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IMPROVEMENT IN DOOR-TO-BALLOON TIMES BY EMERGENCY PHYSICIAN ACTIVATION OF THE CARDIAC CATHETERISATION LABORATORY IN ST-SEGMENT ELEVATION MYOCARDIAL INFARCTION PATIENTS

Cardiology

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ABSTRACT

OBJECTIVE: The present study was to find out if by introducing CODE STEMI protocol in emergency department of tertiary care teaching hospital, helps to reduce door to balloon time of patients presenting with ST elevation myocardial infarction.

MATERIAL & METHODS: A total of 91 consecutive STEMI patients were evaluated from August 2017 to July 2018. The emergency physician activated Code STEMI required simultaneous activation of cardiac catheterisation personnel and the on-call interventional cardiologist by the emergency physician. These patients were compared with our staff cardiologist activated primary angioplasty protocol from August 2016 to July 2017 for 91 consecutive STEMI patients.

RESULTS: Median door-to-balloon time decreased overall (102 vs. 60 min, $p < 0.001$). Of the three components of door-to-balloon time analysed, the ECG to cardiac catheterization laboratory time showed the largest area of improvement with 31 min absolute reduction in median door-to-balloon time. Median hospital length of stay (5 vs. 3 days, $p < 0.01$) also decreased. We did not see any statistically significant difference in all-cause in-hospital mortality ($p = 0.32$).

CONCLUSIONS: Emergency physician activation of the Code STEMI significantly reduces door-to balloon time to within national standards of care, and length of stay in STEMI patients.

KEYWORDS

INTRODUCTION

Cardiovascular diseases (CVDs), especially coronary heart disease (CHD), have assumed epidemic proportions worldwide. Globally, CVD led to 17.5 million deaths in 2012.[1] More than 75% of these deaths occurred in developing countries. In contrast to developed countries, where mortality from CHD is rapidly declining, it is increasing in developing countries.[2]

Emergency percutaneous coronary intervention (PCI) is increasingly used in the management of ST-elevation myocardial infarction (STEMI) and now considered preferred approach for treating STEMI patients (AHA/ACC Class I indication, level of Evidence A). The benefits of emergency PCI are time dependent, with door-to-balloon time delays associated with increasing mortality.[3] Therefore, consensus guidelines recommend that STEMI patients should achieve a door-to-balloon time of ≤90 minutes as earlier reperfusion of the occluded infarct related artery has been translated into improved survival.[4] More recently, the American College of Cardiology, American Heart Association, the Centers for Medicare and Medicaid Services, and the Joint Commission on Accreditation of Healthcare Organizations have all included door-to balloon time as a core hospital quality-of-care indicator.[5-7]

Still, there has been limited temporal improvement in door-to- balloon time,[8] leading some to suggest that future improvements in door-to-balloon time are unlikely.[9] Interestingly, few hospitals have achieved improvements in door-to balloon times, and recent studies have highlighted qualitative characteristics unique to these institutions.[10] Among many proposed methods to reduce door-to-balloon time, emergency physician initiation of percutaneous coronary intervention may affect door-to-balloon time immediately, without incurring substantial cost or additional hospital resources. More recently, a survey of hospital strategies revealed that activation of the catheterization laboratory by the emergency department physician rather than cardiologist was associated with faster door-to-balloon times.[11]

There are limited prospective data on the effect of adopting emergency department physician activation of the catheterization laboratory on door-to-balloon time in centres already dedicated to primary PCI. We therefore prospectively tried to determine the impact on door-to-balloon time of emergency department physician activation of the catheterization laboratory.

Subjects and Methods

Study design, settings and participants:

It was a hospital based Retro-Prospective Observational cohort study of median door-to-balloon times without randomisation or control group. We compared the door-to-balloon times from the 12 months prior to initiation of the Code STEMI protocol in 2016 with the following 12 months in 2017 during which time Code STEMI was fully operational. The study was carried out in Emergency department of Khyber Medical Institute, Srinagar, Jammu & Kashmir, India. 91 patients before activation of code STEMI was compared with 91 patients of acute STEMI after code activation.

METHODOLOGY:

Beginning on 1 August 2017, an emergency physician activated, Call operator mediated 'Code STEMI' protocol was implemented at emergency department of our institution, Khyber Medical Institute. The purpose of Code STEMI is to allow simultaneous and immediate activation of the Cardiac Catheterisation Laboratory and the Interventional Cardiologist on call by the emergency physician upon identification of an ST-segment elevation myocardial infarction. We compared the door-to-balloon times from the 12 months prior to initiation of the Code STEMI protocol with the following 12 months during which time Code STEMI was fully operational. A standardised STEMI activation form was used to collect data from primary documents in the medical record. Patients with transferred patients for emergency PCI from another ED, patients in which No PCI performed, and Delay in decision about consent for cardiac catheterisation were excluded.

DATA COLLECTION AND PROCESSING:

Protocol during cardiology activation 'usual care': 1 August 2016, through 31 July 2017

Upon arrival at the ED, all patients suspected of having symptoms related to acute myocardial ischemia received an ECG. ECGs were immediately evaluated by an emergency physician to identify possible STEMI candidates. Upon identifying a patient with a STEMI, the emergency attending physician called the in-house cardiologist. The cardiologist first came to the emergency room to assess the patient. If the cardiologist agreed with the diagnosis of STEMI, he then contacted the interventional cardiologist of choice to evaluate the patient for

primary PCI. After discussion with the interventional cardiologist, the cardiologist would then activate the catheterisation laboratory.

Protocol during emergency physician activation 'Code STEMI': 1 August 2017, through 31 July 2018

On 1 August 2017, we implemented a Code STEMI protocol authorising ED physicians' immediate, direct and simultaneous activation of the interventional cardiologist on call, the Cardiac Catheterisation Laboratory and the on-call Cardiologist. This simultaneous three-fold activation was initiated by the Emergency physician placing a single call to a central hospital operator.

Patient demographic and historical information was obtained for both periods, including age, gender, race, time of initial presentation, previous known history of coronary artery disease, coronary artery bypass grafting (CABG), diabetes mellitus, hypertension, dyslipidaemia, smoking and family history of premature coronary artery disease.

Statistical analysis

Data were analysed and statistically evaluated using SPSS software, version 17 (Chicago II, USA).[12] Quantitative data was expressed in mean, standard deviation while qualitative data were expressed in percentage. Statistical differences between the proportions were tested by chi square test or Fisher's exact test. 'P' value less than 0.05 was considered statistically significant.

Ethical issues

All participants were explained about the purpose of the study. Confidentiality was assured to them along with informed written consent. The study was approved by the Institutional Ethical Committee.

RESULTS

Mean age of STEMI subjects before code activation was 61.67±11.82 years while after code activation mean age was 60.75±11.91 years. Most of the patients with STEMI were male in both the groups (69.2% in before code activation v/s 74.7% in after code activation). Both groups were comparable in term of age and gender distribution ($p>0.05$).

There was no detectable difference between either group in relation to history of: hypertension, diabetes, hyperlipidaemia, coronary heart disease, CABG, peripheral vascular disease, stroke, family history of coronary artery disease. (Table 1)

Our primary outcome measure was the comparison of the median door-to-balloon time between both groups. Within the serial activation cohort, the median door-to-balloon time was 102 min. After our protocol was changed, the median door-to balloon time decreased to 60 min, representing a 42- min improvement ($p < 0.001$). (Table 2)

In the serial activation group, only 29 of 91 (31.9%) patients had a door-to balloon time < 90 min compared with 84 of 91 (92.3%) in the concurrent activation group.

To analyse further the direct effect of our protocol revision, we divided the door-to-balloon time into three components. Of the three periods analysed, door to ECG had 4 min ($p < 0.001$), the ECG to cardiac catheterisation laboratory had 31 min ($p < 0.001$) and catheterisation laboratory arrival to balloon time had 5 min ($p < 0.001$) absolute time reduction. ECG to cardiac catheterisation laboratory time exhibited the largest area of improvement. This 31 min absolute reduction accounts for the majority of time saved in our overall median door-to-balloon times. (Table 2).

Length of hospital stay was significantly decreased from 5 days in serial activation group to 3 days in concurrent activation group ($p < 0.001$).

11 (12.1%) patients died before code implementation protocol and 7 (7.7%) patients died after code protocol. We did not observe any statistically significant difference in all-cause in hospital mortality between both groups ($p = 0.32$). Patients, who died in each group, were initially presented as cardiogenic shock or cardiac arrest.

DISCUSSION

The present study was a Hospital based Retro-Prospective Observational cohort study cohort study of median door-to-balloon times without randomisation or control group. We compared the door-to-balloon times from the 12 months prior to initiation of the Code STEMI protocol in 2016 with the following 12 months in 2017 during which time Code STEMI was fully operational.

Many recent investigations have shown the superiority of PCI over thrombolytic therapy for the treatment of STEMI if available within the ACC⁄AHA ≤90-min door-to-balloon-time guideline.[4,13]

Even small reduction in door-to-balloon time is of critical importance, with recent literature showing now a clear reduction in mortality when that measure is achieved.[8] In November 2006, the ACC renewed emphasis on meeting the 90-min guideline by launching 'GAP-D2B: an Alliance for Quality' (http://www.D2Ballinace.org).[14]

Our primary outcome measure was the comparison of the median door-to-balloon time between both groups. Within the serial activation cohort, the median door-to-balloon time was 102 min. After our protocol was changed, the median door-to balloon time decreased to 60 min, representing a 42- min improvement ($p < 0.001$). In before code activation group, only 29 of 91 (31.9%) patients had a door-to balloon time < 90 min compared with 84 of 91 (92.3%) in the after code activation group.

Our data should be examined in the light of similar recent studies. A study by Bradley EH et al.[10] showed a 19-min lesser median door-to balloon time in hospitals embracing approach of emergency physician making single call to a central page operator, compared with hospital using serial activation approach by multivariate analysis. Finding of our study were also collaborated by Parikh R et al[15] in which median door to balloon time was significantly reduced after cod activation from 112 minutes to 74 minutes

Another study by Mahler SA et al[16] also reported that Median door-to-balloon time decreased significantly (33.5 minutes) from 163.5 minutes before to 130 minutes after ED activation. Door-to-balloon time on nights, weekends and holidays decreased from a median of 165.5 minutes to 130 minutes, a reduction of 35.5 minutes. Our findings were also supported by Ong ME et al in which mean DTB time was reduced by 17 min after EP activation was implemented. Subgroup analysis reveals a mean DTB reduction of 12.2 min during office hours and 23.4min after office hours. These figures were supported by a significant reduction in ECG-to-activation time for each variable. EP activation of PCI did not result in increase in false activation.[17]

One of the very important concerns about authorising the emergency physicians to activate the cardiac catheterisation laboratory without cardiology input was the possibility of inappropriate activations for patients who did not meet ACC⁄AHA criteria for STEMI.[1] It was reported that Emergency physician interpretation of the ECG has more than 50% overall discordance with cardiologist interpretation. With regard to myocardial ischemia or infarction, the anterior wall is the most frequently misinterpreted. [17,18] As a result of this finding, a number of clinicians and interventional cardiologist in our organisation expressed concern about the emergency room physician providing the ECG interpretation, which will falsely activate the interventional cardiology team. We tried to overcame this resistance by emphasising that the decision to activate the laboratory and the decision to perform catheterisation and intervention were distinct. Thus, the final decision regarding appropriateness for emergency catheterisation remained with the interventional cardiologist on call. Our interventional cardiologists were instructed to perform catheterisation only if they agreed with the ED assessment. In seven (7.6%) cases, emergency room physician falsely activated Code STEMI. The catheterisation laboratory team and interventional cardiologist arrived in the catheterisation laboratory after activation and Code STEMI was cancelled after reviewing the ECG and examining patient. We believe that false activation is a small price to pay for the greater reduction in door-to-balloon time, by allowing the emergency physician to activate the catheterisation laboratory.

In addition, the clinical benefit of maintaining a proficiently cross-trained staff is unknown. Our use of one call-Code STEMI allowed us to improve substantially the care of STEMI patients in the off and weekend, while maintaining the delivery of care by a highly trained catheterisation staff. Code STEMI is a 'real-life' quality improvement

initiative with a successful outcome. This type of experience could provide an incentive and a model for smaller hospitals that are still struggling with issue of achieving door to- balloon time < 90 min.

Study limitations

Our study has several limitations. It was a single centre experience study in which we used pre- and post-study design without randomisation or control group. There may be other variables that decreased our mean door-to-balloon time, which we did not consider because of our retrospective study design. We tried to eliminate this limitation by implementing no other structured protocol revisions during the 12-month study period. However, impact of protocol awareness could be very substantial and might be a source of bias. Our results were generated in a centre with a substantial internal medicine, emergency medicine and cardiology academic presence and thus, may not be generalizable to other community hospitals without a similar tertiary care infrastructure.

Table 1: History of different coronary risk factors

Coronary risk factors	Before code activation		After code activation		P value
	No.	%	No.	%	
Smoking	53	58.2	56	61.5	0.65
Alcohol intake	62	68.1	59	64.8	0.63
Hypertension	44	48.4	53	58.2	0.18
Diabetes Mellitus	30	33.0	36	39.6	0.35
Dyslipidaemia	55	60.4	47	51.6	0.23
Stroke	11	12.1	8	8.8	0.47
CHD	28	30.8	24	26.4	0.51
Prior PCI	12	13.2	16	17.6	0.41
Prior CABG	7	7.7	5	5.5	0.55
PVD	6	6.6	7	7.7	0.78
Family history	26	28.6	31	34.1	0.42

Table 2: Different components of Door to Balloon time before and after activation of code in STEMI subjects

Time (in minutes)	Before code activation		After code activation		P value
	Mean±SD	Median (IQR)	Mean±SD	Median (IQR)	
Door to Balloon time	105.98±22.23	102 (90-120)	61.04±21.76	60 (50-66)	<0.001
Door to ECG time	9.41±3.42	9 (6-12)	4.85±3.17	5 (3-5)	<0.001
ECG to cardiac lab arrival time	57.85±13.99	55 (47-65)	26.24±15.31	24 (17-30)	<0.001
Lab arrival to balloon time	38.73±16.31	35 (29-46)	29.96±10.11	30 (25-35)	<0.001

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