Outcomes for Patients With ST-Elevation Myocardial Infarction in Hospitals With and Without Onsite Coronary Artery Bypass Graft Surgery

The New York State Experience

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Background—The benefit of primary percutaneous coronary interventions (P-PCI) for patients with ST-elevation myocardial infarction (STEMI) has been well documented. However, controversy still exists as to whether PCI should be expanded to hospitals without coronary artery bypass graft surgery.

Methods and Results—Patients who were discharged after PCI for STEMI between January 1, 2003, and December 12, 2006, in P-PCI centers (hospitals with no coronary artery bypass graft surgery, and PCI only for patients with STEMI) were propensity matched with patients in full service centers, and mortality and subsequent revascularization rates were compared. For patients undergoing PCI, there were no differences for in-hospital/30-day mortality (2.3% for P-PCI centers versus 1.9% for full service centers \(P=0.40\)), emergency coronary artery bypass graft surgery immediately after PCI (0.06% versus 0.35%, \(P=0.06\)), 3-year mortality (7.1% versus 5.9%, \(P=0.07\)), or 3-year subsequent revascularization (23.8% versus 21.5%, \(P=0.52\)). P-PCI centers had a lower same/next day coronary artery bypass graft rate (0.23% versus 0.69%, \(P=0.046\)) and higher repeat target vessel PCI rates (12.1% versus 9.0%, \(P=0.003\)). For patients with STEMI who did not undergo PCI, P-PCI centers had higher in-hospital mortality (28.5% versus 22.3%; adjusted odds ratio, 1.38; 95% CI, 1.10 to 1.75).

Conclusions—No differences between P-PCI centers and full service centers were found in in-hospital/30-day mortality, the need for emergency surgery, 3-year mortality or subsequent revascularization, but P-PCI centers had higher repeat target vessel PCI rates and higher mortality rates for patients who did not undergo PCI. P-PCI centers should be monitored closely, including the monitoring of patients with STEMI who did not undergo PCI. (Circ Cardiovasc Interv. 2009;2:519-527.)

Key Words: percutaneous coronary intervention (PCI) \(\rightarrow\) onsite coronary artery bypass graft (CABG)  
\(\rightarrow\) STEMI \(\rightarrow\) mortality

The benefit of percutaneous coronary interventions (PCIs) relative to thrombolytic therapy for patients with ST-elevation myocardial infarctions (STEMIs) is well documented.\(^1\)\(^-\)\(^4\) However, the benefit of PCI is at least partially dependent on the need for patients to receive PCI as quickly as possible,\(^5\) ideally within 90 minutes of the patient’s contact with the healthcare system.\(^6\) Consequently, it is desirable to have systems that enable performance of PCI within a short time frame after the onset of patient symptoms.\(^7\)

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However, expanding the number of hospitals that perform PCI for patients with STEMI may be difficult and have potential disadvantages, including no coronary artery bypass graft surgery backup and worse outcomes because of lower volumes.\(^8\)-\(^10\)

In 2000, the New York State Department of Health, which has a Certificate of Need system for limiting the number of hospitals in which CABG surgery and PCI are performed, began to allow a limited number of hospitals to perform emergency (primary) PCI for patients with STEMI. This was accompanied by strict criteria governing the practice of primary PCI (P-PCI) in these hospitals, including a thorough review of their data at 6- to 12-month intervals. Also, the hospitals were required to participate in the Atlantic Cardiovascular Patient Outcomes Research Team trial.\(^11\)

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By 2006, a total of 11 hospitals were certified to perform PCI without surgical backup (henceforth called P-PCI centers). This study compares patient outcomes for patients with STEMI in those hospitals with patient outcomes in full service (FS) cardiac hospitals (hospitals that perform CABG surgery as well as P-PCI and elective PCI).

Methods

Databases

The main database in the study was the New York State Percutaneous Coronary Intervention Reporting System (PCIRS) registry, which was developed in 1991 for the purpose of collecting information on all patients undergoing PClCs in New York’s nonfederal hospitals.

Patient identifiers in PCIRS and New York’s companion registry for patients undergoing CABG surgery, the Cardiac Surgery Reporting System, were used to obtain data on repeat in-state revascularizations by creating a patient-level longitudinal file based on the PCIRS and the Cardiac Surgery Reporting System. Deaths occurring among New York State patients after discharge from the hospital were obtained by matching the PCIRS with New York’s Vital Statistics Death file using specific patient identifiers. Patients with STEMI who did not undergo revascularization were identified by New York’s administrative discharge database, the Statewide Planning and Research Cooperative System.

Study Group and End Points

The primary focus of the study is patients who were discharged after PCI for STEMI between January 1, 2003, and December 12, 2006. All these patients were followed through December 12, 2006, to detect the end points except patients who had left main disease (334 patients), had thrombolytic therapy before PCI (2028 patients), or were transferred from a hospital without PCI capability (3497 patients), or were from out of state (319 patients). The remaining group consisted of 1735 patients who underwent P-PCI at P-PCI centers and 8817 patients from FS centers. These groups were propensity matched (as described in the methods), and the analyses compared the outcomes of 1729 patients from each of the 2 types of hospitals.

Short-term end points in the study for PCI patients were in-hospital/30-day mortality, emergency CABG surgery after PCI, and same/next day CABG surgery after PCI. “Emergency cardiac surgery” was coded as a data element in PCIRS and defined as “the patient is taken to the operating room for cardiac surgery on an emergency basis due to a complication of PCI.” For P-PCI centers, same/next day surgery involved a transfer to a FS center for surgery. Longer-term end points were 3-year mortality, repeat target vessel PCI (TVPCI), and subsequent revascularization (SR) in any vessel. Because subsequent CABG surgery after discharge could not be confirmed to be related to the TV, we examined repeat TVPCI only rather than repeat TV revascularization by CABG or PCI. SR was defined as CABG surgery at any time after the index procedure, or PCI at any time in any hospital subsequent to 30 days after the index procedure. The 30-day window was used so that staged PCIs would not be counted as adverse events. Subsequent TVPCI was defined as occurring in any hospital at any time subsequent to discharge after the index procedure.

Another focus of the study was to compare the percentage of patients with STEMI who did not undergo PCI in P-PCI centers and FS centers to compare their short-term outcomes. The end point for these analyses was risk-adjusted in-hospital mortality, the only available outcome for the non-PCI patients.

Statistical Analysis

The main purpose of the study was to compare outcomes of patients with STEMI who underwent PCI in FS centers with outcomes of patients in P-PCI centers. Because patients were not randomized to the 2 types of hospitals, the strategy used was to identify patient’s preprocedural characteristics that were potentially related to patients’ long- and short-term outcomes and to match patients based on those characteristics using propensity-matched samples. These characteristics included demographics, previous revascularization, left ventricular function, time since onset of myocardial infarction (MI), comorbidities, hemodynamic status, and the number and location (left anterior descending/no left anterior descending) of diseased coronary vessels. The prevalences of these characteristics were compared for patients who underwent PCI in FS centers and P-PCI centers, and the differences were tested using $\chi^2$ tests and t tests.

These characteristics were then used to develop a logistic regression model that predicted the probability that a given STEMI patient would undergo PCI in a P-PCI center rather than a FS center. This value, the propensity score, was used to match patients without replacement on a 1-to-1 basis. A patient undergoing PCI in a P-PCI center was randomly selected and then matched with a patient undergoing PCI in a FS center who had a propensity score that was closest to the P-PCI patient. Patients from FS centers were matched to P-PCI patients unless the estimated log-odds from the logistic regression model for the patient was larger than 0.2 SDs from that of the P-PCI patient. Differences between the 2 matched samples in the prevalence of propensity model variables were evaluated using standardized differences. Usually, small (<10%) standardized differences support the assumption of balance between matched groups. The propensity-matched pairs were then used to analyze differences in outcomes between the 2 groups.

For short-term outcomes (in-hospital/30-day mortality, emergency CABG surgery following PCI, and same/next day CABG surgery after PCI), McNemar test was used to test for differences in the propensity-matched samples. For the 3 longer-term outcomes, Kaplan–Meier survival curves were developed, and differences in the curves were tested taking into account that the analysis involved matched samples.

Door-to-balloon times were compared for unmatched patients in 2006 using the Wilcoxon rank-sum test to compare median values and the $\chi^2$ test to compare the percentage of patients with times <90 minutes. Also, patients with STEMI who did not undergo PCI were identified using administrative data from the Statewide Planning and Research Cooperative System. Differences in in-hospital mortality rates (30-day outcomes were not available in the Statewide Planning and Research Cooperative System) between patients in P-PCI centers and FS centers were tested using logistic regression with generalized estimating equations to account for the clustering of patients within hospitals, with type of hospital as the study variable and with the same risk factor covariates used by the Centers for Medicaid and Medicare Services.

With regard to the analyses of patients undergoing PCI, the statistical power to identify an adjusted odds ratio (OR) of 2.0 as significant with a type I error of 0.05 for short-term outcomes in the matched pairs analysis was 0.99 for mortality and 0.98 for same-stay CABG. The power to identify an adjusted hazard ratio of 1.5 as significant with a type I error of 0.05 for the longer-term outcomes was 0.82 for mortality, 0.89 for TVPCI, and 0.99 for any revascularization.

All tests were 2-sided and conducted at the 0.05 level, and all analyses were conducted in SAS 9.1 (SAS Institute, Cary, NC).

Results

Table 1 presents the patient characteristics in the 2 types of hospitals before using propensity scores to match patients. As indicated, there were 1735 patients undergoing P-PCI in P-PCI centers and 8817 patients undergoing P-PCI in FS centers. There were significant differences in the prevalences of several characteristics, with FS center patients having a higher percentage of patients who were in the age range of 64 to 74 years, female, black, and had lower ejection fractions, longer times since the onset of symptoms of MI, and higher prevalences of carotid/cerebrovascular disease, peripheral vascular disease, previous revascularization rate, hemody-
odynamic instability, congestive heart failure, and chronic obstructive pulmonary disease. It is notable that 92% of patients in P-PCI centers underwent PCI within 6 hours of symptom onset, compared with 71% in FS centers.

Table 1 also demonstrates that the volumes for operators in P-PCI hospitals are higher than volumes of operators in FS cardiac centers. For instance, the median 4-year volume for operators in P-PCI centers was 697 compared with 491 for operators whose practice is limited to FS centers, and the respective four-year median volumes for P-PCIs were 78 and 34. The volumes reported for operators in P-PCI centers also reflect their volumes in FS centers and all but 3 of the 61 also performed PCIs in FS centers.

The propensity score model consisted of all variables in Table 1, and the area under the operating characteristic curve was 0.67. Differences in patient characteristics/risk factors in the 2 types of hospitals after propensity matching are presented in Table 2. As indicated, the percent standardized difference was quite low for most risk factors, with only 2 risk factor categories above 5.0%.

Short-term (in-hospital/30-day mortality) respective adverse outcome rates for P-PCI centers and FS centers were

| Table 1. Patient Characteristics for All Unmatched PCI Patients From P-PCI Centers and Full Service Centers, New York State, January 1, 2003, to December 31, 2006 |
|-------------------------------------------------|------------------|------------------|
| | P-PCI Centers | Full Service Centers | P |
| No. of hospitals | 11 | 40 |  |
| No. of patients | 1735 | 8817 |  |
| All cases |  |  |  |
| Mean (SD) 1-y volume | 221 (165) | 189 (149) |  |
| Median (IQR) | 195 (114, 276) | 158 (90, 241) |  |
| STEMI cases |  |  |  |
| Mean (SD) 1-y volume | 23 (15) | 17 (13) |  |
| Median (IQR) | 21 (12, 33) | 14 (6, 24) |  |

Age, y

Mean: 59, 60

Age, %

<55: 39.1, 36.4

55–64: 27.5, 27.5

64–74: 15.9, 19.0

75–84: 14.5, 13.6

≥84: 3.0, 3.5

Female, %

25.9, 28.5

Black, %

5.9, 7.6

Ejection fraction, %

<20: 0.9, 1.3

2–29: 4.2, 6.6

30–39: 12.3, 15.4

40–49: 32.9, 26.5

≥50: 49.8, 50.2

Myocardial Infarction (hours from symptom onset to PCI), %

<6: 91.5, 70.5

6–11: 6.9, 13.7

11–23: 1.6, 15.8

Carotid/cerebrovascular disease: 1.8, 4.5

Peripheral vascular disease: 2.4, 4.0

Previous revascularization: 9.6, 11.3

Hemodynamic status, %

Stable: 97.1, 94.9

Unstable: 2.4, 3.8

Shock: 0.6, 1.2

Congestive heart failure, %

This admission: 3.1, 6.1

Before this admission: 0.5, 0.6

IQR indicates interquartile range; LAD, left anterior descending.

nomic instability, congestive heart failure, and chronic obstructive pulmonary disease. It is notable that 92% of patients in P-PCI centers underwent PCI within 6 hours of symptom onset, compared with 71% in FS centers.

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Short-term (in-hospital/30-day mortality) respective adverse outcome rates for P-PCI centers and FS centers were
2.31% and 1.91% for mortality ($P = 0.40$) and 0.23% and 0.69% for same/next day CABG ($P = 0.046$; Table 3). Emergency surgery occurred rarely (6 patients, 0.35% in FS centers and 1 patient, 0.06% in P-PCI centers, $P = 0.06$). For longer-term outcomes, median follow-up times for the 3 outcomes varied from 426 to 577 days for P-PCI centers and from 530 to 664 days for FS centers. There were no differences in mortality or SR rates. Three-year mortality rates were 7.1% and 5.9%, $P = 0.07$, and 3-year SR rates were 23.8% and 21.5%, $P = 0.52$. However, P-PCI centers had higher repeat TVPCI rates (eg, 3-year rates were 12.1% versus 9.0%, $P = 0.003$; Figures 1 through 3). When drug-eluting stent was included as one of the matching variables in

### Table 2. Patient Characteristics for Propensity-Matched Samples of Patients With STEMI Undergoing PCI in P-PCI Centers and Full Service Centers, New York State, January 1, 2003, to December 31, 2006

<table>
<thead>
<tr>
<th></th>
<th>P-PCI Centers</th>
<th>Full Service Centers</th>
<th>% Standardized Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>1729</td>
<td>1729</td>
<td></td>
</tr>
<tr>
<td>Age, y</td>
<td>59.6</td>
<td>59.4</td>
<td>1.5</td>
</tr>
<tr>
<td>Age, %</td>
<td>59.6</td>
<td>59.4</td>
<td></td>
</tr>
<tr>
<td>&lt;55</td>
<td>39.2</td>
<td>40.0</td>
<td>1.7</td>
</tr>
<tr>
<td>55–64</td>
<td>27.5</td>
<td>27.0</td>
<td>1.0</td>
</tr>
<tr>
<td>64–74</td>
<td>16.0</td>
<td>16.5</td>
<td>1.4</td>
</tr>
<tr>
<td>75–84</td>
<td>14.5</td>
<td>13.7</td>
<td>2.3</td>
</tr>
<tr>
<td>≥84</td>
<td>3.0</td>
<td>2.9</td>
<td>0.3</td>
</tr>
<tr>
<td>Female, %</td>
<td>25.9</td>
<td>24.3</td>
<td>1.2</td>
</tr>
<tr>
<td>Black, %</td>
<td>6.0</td>
<td>5.0</td>
<td>4.3</td>
</tr>
<tr>
<td>Ejection fraction, %</td>
<td>0.9</td>
<td>0.5</td>
<td>4.2</td>
</tr>
<tr>
<td>&lt;20</td>
<td>4.2</td>
<td>4.3</td>
<td>0.9</td>
</tr>
<tr>
<td>2–29</td>
<td>12.3</td>
<td>12.4</td>
<td>0.4</td>
</tr>
<tr>
<td>30–39</td>
<td>32.7</td>
<td>32.6</td>
<td>0.4</td>
</tr>
<tr>
<td>40–49</td>
<td>49.9</td>
<td>50.1</td>
<td>0.5</td>
</tr>
<tr>
<td>Myocardial infarction (hours from symptom onset to PCI), %</td>
<td>91.6</td>
<td>91.7</td>
<td>0.4</td>
</tr>
<tr>
<td>&lt;6</td>
<td>6.9</td>
<td>6.8</td>
<td>0.7</td>
</tr>
<tr>
<td>6–11</td>
<td>1.5</td>
<td>1.5</td>
<td>0.5</td>
</tr>
<tr>
<td>11–23</td>
<td>1.8</td>
<td>1.9</td>
<td>0.9</td>
</tr>
<tr>
<td>Carotid/cerebrovascular disease, %</td>
<td>2.4</td>
<td>1.7</td>
<td>4.5</td>
</tr>
<tr>
<td>Peripheral vascular disease, %</td>
<td>9.6</td>
<td>10.1</td>
<td>0.2</td>
</tr>
<tr>
<td>Previous revascularization, %</td>
<td>97.1</td>
<td>96.9</td>
<td>0.7</td>
</tr>
<tr>
<td>Hemodynamic status, %</td>
<td>2.4</td>
<td>2.5</td>
<td>0.8</td>
</tr>
<tr>
<td>Stable</td>
<td>0.6</td>
<td>0.6</td>
<td>0.0</td>
</tr>
<tr>
<td>Unstable</td>
<td>3.1</td>
<td>2.4</td>
<td>4.6</td>
</tr>
<tr>
<td>Shock</td>
<td>0.5</td>
<td>0.5</td>
<td>0.0</td>
</tr>
<tr>
<td>Congestive heart failure, %</td>
<td>96.4</td>
<td>97.1</td>
<td>4.2</td>
</tr>
<tr>
<td>This admission</td>
<td>1.0</td>
<td>1.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Before this admission</td>
<td>2.0</td>
<td>2.2</td>
<td>1.2</td>
</tr>
<tr>
<td>Malignant ventricular arrhythmia, %</td>
<td>15.8</td>
<td>14.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Chronic obstructive pulmonary disease, %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diabetes, %</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LAD indicates left anterior descending.

Table 3. Adverse Outcome Rates and $P$ Values for Matched Patients With STEMI Undergoing P-PCI in P-PCI Centers and Full Service Centers: New York, January 2003 to December 2006

<table>
<thead>
<tr>
<th></th>
<th>Rate in P-PCI Centers, %</th>
<th>Rate in Full Service Centers, %</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-hospital/30-day mortality</td>
<td>2.31</td>
<td>1.91</td>
<td>0.40</td>
</tr>
<tr>
<td>Same/next day CABG</td>
<td>0.23</td>
<td>0.69</td>
<td>0.046</td>
</tr>
<tr>
<td>Emergency CABG surgery</td>
<td>0.06</td>
<td>0.35</td>
<td>0.06</td>
</tr>
</tbody>
</table>
the propensity analyses, P-PCI centers still had higher TVPCI rates (3-year rates were 12.1% versus 10.5%, \(P=0.02\)).

Door-to-balloon times were not statistically different (median values of 89 for P-PCI centers and 90 for FS centers \([P=0.55]\) and percentages of patients with door-to-balloon times <90 minutes were 52% for P-PCI centers and 50% for FS centers \([P=0.48]\)).

A total of 34.3% of patients with STEMI presenting at P-PCI centers (including 2.9% who were transferred to FS centers) and 30.3% presenting at FS centers did not undergo P-PCI. The respective in-hospital mortality rates for P-PCI and FS patients who did not undergo PCI were 28.5% and 22.3%. After adjusting for differences in patient risk factors, patients with STEMI treated without PCI in P-PCI centers were found to have significantly higher in-hospital mortality (adjusted OR, 1.38; 95% CI, 1.08 to 1.75) than their counterparts in FS centers. After removing the 80 patients who died within 2 hours of arriving at the hospital, P-PCI center patients still had higher mortality rates (adjusted OR, 1.39; 95% CI, 1.10 to 1.77).
In view of the desire to transport patients with STEMI quickly to hospitals that perform PCI, there has been a movement toward providing PCI in hospitals without CABG surgery backup. A potential advantage of this policy is that the travel time to the nearest PCI hospital should decrease. Also, as PCI outcomes have improved over time, the likelihood of patients requiring CABG surgery backup is now very low. However, there is still a possibility that emergency CABG surgery will be needed, and hospitals with no CABG backup are more likely to have lower PCI volumes when they do not provide elective PCI. This can lead to worse outcomes because of a demonstrated volume-outcome relationship for hospitals and operators performing PCI\(^8\)–\(^{10}\) and P-PCI\(^8\), although the magnitude of this effect is controversial\(^{10,20,21}\).

Several studies have examined PCI outcomes for patients with STEMI in hospitals without backup CABG surgery.\(^{22–38}\) Of these studies, only a few have compared PCI outcomes for patients with acute MI or STEMI in hospitals with and without CABG surgery backup.\(^{22–25,26,37}\) In a study using 2004–2006 National Cardiovascular Data Registry information, Kutcher et al\(^{37}\) found that off-site PCI centers had similar risk-adjusted in-hospital mortality, procedure success, morbidity, and emergency cardiac surgery rates as hospitals with cardiac surgery onsite.

In a comparison of MI and elective Medicare PCI patients in 1999–2001, Wennberg et al found that after adjusting for baseline differences, mortality for patients with P-PCI was similar in hospitals without and with cardiac surgery. However, Wennberg et al\(^{22}\) also found that for non-P-PCI, mortality was higher in hospitals without onsite cardiac surgery (adjusted OR, 1.38; 95% CI, 1.14 to 1.37; \(P=0.001\)).

In a study of 2 hospitals in the Mayo Health System between 1999 and 2005, 1 with and 1 without backup cardiac surgery, Ting et al found that among 285 P-PCIs for STEMI, procedural success was 93% at the hospital without backup and 96% at the hospital with backup (\(P=0.085\)). There were no differences between the hospitals in 2-year survival.\(^{23}\)

Weaver et al,\(^{24}\) in a registry with 1062 patients with MI treated with PCI, found no differences based on whether the hospital had onsite cardiac surgery. In the PAMI-No SOS study, Wharton et al compared patients with MI at high risk presenting to 19 PCI hospitals with no surgical backup to P-PCI at those hospitals and transfer for P-PCI at hospitals with cardiac surgical backup. There was no significant difference in the combined primary end point of 30-day mortality, reinfarction, or disabling stroke, or in adjusted mortality.\(^{25}\)

In view of results like these, the Society for Cardiovascular Angiography and Interventions has concluded that “PCI without onsite backup is being performed with acceptable outcomes and risks in the United States and other countries” and has recommended that independent program oversight should occur either within the hospital’s quality assurance program or through an independent government or external agency, and that further data collection and analysis should be done to further understand the role of PCI without surgical backup.\(^{39}\)

Our study is an evaluation of the pilot program launched by the New York State Department of Health that allowed 11 hospitals without CABG surgery capability to provide PCI for patients with STEMI. In particular, this study is an evaluation of their in-hospital and longer-term outcomes relative to outcomes of FS centers that have CABG surgery backup.

Results of our study demonstrate that in New York, P-PCI patients in P-PCI centers were generally less sick in that they had higher left ventricular ejection fractions and were less likely to have each of several comorbidities (carotid/cerebrovascular disease, peripheral vascular disease, hemodynamic
instability, congestive heart failure, malignant ventricular arrhythmia, and chronic obstructive pulmonary disease). Also, they were more likely to have experienced the onset of MI symptoms within 6 hours, which is desirable from the standpoint of benefiting from P-PCI.

Our results also demonstrate that after propensity-matching P-PCI patients from the 2 types of centers, there were no significant differences in in-hospital/30-day mortality or emergency CABG surgery. However, patients in P-PCI centers had a lower rate of same/next day CABG. There were no significant differences in 3-year mortality or SR rates, but patients in P-PCI centers had significantly higher 3-year rates of TVPCI (12.1% versus 9.0%, P=0.003). Because patients in FS centers underwent PCI with drug-eluting stents more frequently (53.7% versus 42.7%), and because earlier studies have identified lower TV revascularization rates for patients receiving drug-eluting stent, we developed a new pair of propensity-matched samples in which drug-eluting stent was included as one of the matching variables (the percentages after matching were 42.7% for P-PCI centers and 43.6% for FS centers). P-PCI centers continued to have higher TVPCI rates (3-year rates were 12.1% versus 10.5%, P=0.02).

Also, a higher percentage of patients with STEMI arriving at P-PCI centers did not undergo PCI (34.2% versus 30.3%), and these patients had higher mortality rates (28.5% versus 22.3%; adjusted OR, 1.38; 95% CI, 1.08 to 1.75). It is essentially impossible to determine precisely why this occurred given that only administrative data were available for these patients. The mortality measure was limited to in-hospital mortality because 30-day mortality data were not available, and it is possible that 30-day outcomes may have yielded different conclusions. More importantly, other information would have been valuable to have. For instance, patients treated at P-PCI centers may have included a subset of patients who would have received CABG surgery if they had presented at a FS center. One possible explanation for higher mortality rates and a higher percentage of patients not undergoing PCI in P-PCI centers is that since symptom onset times are lower in P-PCI centers, the sickest patients are dying before they can get PCI, but that similar patients are dying en route to FS centers (and therefore not showing up as deaths). Another possibility is that FS centers are better geared up to provide lytics and other care than P-PCI centers.

The bottom line is that to accurately assess quality of care in the 2 types of hospitals, these patients should be included, but more data are needed on them. This should include the kind of information that is available in PCI registries but not in administrative data, such as time since onset of symptoms and physiological data like blood pressure at admission.

There are also some caveats to our study with regard to whether the results can be repeated in other settings. First, it is important to note that the operators in New York P-PCI centers were required to perform at least 200 PCIs in the past 3 years, 75 PCIs per year, and 11 P-PCIs per year on a regular basis. Also, P-PCI centers were required to ensure 24/7/365 coverage for P-PCI, maintain a volume of 36 P-PCIs per year, and maintain an active affiliation with a high-volume FS center.

The Society for Cardiovascular Angiography and Interventions recommended that operators performing PCI without onsite surgical backup should perform >100 total PCIs per year and >18 P-PCIs per year as well as have a lifetime experience of >500 PCIs as a primary operator after completing their fellowship. In P-PCI centers in our study, 72% of operators had annualized 4-year volumes that were at least 100 compared with 59% of operators in FS cardiac hospitals. Also, 54% of operators in P-PCI centers had annualized 4-year volumes of P-PCIs that were at least 18 compared with 26% in FS cardiac hospitals. As noted in the Results section, the reason for these results is that all but 3 of the 61 operators in P-PCI centers also performed PCIs in FS cardiac centers.

Another caveat is that our study is an observational study and is therefore subject to potential selection bias. In fact, as noted earlier, we found that patients in FS centers had worse ventricular function and more comorbidities on average. However, we adjusted for these differences by propensity-matching patients so that no significant risk factor differences existed, and we believe that selection bias has been minimized. Furthermore, it is impractical to conduct a randomized controlled trial for study topic because it would consist of having to randomize patients with STEMI in an ambulance to offsite and onsite surgical centers, and this could endanger patients’ lives depending on relative travel times. Furthermore, patients who self-transport could not be randomized.

Also, it is possible that because the time frame of the study includes the startup period for some of the P-PCI centers during which teams were not familiar with working with one another, the study would be biased against P-PCI centers. However, we repeated the analyses after excluding the first year of operation for P-PCI centers and found no substantive difference between the 2 sets of analyses (eg, FS centers still experienced lower 3-year TVPCI and the other 3-year outcomes were not significantly different).

In conclusion, we have found that in an environment in which the New York State pilot program required strict controls on processes and structures of care, many short- and longer-term outcomes did not differ between P-PCI centers and FS centers. However, there was a tendency for P-PCI centers to have higher repeat TVPCI rates and higher short-term mortality rates for patients with STEMI who did not undergo PCI. Hence, it would seem that there is a need to monitor P-PCI centers very closely, including the monitoring of patients with STEMI who did not undergo PCI. To do this properly, a registry for all patients with STEMI, regardless of whether they undergo PCI, would be ideal.

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Disclosures

Dr King has a speakers’ bureau appointment with the Network for Continuing Medical Education, receives honoraria from Merck & Co and Wyeth Pharmaceuticals, and serves as a consultant for Celonova BioSciences and as an advisory board member of Medtronic.

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CLINICAL PERSPECTIVE

The benefit of primary percutaneous coronary interventions (P-PCI) for patients with ST-elevation myocardial infarction (STEMI) has been well documented. However, controversy still exists as to whether PCI should be expanded to hospitals without coronary artery bypass graft surgery. In this study, patients who were discharged after PCI for STEMI between January 1, 2003, and December 12, 2006, in P-PCI centers (hospitals with no coronary artery bypass graft surgery and PCI only for patients with STEMI) were propensity matched with patients in full service centers, and mortality and subsequent revascularization rates were compared. There were no differences for in-hospital/30-day mortality (2.3% for P-PCI centers versus 1.9% for full service centers [P=0.40]), emergency coronary artery bypass graft surgery (0.06% versus 0.35%, P=0.06), in 3-year mortality (7.1% versus 5.9%, P=0.07) or subsequent revascularization (23.8% versus 21.5%, P=0.52). P-PCI centers had a lower same/next day coronary artery bypass graft rate (0.23% versus 0.69%, P=0.046) and higher repeat target vessel PCI rates (12.1% versus 9.0%, P=0.003). For patients with STEMI who did not undergo PCI, P-PCI centers had higher in-hospital mortality (28.5% versus 22.3%; adjusted odds ratio, 1.38; 95% CI, 1.08 to 1.75). In conclusion, no differences between P-PCI centers and full service centers were found in in-hospital/30-day mortality, the need for emergency surgery, 3-year mortality or subsequent revascularization, but P-PCI centers had higher repeat target vessel PCI rates and higher mortality rates for patients who did not undergo PCI. P-PCI centers should be monitored very closely, including the monitoring of patients with STEMI who did not undergo PCI.
Outcomes for Patients With ST-Elevation Myocardial Infarction in Hospitals With and Without Onsite Coronary Artery Bypass Graft Surgery: The New York State Experience
Edward L. Hannan, Ye Zhong, Michael Racz, Alice K. Jacobs, Gary Walford, Kimberly Cozzens, David R. Holmes, Robert H. Jones, Mary Hibberd, Donna Doran, Deborah Whalen and Spencer B. King III

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