Systems of care: need for hub and spoke systems of care for patients with myocardial infarction. A call for action

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Each day in New Zealand 18 patients die from coronary artery disease. There is a rich evidence base for both prevention and treatment of myocardial infarction (MI) but not all New Zealanders receive guideline-commended treatments. Reperfusion therapy reduces mortality for patients with acute MI but must be administered in a timely manner. Fibrinolytic therapy lyses occlusive thrombi in infarct-related arteries in approximately 60% of patients. However in order to salvage ischaemic myocardium, reperfusion has to occur within 3 hours of symptom onset.\(^1\)

Reperfusion therapy with fibrinolytic therapy has been shown to reduce mortality when administered within 12 hours after symptom onset, but the mechanism of benefit after 3 hours is likely to relate to mechanisms other than myocardial salvage, such as the presence of a patent infarct-related artery reducing remodelling and left ventricular volumes.

Fibrinolytic therapy remains the most common reperfusion strategy used in New Zealand despite its inferior efficacy in opening infarct-related arteries and the small risk of intracranial haemorrhage and major bleeding. Following fibrinolysis the infarct-related artery may reocclude. It is logical to couple percutaneous coronary intervention (PCI) with fibrinolytic therapy to lyse occlusive thrombus early with fibrinolysis, and to stabilise the underlying atherosclerotic plaque with PCI to decrease re-occlusion. However early trials showed no benefit of this approach and there was actually harm with increased bleeding and increased rates of reinfarction. Also recent trials with facilitated PCI—i.e. PCI performed soon after fibrinolysis showed no benefit.\(^2\)

These results are explained by the increased pro-thrombotic milieu induced by fibrinolytic therapy and exacerbated by the instrumentation of PCI. These trials were performed without the antiplatelet agent clopidogrel, which has been shown to reduce MI with PCI, and to improve sustained patency and mortality with fibrinolytic therapy.\(^3\)

However, rescue PCI for ischaemic symptoms or failure of ST segment resolution on the electrocardiogram (ECG) has been shown to reduce reinfarction after administration of fibrinolytic therapy by 42%. In a meta-analysis of 8 trials that included 1117 patients, rescue PCI resulted in a reduction in death, reinfarction, and heart failure at 6 months from 41.0% to 29.2% (p<0.001) compared with fibrinolytic therapy and PCI only for recurrent ischaemia.\(^4\)

Recently, six randomised trials have been completed which evaluated routine PCI in all patients after the administration of fibrinolytic therapy compared with angiography and PCI, as appropriate, when patients developed ischaemic symptoms or failed to have ECG ST segment resolution.\(^5,6\)
These trials showed that composite ischaemic endpoints, including death, MI and need for revascularisation, were significantly reduced. Based on these data, the optimal time to perform routine PCI following the administration of fibrinolytic therapy may be between 3 and 24 hours. Although guidelines recommend the coupling of fibrinolytic therapy with PCI within 24 hours, this is not frequently done in New Zealand.

Primary PCI is much more effective than fibrinolytic therapy in achieving infarct artery patency and achieves this in about 95% of patients. Compared to administration of in-hospital fibrinolytic therapy alone—without the use of clopidogrel, enoxaparin, and routine PCI—primary PCI reduces a composite of death, MI and stroke.

The advantage of primary PCI over fibrinolytic therapy disappears when the time delay between the two strategies exceeds 60 minutes—i.e. ‘door to balloon’ minus ‘door to needle time’. Prehospital administration of fibrinolytic therapy has been shown to be as effective as primary PCI when there is also a high rate (>30%) of routine PCI following fibrinolysis.

Admirably, prehospital fibrinolysis is performed in a number of rural communities in New Zealand, but it is also not usually coupled with routine early PCI. While about 500 patients undergo primary PCI each year.

In this issue of the Journal Swanson and colleagues report on an audit of the ‘door to balloon’ time with primary PCI over a 6-month period before and after a system change at Waikato Hospital. Three changes were initiated:

- Removing the cardiology registrar from being contacted;
- Single page activation of the catheterisation team;
- Feedback performed by email.

These simple measures increased the number of patients with a guideline-recommended 10 minute door-balloon time of <90 minutes and also reduced the ‘door to balloon’ time by 15 minutes.

The reduction in ‘door to balloon’ time was small and not significant, but the study involved only 12 patients’ pre-change and 26 patient post-change. However, small differences in the time to achieving reperfusion can make major differences in mortality. A 15 minute shorter ‘door to balloon’ time could result in between 3–13 lives saved per 1000 patients treated, depending on whether the ‘door to balloon’ time was reduced from a median of 75 minutes to 60 minutes or reduced from 180–165 minutes.

A component of this improvement (not significant alone) was the reduction from the time from admission to catheterisation room arrival. This could have been due to the Hawthorne effect, whereby the process of measuring something actually changes what is measured. In this instance, knowing that the audit was being undertaken may have made the emergency department (ED) physicians, and cardiologists “perform better”. Taking a cardiology trainee out of the algorithm also would have saved time, but could be seen as decreasing their training opportunities, but here the trainee became a part of the catheterisation team.
One of the more powerful effective drivers of change is feedback, and here “on line electronic feedback” was one of the changes instituted. As the authors point out, the major delay is from the onset of ischaemic symptoms, presaging the onset of MI, and arrival at hospital.

Unfortunately numerous attempts, including community education programmes, have had no effect on changing this metric. However, other strategies to reduce ‘door to balloon’ times have been successful, including bypassing the ED completely, and having ambulance officers transmit ECGs, and the catheterisation team being alerted when ST-elevation or left bundle branch block (LBBB not known to be old) is noted. Field triage, as compared to ED triage has been shown to reduce the combined endpoint of death and MI; HR 0.69 95% CI 0.46-0.97, p=0.035.12

Even more successful at reducing time delay, and improving outcomes is activation of the catheterisation team by ambulance officers interpreting the ECGs, and also administering aspirin, clopidogrel and an antithrombotic such as bivalirudin and transporting the patients.

The most effective way of lowering mortality from ST-elevation MI is the implementation of systems to apply the evidence that we already have.1 Primary PCI, provided in experienced centres, should be the standard of care for New Zealanders, if it can be performed within 90 minutes of reaching the hospital. Optimisation of primary PCI use is a treatment gap that can be improved on in New Zealand. Fibrinolytic therapy will continue to have an important role as it can be administered much earlier than primary PCI, and administered in the community, in the patient's home or in the ambulance.

A pharmacoinvasive strategy, of rapid administration of fibrinolytic therapy (prehospital or in-hospital) followed by systematic PCI within 24 hours, is practical in most communities in New Zealand where primary PCI can not be provided. Systems of care should involve “hub-and-spoke” systems in which patients are directly transported to the catheterisation laboratories for primary PCI from the surrounding communities or peripheral hospitals or systems in which prehospital or in-hospital administration of fibrinolytic therapy is followed by rescue and routine PCI.5

Cardiac networks should be developed so that all New Zealanders can receive optimal care if they suffer an MI.

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