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Letter to the Editor

A new paradigm of resuscitation: Perfusion-guided cardiopulmonary resuscitation

Sir,

Survival after cardiac arrest has improved over the years; however, the majority of patients who are successfully resuscitated still die from neurological injury.[1] Cardiopulmonary resuscitation (CPR) guidelines focus on the heart to improve coronary perfusion pressure (CPP); however, a growing body of evidence suggests that such interventions may come at the cost of reducing cerebral perfusion.[2] Therefore, there is a need to be able to measure cerebral perfusion, to ensure that treatments that maintain CPP to improve chances of return of spontaneous circulation are not inadvertently reducing cerebral perfusion.[2]

There is growing interest from critical care clinicians in providing resuscitation treatments based on direct markers of organ perfusion, such as cardiac output monitors. Novel technologies also exist allowing clinicians to measure perfusion to key organs during CPR.[2] Examples of this technology include near-infrared spectroscopy for measuring cerebral perfusion, or bio-impedance devices for cardiac output.[3] These devices are non-invasive, easy to use and are currently used in many critical care departments. We believe that *perfusion-guided resuscitation* be the next major step in addressing the current shortcomings in cardiac arrest care, especially to improve survival with good neurological outcomes.

The ultimate goal of resuscitation is the restoration of tissue perfusion. CPR provides an artificial state of perfusion until innate physiological circulation is restored. An effective strategy is to measure perfusion itself, and direct treatments based on the perfusion response. Resuscitation can be guided by dynamic changes in cardiac flow and cerebral oxygenation. Chest compression rate and depth can be individually adjusted to maximize cardiac output to vital organs. Treatments, such as epinephrine, can be dosed appropriately to help maintain coronary perfusion but can also be adjusted to minimize cerebral vasoconstriction. When using this strategy, dynamic parameters are better over static values to meet the physiological needs of organs during critical illness.[4] This means that resuscitation is patient-specific, as every patient will have a different treatment plan to maximize organ perfusion.[2]

We suggest adapting an existing three-step approach for perfusion-guided therapy in cardiac arrest.[5] First, therapies are targeted to restore heart and brain perfusion. This should be the focus for treatments during CPR. The second step is to ensure global tissue perfusion and step three focuses on perfusion of other organs that remain under-perfused.[5]

Currently, the major gap in providing perfusion-guided resuscitation is clinical data from human subjects. RCTs involving CPR feedback devices have had mixed results.[2] CPR may have to be individualized to each patient's unique physiology to maximize perfusion, and this may be why CPR feedback devices have not produced consistent results. End-tidal CO_2 may be a surrogate measure of cardiac output but there are no studies that have examined its impact on neurological outcomes. Moreover, some animal data suggest that end-tidal CO_2 can decrease despite stable cardiac output and therefore may not be solely sufficient for perfusion-guided resuscitation.[2]

As acute care providers strive to make improvements to outcomes from cardiac arrest, the concept of *perfusion-guided resuscitation* will be the next paradigm shift to produce meaningful, patient-centred outcomes.

Conflicts of interest

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