The advantages of a consultant led primary percutaneous coronary intervention service on patient outcome

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Summary

Background: Mortality among emergency medical admissions has been reported to be higher when patients are admitted to hospital at nights and weekends.

Aim: We studied the outcome of ST elevation myocardial infarction (STEMI) patients presenting at different times to our centre with 24/7 primary percutaneous coronary intervention (PPCI) service.

Methods: We divided all patients who underwent PPCI between September 2009 and November 2011 into three groups according to the time of admission as group 1: in-hours (0800–1800 h weekdays), group 2: out-of-hours (1800–0800 h weekdays) and group 3: weekends (Sat to Mon 0800–0800 h).

Results: A total of 605 (41.1%), 397 (27%) and 469 (31.9%) were included in group 1, 2 and 3, respectively. Apart from cardiogenic shock (8.9%, 5.5% and 7.7%, \( P=0.05 \)) and door to balloon time (median 29, 33 and 36 min, \( P<0.0001 \)), there was no significant difference noted in the baseline and procedural characteristics between the groups. In-hospital mortality (4.6%, 4.3% and 5.3%, \( P=0.5 \)), 30-day mortality (6.4%, 6.3% and 7%, \( P=0.7 \)), 30-day stent thrombosis (0.8%, 0.8% and 0.2%, \( P=0.1 \)) and 1-year mortality (10.7%, 10.8% and 9.8%, \( P=0.7 \)) were no difference between the groups. On logistic regression analysis, out-of-hours and weekend admissions were not found to be a predictor of both 30-day and 1-year mortality.

Conclusion: In this consecutive series of patients admitted to a high volume PPCI centre, there was no difference in mortality when patients were admitted at different times. The involvement of senior medical staff early in the patients’ admission may have contributed to these consistent outcomes.

Introduction

Emergency medical admissions to National Health Service (NHS) hospitals have increased substantially over the last decade. There is a major drive towards 24/7 services to all patients, especially the emergency medical conditions with high mortality. However, this is hampered by limitation in resources and restriction in working hours for health professionals. There is increasing evidence that mortality among emergency admissions at weekends is higher than weekday admissions.\(^1\)\(^-\)\(^4\)

The increased mortality at weekends was also demonstrated in patients admitted with myocardial infarction to the hospitals in New Jersey in America, between 1987 and 2002.\(^5\)

Even the latest data from
all admissions (14.2 million) to the English NHS hospitals during the financial year 2009/10 showed that admission at the weekend was associated with increased 30-day mortality. This finding that mortality rates are increased when patients are admitted at weekends raises important questions about the organisation of out-of-hours services in NHS hospitals. Senior medical staff have traditionally worked during normal office hours and covered junior medical staff at weekends with on-call rotas. It has been proposed that the reduced availability of consultant staff at weekends may contribute to worse outcomes.

Primary percutaneous coronary intervention (PPCI) is the preferred revascularisation strategy for ST segment elevation acute myocardial infarction (STEMI) at the present time. According to the latest Myocardial Ischaemia National Audit Project (MINAP) public report published in August 2011, 82% of patients in England had PPCI as the reperfusion strategy in STEMI, if they were eligible for any form of reperfusion. These procedures are normally undertaken by consultant interventional cardiologists or senior interventional trainees (under direct supervision of consultants) soon after admission with the goal of opening up the blocked artery within 30 min of the patient being admitted to the heart attack centre. One of the additional benefits of this 24/7 service is that patients are seen and assessed by senior medical staff early in their admission. The PPCI service at the Essex Cardiothoracic Centre started on 1 September 2009 and is now one of the largest heart attack centres in the UK. We report the 30-day and 1-year mortality of patients admitted to our consultant delivered heart attack service with particular reference to outcomes of patients admitted at weekends and out-of-hours.

**Methods**

We included all patients who underwent PPCI from September 2009 to November 2011 in our unit. Our PPCI service runs with 10 Interventional Cardiologists and 8 Specialist Registrars in the rota. We divided the patients into three groups according to the time of admission to our unit as group 1: in-hours (8 am to 6 pm weekdays), group 2: out-of-hours (6 pm to 8 am week nights) and group 3: weekend (Saturday 8 am to Monday 8 am) and bank holiday (BH). Their baseline characteristics and procedural data were entered prospectively in our dedicated cardiac service database system (Phillips CVIS system). All patients undergoing PCI were loaded with 600 mg of Clopidogrel and 300 mg of Aspirin prior to the procedure. Procedural decisions such as access site, use of thrombectomy device, adjunctive parenteral antithrombotic therapy and type of stent were also made at the discretion of the operator. All patients were maintained on aspirin 75 mg/day and clopidogrel 75 mg/day for a minimum period of 1 year. Other secondary preventative medications were prescribed at the discretion of the operator. Mortality data for all patients were obtained from NHS spine summary care record (SCR) database, which is a centralised database that is updated on a weekly basis. This was obtained using automatic flagging for date of death with the unique NHS number available for individual patients, which meant 100% mortality follow-up data.

**Definitions**

**Cardiogenic shock:** Cardiogenic shock was defined as anyone with systolic BP of <100 mmHg, heart rate of >100/min and signs of acute circulatory failure.

**Door to balloon time:** Time interval from the arrival to our unit (PPCI unit) to the use of first balloon or thrombectomy device or stent in the culprit lesion.

Procedural success was defined as having a thrombectomy device or balloon catheter/stent across the culprit lesion with at least Thrombolysis in Myocardial Infarction (TIMI) grade 2 flow at the end of procedure.

Definite stent thrombosis was defined according to the Academic Research Consortium (ARC) criteria.

**Statistics**

Continuous data are presented as mean ± standard deviation, unless stated otherwise, and categorical outcomes are presented as percentages. Categorical variables were compared by means of Fisher’s exact test and non-parametric tests (Mann–Whitney U and Kruskal–Wallis tests appropriately) were used to compare continuous variable between the groups. Binary logistic regression analysis was performed to identify predictors of 30-day mortality and 1-year mortality with the following variables: Age >75 years, sex, cardiogenic shock, diabetes, hypertension, previous MI, single vessel PCI (vs. multivessel PCI), pre-procedure TIMI 0/1 flow (vs. TIMI 2/3 flow), drug eluting stent (DES) use (vs. bare metal stent (BMS)), door to balloon time (DTB) in minutes, office hours (vs. out-of-hours) and weekend (vs. weekday) admission. Logistic regression analysis was performed initially with all the above predictors.
Then both stepwise backward elimination and forward inclusion methods were used to identify the best predictors of mortality. Kaplan–Meier methods were used to assess the survival at follow-up; comparisons were made with the log-rank test. All statistical analyses were performed with SPSS version 20 (IBM Corp., USA). A two-tailed P-value of <0.05 was considered to be significant.

Results

Of the 1471 patients who were admitted and underwent PPCI in our unit during the study period, 605 (41.1%), 397 (27%) and 469 (31.9%) were included in groups 1, 2 and 3, respectively. Pre-procedure cardiogenic shock was significantly higher in group 1 compared to group 2 (8.9% vs. 5.5%, P=0.05), but no other significant difference was noted in the baseline and procedural characteristics between the groups (Table 1).

When compared to group 1, DTB time (median, IQR: 29, 24–39 min) was significantly prolonged in group 2 (33, 24–36 min, P=0.004) and group 3 (36, 28–47 min, P<0.0001). There was no difference in DTB time between groups 2 and 3 (P=0.15). However, there was no significant difference in in-hospital mortality, 30-day mortality, 1-year mortality or 30-day stent thrombosis between the groups as shown in Table 2. Even after excluding patients with cardiogenic shock, there was no difference in in-hospital mortality (5.4%, 4.5% and 4.6%), 30-day mortality (7.1%, 6.4% and 6.0%) and 1-year mortality (7.8%, 9.3% and 7.6%) in groups 1, 2 and 3, respectively between the groups. Kaplan–Meier survival curve for all three groups is shown in Figure 1.

Table 1 Baseline and procedural characteristics between the groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Grp 1 (8 am to 6 pm weekdays) n=605</th>
<th>Grp 2 (6 pm to 8 am weekdays) n=397</th>
<th>Grp 3 (weekend + BH) n=469</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years (mean±SD)</td>
<td>65±14</td>
<td>66±13</td>
<td>65±13</td>
<td>0.7</td>
</tr>
<tr>
<td>Age &gt;75 years</td>
<td>164 (27.1)</td>
<td>97 (24.4)</td>
<td>115 (24.5)</td>
<td>0.4</td>
</tr>
<tr>
<td>Female</td>
<td>168 (27.8)</td>
<td>114 (28.7)</td>
<td>118 (25.2)</td>
<td>0.3</td>
</tr>
<tr>
<td>Diabetes</td>
<td>168 (27.8)</td>
<td>114 (28.7)</td>
<td>118 (25.2)</td>
<td>0.3</td>
</tr>
<tr>
<td>Cardiogenic shock</td>
<td>70 (11.6)</td>
<td>49 (12.3)</td>
<td>55 (11.7)</td>
<td>0.8</td>
</tr>
<tr>
<td>OOH cardiac arrest</td>
<td>54 (8.9)</td>
<td>22 (5.5)</td>
<td>36 (7.7)</td>
<td>0.05</td>
</tr>
<tr>
<td>Previous MI</td>
<td>70 (11.6)</td>
<td>56 (14.1)</td>
<td>51 (10.9)</td>
<td>0.07</td>
</tr>
<tr>
<td>Previous PCI</td>
<td>37 (6.1)</td>
<td>28 (7.1)</td>
<td>31 (6.6)</td>
<td>0.6</td>
</tr>
<tr>
<td>TIMI 0/1 flow</td>
<td>440 (72.7)</td>
<td>296 (74.6)</td>
<td>364 (77.6)</td>
<td>0.08</td>
</tr>
<tr>
<td>Single vessel PCI</td>
<td>545 (90.1)</td>
<td>356 (89.7)</td>
<td>412 (87.8)</td>
<td>0.3</td>
</tr>
<tr>
<td>Drug eluting stent (DES)</td>
<td>361 (59.7)</td>
<td>236 (59.4)</td>
<td>278 (59.3)</td>
<td>0.9</td>
</tr>
</tbody>
</table>

OOH, out of hospital; MI, myocardial infarction; CABG, coronary artery bypass graft surgery; PCI, percutaneous coronary intervention; TIMI, thrombolysis in myocardial infarction.

Office hours (weekday 8 am to 6 pm) vs. non-office hours

There were more patients admitted out-of-hours and weekends (n=866) when compared to regular weekday office hours of 8 am to 6 pm (n=605). The mortality rate was compared between these two groups, which did not show any significant difference. [IHM 4.9% vs. 4.6%, P=0.9, 30-day mortality 6.7% vs. 6.4%, P=0.9 and 1-year mortality 10.3% vs. 10.7%, P=0.8, respectively]. (Figure 2).

Weekdays vs. weekends

There was also no difference in mortality between patients who underwent PPCI in weekdays (n=1002) when compared to weekends (n=469). [IHM 4.5% vs. 5.3%, P=0.5, 30-day mortality 6.4% vs. 7.0%, P=0.7 and 1-year mortality 10.8% vs. 9.8%, P=0.7, respectively]. (Figure 2).

Logistic regression analysis

On binary logistic regression analysis of all patients with the variables mentioned in the Methods section, out-of-hours admission and admission during weekends are not shown to be a predictor of 30-day mortality (Table 3). The positive predictors of mortality were age >75 years, cardiogenic shock, diabetes and pre-procedure TIMI 0/1 flow whereas DES usage was the only negative predictor at 30 days (Table 3). Further stepwise analysis performed with both backward elimination/forward selection methods still did not find timing of admission as a predictor of 30-day mortality. Timing of admission was
also not found to be a predictor of mortality at 1 year when similar logistic regression analysis was repeated as above with 1-year mortality as dependant variable. (Table 4).

**Discussion**

We have shown that in a large PPCI service, the outcomes for heart attack patients admitted at evenings and weekends were no worse than for patients admitted during regular office hours. The introduction of primary PCI for ST segment elevation myocardial infarction has transformed the way heart attack patients are managed. Patients are seen and treated by experienced cardiologists, on a 24/7 basis, in well-equipped facilities, usually within the first 30 min after admission to hospital. This contrasts with the less comprehensive service available when patients are admitted to non-specialist hospitals following administration of thrombolytic therapy by junior doctors, nurses or paramedics. Few non-specialist hospitals are able to provide early access to experienced cardiologists at nights and weekends.

Activation of the STEMI pathway in our centre involves the PPCI team (consultant cardiologist, specialist registrar, cardiac catheter lab nurse, radiographer and physiologist) being called in when the paramedic makes the diagnosis of STEMI. The PPCI team usually reach the heart attack centre before the patient arrives and the first doctor to see the patient is often the consultant interventional cardiologist or the specialist registrar. Treatment times are carefully monitored and in our centre the mean interval between the admission time and first balloon inflation in the coronary artery

Table 2  Procedural and clinical outcome of patients in different groups

<table>
<thead>
<tr>
<th></th>
<th>Grp (8 am to 6 pm weekdays) n = 605</th>
<th>Grp 2 (6 pm to 8 am weekdays) n = 397</th>
<th>Grp 3 (weekend + BH) n = 469</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTB in minutes (median, IQR)</td>
<td>29 (24–39)</td>
<td>33 (24–36)</td>
<td>36 (28–47)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Successful procedure</td>
<td>588 (97.2)</td>
<td>379 (95.5)</td>
<td>452 (96.4)</td>
<td>0.2</td>
</tr>
<tr>
<td>IHM</td>
<td>28 (4.6)</td>
<td>17 (4.3)</td>
<td>25 (5.3)</td>
<td>0.5</td>
</tr>
<tr>
<td>30-day mortality</td>
<td>39 (6.4)</td>
<td>25 (6.3)</td>
<td>33 (7.0)</td>
<td>0.7</td>
</tr>
<tr>
<td>30-day ST</td>
<td>5 (0.8)</td>
<td>3 (0.8)</td>
<td>1 (0.2)</td>
<td>0.1</td>
</tr>
<tr>
<td>1-year mortality</td>
<td>65 (10.7)</td>
<td>43 (10.8)</td>
<td>46 (9.8)</td>
<td>0.7</td>
</tr>
</tbody>
</table>

DTB, door to balloon time; IHM, in-hospital mortality; ST, stent thrombosis.

Figure 1. Kaplan–Meier survival analysis at 1 year showed no difference in survival between the three groups.
(DTB time) is <35 min. Once the PCI procedure has been completed the interventional cardiologist is able to direct treatment in patients who may be very unstable. Decisions about intra-aortic balloon pumping, ventilator support and other advanced therapies are made by experienced clinicians within the first hour of admission on a 24/7 basis. It is no coincidence that the introduction of PPCI in the UK has been accompanied by a fall in the mortality for STEMI patients. MINAP data showed that the 30-day mortality in STEMI has fallen from 12–13% in 2003/2004 to 8–9% in 2010/2011. During the same period, PPCI has taken over as the preferred form of reperfusion for STEMI compared to fibrinolysis in England and Wales. This is confirmed by the same MINAP data,
which showed that fibrinolysis as the reperfusion therapy for STEMI has fallen from >90% in 2003/2004 to 18% in 2010/2011.9

We believe our work reinforces the benefits of 24/7 consultant delivered care for acutely ill cardiac patients.

Acknowledgments

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Conflict of interest: None declared.

References