



Out of Hospital cardiac arrest - who should we directly take to Cath lab?

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Introduction:

Cardiac arrest is an important cause of death in England. With less than one in ten patients surviving, there is scope to improve outcomes (1). The benefit of emergency coronary angiography after resuscitation from out-of-hospital cardiac arrest (OHCA) is uncertain for patients without ST-segment elevation. Where Return of Spontaneous Circulation (ROSC) has been achieved and ST elevation persists, clinical research has shown that emergency coronary angiography guided therapy, which may include PPCI, improves prognosis (2-3). However, it is also recognised that for some patients with ROSC and without ST elevation, emergency coronary angiography may not be of benefit and is therefore not always indicated (4-5). Careful and considered assessment of these patients is essential before deciding on an appropriate management plan.

Take Home Messages

- Immediate coronary angiogram (CAG) is recommended for survivors presenting a ST segment elevation on the electrocardiogram (ECG) performed after resuscitation, there is still a debate regarding the best strategy in patients without ST segment elevation.
- Multiple randomised controlled trials have demonstrated no benefit of immediate CAG for haemodynamically stable patients following OHCA without ST elevation and this is reflected in the European Society of Cardiology Guidelines 2023.
- Combined classification of patients with OHCA with 12-lead ECG, a MIRACLE2 score of 0 to 3, and a SCAI grade of B to E identifies a potential cohort at low-risk for neurologic injury that benefits most from immediate coronary angiogram.
- The value of collateral history and multidisciplinary team (MDT) discussion is of utmost importance in management of Out of Hospital Cardiac arrest (OHCA).

Immediate vs delayed coronary angiography in OHCA – What does the current evidence show?

There are marked regional variations in survival following resuscitated OHCA, which are attributable to resources, personnel, and infrastructure in addition to patient characteristics and there have been multiple randomised controlled trials conducted to guide us with management which are explained below (6-10).

In 2019, Lemke et al demonstrated that immediate angiography did not have better survival outcomes at 90 days compared with delayed angiography in patients who had been successfully



resuscitated after OHCA and had no signs of STEMI (6). This randomised controlled trial was limited only to patients with shockable rhythm. In 2020, Kern et al showed that in comatose survivors of cardiac arrest without ST elevation, there is no benefit for early coronary angiography. Although, this was an underpowered trial it adds to literature that does not support early coronary angiography in OHCA patients without ST elevation (7).

EMERGE was a randomized multicentre clinical trial conducted by Hauw-Berlemont et al comparing two strategies: emergency CAG vs delayed CAG, in survivors of an OHCA with no obvious noncardiac cause of arrest and no ST-segment elevation on ECG. At 180 days follow up, no significant difference was found between the two groups in terms of survival rate and no or minimal neurologic sequelae (8). Desch et al conducted a randomized controlled study showed no benefit from immediate angiography confirming the findings of EMERGE. (9).

Finally, in the ARREST trial, a multicentre randomised trial of expedited transfer to a cardiac arrest centre compared to transfer to their nearest local hospital, there was no survival benefit from being transferred to their nearest cardiac centre, but this study was based in London, so these findings are not readily generalisable to rural areas (10).

Studies	Year	Emergency Coronary angiogram (CAG)		Delayed CAG		Risk Ratio (95% CI)	P value
		Events (Death)	No events	Events (Death)	No events		
Lemkes JS et al COACT (5)	2019	97	176	87	178	1.08 (0.86 – 1.37)	0.51
Kern KB et al PEARL (6)	2020	22	27	27	23	0.83 (0.99 – 1.39)	0.55
Hauw-Berlemont C et al EMERGE (7)	2020	90	51	92	46	0.96 (0.81 – 1.14)	0.31
Desch S et al TOMAHAWK (8)	2021	143	122	122	143	1.17 (0.99 – 1.39)	0.66

Table 1: Summary of Randomized Clinical Trials Comparing Emergency vs Delayed CAG in Patients with Cardiac Arrest Without ST-Segment Elevation.

There are multiple scoring systems such as MIRACLE 2, SCAI shock and Kocar Culprit predictor score to help assess suitability for early invasive angiography, which have been discussed in detail below.

MIRACLE 2 score:



The MIRACLE 2 score is an extremely useful and efficient scoring system designed for use in the emergency department for early accurate prediction of poor neurological outcome after OHCA. It was derived from an OHCA database from a quaternary centre in Southeast London. (Table 2). (11-12)

Variable	Definition	Points
Missed	Unwitnessed arrest	1
Initial rhythm	Non-shockable rhythm	1
Reactivity of pupils	No pupil reactivity on ROSC	1
Age	0-60 60-80 >80	0 1 3
Changing rhythm	Any two of VF/PEA/asystole	1
Epinephrine	Any epinephrine doses	2
0 – 2 = LOW risk of poor neurologic outcome 3 – 4 = INTERMEDIATE risk of poor neurologic outcome ≥ 5 = HIGH risk of poor neurologic outcome		

Table 2: The MIRACLE 2 score

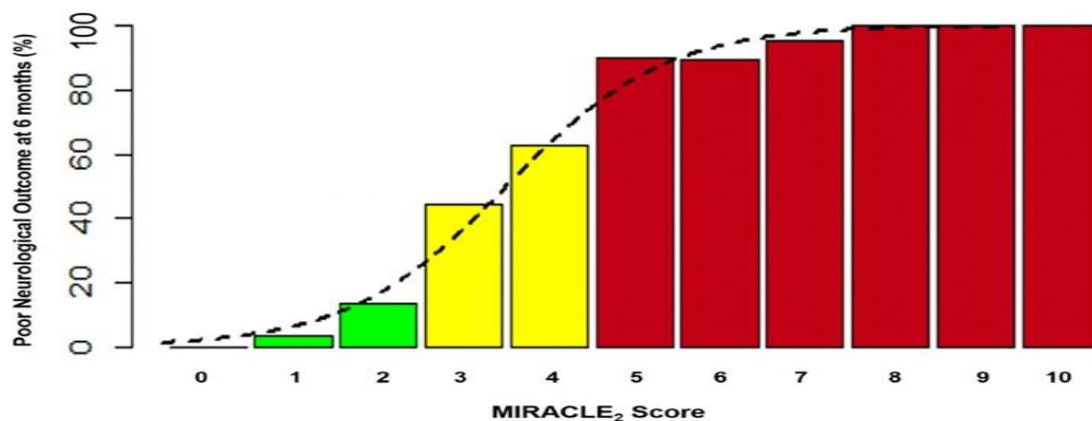


Figure 1: Prognostic correlation according to MIRACLE 2 score

Society for Cardiovascular Angiography & Interventions (SCAI) shock stage



SCAI developed and released the SHOCK Stages classification in 2019 to provide a unified and standardized vocabulary including five stages (A–E), with each increasing stage indicative of progressive deterioration in the patient’s clinical and hemodynamic status (Table 3) (12).

Stages of cardiogenic shock	Definition
A - At risk	A patient with risk factors for cardiogenic shock who is not currently experiencing signs or symptoms.
B – Beginning	A patient who has clinical evidence of relative hypotension or tachycardia without hypoperfusion.
C – Classic	A patient presenting with hypoperfusion requiring intervention beyond volume resuscitation (inotrope, pressor, or mechanical support including CMO).
D – Deteriorating	Patient who fails to respond to initial interventions. Like stage C and getting worse.
E – Extremis	A patient being supported by multiple interventions who may be experiencing cardiac arrest with ongoing CPR (cardiopulmonary resuscitation) and/or ECMO.

Table 3: SCAI Stages of Cardiogenic Shock

KOCAR culprit prediction application:

A novel simple machine learning-derived algorithm can be applied to patients with OHCA to predict a culprit coronary artery lesion with high accuracy and helps predict the presence of a culprit lesion in patients with OHCA using the variables shown in Table 4 (13).

Age	Under 40 40-70 >70
Normal ECG	Yes/No
ST elevation?	Yes/No
Localizing feature? (2mm of ST change in contiguous leads)	Yes/No
Shockable rhythm (Initial rhythm VF/VT)	Yes/No
Witnessed arrest with shockable rhythm	Yes/No
Vascular history (Prior PCI/CABG/Stroke)	Yes/No
Regional wall motion abnormality on ECHO	Yes/No

Table 4: King's Out-of-Hospital Cardiac Arrest Registry (KOCAR) culprit lesion prediction tool web application.

Neuro-prognostication:



In OHCA, 70% of patients die due to hypoxic brain injury, 15% secondary to cardiac aetiology and 15% due to Multiple Organ Dysfunction Syndrome (MODS). MIRACLE 2 score should be implemented on admission alongside MDT between intensive care Unit (ITU), cardiology and emergency department (ED) to achieve best outcomes (14).

Conclusion:

Although there is no demonstrable benefit of immediate coronary angiography for haemodynamically stable patients following OHCA without ST elevation (6-10), those with shockable rhythm, absence of return of spontaneous circulation before hospital admission; and return of spontaneous circulation and criteria for ST-elevation myocardial infarction may benefit from early invasive strategy.

There is agreement that all STEMI patients should be offered immediate CAG and non-STEMI patients should be evaluated on an individual basis, including those with uninterpretable ECGs (LBBB/paced) using the tools described above.

The value of collateral history and MDT discussion is of utmost importance (11-12). In my perspective, for patients without STEMI, we continue to recommend an early invasive approach with potential-culprit-vessel-only PCI in those with haemodynamic *instability*, favourable cardiac arrest circumstances and a high likelihood of clinically significant CAD. Patients deemed not appropriate for an initial early invasive approach should be stabilised and evaluated for other causes while receiving supportive care and awaiting neurological recovery (15).

Disclosures:

I have no conflicts of interest to declare.

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