

Proposal of a pathway to improve access to emergency angiography for comatose patients following cardiac arrest due to myocardial infarction.

Background

Patients who suffer a cardiac arrest outside hospital have an extremely high mortality rate. Within the group who are successfully resuscitated to achieve a return of spontaneous circulation (ROSC), those who are comatose immediately afterwards have historically had a very high mortality and neurological morbidity rate.

In 2002 a European multicentre randomised controlled trial¹ demonstrated a substantial reduction in the mortality and neurological injury rate in comatose survivors of out-of-hospital primary cardiac arrest (OOHCA) by cooling these patients to 33⁰C for 24 hours. The treatment group had a 55% chance of being alive and capable of independent living at six months. The NNT to save a life with this therapy in this trial was 6. Therapeutic hypothermia is recommended by the International Liaison Committee on Resuscitation (ILCOR) for comatose survivors of OOHCA with a shockable rhythm. They also state that it may be a useful therapy for comatose survivors of in-hospital cardiac arrest or with a non-shockable rhythm². Published data from a voluntary Northwest registry³ and a recent service evaluation at Blackpool Victoria Hospital⁴ have both shown that using this therapy the local survival rate for this patient group is the same as in the landmark trials, i.e. around 55%. In both of these local studies, none of the patients who survived to hospital discharge had a severe neurological injury.

The most common cause of cardiac arrest in this group is myocardial infarction (MI). In the case of an ST-elevation MI (STEMI) the gold standard of treatment is emergency angiography and primary PCI to restore coronary blood flow. Currently patients suffering a cardiac arrest caused by a STEMI are being cooled on intensive care units across the region, which is the best therapy to protect their brain and improve their survival. They are also receiving medical therapy for MI but their access to PCI appears to be limited. From the Blackpool data, between 2008 & 2011, of the 19 OOHCA patients meeting ECG criteria only 5 underwent primary PCI. During this time only one OOHCA patient was transferred in from another hospital for PCI⁴. There is currently no available data describing practice at the other cardiac centres in the region.

The cardiac centres are developing mechanisms for integrating therapeutic hypothermia, ICU support and interventional cardiology, either informally or by establishing formal pathways. Locally, these patients are benefitting from higher rates of emergency revascularisation and specialist cardiology follow-up without compromising their cooling and critical care management⁴. It is recognised that critical care patients in non-cardiac centres, who could benefit from PCI in these circumstances, have more limited access to this

kind of service. On 5th October 2012 there was a joint critical care networks conference with consultants representing critical care and cardiology in attendance. It was agreed that it would be desirable to develop a pathway for appropriate patients to be transferred to cardiac centres to receive PCI.

Proposed pathway for comatose survivors of cardiac arrest due to MI

1. Patients suffering an OOHCA are transferred by emergency ambulance to the nearest A&E department (no change to current practice).
2. Patient is reviewed by the critical care doctor on-call and in discussion with the consultant responsible for critical care a decision regarding suitability for ICU admission +/- cooling is made (no change to current practice).
3. Local practices will vary but these patients will usually default to being under the care of the medical consultant on call (although in some centres this will be cardiology and if there is an apparent non-cardiac precipitant of cardiac arrest another specialty may be more appropriate). The on-call registrar for the parent team should be contacted and should review the patient.
4. Where there is no other apparent precipitant for the cardiac arrest it will be presumed to be a primary cardiac arrest, with myocardial ischaemia usually being the most likely underlying cause.
5. Cooling and administration of MI medications (when indicated) will occur as soon as possible, irrespective of plans for referral to a PCI centre.
6. If 12-lead ECG suggests myocardial infarction and the patient is suitable for critical care admission, a senior member of the parent team will discuss with the cardiology registrar on-call for the catheter lab at the nearest primary PCI centre. As the transfer to a PCI centre involves a tangible risk and access to an expensive resource, the parent team consultant should be involved in the decision to refer/transfer. This will also facilitate continuity when the patient is repatriated.
7. The cardiology registrar at the PCI centre will decide if the patient would benefit from transfer and emergency angiography. The expectation is that patients with ST-elevation or new left bundle branch block on ECG will usually be transferred for PCI. The cardiology team may also consider other patients to be suitable for emergency angiography or other care at the specialist centre.
8. The cardiology registrar will contact critical care on-call at their centre to confirm availability of a critical care bed for the patient post procedure. Practices regarding critical care bed provision are likely to vary between units depending on their local bed pressures. Some want to have a bed arranged prior to transfer, others do not and at least one unit wants to offer a "treat-and-return" service when their critical care unit is full.

9. If the catheter lab at the PCI unit is not immediately available, in the interests of timely reperfusion it will usually be more appropriate to transfer the patient and hold them in the angiography suite recovery area with anaesthetist in attendance or the PCI centre critical care unit, rather than waiting at the referring centre.
10. If the patient is not for transfer then care will be at the referring unit as previously. If the decision is made that the cardiac arrest was due to cardiac disease but the patient is not for transfer, then it should be explicitly clear whether ongoing cardiology input and eventual follow up will be from the referring hospital or the cardiac centre. Practices will vary depending on cardiology specialist provision at each referring hospital.
11. Patients for angiography will be cooled prior to and during transfer, with a target temperature of 33⁰C. Temperature should be invasively monitored. Although they can occur simultaneously, cooling offers the greatest benefit in this patient group and takes precedence over angiography if for whatever reason they become mutually exclusive.
12. Portable cooling pads (e.g. Emcool) or other devices can be used to cool the patients before and during transfer (and throughout angiography). These should be available in the A&E department of referring hospitals.
13. Transfer to catheter lab will be treated as a matter of urgency by the critical care team, as the benefits of revascularisation are time dependent.
14. Patients will be transferred by NWAS as a matter of urgency and will have an airway trained medical escort.
15. Care of the patient will be handed over to the cardiologist and the anaesthetist covering catheter lab at the receiving hospital. The receiving units will need a clear mechanism of providing anaesthetic support for these patients during PCI.
16. Post angiography the patient will be transferred to critical care under the care of a cardiology consultant.
17. If the patient survives to ICU discharge they will go to a ward under the care of their cardiologist who will assess their need for ICD implantation, surgery, electrophysiological studies, etc. prior to their discharge. Patients may be repatriated to the referring hospital after these decisions are made, where appropriate.
18. The continuity of this and other services at receiving hospitals may depend upon patients being repatriated to their referring hospital before ICU discharge. This will involve discussion between intensive care consultants at both units as well as handover from cardiology to the parent team at the base hospital. The plan for cardiology workup and follow up should be clear prior to repatriation. Base hospitals should make every effort to accommodate these patients promptly.

Possible alternatives to this pathway and rationale for rejecting them

1. *All patients suffering an OOHCA could be transferred directly to a PCI centre, thereby reducing the time taken to restore myocardial perfusion. It would also remove the need for a second transfer.*

Most patients suffering an OOHCA will not benefit at all from PCI. Those suffering a cardiac arrest secondary to non-cardiac disease (e.g. pneumonia, DKA, trauma etc.) require urgent medical attention and their care will be delayed by unnecessary transfer to a cardiac centre. Two-thirds of those suffering a primary cardiac arrest will not benefit from angiography. Their stabilisation and cooling will again be delayed by a longer primary transfer, probably to their detriment. Even in the small group who would benefit from an earlier arrival in the catheter lab, it is most likely that the benefit would be outweighed by the detrimental effects of a later securing of the airway, correction of hypoxia, stabilisation and cooling.

2. *Patients could commence cooling in the cardiac centre after their PCI. Cooling during transfer adds unnecessary complexity. ILCOR recommends cooling within 6 hours of ROSC.*

ILCOR recommends cooling as soon as possible, with 6 hours being a maximum after which cooling is probably not worthwhile. Animal models suggest that the sooner cooling is commenced the better the outcome. Most of these patients will die from complications secondary to hypoxic brain injury rather than myocardial ischaemia. Transfer for PCI must not compromise the cooling process.

Cost considerations

Data from across the region is not available. I have extrapolated the Blackpool data (where there were 6.3 patients per year eligible for this service) across the whole of Northwest which is currently covered by the primary PCI service (i.e. not north Cumbria). This estimates that 76 patients per year would be eligible to access this service under these criteria. This may be inaccurate due to its extrapolation from a small area. Once the service is established there may be additional demand from patients who are unstable having a non-STEMI who may be felt to benefit from emergency revascularisation. Conversely there may be less transfers in due patients being too unstable to transfer. Many of these patients will not require secondary transfer, as their initial presentation will be to a PCI centre.

Costs:

Transfers

This will add less than 100 emergency transfers per annum to the workload of NWAS.

Emcool pads cost £300 per patient. The network may prefer to not bear this cost and use improvised cooling methods during transfer (e.g. ice packs) on an ad hoc basis instead.

Interventional cardiology

Although there is no new cardiology service being offered, this pathway will encourage access for those who are already eligible to receive it. We could anticipate an additional approximately 75-100 emergency angiograms per year across the region.

Critical Care

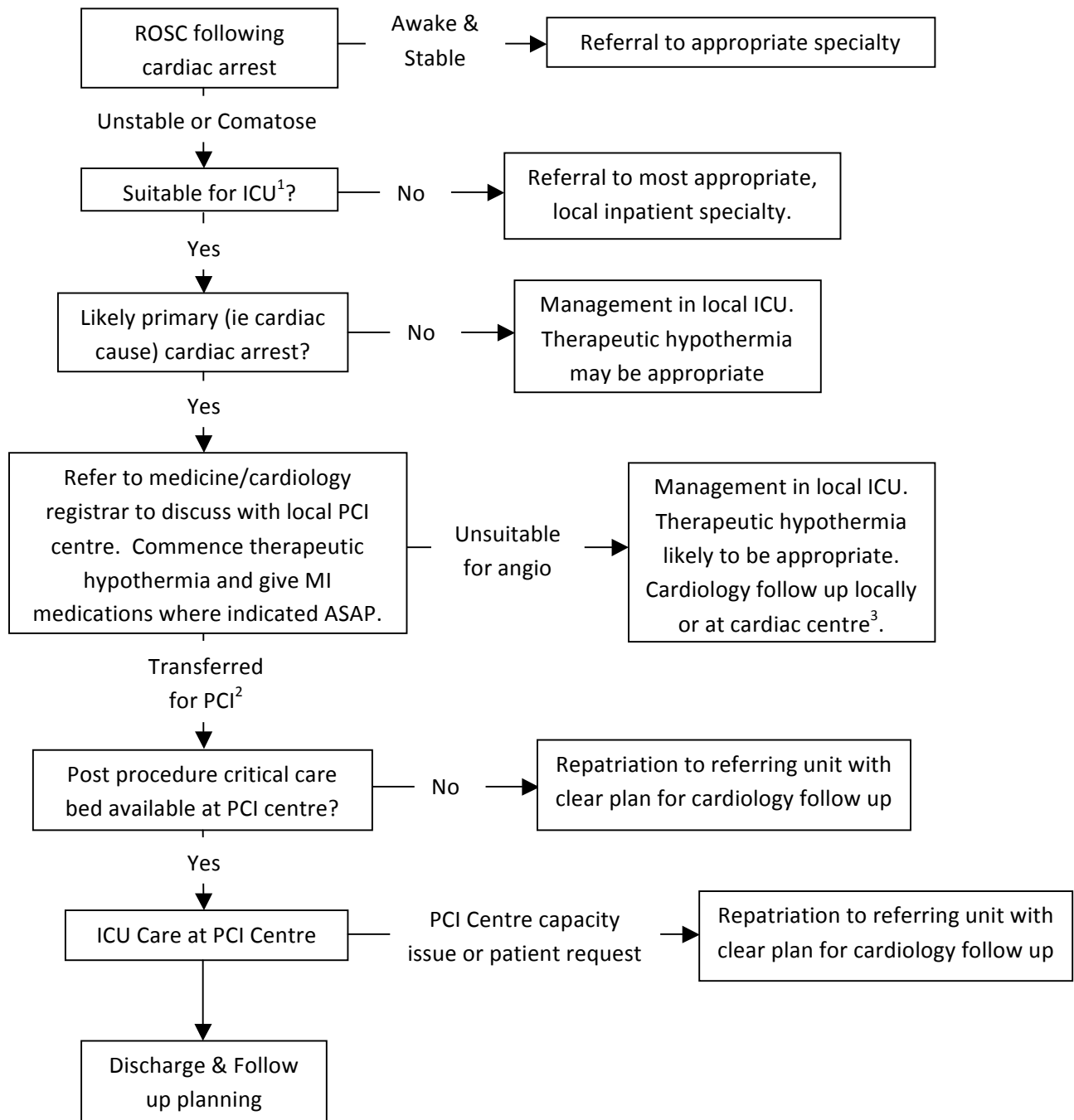
Under the PbR framework the critical care costs will simply be shifted from the referring unit to the receiving unit, with no net additional cost to the commissioners. This will impact on the PbR income of the individual referring & receiving units.

References

1. The Hypothermia after Cardiac Arrest study group. Mild therapeutic hypothermia to improve the neurologic outcome after cardiac arrest. NEJM. (2002); 346:549-556.
2. 2010 International consensus on cardiopulmonary resuscitation and emergency cardiovascular care science with treatment recommendations. Resuscitation. (2010); 81s:e1-e330

3. Nichani R. et al. Cooling practices and outcome following therapeutic hypothermia for cardiac arrest. JICS (2012); 13:102-106
4. Unpublished data. Contact robert_shawcross@hotmail.com for details.

Proposed pathway for access to interventional cardiology services for survivors of Out of hospital cardiac arrest



Footnotes

1. To be decided by local Critical care team.
2. With airway trained escort. To be treated as a time critical transfer. Should be cooled, with a target temperature of 33⁰C during transfer.
3. Practice will vary according to local cardiology provision. The team responsible for follow up should be clearly determined at the time of decision whether or not to transfer.