure among patients admitted with an AMI varies among studies, ranging from 14% to 36%.[11] Here, we demonstrate a decline in the proportion of patients with a higher Killip class among ACS patients. Nevertheless, these patients still constitute a high-risk group even when compared with the general AMI population.[11-13] The FAST-MI (French registry of Acute ST elevation or non-ST-elevation Myocardial Infarction) registry showed that AMI patients with heart failure, compared with AMI patients without heart failure, had a significantly increased risk of death during index hospitalization (12.2% vs 3.0%) and at 1 year (26.6% vs 5.2%).[13] We report similar 1-year mortality rates in patients presenting with higher Killip classes regardless of their AMI status- either STEMI or NSTEMI. The poor 1-year survival rate of patients with a higher Killip class is even more pronounced with regards to the improvement in 1-year survival of patients with Killip class I. Furthermore, within the higher Killip classes, we observed a graded association between the specific Killip class (II, III, or IV) and worse prognosis.

The lack of improvement in 1-year survival of patients with a higher versus lower Killip class is probably multifactorial. First, the population of patients with ACS has become "sicker" during the last decades as shown here and by others,[14] and the increased burden of co-morbidities might have diminished the added value of contemporary treatment and prevention strategies. However, even after adjusting for patients' co-morbidities by propensity score analyses, 1-year survival in patients with higher Killip classes remains poor. Moreover, patients with lower Killip class, who also demonstrate increased co-morbidities burden did, in-fact, improved their 1-year survival rates. Second, patients with higher Killip classes are consistently undertreated according to contemporary ACS guideline recommendations. In our cohort, patients with higher Killip classes demonstrate a nongrowing rate of primary PCI with overall coronary angiography rate during admission of 76%, much lower than the rate in patients with lower Killip class (93%, p <0.001). The under-utilization of invasive management in the higher Killip classes is probably the result of several factors: The low incidence of typical chest pain as a presenting symptom, the higher rates of chronic kidney disease at baseline and the higher burden of co-morbidities (such as previous stroke and malignancy) which may have influenced the decision to execute an invasive approach. Moreover, we demonstrate under-utilization of angiotensin converting enzyme inhibitors/angiotensin receptor blockers, another proven treatment in AMI patients with heart failure,[11] in the population of patients with higher versus lower Killip class. This gap may be the result of the increased rate of renal dysfunction in the group of patients with higher versus lower Killip class. Moreover, chronic kidney disease along with other significant comorbidities which are known to increase patient's risk of bleeding, such as malignancy and stroke, may account for the lower use of dual-antiplatelet treatment in the higher Killip class group. Notably, the higher versus lower Kllip class had a higher utilization of mineralocorticoid antagonists (22% in the current era). However, as the higher Killip class was more frequently diagnosed with moderate or severe LV systolic dysfunction, this relatively higher prescription rate may still in fact present under-treatment of these patients.

Our study has several limitations. First, the study presented herein is an observational retrospective study. However, we did an attempt to correct for any baseline differences by applying propensity score analyses and multivariate analyses. Yet, as our cohort is based on patients that were hospitalized in cardiac and intensive care units, we cannot exclude a selection bias in the admission of patients to these facilities at the first place. Second, data regarding cardiac versus noncardiac causes for mortality

Table 5
Mortality and MACE* of patients with lower versus higher Killip classes categorized by time period after propensity score matching

Variable	Killip class I			Killip class II-IV		
	Early time period (n = 2,734)	Late time period (n = 1,367)	p Value	Early time period (n = 724)	Late time period (n = 362)	p Value
MACE 30 days	388 (14.2%)	112 (8.2%)	<0.001	170 (23.5%)	60 (16.6%)	0.011
Mortality, 30 days	65 (2.4%)	22 (1.6%)	0.136	87 (12.0%)	44 (12.3%)	0.994
Mortality, 1 year	160 (5.9%)	52 (3.8%)	0.006	175 (24.3%)	85 (24.2%)	1.000

* MACE−all-cause mortality/Re-MI/CVA/ST thrombosis/urgent re-vascularization.

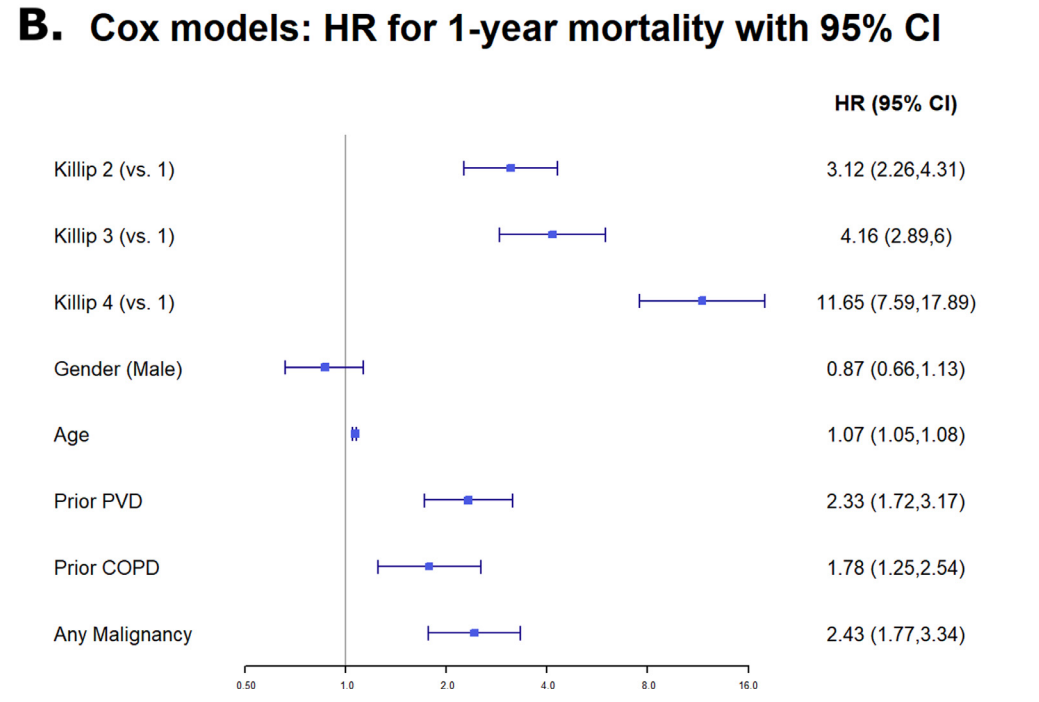

Figure 2. Cox regression multivariate analysis of 1-year mortality in ACS patients categorized by Killip class according to time periods: *(A)* Early time period (2000 to 2008), *(B)* Late time period (2010 to 2016).CAD = coronary artery disease; COPD = chronic obstructive pulmonary disease; MI = myocardial infarction; PVD = peripheral vascular disease; TIA = transient ischemic attack.

were not available. Third, follow-up data regarding the extent of systolic dysfunction and the use of implantable cardioverter defibrillators are lacking.

In conclusion, despite improved 1-year survival over the last 2 decades in ACS patients with lower Killip class, patients presenting with ACS and higher Killip classes suffer from increased rates of in-hospital complications and poor 1-year survival. Improved efforts should focus on improving the utilization of guideline-recommended therapies on one hand, and on examining new specific treatments in this high-risk population, on the other hand. The Killip classification system is a simple, free of cost and reliable tool for the risk stratification of ACS patients even in the current era.

Disclosures

The authors have no conflicts of interest to disclose.

Supplementary materials

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.amjcard.2019.09.012.

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