CARDIO

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Reducing time to primary angioplasty in acute ST elevation myocardial infarction: quality improvement initiatives in a Singaporean hospital

INTRODUCTION

"Primary angioplasty is more effective than thrombolytic therapy…" Keeley[1]

Acute ST elevation myocardial infarction occurs when a coronary artery is occluded by a blood clot. Treatment involves restoring blood supply to myocardium that has not sustained permanent damage. Primary percutaneous coronary intervention (PCI) and thrombolysis are two alternatives for treatment. In the last few years, evidence from systemic reviews and meta-analyses have demonstrated the superiority of the former over the latter if it can be provided promptly.[1-3]The resultant emergence of PCI as the gold-standard has transformed the delivery of acute cardiac care. Management is now centralised in specialist tertiary centres staffed often 24/7 with interventional cardiologists and ancillary staff in catheter laboratories. The establishment of such primary angioplasty services has not been without challenge. It has higher initial costs, potentially involves major reorganization of clinical services (both pre-hospital and in-hospital), has significant infrastructure requirements, requires change to workforce rotas and in some geographical settings might not be feasible.[4]

"Time is myocardium and time is outcomes" Gibson[5]

Despite the above, primary angioplasty services have been successfully implemented around the world for some time now. Recent research has now focused on improving outcomes for such services notably by reducing the door-to-balloon times as it has been shown to relate continuously and non-linearly with in-hospital mortality.[6] Although present American College of Cardiology/American Heart Association guidelines suggest a median door-to-balloon time of less than 90 minutes, in practice this should be as quick as possible as the mortality benefit continues below that. At door-to-balloon time of 30 minutes, risk of mortality is 3.0%, 60 minutes 3.5%, 90 minutes 4.3%, 120 minutes 5.6%, 150 minutes 7.0% and 180 minutes 8.4%, $P<0.001$.[6]

A case study

In this article briefly described are a series of quality improvement initiatives in a Singaporean hospital that resulted in successful reduction of time to primary PCI in patients with acute ST elevation myocardial infarction.

SETTING

The National Heart Centre Singapore (NHCS) is a 185 bed hospital, located within the campus of Singapore General Hospital. It has been offering a 24-hour emergency PCI service since 1999[7] and is part of five public hospitals in Singapore (Khoo Teck Puat

Hospital, Changi General Hospital, National University Hospital and Tan Tock Seng Hospital) currently offering this.[8] NHCS possesses facilities seen in other high-volume tertiary cardiac referral centres and has 4 catheter laboratories, cardiac MRI and on-site cardiothoracic surgery facilities. It has a ward setup conventional to other centres, cardiac ICU for patients requiring sedation or multiple organ support, a high dependency unit or an intermediate care area for patients requiring telemetry or dedicated nursing, a step-down unit and general wards for low-risk patients. The NHCS is scheduled for expansion in the near future and will move to a new 9-storey building, three times the size of its current premises in 2013.

IMPROVEMENT INITIATIVES

"The aim is to reduce door-to-balloon times ... as much as possible" Ong[9]

Median emergency door-to-balloon times have decreased steadily at NHCS from 130.5 minutes in 2002/3[10] to a low of 52 minutes in 2008/10[11,12] This has been the result of various changes implemented that have previously described in presentations and literature.[10-14] The changes were spearheaded mainly by a) a multi-disciplinary workgroup in 2003 that audited times and recommended various internal workflow changes and b) a quality improvement project driven by a Clinical Practice Improvement Programme (CPIP) in 2007 that further reviewed operational processes. Although an expansive number of changes were subsequently employed, we will attempt to summarise some of the key developments below. To date, ongoing improvement initiatives still continue.

Phase I: First stirrings, an audit-driven approach

A multi-disciplinary workgroup comprising of emergency physicians, emergency department nurses, cardiologists, catheter laboratory staff and a health programme group was set up to look at door-to-balloon times. An audit was conducted where a time record sheet was completed for each acute STEMI patient documenting the time taken at various stages. This data was analysed and key interventions were proposed. The key interventions were: (i) fast-tracking chest pain patients to have an immediate ECG and physician review (ii) setting target timelines for each stage (iii) regular review of audit targets and education of ground level medical and nursing staff to minimise delay in STEMI patients (iv) clocking the times on a custom worksheet with attached clipboard and stopwatch. At the end of the study, median door-to-balloon times were shortened from 130.5 in 2002 to 109.5 minutes in 2003/4 ($p<0.0001$), showing the value of audit as a quality improvement tool.[10]

Phase II: CPIP, further simple operational improvements

The Clinical Practice Improvement Programme is a training programme for health leaders to improve health care. It possesses five phases – project phase, diagnostic phase, intervention phase, impact phase and sustaining improvement phase. Key staff members were interviewed to suggest and vote for likely reasons of long median door-to-balloon times at the institution. Based on the results, three key interventions were identified and implemented. At the end of the 12-month CPIP intervention period, median door-to-

balloon time shortened from 101 minutes in 2006 to 72 minutes in 2007/8.[14] The three interventions were:

Emergency physician direct activation of catheter laboratories
This was rather than previous cardiologist activation. Emergency physician direct activation was conducted if cases had eligible ST elevation criteria and did not have relative contraindications to PCI. Inappropriate activations were not penalised. Cardiologist activation was conducted in the remainder of complicated cases. A prospective study at the institution found that this intervention alone reduced median door-to-balloon times significantly from 97 minutes in 2006/7 to 75 minutes in 2007/8 for uncomplicated cases. There was no significant difference in adverse outcomes. Mean door-to-balloon times were reduced by 14 minutes.[13-14]

Centralised activation of catheter staff by mobile phone
After a single call by the emergency physician, a centralized telephone operator notified intervention laboratory staff who were off-site by mobile phone rather than pager as previously.

Immediate transfer of patient to the catheter laboratory
This was done immediately upon activation and the patient was transferred to the laboratory to wait for the intervention team. The patient was accompanied by the cardiology registrar in the event of any deterioration.

Dedicated night nurse to open catheter laboratory
It was found in the institution that having a dedicated nurse to open the laboratory at night improved mean door-to-balloon times from 82 minutes in 07/09 to 60 minutes in 09/10.[12]

Phase III: Pre-hospital ECG transmission
12-lead ECGs were performed in the ambulance on-scene by ambulance crews and transmitted wirelessly to the hospital and interpreted by emergency physicians, who then activated on-call off-site catheter staff. In this 2 year prospective study, ambulance on-scene times were only increased by 37 seconds but median door-to-balloon times decreased from 88 minutes in 2006/8 to 51 minutes in 2008/10, a difference of 37 minutes.[9,11]

Phase IV?: Further developments lie out of hospital
It has been clear for some time now that although door-to-balloon time is important, the major delay to therapy is represented by symptom-to-door time, the duration between patient symptom onset and arrival to medical attention.[15] Whilst promoting further expeditious in-hospital intervention will undoubtedly further improve outcome, the greatest benefit is likely to be seen *out of hospital* through patient education as an effort to reduce symptom-to-door time and also training of ambulance personnel to perform ECGs and obtain pre-hospital diagnosis of acute myocardial infarction. The current policy of sending patients to the nearest hospital by ambulance should also be revisited,

transferring patients to the nearest appropriate facility even if it means bypassing smaller hospitals are likely to prevent unnecessary delay.

CONCLUSION

The development of a primary angioplasty service has been shown to be feasible in certain geographical settings. Its establishment requires good communication between multi-disciplinary stack holders. Marked transformation of door-to-balloon performance has been achieved in the last few years. These significant decreases have been accomplished through the establishment of accurate registries, audit processes and improvements to healthcare workflow. The experiences of the NHCS are not unique as many other primary angioplasty services seek to improve.[16] Further developments lie out of hospital. As with many conditions, "good patient education … continues to be a major challenge".[17]

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