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Age and outcomes of primary percutaneous intervention for ST elevation myocardial infarction in a tertiary center—are we there yet?

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Abstract

Background Primary percutaneous intervention (PPCI) is the treatment of choice for ST elevation myocardial infarction (STEMI) but robust evidence in the very elderly is lacking. We compared PPCI outcomes between different age quartiles (quartile 1 < 60 years, quartile 2 ≥ 60 to < 70 years, quartile 3 ≥ 70 to < 80 years, quartile 4 ≥ 80 years). **Methods** Retrospective observational analysis of our Morriston Tertiary Cardiac Center (Abertawe Bro Morgannwg University Health Board) patients from 2005 to 2010 with STEMI who underwent PPCI. **Results** Of 434 patients, 57 (13%) were in quartile 4 (≥ 80 years). In older age quartiles, patients were less likely to receive a drug eluting stent (DES, $P = 0.001$) or glycoprotein IIb/IIIa inhibitor (GPI, $P < 0.0001$). Increase in age was associated with reduced time to survival (β-coefficient: –0.192, t: –3.70, 95%CI: –4.91 to –1.50, $P < 0.0001$) as was the presence of cardiogenic shock (β-coefficient: –0.194, $t = 3.77$, 95%CI: –5.26 to –1.65, $P < 0.0001$). Use of GPI was associated with increased time to survival (β-coefficient: 0.138, $t = 2.82$, 95%CI: 1.58–8.58, $P = 0.005$) but older age quartiles were less likely to receive GPI ($P < 0.0001$). In-hospital mortality (1.8% quartile 1, 3.6% quartile 2, 10.9% quartile 3 and 12.3% quartile 4, $P = 0.002$) and 1-year mortality (5.4% quartile 1, 5.5% quartile 2, 16.8% quartile 3 and 24.6% quartile 4, $P < 0.0001$, respectively) was significantly higher in older age quartiles. **Conclusions** Increased short term and intermediate term mortality is seen in the very elderly after PPCI. Age and cardiogenic shock were prognostic factors. Intervention should not be based on age alone and awareness regarding prognostic factors can help improve management.

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Keywords: Myocardial infarction; Primary percutaneous intervention; The elderly

1 Introduction

The number of people > 85 years in England and Wales has increased, reaching 1.4 million in 2009.[1] This increase is reflected in the proportion of very elderly patients (≥ 80 years old) presenting with ST elevation myocardial infarction (STEMI). These patients are more likely to have multiple co-morbidities and contraindications to reperfusion and therefore are less likely to receive reperfusion.[2,3] Primary percutaneous coronary intervention (PPCI) is the treatment of choice for STEMI but the evidence in the very elderly is unclear, with little published data available. We compared outcomes of PPCI between age quartiles (quartile 1 < 60 years, quartile 2 ≥ 60 to < 70 years, quartile 3 ≥ 70 to < 80 years and quartile 4 ≥ 80 years) at our tertiary Cardiac Center.

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2 Methods

2.1 Definitions

STEMI was defined as patients presenting with chest pain and new ST elevation ≥ 2 mm in men or ≥ 1.5 mm in women in at least two of V2-V3 leads or ≥ 1 mm in other contiguous precordial leads or limb leads. New left bundle branch block in the context of chest pain was considered a STEMI equivalent.

Diabetes mellitus (DM) was defined as patients with a prehospital diagnosis of DM either type 1 (on insulin) or type 2 (on oral medications or diet control). New onset DM at the time of the STEMI would be based on fasting blood sugars and HbA1c which are performed after admission and do not get input into the database at the time of the STEMI admission.

Hypertension (HTN) was defined as patients with a prehospital diagnosis of HTN either on or off medications.

Peripheral vascular disease was defined as patients with a previous history of limb claudication or peripheral angioplasty.

Cerebrovascular disease (CVD) was defined as patients with a history of transient neurological deficit or permanent neurological deficit due to either an ischaemic or haemorrhagic cause were considered to have CVD.

Current smokers were defined as patients who were smoking upto admission; ex-smokers were defined as patients who stopped smoking at least four weeks prior to admission; non-smokers were defined as patients who have never smoked before.

Multi-vessel disease (MVD) was defined as patients with disease ≥ 70% in at least one other artery other than the infarct related artery or ≥ 50% in the left main stem were considered to have MVD.

Cardiogenic shock was defined as patients with STEMI presenting with systolic blood pressure < 90 mmHg (mean arterial pressure < 30 mmHg) with clinical signs of systemic hypoperfusion.

Stent thrombosis (ST) according to academic research consortium (ARC) definition: (1) Definite ST: symptoms suggestive of acute coronary syndrome and angiographic/pathologic confirmation of stent thrombosis; (2) probable ST: unexplained death ≤ 30 days or target vessel myocardial infarction (MI) without angiographic confirmation of ST; and (3) possible ST: unexplained death > 30 days. Based on time since stent implantation ST could also be: (1) early (0–30 days post stent implantation-acute < 24 h; (2) subacute 1–30 days); (3) late (> 30 days); and (4) very late (> 12 months).

2.2 Patients

We retrospectively analyzed our National Database at our tertiary center. Patients who underwent PPCI for STEMI between 2005 and 2010 were included. 24/7 PPCI was only available from December 2008 onwards. Patients who received thrombolysis or rescue angioplasty were excluded. Bleeding complications were obtained from the haematology database and transfusion registry. Bleeding was classified according to the thrombolysis in myocardial infarction (TIMI) definition.[4] Mortality data was obtained from the Office of National Statistics and the hospital online patient record database. Based on age, patients were divided age quartiles (quartile 1 < 60 years, quartile 2 ≥ 60 to < 70 years, quartile 3 ≥ 70 to < 80 years and quartile 4 ≥ 80 years). Baseline, angiographic and procedural characteristics were compared between the quartiles. Primary outcomes analyzed were in-hospital mortality and mortality at 12 months. Secondary outcomes analyzed were in-hospital major adverse cardiovascular events [MACE: composite of in-hospital death, stroke, MI and emergency coronary artery bypass graft surgery (CABG)] and net adverse cardiac events (NACE: (NACE: composite of in-hospital mortality, stroke, myocardial infarction and non-CABG TIMI combined bleeding).

2.3 Statistical analysis

Analysis was performed using SPSS version 20. Patients were divided into four quartiles based on age as described above. Patient demographics, procedural characteristics, in-hospital outcomes (mortality, MI, referral for emergency CABG, stroke and non-CABG bleeding events), 1-year mortality, MACE and NACE were compared between the quartiles. Categorical variables were presented as percentage. Continuous variables were presented as mean ± SD, where the data was skewed, it was presented as median (+ interquartile range) and log transformed for the purpose of further analysis. Where appropriate, the chi-square, Fisher's exact, contingency analysis, Student *t* or Kruskall Wallis tests were utilized for analysis.

Age quartiles, other patient demographics and procedural/STEMI characteristics (infarct artery, MVD and cardiogenic shock) were entered as separate blocks into a hierarchical linear regression model to assess their relationship to time to survival. Preliminary analyses conducted ensured no violation of assumptions of outliers, normality, linearity, and homoscedasticity (Normal P-P plot of the regression standardised residual, scatterplot with standardised residuals within −3.3 to +3.3 range). All but two variables had tolerance levels > 0.7 and variance inflation factor (VIF) < 10.0. Variables were transformed (Zscore) if multicollinearity was suggested. Independent variables with ≥ 10% missing values were excluded from the analysis. Cases with missing data were excluded pairwise. In addition, survival was compared with the log rank test and summarized as Kaplan-Meir estimate graph.

3 Results

Four hundred and thirty four patients were included of whom 57 (13%) were ≥ 80 years old (Table 1) with median age in in this group being 83 (81–87) years. In the older age quartiles, patients were more likely to be female (P < 0.0001), hypertensive (P = 0.005) with previous CVD (P = 0.007), and less likely to be smokers (P < 0.0001) compared to the younger age quartiles (Table 1).

Approximately 40% of patients presented out of hours (i.e., before 08: 00 am or after 05: 00 pm). Radial access for PPCI was similar across the four quartiles (Table 2). Around 35%–50% of patients presented with left anterior descending as the culprit artery with increased incidence of MVD (P = 0.003) seen in the older patients. Median door to balloon time varied from 60–66 min between the quartiles (Table 2).

Table 1. Baseline patient characteristics.

Variable	Quartile 1 < 60 yr	Quartile 2 ≥ 60 to < 70 yr	Quartile 3 ≥ 70 to < 80 yr	Quartile 4 ≥ 80 yr	*P* value
Total	166 (38.2)	110 (25.3)	101 (23.3)	57 (13.1)	-
Age, yrs	52 (47–55)	64 (61–66)	74 (71–76)	83 (81–87)	-
Female	29 (17.5)	23 (20.9)	32 (31.7)	27 (47.4)	< 0.0001
Hypertension	53 (35.3)	52 (52.5)	48 (55.5)	30 (53.6)	0.005
Diabetes mellitus	22 (13.7)	21 (19.4)	15 (15.6)	11 (19.3)	0.572
Smoker	95 (62.1)	38 (36.9)	23 (25.3)	9 (16.9)	< 0.0001
Previous myocardial infarction	19 (11.7)	13 (12.3)	14 (14.6)	9 (15.8)	0.830
Peripheral vascular disease	6 (3.9)	2 (2.0)	5 (5.7)	0 (0)	0.233
Previous cerebrovascular disease	2 (1.3)	2 (1.9)	4 (4.5)	6 (10.7)	0.007

Values are *n* (%) or median (quartiles).

Table 2. Procedural characteristics.

Variable	Quartile1 < 60 yr	Quartile 2 ≥ 60 to < 70 yr	Quartile 3 ≥ 70 to < 80 yr	Quartile 4 ≥ 80 yr	*P* value
Radial access	80 (48.5)	56 (50.9)	39 (39.0)	28 (49.1)	0.322
Procedure done out of hours	71 (42.8)	42 (38.2)	37 (36.6)	22 (38.6)	0.756
Left anterior descending culprit	73 (44.0)	42 (38.2)	35 (34.7)	30 (52.6)	0.123
Left circumflex culprit	20 (12.0)	16 (14.5)	12 (11.9)	0 (0)	0.034
Right coronary artery culprit	71 (42.3)	49 (44.5)	50 (49.5)	26 (45.6)	0.760
Other culprit	2 (1.2)	3 (2.7)	4 (4.0)	1 (1.8)	0.514
Multi vessel disease	42 (26.1)	39 (36.4)	40 (40.4)	28 (51.9)	0.003
Door to balloon time	60 (30–90)	55 (33–91)	67 (43–93)	66 (35–108)	0.317
Stent implantation	156 (94.0)	106 (96.4)	93 (92.1)	50 (87.7)	0.182
1 stent	154 (98.7)	102 (96.2)	86 (92.5)	49 (98.0)	-
≥ 2 stents	2 (1.3)	3 (2.8)	7 (7.5)	1 (2.0)	-
No Stent	10 (6.0)	5 (4.5)	8 (7.9)	7 (12.3)	-
Drug eluting stent implantation	109 (65.7)	76 (69.1)	56 (55.4)	23 (40.4)	0.001
Glycoprotein IIb/IIIa inhibitor	111 (67.3)	75 (69.4)	60 (60.6)	21 (37.5)	< 0.0001
Bivalirudin	2 (1.20)	0 (0)	2 (2.0)	2 (3.5)	0.291
Thrombectomy catheter use	81 (52.3)	52 (50.0)	45 (46.5)	21 (38.2)	0.323
Cardiogenic shock	12 (7.2)	13 (11.8)	15 (14.9)	7 (12.3)	0.245
Procedural time	40 (29.5–54)	40 (31–56)	44.5 (30–60)	48 (36–78)	0.008
Screening time	8.3 (5.2–13)	9 (5.5–16)	10.3 (6.6–15)	12 (7–21.3)	0.009
Final TIMI flow					0.734
0	5 (3)	1 (0.9)	2 (2.0)	2 (3.5)	
1	3 (1.8)	0 (0)	1 (1.0)	1 (1.8)	
2	3 (1.8)	3 (2.8)	5 (5.0)	2 (3.5)	
3	155 (93.4)	105 (96.3)	92 (92.0)	52 (91.2)	

Values are *n* (%) or median (quartiles). TIMI: thrombolysis in myocardial infarction.

There was a similar incidence of stent implantation in all four quartiles but patients in the older quartiles were less likely to receive a drug eluting stent (DES, $P = 0.001$) or glycoprotein IIb/IIIa inhibitor (GPI, $P < 0.0001$, Table 2). One year mortality was greater in patients not given GPI (5.6% in quartile 1, 9.1% quartile 2, 23.1% quartile 3 and 28.6% quartile 4, $P = 0.0099$).

Procedural and screening times increased with increasing age however final TIMI flow of 3 was achieved in more than 90% of patients in all four quartiles.

Thrombectomy catheter use was more likely in the younger rather than older age quartiles. The incidence of in-hospital mortality significantly increased with increasing age (1.8% quartile 1, 3.6% quartile 2, 10.9% quartile 3, and 12.3% quartile 4, $P = 0.002$, Table 3). Overall MACE (3.6% quartile 1, 7.3% quartile 2, 12.9% quartile 3 and 14% quartile 4, $P = 0.015$) and NACE (11.4% quartile 1, 10.9% quartile 2, 20.8% quartile 3, 22.8% quartile 4, $P = 0.037$) were also significantly increased in the older age quartiles compared to the younger cohort, driven mainly by the in-hos-

pital mortality (Table 3). Patients in quartile 4 (≥ 80 years) stayed the longest in hospital for a median of 5 days (range 4–8 days).

Overall, non-CABG bleeding incidence was increased in quartiles 3 and 4 (Table 3). All-cause mortality at 1-year was also significantly greater in the older age groups (16.8% quartile 3 and 24.6% quartile 4 versus 5.4% quartile 1 and 5.5% quartile 2, $P < 0.0001$, Table 3). This was driven by cardiac cause of death in > 40% across all quartiles (Table 3 & 4). There was no incidence of TVR or TLR in the very elderly comprising quartile 4.

Early and late stent thrombosis (ARC definition) was seen infrequently across all tertiles with no incidence seen in those patients < 60 years (Table 4). Log rank cumulative mortality events demonstrated by Kaplan Meir curves show mean survival of 37 months (quartile 4) and 59 months

Table 3. In-hospital and follow up outcomes.

Variable	Quartile1 < 60 yr	Quartile 2 ≥ 60 to < 70 yr	Quartile 3 ≥ 70 to < 80 yr	Quartile 4 ≥ 80 yr	*P* value
In-hospital mortality	3 (1.8)	4 (3.6)	11 (10.9)	7 (12.3)	0.002
MI	0 (0)	1 (0.9)	1 (1.0)	0 (0)	0.546
eCABG	3 (1.8)	1 (0.9)	1 (1.0)	0 (0)	0.713
Stroke	0 (0)	2 (1.8)	1 (1.0)	2 (3.5)	
Non-CABG Bleeding (TIMI major & minor)	15 (9.4)	9 (8.4)	16 (16.3)	9 (16.1)	0.173
Non-CABG bleeding (femoral access, TIMI major and minor)	8 (5.1)	5 (4.7)	13 (13.4)	4 (7.1)	0.586
MACE	6 (3.6)	8 (7.3)	13 (12.9)	8 (14)	0.015
NACE	19 (11.4)	12 (10.9)	21 (20.8)	13 (22.8)	0.037
Duration of in-hospital stay	3 (3–5)	3 (3–5)	3.5 (3–5)	5 (4–8)	< 0.0001
All-cause one year mortality	9 (5.4)	6 (5.5)	17 (16.8)	14 (24.6)	< 0.0001
TVR	8 (4.8)	5 (4.5)	3 (3.0)	0 (0)	0.368
TLR	8 (4.8)	5 (4.5)	3 (3.0)	0 (0)	0.368
Re-catheterization in one year	25 (15.1)	15 (13.6)	9 (8.9)	4 (7.0)	0.270

Values are n (%) or median (quartiles). eCABG: emergency coronary artery bypass grafting; MACE: major adverse cardiovascular events; MI: myocardial Infarction; NACE: net adverse cardiovascular events; TIMI: thrombolysis in myocardial infarction. TLR: target lesion revascularization; TVR: target vessel revascularization.

Table 4. Details of mortality.

Variable	Quartile1 < 60 yr	Quartile 2 ≥ 60 to < 70 yr	Quartile 3 ≥ 70 to < 80 yr	Quartile 4 ≥ 80 yr	*P* value
In-hospital mortality	3 (1.8)	5 (4.5)	11 (10.9)	7 (12.3)	0.002
Cardiac	0 (0)	0 (0)	5 (45.5)	1 (14.3)	–
Cardiac with cardiogenic shock	3 (100)	3 (60)	3 (27.3)	5 (71.4)	–
Stent thrombosis	0 (0)	1 (20) (definite)	1 (9.0) (probable)	0 (0)	–
Stroke	0 (0)	0 (0)	0 (0)	1 (14.3)	–
Non cardiac	0 (0)	1 (20)	2 (18.2)	0 (0)	–
Unknown	0 (0)	0 (0)	0 (0)	0 (0)	–
All-cause one year mortality	9 (5.4)	6 (5.5)	17 (16.8)	14 (24.6)	< 0.0001
Cardiac	1 (11.1)	0 (0)	6 (35.3)	3 (21.4)	–
Cardiac with Cardiogenic shock	3 (33.3)	3 (50)	3 (17.6)	5 (35.7)	–
Stent thrombosis	0 (0)	2 (33.3) (1 definite &1 possible)	1 (5.9) (probable)	1 (7.1) (possible)	–
Stroke	0 (0)	0 (0)	0 (0)	2 (14.3)	–
Non cardiac	4 (44.4)	1 (16.7)	4 (23.5)	2 (14.3)	–
Unknown	1 (11.1)	0 (0)	3 (17.4)	1 (7.1)	–

Values are *n* (%).

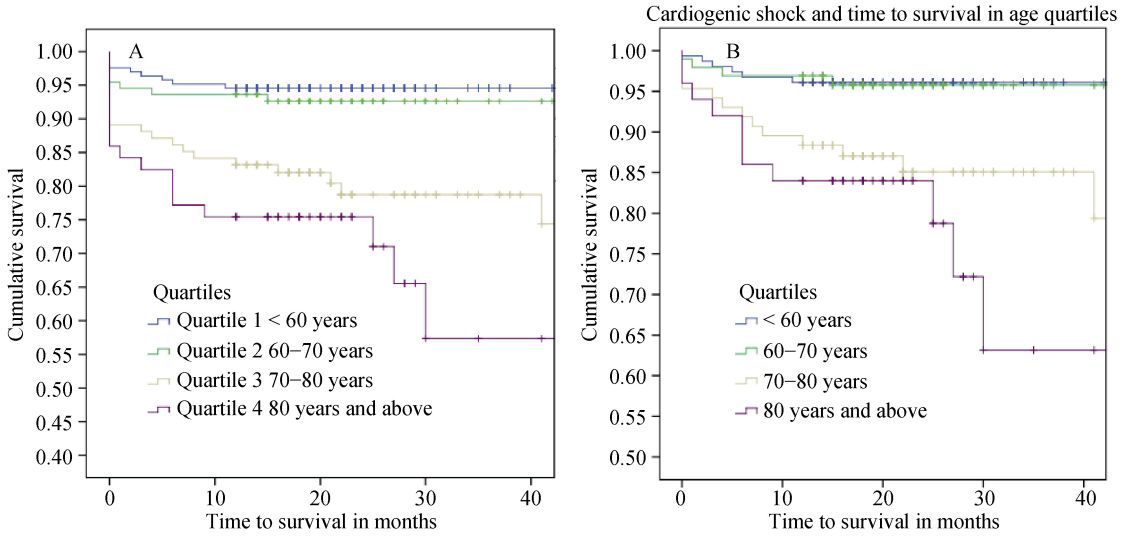

Figure 1. Kaplan Meir curves for time to survival in months in different age quartiles (A) and in the presence of cardiogenic shock in different age quartiles (B).

(quartile 3) compared to 70 months for quartiles 1 and 2 (log rank $P < 0.0001$), following PPCI for STEMI at a median time of 23 months (16 to 33 months, Figure 1).

Cumulative events rates for presence of cardiogenic shock and time to survival (Figure 1B) demonstrate a significantly reduced survival for older age quartiles (quartiles 3, mean 31.3 months and quartile 4, mean 4 months) compared to younger age quartiles (quartiles 1, mean 49.5 months and quartile 2, mean 45 months, $P < 0.0001$) in the presence of cardiogenic shock.

Hierarchical multiple regression to determine predictors of time to survival was performed in a stepwise manner. Goodness of fit of the model was ensured. The correlations amongst the predictor variables were weak to moderate as were the correlations of predictor variables with the dependent variable. Age quartiles were entered in the first block of the hierarchical linear regression. In the final model, seven variables were statistically significant (age quartiles, gender, access route, thrombectomy catheter use, GPI use, MVD and cardiogenic shock, Table 5).

Increase in age quartile was associated with reduced time to survival (β coefficient: –0.192, *t*: –3.70, 95% CI –4.91 to –1.50, $P < 0.0001$) as was the presence of cardiogenic shock (β coefficient: –0.194, *t*: –3.77, 95% CI –5.26 to –1.65, $P < 0.0001$). Femoral route as an access and MVD were also positively associated with increased time to survival. Use of GPI was associated with increased time to survival (β coefficient: 0.138, $t = 2.82$, 95%CI: 1.58–8.58, $P = 0.005$).

4 Discussion

In this retrospective single center observational study, we have demonstrated increased in-hospital and one year mortality, increased MACE and NACE in older age quartiles compared to younger age quartiles undergoing PPCI for STEMI.

Patients in older age quartiles in our study were more likely to be female, hypertensive with a previous history of CVD (Table 1). This has been corroborated in other stud-

Table 5. Predictors of time to survival.

	B	SE (B)	β Coefficient	*t*	*P* value	95% CI	
						Lower	Upper
Age quartiles	–3.21	0.867	–0.192	–3.70	< 0.0001	–4.91	–1.50
Gender	6.99	1.98	0.172	3.54	< 0.0001	3.10	10.87
Access route (femoral)	7.54	1.726	0.212	4.37	< 0.0001	4.15	10.94
Thrombectomy catheter	–10.01	1.74	–0.284	–5.81	< 0.0001	–13.50	–6.67
Glycoprotein IIb/IIIa Inhibitor	5.06	1.79	0.138	2.82	0.005	1.53	8.58
MVD	5.76	1.80	0.155	3.21	0.001	2.22	9.29
Cardiogenic shock	–3.452	0.916	–0.194	–3.77	< 0.0001	–5.26	–1.65

MVD: multi-vessel disease.

ies.[5–8] Use of GPI was associated with increased time to survival (Table 5) but older age quartiles in our study were less likely to receive GPI ($P < 0.0001$). One-year mortality was greater in this group of patients not given GPI (28.6% quartile 4, 23.1% quartile 3, 9.1% quartile 2 and 5.6% in quartile 1, $P = 0.0099$). This could be a contributory factor to reduced survival as various studies have demonstrated mortality benefit with GPI use in MI.[9–11] Reduced duration or reduced dose of GPI has been demonstrated to be a bleeding avoidance strategy (BAS) in elderly patients.[12,13] Reduced use of DES was also seen in the older age quartile ($P = 0.001$). The reduced use of DES in the very elderly is probably in keeping with concerns regarding increased bleeding risks while on increased duration of DAPT.[14,15] The newer generation everolimus and zotarolimus stents now have a CE (Conformité Européenne) mark for dual antiplatelet therapy for shorter duration and could be an option.

Increased in-hospital and 1-year mortality (24.5%) was observed in our study along with increased MACE and NACE in the older age quartile. This is comparable to results published by Claessen, *et al*.[16] in a larger observational study. They demonstrated that the 1-year mortality in octogenarians (8.4% of patient cohort) undergoing PPCI was 28.2% much higher than the 12.8% in those aged 60–79 years.[16] In a smaller study analyzing PPCI outcomes in those ≥75 years (mean age 80 years), one year mortality was as high as 25%.[17] Malik, *et al*.[18] demonstrated a step wise increase in 30-day mortality with age in patients who underwent PPCI for STEMI, reaching 26% in those ≥ 85 years of age. Increasing age also predicted reduced time to survival (β coefficient: –0.192, $P < 0.0001$, Table 5). Mortality is known to increase with increasing age in the setting of MI,[19,20] and has been demonstrated to be secondary to electrical and mechanical complications in this age group.[21] In our study, 1-year all-cause mortality was secondary to cardiac causes in > 50% patients in quartiles 2, 3 and 4. The Kaplan Meir survival curves demonstrated early separation of curves between the quartiles demonstrating the increased in-hospital and 1-year mortality after the index event (i.e., STEMI with PPCI) in older quartiles.

Gender (male) had a positive correlation with time to survival (β coefficient: 0.172, $P < 0.0001$, Table 5). This is in keeping with previous studies which have demonstrated female gender to be an indicator of mortality in patients with MI.[16,22,23] Thrombectomy catheter use was more frequently observed in the younger age quartiles up to 50% compared to older age quartiles and had a negative correlation with time to survival. Only the Export@ (Medtronic) catheter was available for use as a thrombus aspiration catheter. Rheolytic thrombectomy was not available at our center. Increased survival was indicated by reduced use of this device in our study. This device is routinely used at our center in the presence of visible thrombus (operator dependent) and a hypothetical explanation could be that patients in whom this device was used had a large thrombus burden and subsequent poorer outcomes. Details regarding thrombus burden, TIMI frame counts and myocardial blush grades were not available for the purpose of this study. Srinivasan, *et al*.[24] had demonstrated that adjunctive thrombectomy with an aspiration catheter offers distal microvascular protection. Trials such as the TAPAS and TASTE demonstrated conflicting benefit of thrombus aspiration and a prospective randomised trial by Frobert *et al.* demonstrated that routine thrombus aspiration before PPCI did not improve short term outcomes.[25–27] Both femoral access and MVD were associated with increased time to survival. While the latter may be explained by the concept of ischaemic preconditioning, the former (femoral access) is probably explained by limited numbers and correlation of access site as a variable with other predictors. Radial access rate was not significantly different between the quartiles (39% to 51%, $P = 0.322$).

The presence of cardiogenic shock was also a predictor of reduced time to survival in the long term (β coefficient: –0.194, $P < 0.0001$, Table 5). The overall incidence of cardiogenic shock in all four quartiles was 10.8% and was not significantly different between the quartiles (2.8% quartile 1, 3.0% quartile 2, 3.5% quartile 3 and 1.8% quartile 4, $P = 0.089$). The presence of cardiogenic shock reduced mean survival to four months in quartile 4, compared to 49.5 months for quartile 1, 45 months for quartile 2 and 31.3 months for quartile 3 ($P < 0.0001$). Lindholm, *et al*.[28] have demonstrated that increased mortality occurs up to 6 years in patients with MI (STEMI and NSTEMI) and cardiogenic shock. Outcomes were worse if the cardiogenic shock developed later (after admission or completion of MI) rather than earlier. We do acknowledge that our observational study is limited by small numbers in quartile 4 (57 patients of whom 7 had cardiogenic shock) which limits the robustness of these findings in this age group.

In conclusion, in this retrospective observational study, we have demonstrated that time to survival following PPCI for STEMI is significantly reduced with increasing age quartiles. The presence of cardiogenic shock was a strong predictor of reduced time to survival. In addition, GPI use was associated with increased time to survival but elderly patients were less likely to receive this. Increased in-hospital and one year mortality in the older age quartile was also seen, driven mainly by cardiac cause of mortality. Older age quartiles have increased risk of adverse outcomes after PPCI for STEMI, especially in the presence of cardiogenic shock. The focus should be on all attempts to improve outcomes and recognition of the prognostic factors. The limitation of this study is that this is a retrospective observational study

with relatively limited number of patients which could affect the robustness of the conclusions.

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