Association of door-to-balloon time and mortality in patients admitted to hospital with ST elevation myocardial infarction: national cohort study

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ABSTRACT

Objective To evaluate the association between door-to-balloon time and mortality in hospital in patients undergoing primary percutaneous coronary intervention for ST elevation myocardial infarction to assess the incremental mortality benefit of reductions in door-to-balloon times of less than 90 minutes.

Design Prospective cohort study of patients enrolled in the American College of Cardiology National Cardiovascular Data Registry, 2005-6.

Setting Acute care hospitals.

Participants 43 801 patients with ST elevation myocardial infarction undergoing primary percutaneous coronary intervention.

Main outcome measure Mortality in hospital.

Results Median door-to-balloon time was 83 minutes (interquartile range 6-109, 57.9% treated within 90 minutes). Overall mortality in hospital was 4.6%. Multivariable logistic regression models with fractional polynomial models indicated that longer door-to-balloon times were associated with a higher adjusted risk of mortality in hospital in a continuous non-linear fashion (30 minutes=3.0%, 60 minutes=3.5%, 90 minutes=4.3%, 120 minutes=5.6%, 150 minutes=7.0%, 180 minutes=8.4%, P=0.001). A reduction in door-to-balloon time from 90 minutes to 60 minutes was associated with 0.8% lower mortality, and a reduction from 60 minutes to 30 minutes with a 0.5% lower mortality.

Conclusion Any delay in primary percutaneous coronary intervention after a patient arrives at hospital is associated with higher mortality in hospital in those admitted with ST elevation myocardial infarction. Time to treatment should be as short as possible, even in centres currently providing primary percutaneous coronary intervention within 90 minutes.

INTRODUCTION

Clinical guidelines recommend that hospitals providing primary percutaneous coronary intervention to patients with ST segment elevation myocardial infarction should treat patients within 90 minutes of contact with the medical system or admission to hospital.1 Although most studies point to an independent association between longer time to treatment and higher mortality, the specific shape of the relation between mortality risk and time to treatment is unclear. While some studies indicate that any delay after admission is associated with higher mortality,2-11 others suggest mortality is higher only after an initial delay in treatment of an hour or more.12,13 In addition, it is unclear whether mortality is higher with successively longer times to treatment,2-6,9,10,12,13 or if mortality eventually plateaus after two or more hours of delay.2,11,14,15

Clarifying the specific shape of the association between door-to-balloon time (that is, between arrival at hospital and treatment) and mortality is important given recent efforts to reduce delays. Current quality improvement initiatives, such as the Door-to-Balloon Alliance, seek to achieve a door-to-balloon time of 90 minutes or less among 75% or more of patients undergoing primary percutaneous coronary intervention at participating hospitals.16 Several hospitals have shown that it is possible to push beyond this benchmark and achieve median door-to-balloon times approaching 60 minutes.17 Relatively little data exist regarding the incremental benefit of further reductions beyond 90 minutes.

We analysed data from the American College of Cardiology National Cardiovascular Data Registry, a large national database containing detailed medical records of community patients undergoing percutaneous coronary intervention. We hypothesised that any increase in door-to-balloon time would be associated with increased mortality and that this mortality risk would persist irrespective of the length of the delay in treatment.

METHODS

National Cardiovascular Data Registry

The registry, described in detail elsewhere, is sponsored by the American College of Cardiology and contains details of patients undergoing cardiac
catheterisation at more than 600 participating centres in the United States. Sites were encouraged to prospectively collect detailed clinical information including medical history, indications for procedure, angiographic findings, treatment, events, and procedural outcomes, from all patients undergoing cardiac catheterisation. Data quality was ensured through the use of standardised data elements and definitions, systematic data entry with common registry software, an onsite audit programme, and transmission to a central data warehouse for additional review before analysis.

**Study sample**

We limited our analysis to patients who, in 2005-6, presented to a participating centre within 12 hours of symptom onset with laboratory and electrocardiographic evidence of ST elevation myocardial infarction and subsequently underwent primary percutaneous coronary intervention (n=64,676). We excluded patients who were transferred from other hospitals (n=17,992) because we could not evaluate their status on admission. We also excluded patients who first received fibrinolytic therapy and were subsequently referred for primary percutaneous coronary intervention (n=3,313). Patients under 18 years or over 99 years (n=9) were excluded to focus analysis on adult

| Characteristic | Overall | ≤60 | 60-89 | 90-119 | ≥120 | Overall P | P for trend |
|---------------|---------|-----|------|-------|------|-----------|------------|
| No of patients | 43,801  | 9971| 15,388| 10,208| 8,234| —        | —          |
| Demographics: |         |     |      |       |      |           |            |
| Median age (IQR) | 59 (51-70) | 58 (51-68) | 59 (51-69) | 60 (51-71) | 61 (52-73) | <0.001 | <0.001 |
| Women | 27.9 | 24.8 | 25.8 | 29.2 | 34.0 | <0.001 | <0.001 |
| White race | 84.7 | 86.3 | 85.5 | 84.2 | 81.8 | <0.001 | <0.001 |
| Medical history: |         |     |      |       |      |           |            |
| Previous myocardial infarction | 18.3 | 16.5 | 17.4 | 19.4 | 21.1 | <0.001 | <0.001 |
| Previous heart failure | 4.1 | 3.0 | 3.3 | 4.5 | 6.6 | <0.001 | <0.001 |
| Diabetes | 20.0 | 17.5 | 18.4 | 21.1 | 24.9 | <0.001 | <0.001 |
| Renal failure | 2.4 | 1.6 | 2.0 | 2.6 | 4.0 | <0.001 | <0.001 |
| Hypertension | 59.0 | 55.2 | 57.1 | 60.3 | 65.4 | <0.001 | <0.001 |
| Cerebrovascular disease | 6.5 | 5.5 | 5.7 | 7.0 | 8.5 | <0.001 | <0.001 |
| Peripheral vascular disease | 6.2 | 5.2 | 5.4 | 6.3 | 8.8 | <0.001 | <0.001 |
| Current tobacco use | 44.1 | 46.2 | 45.4 | 43.8 | 39.4 | <0.001 | <0.001 |
| Chronic lung disease | 11.5 | 10.7 | 10.8 | 11.8 | 13.5 | <0.001 | <0.001 |
| Dyslipidaemia | 57.3 | 57.4 | 56.8 | 57.4 | 57.9 | 0.083 | 0.38 |
| Family history of early onset CAD | 23.3 | 24.1 | 22.9 | 23.2 | 23.0 | 0.28 | 0.16 |
| Previous PCI | 19.3 | 18.4 | 18.3 | 20.2 | 20.9 | <0.001 | <0.001 |
| Previous CABG | 5.7 | 3.2 | 4.4 | 6.9 | 9.7 | <0.001 | <0.001 |
| Admission findings: |         |     |      |       |      |           |            |
| Admitted ≤6 hours after symptom onset | 90.9 | 92.4 | 92.6 | 90.8 | 86.4 | <0.001 | <0.001 |
| Heart failure on admission | 8.4 | 6.8 | 7.2 | 8.7 | 12.1 | <0.001 | <0.001 |
| Cardiogenic shock | 9.5 | 8.6 | 8.9 | 9.6 | 11.7 | <0.001 | <0.001 |
| NYHA class: |         |     |      |       |      |           |            |
| I | 24.2 | 26.3 | 23.5 | 23.4 | 23.8 | <0.001 | — |
| II | 5.8 | 5.6 | 5.2 | 6.2 | 6.8 | — | — |
| III | 15.7 | 14.7 | 15.5 | 16.2 | 16.7 | — | — |
| IV | 54.3 | 53.4 | 55.9 | 54.2 | 52.6 | — | — |

IQR=interquartile range, CAD=coronary artery disease, PCI=percutaneous coronary intervention, CABG=coronary artery bypass graft, NYHA=New York Heart Association.
patients suitable for primary percutaneous coronary intervention. Finally, to minimise data coding errors, we excluded patients treated at hospitals that reported fewer than five primary percutaneous coronary interventions (n=29). A total of 18,989 patients met one or more of the above exclusion criteria, leaving 45,687 patients eligible for analysis.

Door-to-balloon time

Door-to-balloon time was defined as the time in minutes between a patient’s arrival at the hospital and the first balloon inflation or device deployment as documented in the patient’s medical record. For the purpose of evaluating differences in patients’ characteristics associated with time to treatment we divided patients into four groups: <60, 60-89, 90-119, and ≥120 minutes. For all other analyses, we modelled door-to-balloon time as a continuous variable.

Of the 45,687 patients eligible for analysis, we excluded 503 for whom door-to-balloon time was missing. Patients with a door-to-balloon time <15 minutes (n=971) were excluded to avoid potentially incorrectly coded times. Patients with a door-to-balloon time ≥6 hours (n=915) were also excluded because they presumably did not receive percutaneous coronary intervention as a primary reperfusion strategy. The final study sample therefore consisted of 43,801 patients.

**Table 3** Procedural characteristics and door-to-balloon time in patients undergoing primary percutaneous coronary intervention for ST elevation myocardial infarction. Figures are percentages of patients unless stated otherwise

| Door-to-balloon time (minutes) | Overall | <60 | 60-89 | 90-119 | ≥120 | Overall P | P for trend |
|-------------------------------|---------|-----|-------|--------|------|-----------|-------------|
| No of patients                | 43,801  | 9,971 | 15,388 | 10,208 | 8,234 | —         | —           |
| Weekend procedure             | 28.2    | 17.0 | 28.2   | 34.7   | 33.7  | <0.001    | <0.001      |
| Time of presentation:         |         |     |       |        |       | <0.001    | —           |
| Weekday 0000-0759             | 17.0    | 11.2 | 16.7   | 20.5   | 20.2  |           |             |
| Weekday 0800-1559             | 32.8    | 52.8 | 31.9   | 21.9   | 23.6  |           |             |
| Weekday 1600-2359             | 22.0    | 19.0 | 23.2   | 22.9   | 22.6  |           |             |
| Weekend 0000-0759             | 6.6     | 3.1  | 6.0    | 9.4    | 8.7   | <0.001    | —           |
| Weekend 0800-1559             | 12.5    | 8.6  | 12.6   | 14.5   | 14.4  |           |             |
| Weekend 1600-2359             | 9.0     | 5.3  | 9.5    | 10.8   | 10.5  |           |             |

Angiographic findings

| Mean (SD) | No of lesions | 1.3 (0.6) | 1.3 (0.6) | 1.3 (0.6) | 1.3 (0.6) | 1.4 (0.7) | 0.035 | 0.022 |
|——         |              |           |           |           |           |           |       |       |

Stenosis locations:

| Left main | 2.7 | 2.2 | 2.7 | 2.8 | 3.4 | <0.001 | <0.001 |
| Left anterior descending | 55.0 | 51.4 | 54.0 | 56.2 | 59.6 | <0.001 | <0.001 |
| Circumflex | 33.3 | 29.8 | 31.8 | 34.6 | 38.4 | <0.001 | <0.001 |
| Right coronary artery | 59.8 | 60.7 | 60.5 | 59.9 | 57.4 | <0.001 | <0.001 |
| IABP used | 10.8 | 10.0 | 10.4 | 11.0 | 12.4 | <0.001 | <0.001 |
| Thrombin inhibitors | 10.8 | 11.3 | 10.7 | 9.9 | 11.4 | 0.003 | 0.61 |
| Non-stent device used | 90.6 | 91.8 | 91.4 | 90.2 | 88.1 | <0.001 | <0.001 |

SCAI classification:

| Not reported | 0.5 | 0.4 | 0.5 | 0.6 | 0.7 | <0.001 | — |
| I | 16.5 | 14.1 | 15.6 | 17.6 | 19.6 |           |             |
| II | 19.6 | 17.2 | 18.9 | 21.1 | 22.1 |           |             |
| III | 21.2 | 23.3 | 21.8 | 20.0 | 18.8 |           |             |
| IV | 42.2 | 45.0 | 43.2 | 40.6 | 38.7 |           |             |

IABP=Intra-aortic balloon pump, SCAI=Society for Cardiac Angiography and Interventions.
lung disease), procedural characteristics (pre-procedure intra-aortic balloon pump, use of non-stent device, use of thrombin inhibitors, time of day, weekend procedure), and angiographic findings (left main disease, proximal left anterior descending lesion, Society of Cardiac Angiography and Intervention lesion classification). In addition, we adjusted for hospital characteristics, including annual primary percutaneous coronary intervention volume, teaching status, ownership, and rural location.

To assess the robustness of our findings, we repeated analyses excluding patients who arrived in shock because time to treatment might be less important for patients who do not present in shock. To further reduce sample heterogeneity, we repeated analyses in the cohort of patients who presented within six hours of symptom onset.

Logistic regression models accounted for clustering of patients by hospital with Huber-White robust estimates of standard error. Statistical analyses were conducted with SAS 9.1 (SAS Institute, Cary, NC) and StataSE 9.0 (Stata Corporation, College Station, TX).

RESULTS

The median door-to-balloon time in the study cohort was 83 minutes (interquartile range 62-109 minutes), with 25,359 patients (57.9%) treated within 90 minutes of admission (table 1). A greater proportion of patients who had longer door-to-balloon times were women, non-white, and, on average, older than patients with shorter door-to-balloon times. In general, patients with longer door-to-balloon times had more comorbidities than patients with shorter door-to-balloon times, including a higher prevalence of previous myocardial infarction, heart failure, diabetes, hypertension, peripheral vascular disease, and previous revascularisation. Patients with shorter door-to-balloon times had a lower incidence of cardiogenic shock and stenoses of the left main and left anterior descending arteries, and a greater proportion had Society of Cardiac Angiography and Intervention IV lesions. A greater proportion of patients with shorter door-to-balloon times were treated on a weekday between 8 am and 4 pm and at urban hospitals (tables 2-4).

Mortality in the study cohort was 4.6% (1999/43,801) overall. Patients who died in hospital had a 14 minute longer median door-to-balloon time than patients who survived (96 v 82 minutes, P<0.001). Patients with longer door-to-balloon time groups had higher crude mortality across the four door-to-balloon time groups (<60 minutes=3.2% (323/9971), 60-89 minutes=3.7% (568/15,388), 90-119 minutes=4.6% (473/10,208), ≥120 minutes=7.7% (635/8234), P<0.001 for trend).

Logistic regression analysis with a third degree fractional polynomial (door-to-balloon time, door-to-balloon time², and door-to-balloon time³) best modelled the unadjusted association of door-to-balloon time with mortality, showing an increased risk of mortality associated with any delay in door-to-balloon time (fig 1). Estimated unadjusted mortality ranged from 2.8% for patients with door-to-balloon times of 30 minutes to 9.8% for patients with door-to-balloon times of 240 minutes (table 5).

Longer door-to-balloon times continued to be associated with increased mortality after multivariable adjustment (fig 2). A third degree fractional polynomial model continued to provide the best fit for the

| Characteristic                             | Overall | Door-to-balloon time (minutes) | Door-to-balloon time (minutes) | Door-to-balloon time (minutes) | Door-to-balloon time (minutes) | Door-to-balloon time (minutes) | Door-to-balloon time (minutes) | Overall P | P for trend |
|--------------------------------------------|---------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-----------|-------------|
| No of patients                             | 43,801  | 9971                          | 15,388                        | 10,208                        | 8,234                         | —                             | —                             |           |             |
| Median annual primary PCI volume (IQR)     | 144 (89-215) | 145 (91-238) | 146 (91-215) | 143 (87-214) | 135 (82-210) | <0.001 | <0.001 |
| Hospital data unavailable                  | 3.3     | 3.6                           | 3.4                           | 3.1                           | 3.0                           | 0.06                          | 0.006                         |           |             |
| Rural hospital                             | 0.5     | 0.5                           | 0.5                           | 0.7                           | 0.5                           | 0.20                          | 0.83                          |           |             |
| Teaching hospital                          | 48.7    | 51.2                          | 48.3                          | 47.3                          | 48.2                          | <0.001 | <0.001 |
| Ownership:                                 |         |                               |                               |                               |                               |                               |                               |           |             |
| Public                                     | 8.2     | 7.9                           | 8.3                           | 8.0                           | 8.4                           | <0.001 | —             |
| Not for profit                             | 82.2    | 82.2                          | 82.6                          | 82.3                          | 81.4                          |           |             |
| For profit                                 | 6.3     | 6.3                           | 5.6                           | 6.5                           | 7.3                           | <0.001 | —             |

PCI=percutaneous coronary intervention, IQR=interquartile range.
adjusted association of door-to-balloon time with mortality, with any delay in door-to-balloon time continuing to be associated with an increased mortality risk. Estimated adjusted mortality ranged from 3.0% for patients with door-to-balloon time of 30 minutes to 10.3% for patients with door-to-balloon times of 240 minutes (table 5).

Findings were similar when we repeated analyses excluding the 4166 patients who presented in shock. In the 39,635 patients without shock, longer door-to-balloon times continued to be associated with higher crude mortality (<60 minutes=1.7% [156/9111], 60-89 minutes=1.8% [247/14,024], 90-119 minutes =2.2% [203/9226], ≥120 minutes=3.6% [262/7274], P<0.001 for trend). A third degree fractional polynomial model also provided the best fit for the adjusted association of door-to-balloon time with mortality in patients without shock, with any increase in door-to-balloon time associated with increased mortality (results not shown).

### DISCUSSION

Any delay in door-to-balloon time for patients with ST elevation myocardial infarction undergoing primary percutaneous coronary intervention is associated with higher mortality, even among patients treated within 90 minutes of admission. The mortality risk with door-to-balloon time persists irrespective of the length of the treatment delay. Our data suggest that physicians could reduce mortality among such patients by minimising door-to-balloon time to the greatest extent possible, even among those treated within times recommended by guidelines.

#### Comparison with other studies

Our analysis improves on previous studies that modelled time to treatment as a categorical4 5 7 8 10-14 20-24 or continuous linear variable.2 3 9 Use of categorical variables might result in a loss of statistical power, which could explain why certain studies report no increased risk associated with delayed time to treatment.2 3 9 Alternatively, by modelling time to treatment as a linear continuous variable, previous analyses assumed each additional delay in treatment was associated with the same additional increased risk in mortality, which is not necessarily true.2 3 Neither approach accounts for the possibility that the mortality risk associated with time to treatment might vary over time. By using fractional polynomial regression, we assessed the association of door-to-balloon time and mortality using statistical modelling techniques that made no assumptions regarding the shape of the association between time to treatment and mortality.

Our principal finding of an immediate increase in mortality associated with any delay in door-to-balloon time reconciles competing reports concerning the shape of the mortality risk associated with delayed primary percutaneous coronary intervention. While some studies found that increased mortality associated with delays were present solely within the first few hours of presentation and then plateaued,12 13 others had suggested the reverse—a risk that was initially unchanged and increased only after a few hours of delay.12 13 Our study suggests that both reports might be correct in that the mortality risk associated with any delay in time to treatment might be present immediately after admission and persist for several hours. A closer assessment of previous studies indicates that many, in fact, suggest such a consistent trend of increased mortality with any delay in time to treatment. For instance, although Cannon and colleagues reported that mortality associated with longer door-to-balloon time manifested after two or more hours of delay, there is a clear trend towards increased mortality in patients with door-to-balloon times of 61.90 minutes and 91-120 minutes.12 13 Furthermore, the few studies that have also modelled time to treatment as a continuous variable have similarly shown increases in adverse outcomes associated with any delay in

### Table 5

Estimated in hospital mortality (95% confidence interval) by door-to-balloon time in patients undergoing primary percutaneous coronary intervention for ST elevation myocardial infarction

| Time (minutes) | Unadjusted | Adjusted* |
|----------------|------------|-----------|
| 15             | 2.6 (2.3 to 2.8) | 2.9 (2.8 to 3.1) |
| 30             | 2.8 (2.5 to 3.0) | 3.0 (2.9 to 3.2) |
| 45             | 3.1 (2.8 to 3.3) | 3.2 (3.1 to 3.3) |
| 60             | 3.4 (3.2 to 3.7) | 3.5 (3.4 to 3.6) |
| 75             | 3.9 (3.7 to 4.1) | 3.8 (3.7 to 4.0) |
| 90             | 4.4 (4.2 to 4.6) | 4.3 (4.2 to 4.4) |
| 105            | 5.0 (4.8 to 5.2) | 4.9 (4.8 to 5.0) |
| 120            | 5.6 (5.4 to 6.0) | 5.6 (5.4 to 5.7) |
| 135            | 6.3 (6.0 to 6.7) | 6.3 (6.1 to 6.4) |
| 150            | 7.0 (6.6 to 7.5) | 7.0 (6.8 to 7.2) |
| 165            | 7.7 (7.2 to 8.3) | 7.7 (7.5 to 8.0) |
| 180            | 8.4 (7.7 to 9.1) | 8.4 (8.2 to 8.7) |
| 195            | 8.9 (8.2 to 9.8) | 9.1 (8.8 to 9.4) |
| 210            | 9.4 (8.5 to 10.3) | 9.7 (9.3 to 10.0) |
| 225            | 9.7 (8.7 to 10.8) | 10.1 (9.7 to 10.4) |
| 240            | 9.8 (8.7 to 11.0) | 10.3 (10.0 to 10.7) |

*Adjusted for sex, age, race, findings on presentation, medical history, procedural characteristics, angiographic findings, and hospital factors.
to-balloon times, even below the 90 minute benchmark endorsed by clinical practice guidelines, offer the potential to significantly reduce mortality. For instance, our data show that reducing average door-to-balloon times from 90 minutes to 60 minutes might reduce in hospital mortality by as much as 0.8% (from 4.3% to 3.5%). A further 30 minute reduction in door-to-balloon to an average of 30 minutes offers the potential of an additional 0.5% reduction (from 3.5% to 3.0%), underscoring the non-linear relation between time to treatment and mortality. Rather than accepting a 90 minute door-to-balloon time benchmark for primary percutaneous coronary intervention, our data support calls for an “as soon as possible” standard for patients undergoing primary percutaneous coronary intervention. Such an approach, using necessary safeguards against inappropriate treatment, offers the potential for notable reductions in mortality.

Study limitations
Our study has several limitations that merit consideration. Firstly, we were unable to assess the association of time from the onset of symptoms to arrival at hospital and mortality or the association of total ischaemic time and mortality. We attempted to limit this effect by conducting a secondary analysis restricted to patients who presented within six hours of symptom onset and found our results were similar. Furthermore, robust assessment of time from onset of symptoms to hospital admission might be problematic in that these times rely on patients’ reports and thus cannot be independently verified, whereas door-to-balloon times are probably more accurately recorded. Secondly, we assessed the outcome of in hospital mortality and cannot comment on the association of door-to-balloon time and mortality at later end points. Previous studies, however, have reported that the association of door-to-balloon time and mortality is comparable whether assessed during hospital admission, at 30 days, or at one year. Finally, as our analysis was based on observational data our findings might be attributable to biases introduced by unmeasured factors. We attempted to mitigate this effect through robust risk adjustment but cannot preclude the possibility of residual confounding by other non-measured patient or hospital factors associated with door-to-balloon time or mortality.

Conclusion
Door-to-balloon time is associated with mortality in patients undergoing primary percutaneous coronary intervention for ST elevation myocardial infarction. Contrary to previous studies, we found that this risk was present on admission and was not attenuated with the passage of time, indicating that any delay in door-to-balloon time in such patients is associated with an increased mortality. As such, our findings suggest a benefit from reducing door-to-balloon time for all patients undergoing primary percutaneous coronary intervention, including those currently treated within 90 minutes of hospital admission.

Implications for practice
We believe our finding that any minute of delay in treatment is associated with an increased risk of mortality has important implications for clinical practice. Notably, our data suggest that there is no “floor” to the mortality reduction that can be achieved by reducing time to treatment. As such, further reductions in door-to-balloon times, even below the 90 minute benchmark, might reduce mortality in these patients.

Pathophysiology of delayed time to treatment
An increased mortality risk associated with delayed time to treatment in patients undergoing primary percutaneous coronary intervention is consistent with current pathophysiological models of myocardial infarction. Experimental models have shown that the continuous, progressive “wave front of necrosis” largely depends on the duration of ischaemia.20,21 Thus, patients with longer door-to-balloon times will experience longer periods of vessel occlusion, resulting in more ischaemia and greater necrosis than patients with shorter times to treatment.22 Although there might be benefits to reperfusion therapy performed after long delays, including improved ventricular remodelling and reduced susceptibility to arrhythmic events,23 our data suggest that these benefits do not offset the underlying myocardial necrosis and attendant processes resulting from longer delays in time to treatment.24 This hypothesis is supported by the observation that patients transferred for primary percutaneous coronary intervention achieve similar rates of normal complete antegrade perfusion (TIMI 3 flow) as patients who are not transferred but have larger infarcts and poorer myocardial salvage.25

WHAT IS ALREADY KNOWN ON THIS TOPIC
Clinical guidelines recommend that hospitals providing primary percutaneous coronary intervention to patients with ST segment elevation myocardial infarction treat within 90 minutes of contact with the medical system or admission to hospital. The specific shape of the relation between mortality risk and time to treatment, and the incremental benefit of reductions in door-to-balloon times beyond 90 minutes, is unclear.

WHAT THIS STUDY ADDS
Any delay in door-to-balloon time for patients with ST elevation myocardial infarction undergoing primary percutaneous coronary intervention is associated with higher mortality, even among patients treated within 90 minutes of admission. Reducing door-to-balloon time to the greatest extent possible for all patient, including those currently treated within 90 minutes of admission, might reduce mortality.
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