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Thrombolysis and Q Wave Versus Non-Q Wave First Acute Myocardial Infarction: A GUSTO-I Substudy

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Objectives. **We assessed the outcomes of patients with a first myocardial infarction with ST segment elevation, with and without the development of abnormal Q waves after thrombolysis.**

Background. **Prethrombolytic era studies report conflicting short- versus long-term mortality in the overall non-Q wave population, probably related to its heterogeneity.**

Methods. **Patients with no electrocardiographic (ECG) confounding factors or evidence of previous infarction were included. Q wave infarction was defined as a Q wave duration ≥30 ms in lead aVF; R wave ≥40 ms in lead V_1; any Q wave or R wave ≤10 ms and ≤0.1 mV in lead V_2; or Q wave ≥40 ms in at least two of the following leads: I, aVL, V_4, V_5 or V_6. In-hospital clinical events and mortality at 30 days and 1 year were assessed.**

Results. **No Q waves developed in 4,601 (21.3%) of the 21,570 patients. This group comprised more women and had a lower Killip class, lower weight and less anterior baseline ST elevation. The non-Q wave group had less in-hospital cardiogenic shock (2.1% vs. 3.3%, $p < 0.0001$), less heart failure (8.5% vs. 13.9%, $p < 0.0001$) and a trend toward less stroke (0.7% vs. 1.0%, $p = 0.07$) but an increased use of angioplasty (28% vs. 24%, $p = 0.0001$). The unadjusted mortality rate in the non-Q wave group was lower at 30 days (0.9% vs. 1.8%, $p = 0.0001$) and 1 year (2.7% vs. 4.2%, $p = 0.0001$), as was the adjusted 30-day mortality rate (4.8% vs. 5.3%, $p < 0.0001$).**

Conclusions. **Patients with no ECG confounding factors or evidence of previous infarction who do not develop Q waves after thrombolysis have a better 30-day and 1-year prognosis than patients with a Q wave infarction.**

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Acute myocardial infarction is caused by a plaque fissure or rupture with attendant platelet-fibrin thrombus and has been traditionally classified, from the evolution of electrocardiographic (ECG) changes, into Q wave and non-Q wave infarction. The use of thrombolytic agents reduces both in-hospital and long-term mortality among patients with acute myocardial infarction, but only in the subgroup of patients who present with ECG ST segment elevation (1,2).

Patients who do not develop Q wave myocardial infarction represent a heterogeneous population with a wide range of coronary disease severity and myocardial necrosis (3). Studies in the non-Q wave infarction population from the prethrombolytic era (3–9) have reported conflicting short- and long-term mortality rates, probably related to this heterogeneity. Many investigators (3,5,10) have found a lower in-hospital event rate among patients with non-Q wave infarction but a long-term mortality rate similar to that of patients with Q wave infarction, leading to more aggressive revascularization among these patients.

Patients with non-Q wave infarction after thrombolysis probably represent a different population from those with non-Q wave infarction without thrombolysis. Patients with a non-Q wave infarction without baseline ST segment elevation may also reflect a different pathophysiologic mechanism because they have not been shown to benefit from thrombolysis (11). Few data are available concerning patients with ST segment elevation non-Q wave infarction treated with thrombolytic agents. Patients admitted with ST segment elevation who undergo thrombolysis may not develop Q waves because of timely reperfusion, and the clinical dilemma regarding management of this population after discharge is complicated by the fact that the data in support of various strategies are from the prethrombolytic era (3,9,10).

To characterize this new entity, we compared the outcomes

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Abbreviations and Acronyms

ACE	=	angiotensin-converting enzyme
CK	=	creatine kinase
ECG	=	electrocardiogram, electrocardiographic
GUSTO-I	=	Global Utilization of Streptokinase and Tissue Plasminogen Activator for Occluded Coronary Arteries
TIMI	=	Thrombolysis in Myocardial Infarction
t-PA	=	tissue-type plasminogen activator

of patients with a first non-Q wave versus Q wave infarction enrolled in the Global Utilization of Streptokinase and Tissue-Plasminogen Activator for Occluded Coronary Arteries (GUSTO-I) study (12).

Methods

The GUSTO-I trial was an international study of 41,021 patients with acute myocardial infarction presenting to 1,081 hospitals among 15 countries in North America, Europe, Israel, Australia and New Zealand. Detailed descriptions of the study population, design and results have been published elsewhere (12).

Patients and thrombolytic treatment. Patients within 6 h of symptom onset, with chest pain lasting at least 20 min and accompanied by ECG evidence of ST segment elevation (≥0.1 mV in two or more limb leads or ≥0.2 mV in two or more contiguous precordial leads) were randomized to receive streptokinase with subcutaneous heparin; streptokinase with intravenous heparin; accelerated tissue-type plasminogen activator (t-PA) with intravenous heparin; or combined t-PA and streptokinase with intravenous heparin. Subcutaneous heparin was given for 7 days or until discharge; intravenous heparin was given for a minimum of 48 h.

Adjunctive therapy. Chewable aspirin was given as soon as possible (≥160 mg), followed by a daily dose of 160 to 325 mg. Patients with no contraindication received 10 mg of intravenous atenolol in two divided doses, followed by daily oral therapy of 50 to 100 mg. All other medications and the use of angiography, angioplasty and bypass surgery were left to the discretion of the investigator.

Data management and quality assurance. Data were entered at the coordinating center (Duke University). The quality of the data was ensured by auditing 10% of the data forms. Audits involved at least one visit to the enrolling site, during which cross-checks between case report forms and the source medical records were made. The data reported are 99.9% complete for 30-day mortality and 96% for 1-year mortality.

Electrocardiographic interpretation. All ECGs were sent to the core laboratory at Duke University. Two standard 12-lead tracings were obtained for each patient, one before the start of thrombolysis (baseline) and one during the hospital stay (final). This analysis was restricted to GUSTO-I patients who had an interpretable final ECG at least 24 h after the baseline ECG with no evidence of reinfarction between the two recordings.

Patients with evidence of a previous infarction were excluded by applying the screening criteria from the Selvester QRS scoring system to the baseline ECG (13–15). The presence of factors that could confound the evaluation of ischemia (see later) on the baseline ECG was also an exclusion criterion. The determination of Q wave versus non-Q wave infarction was performed on the final ECG with the same Selvester screening criteria because their specificity and sensitivity have been proved in normal control subjects and in patients whose infarctions were measured anatomically at autopsy (14)

The following steps were followed for qualitative ECG data analysis:

1. All final ECGs were screened by the GUSTO ECG Core Laboratory for the presence of abnormal Q waves in the distribution of the three major coronary arteries. Those with ECG confounding factors—including left or right ventricular hypertrophy, left or right bundle branch block, left anterior or posterior fascicular block, ventricular pacing, Wolff-Parkinson-White syndrome, ventricular rhythms, low voltage and poor quality and incomplete recording—were excluded from this analysis (see Appendix 1 for definitions).

2. Location of Q wave infarction was classified as *anterior* (left anterior descending) if any Q wave or a Q wave equivalent (initial R wave ≤0.1 mV and ≤10 ms) was present in lead V_2; *inferior* (right coronary artery) if a Q wave ≥30 ms was present in lead aVF; *posterior* (circumflex artery) if a Q wave equivalent (initial R wave ≥40 ms) was present in lead V_1; *lateral* if Q waves ≥40 ms were present in both leads I and aVL; or *apical* if Q waves ≥40 ms were present in two or more of leads V_4, V_5 or V_6.

3. All ECGs classified as either non-Q wave infarction or posterior infarction only by the ECG core laboratory were reviewed independently by the investigators (A.B., E.B.S., S.G.G., G.S.W.). Discrepancies in classification were resolved by consensus.

Clinical end points. The primary end points of this substudy were mortality at hospital discharge, at 30 days and at 1 year. We also collected data for recurrent ischemia, heart failure, cardiogenic shock, stroke and other clinical events during the hospital period. We did not include patients with reinfarction before the final ECG, who were identified through use of the Selvester screening criteria. Because of the large size and scope of this trial, we did not collect 1-year events other than mortality. Definitions of the clinical events are those used in the main GUSTO-I study (Appendix 2).

Statistical methods. Baseline variables are descriptively summarized. Continuous variables are presented as mean value ± SD or median (25th, 75th percentiles); discrete variables are described as frequencies and percentages. To compare continuous baseline characteristics, the nonparametric Wilcoxon rank-sum test was performed. For the discrete variables, chi-square tests were used. Posterior myocardial infarction was coded as a Q wave infarction to compare the patient groups.

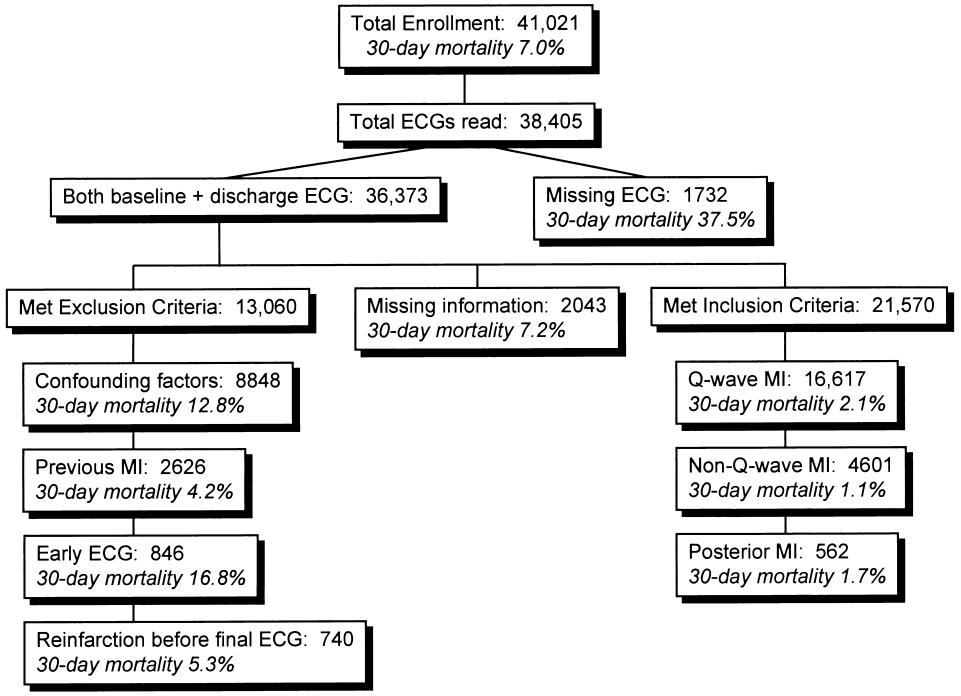

Figure 1. Flowchart showing disposition of patients and 30-day mortality rates. MI = myocardial infarction.

We modified a logistic regression model (16) for prediction of 30-day mortality. The presence of Q wave infarction was added to this model, which contains the variables found to be predictive of mortality in the overall GUSTO-I trial: age, height, weight, systolic blood pressure, Killip class, heart rate, infarct location, previous infarction, time to treatment, diabetes, smoking status (current and former), thrombolytic strategy, previous bypass surgery, hypertension and previous cerebrovascular disease. Modeling was done with inclusion of the posterior infarction patients first in the non-Q wave group, then in the Q wave group. The differences in model chi-square results were analyzed to assess the importance of Q wave infarction for 30-day mortality.

Results

The ECGs from 38,405 patients were available in the GUSTO-I data base. Of these, 2,626 patients were excluded for previous infarction, 8,848 for baseline or final ECG confounding factors, 3,775 for missing information, 846 for "early" ECG (within 24 h of the baseline tracing) and 740 because of reinfarction before the final ECG (Fig. 1). The median (25th, 75th percentiles) time to the final ECG was 6 (3,9) days.

Patient characteristics. A total of 21,570 patients met our inclusion criteria (4,601 patients [21.3%] in the non-Q wave group, 16,617 [78.7%] in the Q wave group) (Table 1); 352 patients had a purely posterior infarction. Patients in the non-Q wave group more often were female, shorter, lighter, diabetic and current or former smokers, and they presented more often with an inferior infarction, a lower systolic blood pressure and a Killip class I heart failure status. Although the non-Q group had somewhat more previous angioplasty, bypass surgery and angina, the Q wave group had more previous infarctions (as indicated on the case report form at enrollment). Time to thrombolytic treatment and age were similar between groups.

Clinical outcomes. Patients with a non-Q wave infarction had significantly lower mortality than those with Q wave infarction at hospital discharge, which was maintained at 30 days and at 1 year (Table 2, Fig. 2). Patients with a non-Q wave infarction also had significantly lower peak creatine kinase (CK) and CK-MB values, less in-hospital cardiogenic shock and heart failure, a similar rate of recurrent ischemia and a trend toward decreased stroke (0.7% vs. 1.0%, $p = 0.07$).

In-hospital management. Patients with a non-Q wave infarction were more often receiving calcium-channel blocking agents at hospital discharge and were less often receiving digitalis or angiotensin-converting enzyme (ACE) inhibitors than those with a Q wave infarction (Table 3). Information about the use of aspirin after discharge was not available. The use of angioplasty was greater in the non-Q wave infarction group. Although patients in both groups who underwent angioplasty generally had an improved outcome (Table 4), the pattern of worse outcomes in patients with Q wave versus non-Q wave infarction persisted.

Thirty-day mortality. After adjustment for differences in baseline characteristics, non-Q wave infarction was still a significant ($p = 0.0001$) predictor of lower 30-day mortality. The relation remained strong ($p = 0.0001$) when patients with a posterior infarction were included in the non-Q wave infarction group (Table 5). The adjusted 30-day mortality rate for patients with a non-Q wave infarction was 4.8% compared with 5.3% for those with a Q wave infarction ($p < 0.0001$).

Table 1. Baseline Characteristics

	Q Wave MI* (n = 16,969)	Non-Q Wave MI (n = 4,601)	p Value
Age (yr)	59.4 ± 11.7	59.2 ± 11.8	0.295
Male	13,149 (77.5%)	3,157 (68.6%)	0.0001
Height (cm)	171.7 ± 9.2	170.7 ± 9.7	0.0001
Weight (kg)	80.8 ± 15.6	79.0 ± 16.1	0.0001
Diabetes	2,238 (13.2%)	661 (14.4%)	0.037
Current smoker	7,689 (45.4%)	2,270 (49.4%)	0.0001
Former smoker	11,996 (71.0%)	3,352 (73.1%)	0.006
Hypertension	6,117 (36.1%)	1,680 (36.6%)	0.559
Previous CVD	283 (1.7%)	72 (1.6%)	0.628
Previous angina	5,697 (33.7%)	1,664 (36.3%)	0.001
Previous MI†	2,027 (12.0%)	488 (10.6%)	0.012
Previous PTCA	597 (3.5%)	181 (3.9%)	0.181
Previous CABG	540 (3.2%)	163 (3.5%)	0.224
SBP (mm Hg)	129.2 ± 22.5	128.3 ± 22.7	0.006
HR (beats/min)	74.6 ± 16.8	74.0 ± 16.2	0.0545
Killip class			0.0001
I	14,858 (87.8%)	4,197 (91.6%)	
II	1,847 (10.9%)	353 (7.7%)	
III	148 (0.9%)	19 (0.4%)	
IV	63 (0.4%)	11 (0.2%)	
MI location			0.0001
Anterior	6,031 (35.6%)	1,186 (25.9%)	
Inferior	10,509 (62.0%)	3,130 (68.4%)	
Other	413 (2.4%)	252 (5.5%)	
Time to treatment (h)	3.0 ± 1.6	3.0 ± 1.7	0.2593
Treatment group			0.463
Accelerated t-PA	4,342 (25.6%)	1,217 (26.5%)	
SK+SC heparin	4,298 (25.3%)	1,160 (25.2%)	
t-PA+SK	4,330 (25.5%)	1,184 (25.7%)	
SK+IV heparin	3,999 (23.6%)	1,040 (22.6%)	

*Includes the 352 patients with posterior myocardial infarction (MI). †As indicated on the case report form at enrollment. Data presented are mean value ± SD or number (%) of patients. CABG = coronary artery bypass graft surgery; CVD = cerebrovascular disease; HR = heart rate; IV = intravenous; PTCA = percutaneous transluminal coronary angioplasty; SBP = systolic blood pressure; SC = subcutaneous; SK = streptokinase; t-PA = tissue-type plasminogen activator.

Discussion

The discrepancy between the relatively better early outcomes and the similar or even worse long-term prognoses in patients with non-Q wave versus Q wave infarction has led to a more aggressive approach in the management of this group of patients (3,5,10). Our findings conflict somewhat with reports from the prethrombolytic era (3–5,9,17–19), in which 1-year mortality was similar or even higher in the non-Q wave infarction populations. The difference could be related to the heterogeneity of the populations, the definitions used and the use of thrombolysis (3–9,11).

Another possible explanation for this disagreement is the initial ST segment deviation. In most studies of Q wave or non-Q wave infarction, the initial ST segment shift was seldom considered a prognostic marker. The observation that patients with initial ST segment depression have a worse prognosis than those with ST segment elevation and either Q wave or non-Q wave infarction (20–23), with the additional evidence that thrombolysis benefits only the subgroup with ST segment elevation (1,2,11), suggests that different pathophysiologic mechanisms may lead to different outcomes as a function of specific ECG findings (21,24,25).

Approximately 45% of patients with evolving acute myocardial infarction who do not develop Q waves present with ST segment elevation (3,24,26). The outcomes of these patients appear to be better than those of patients with baseline ST segment depression. A substudy of the Multicenter Investigation of the Limitation of Infarct Size (MILIS) trial (21) compared outcomes in non-Q wave infarction among patients with initial ST segment elevation versus initial ST segment depression. The prognosis was strikingly worse in the ST segment depression group. The same observation was made in a report by the Diltiazem Multicenter Postinfarction Trial (20). We used the GUSTO-I data base (12), which consists only of patients with initial ST segment elevation who were eligible for thrombolytic therapy, because only patients with ST elevation are candidates for thrombolysis. This non-Q wave infarction subgroup is more homogeneous than a general population with patients eligible for thrombolysis included (1,2,11).

Our patients, who presented with ST segment elevation, showed no ECG confounding factors or evidence of a previous infarction, and received thrombolytic therapy and had very low 30-day and 1-year mortality, more so in the absence of Q waves on the final ECG. These results suggest, as shown in other reports (8,11,27–29), that the highest mortality in patients treated with thrombolytic therapy occurs in the subgroup of patients with initially abnormal QRS complexes (due to previous infarction, bundle branch block or left ventricular hypertrophy), regardless of the thrombolytic strategy used (Fig. 1). An abnormal baseline QRS complex generally reflects previous damage to the myocardium and thus may indicate a higher baseline risk in these patients. In addition, this abnormal QRS complex can obscure the diagnosis of non-Q wave infarction, masking the appearance of Q waves either by cancellation of net forces or by a second infarction in the distribution of a previous insult (30). We attempted to control for this issue in the current study by exclusion of patients with ECG evidence of previous myocardial necrosis and ECG confounding factors.

Non-Q wave myocardial infarction after thrombolysis. Two other multicenter trials (31,32) have addressed the issue of non-Q wave myocardial infarction after thrombolysis. Our study is more comparable to the Thrombolysis in Myocardial Infarction (TIMI)-II substudy (32) because both trials studied patients with a first infarction and made the diagnosis of Q wave versus non-Q wave infarction within a shorter interval, whereas the Late Assessment of Thrombolytic Efficacy (LATE) trial (31) included only patients randomized >6 h after symptom onset. The TIMI-II investigators found a trend toward a lower 42-day and 1-year mortality in patients with a non-Q wave infarction. In our much larger sample, we found significantly lower mortality in the non-Q wave population,

Table 2. Mortality and In-Hospital Outcome

	Q Wave MI (n = 16,969)	Non-Q Wave MI (n = 4,601)	p Value
Mortality rate			
In-hospital	299 (1.8%)	40 (0.9%)	0.0001
30 days	346 (2.1%)	48 (1.1%)	0.0001
1 yr	4.2%	2.7%	0.0001
Peak CK (IU)	n = 16,363	n = 4,488	
Mean ± SD	2,133.4 ± 1,784.2	997.2 ± 1,201.6	0.0001
Median (25th, 75th percentiles)	1,682 (892, 2,872)	651.5 (278, 1,300.5)	
Peak CK-MB (IU)	n = 6,969	n = 1,767	
Mean ± SD	192.4 ± 204.0	100.4 ± 167.7	0.0001
Median (25th, 75th percentiles)	132 (71, 250)	62 (27, 115.8)	
In-hospital outcome			
Cardiogenic shock	555 (3.3%)	96 (2.1%)	0.0001
Heart failure	2,349 (13.9%)	383 (8.5%)	0.0001
Recurrent ischemia	3,020 (17.8%)	832 (18.1%)	0.66
Stroke	167 (1.0%)	32 (0.7%)	0.07
AV block	1,301 (7.7%)	233 (5.1%)	0.0001
Sustained VT	790 (4.7%)	147 (3.2%)	0.0001
VF	900 (5.3%)	195 (4.2%)	0.003
AF	1,370 (8.1%)	308 (6.7%)	0.002
Sustained hypotension	1,526 (9.0%)	290 (6.3%)	0.0001

Data presented are number (%) of patients, unless otherwise indicated. AF = atrial fibrillation; AV = atrioventricular; CK = creatine kinase; MI = myocardial infarction; VF = ventricular fibrillation; VT = ventricular tachycardia.

although we could not analyze long-term events, such as reinfarction or revascularization procedure use, because this analysis was beyond the scope of the trial.

There was a significantly greater use of calcium channel blockers and lesser use of digitalis and ACE inhibitors in the non-Q wave group. This frequent use of calcium channel blockers could be the consequence of evidence in favor of this medication (33) in patients with a non-Q wave infarction, and the more frequent use of digitalis and ACE inhibitors among patients with a Q wave infarction reflects the higher risk within this subgroup. Another observation is the more frequent use of in-hospital angioplasty in the non-Q wave group, despite similar rates of recurrent ischemia in the two groups. The increased use of angioplasty could reflect a more aggressive approach in the non-Q wave population, which could also account for their better outcomes. The use of revascularization procedures by 1 year in these groups will be addressed in a future study. We cannot discard the possible effect on outcome in view of the more frequent use of revascularization in the non-Q wave group.

Successful thrombolysis generates an incomplete infarction regardless of the presence or absence of Q waves and shares many characteristics with the "naturally occurring non-Q wave infarction" (34). The question of whether non-Q wave infarctions after thrombolysis represent Q wave infarctions that have been aborted by timely reperfusion or reflect a different mechanism remains to be addressed. Early angiographic data from the Q wave and non-Q wave populations from the TIMI-II study and the GUSTO-I angiographic substudy (32,35) suggest that the non-Q wave population has greater early TIMI grade 3 flow, a smaller initial ischemic burden, better left ventricular function and infarcts more frequently associated with circumflex lesions and equivalent collateral circulation.

Figure 2. Kaplan-Meier plot of 1-year survival among patients with Q wave **(thick line)** and non-Q wave **(thin line)** myocardial infarction.

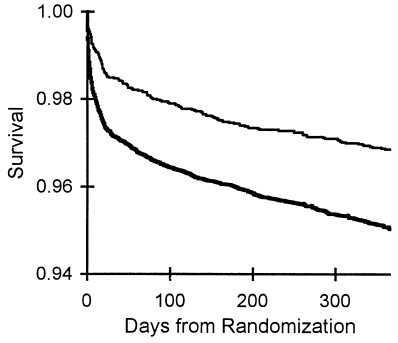

Table 3. In-Hospital Management

	Q Wave MI	Non-Q Wave MI	p Value
CABG	1,366 (8.1%)	390 (8.5%)	0.34
PTCA	4,092 (24.2%)	1,264 (27.6%)	0.0001
Discharge therapy			
Beta-blockers	10,089 (61.1%)	2,782 (61.6%)	0.592
Ca channel blockers	3,631 (22.0%)	1,469 (33.4%)	0.0001
Nitrates	7,482 (45.7%)	2,074 (46.2%)	0.767
Digitalis	1,437 (8.7%)	294 (6.5%)	0.0001
ACE inhibitors	2,819 (17.2%)	371 (8.3%)	0.0001

Data presented are number (%) of patients. ACE = angiotensin-converting enzyme; Ca = calcium; other abbreviations as in Table 1.

Table 4. Clinical Outcome by Use of Angioplasty

	No Angioplasty			Angioplasty		
	Q Wave MI (n = 12,801)	Non-Q Wave MI (n = 3,313)	p Value	Q Wave MI (n = 4,092)	Non-Q Wave MI (n = 1,264)	p Value
Mortality rate						
30 days	300 (2.4%)	44 (1.3%)	0.0001	43 (1.1%)	4 (0.3%)	0.01
1 yr	4.7%	3.2%	0.0001	2.6%	1.5%	0.03
Cardiogenic shock	392 (3.1%)	67 (2.0%)	0.001	158 (3.9%)	28 (2.2%)	0.005
Heart failure	1,827 (14.3%)	275 (8.3%)	0.0001	512 (12.5%)	117 (9.3%)	0.002
Recurrent ischemia	1,757 (13.7%)	468 (14.1%)	0.558	1,246 (30.5%)	361 (28.6%)	0.197
Stroke	147 (1.2%)	26 (0.8%)	0.07	19 (0.46%)	4 (0.32%)	0.482
CABG	1,205 (9.4%)	356 (10.8%)	0.021	155 (3.8%)	31 (2.5%)	0.023

Data presented are number (%) of patients. Abbreviations as in Table 1.

Clinical events. The lower 1-year mortality rate in our study conflicts with others that have reported an equal or even higher mortality in the non-Q wave infarction population. The accepted explanation for this finding is that patients with a non-Q wave infarction are at higher risk of recurrent ischemic events, including reinfarction, and progressive myocardial necrosis leading to congestive heart failure. In our population, we observed an equivalent in-hospital recurrent ischemia rate in both groups. Because we excluded patients with reinfarction before the final ECG (to avoid overestimation), the reinfarction rate is artificially low. Studies have shown (31,32) a trend toward more reinfarction in the non-Q wave population and a similar rate of recurrent ischemia (32). Although we did not monitor 1-year events other than mortality, the lower 1-year mortality rate suggests that non-Q wave infarction after thrombolysis is indeed associated with a milder evolution until at least 1 year, despite the potential role of reinfarction.

In-hospital heart failure and cardiogenic shock are clearly reduced in the non-Q wave group. This observation, along with the less frequent use of digitalis and ACE inhibitors, the lower peak CK levels, the decreased regional dysfunction and better left ventricular function, is consistent with the lower 1-year mortality rate observed in our study (32,35).

Definition of non-Q wave infarction. The ECG criteria for diagnosis of non-Q wave infarction have not been standard across the various studies. The specificity- and sensitivity-established Selvester screening criteria (13–15) were used to analyze the GUSTO-I patients. Some studies have included patients with various other conditions that can either mask or mimic Q wave infarction. Others have required overly strict Q wave definitions, such as a duration ≥40 ms, or extremely loose definitions, such as widespread Q equivalency and Q amplitude. The criteria used in the present study were specificity-proved in 500 control subjects with an equal distribution of both age and gender and sensitivity-proved in patients with infarction in each of the three major coronary distributions, sized anatomically at autopsy.

Study limitations. The exclusion of patients with an ECG-confirmed previous infarction and ECG confounding factors and patients with reinfarction before the final ECG limits this secondary analysis to a relatively low risk patient population. Higher risk patients who did not have a final ECG were not included in the analysis.

Only patients who had a final ECG after at least 24 h of hospital stay were considered for this analysis. The time of ECG classification has also varied in most previous studies; most classifications have been done at hospital discharge. Only 1.5% of patients progressed from non-Q wave to Q wave infarction after thrombolysis between 24 h and discharge in the only study of this issue performed in the thrombolytic era (36).

Finally, we could not address the number of bypass and angioplasty procedures that were performed from hospital discharge to 1-year follow-up. The better outcomes in the non-Q wave infarction population could be related to a greater use of revascularization procedures.

Conclusions. Patients with no ECG confounding factors or evidence of a previous infarction who do not develop Q waves after thrombolysis have a better 30-day and 1-year prognosis than patients with a Q wave infarction. Future studies are needed to confirm this observation and to determine the reason for these improved outcomes.

Table 5. 30-Day Mortality Modeling

Model	Coeff	Chi-Square	p Value	OR (95% CI)
Without Q wave (16)*		545.94		
With Q wave, no posterior MI	0.5360	560.31	0.0001	171 (1.27–2.29)
With Q wave, including posterior MI	0.5825	561.57	0.0001	1.79 (1.32–2.44)

*Includes age, height, weight, systolic blood pressure, Killip class, heart rate, infarct location, previous infarction, time to treatment, diabetes, smoking status (current and former), thrombolytic strategy, previous bypass surgery, hypertension and previous cerebrovascular disease. CI = confidence interval; Coeff = coefficient; OR = odds ratio.

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Appendix 1

Definitions of Confounding Electrocardiographic Factors

The following were classified if the criteria listed were present:

1. Left ventricular hypertrophy (two of three criteria required): Sokolow-Lyon, Cornell voltage and Romhilt-Estes.
2. Right ventricular hypertrophy: Butler-Leggett criteria.
3. Left bundle branch block: QRS duration ≥120 ms with a terminal broad S wave in lead V_1.
4. Right bundle branch block: QRS duration ≥120 ms with a terminal R or R′ wave in lead V_1.
5. Left anterior fascicular block: left axis deviation between −45° and −90°, rS pattern in leads II, III and aVF and no evidence of left ventricular hypertrophy or left bundle branch block.
6. Left posterior fascicular block: right axis deviation ≥120°, rS pattern in leads I and aVL and no evidence of right ventricular hypertrophy. Only ventricular pacing was considered a confounding factor.
7. Wolff-Parkinson-White syndrome: PR interval ≤120 ms, widened QRS complex and slurred upstroke on the initial part of the QRS complex (delta wave).
8. Low voltage: sum of the R+S amplitudes in limb leads ≤0.5 mV and sum of the R+S amplitudes in precordial leads ≤1.0 mV.
9. Poor-quality recordings: baseline wander, excessive artifact, poor photocopies.
10. Incomplete tracings: not standard 12-lead (25 mm/s) tracings.

Appendix 2

Definitions of Clinical Events

Reinfarction: Assessment by the physician that a second myocardial infarction has occurred after the first, for which the patient was enrolled, on the basis of the presence of at least two of the following criteria: 1) recurrent ischemic symptoms lasting >15 min, after resolution of symptoms of the index myocardial infarction; 2) occurrence of new ST-T wave changes or new Q waves; 3) a second elevation in cardiac enzyme levels to above the normal upper limit (or by a further 20% if already above the normal upper limit); or 4) angiographic reocclusion of a documented previously patent infarct-related artery. For each reinfarction, an ancillary data form was completed.

Cardiogenic shock: Systolic blood pressure <90 mm Hg for at least 1 h, not responsive to fluid replacement alone, thought to be secondary to cardiac dysfunction and associated with signs of hypoperfusion (cool, clammy skin, oliguria or altered sensorium) or cardiac index ≤2.2 liters/min per m^2. If systolic pressure increased to >90 mm Hg within 1 h solely as a result of positive inotropic agents, the patient was still considered to have cardiogenic shock. If the patient was in cardiogenic shock at enrollment, this was not classified as an in-hospital event. An ancillary data form was completed for all patients who presented with shock or developed shock.

Stroke: Acute new neurologic deficit resulting in death or lasting at least 24 h, classified by a physician as a stroke, with supporting information, including brain images and neurologic/neurosurgical evaluation. Brain imaging, either computed tomography or magnetic resonance imaging, was required for all patients with suspected stroke. Adverse cerebrovascular events were classified as primary intracranial hemorrhage, nonhemorrhagic stroke (cerebral infarction), hemorrhagic conversion of infarct or unknown stroke type. An ancillary data form was completed for all patients with suspected stroke.

Congestive heart failure, pulmonary edema: Signs or symptoms of congestion (rales greater than basilar, dyspnea, pulmonary edema on chest X-ray film, peripheral edema) or low cardiac output (weakness, fatigue) thought to be secondary to cardiac dysfunction.

Recurrent ischemia: Symptoms (e.g., chest discomfort, arm pain, jaw pain, nausea); ECG changes or new hypotension, or both; pulmonary edema or murmur thought by the physician to represent myocardial ischemia.

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