

June 15, 2018

Vancouver ECPR Protocol: Protocol Change Notification

To: All Primary Care Paramedics, Advanced Care Paramedics, and Paramedic Specialists practicing in Vancouver

Thank you for your involvement and participation with our BC ECPR Trial and clinical protocol! Enthusiasm and clinical excellence from paramedics with regards to this protocol has been beyond expectations. The provision of ECPR for refractory out-of-hospital cardiac arrest is still a very new strategy, and we continue to invest in ways to improve our protocol.

One of the key challenges for ECPR programs is: What is the best method of identifying those who will benefit from this therapy? With this in mind, based on our experience and that of recent published studies, we have elected to make some modifications to our eligibility criteria. The new protocol places more focus on those with: (1) initial shockable cardiac rhythms, and; (2) those with signs of neurological activity during CPR. More restrictions have been placed on those with non-shockable initial rhythms.

Explanations for the rationale of these changes are below. We have also made a few comments on the team approach and the timing of transport. There are some case examples attached.

Please continue to provide feedback on the protocol and how it can be improved!

Thank you,

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Explanation of the New Criteria

1. “Signs of Life During CPR”

- Patient selection for ECPR seeks to identify those who have minimal neurological injury from the cardiac arrest. Neurological signs during CPR suggest that there is adequate brain perfusion during the resuscitation. Evidence of patient movement or breathing (that persists until the time of protocol activation) may indicate an excellent ECPR candidate, even if the arrest was unwitnessed or didn't have bystander CPR. Persistent non-dilated pupils may also demonstrate a favourable neurological status.

2. Initial Cardiac Rhythm:

- Asystole: It was hoped that ECPR would lead to a significant improvement in outcomes among those with asystole, a subgroup for whom outcomes are currently dismal. However based on the experience of our region (we have not had a asystole survivor since starting the protocol, but there was one prior to the formal protocol) and others, this has not turned out to be the case.¹ Asystole may predict a cause of arrest that is not reversible, such as aortic dissection or intracranial hemorrhage. We have elected to remove asystole from the inclusion criteria (unless there are signs of life or if pupils are ≤ 5 mm at time of protocol activation).
- Ventricular Fibrillation (VF): Those with an initial rhythm of VF have demonstrated the best outcomes of ECPR.² Clearly these also enjoy the best outcomes with conventional resuscitation; however in those who are unable to be resuscitated ECPR may be a high yield rescue therapy. One study reported 45% survival among those with initial VF and refractory arrest.² Thus, the new criteria emphasises those with initial shockable rhythms, and no longer requires bystander CPR or a defined period of EMS response.
- PEA: These patients are not as ideal as those with VF, however still may benefit from ECPR provided other favourable characteristics are present. Thus we have modified the criteria to reflect those with PEA require bystander CPR or be an EMS-witnessed arrest to be eligible.

3. Pupils ≤ 5 mm?

- One study demonstrated that pupil size at time of protocol activation was correlated with outcomes.³ Among those with favourable neurological outcomes, 75% had had pupils ≤ 5 mm. Most non-surviving patients had pupils > 5 mm. Small pupils may be a marker of an intact neurological system. However be sure to exclude those for whom you suspect opioid overdose. Also, please do not give atropine which will complicate this physical sign.

4. ETCO₂ > 10 mmHg

- As all are aware, ETCO₂ is a marker of successful chest compressions and thus a low value may indicate those in whom there is a lack of cerebral perfusion.
- Unless there is a specific indication such as TCA overdose or suspected hyperkalemia, please do not give bicarbonate (which has not been shown to improve outcomes) as will make ETCO₂ assessment more difficult.

5. Witnessed arrest (seen or heard)

- With this new, more focused eligibility assessment tool, we have expanded the “witnessed” definition to those for whom the arrest was heard. Please ensure bystanders clearly heard the arrest, in comparison to cases in which bystanders indicate “we practically just a him/her a minute ago!”.

Other Protocol Changes

1. **Advanced Airway:** Whereas the first protocol required that endotracheal intubation be performed prior to protocol activation we have changed this to placing an “advanced airway” (which may be a supraglottic airway such as the i-gel). This may decrease the overall time required to get a patient on ECMO. You may have also seen the recent publication demonstrating that out-of-hospital cardiac arrest patients treated with supraglottic airways had better outcomes than those treated with endotracheal tubes. Within this protocol it will remain up to the paramedic’s discretion which airway device to use.
2. **Limit Total Epinephrine to 5 mg.** Among those treated with ECPR, high doses of preceding epinephrine may worsen neurological outcomes. A recent study in Paris compared phase 1 and phase 2 of their ECPR protocol, with phase 2 incorporating “signs of life” into the eligibility assessment and also limiting epinephrine to 5mg.⁴ Survival increased from 8 to 29%. An ECPR protocol in Minnesota, which includes only those with initial shockable rhythms, has shown survival in 45%.² Their protocol limits epinephrine to 3 mg.

The Whole Team is Critical for ECPR Activations

We initially focused on training the ALS paramedics for this protocol, which was a short-sighted approach. We have heard time and time again the critical importance of having PCP’s who are familiar and skilled in the ECPR protocol implementation, for the following reasons:

1. Early identification of eligible patients by PCP’s is highly beneficial. Alerting the incoming ALS crew to bring the Lucas to the patient will save time. It will also frame the priorities of the resuscitation from the beginning.
2. While ALS members are initiating ACLS treatment, PCP team members can be co-ordinating preparation for extrication.
3. Protocol Activation: After all treating team members are in agreement that the patient is eligible for ECPR, PCP members can call the hospital to activate the ECPR protocol. Earlier advanced warning is highly appreciated by the emergency department which allows for preparation, and to alert other team members.
4. Tango Unit: Many have commented that ECPR activations in which the Paramedic Specialist also attended resulted in an improved transition to transport and hospital

arrival. While the Tango unit is not required, it may be beneficial to notify the Tango unit to see if they may be able to offer assistance, especially in cases of a de-paired ALS unit.

When to Transport

- Several studies have shown that earlier ECPR initiation leads to significantly better outcomes. An arrest-to-ECPR initiation interval of > 60 has been shown to be associated with worse outcomes among those treated with ECPR. This has been compared to the “golden hour of trauma”.
- However, we also know that resuscitation quality may be negatively impaired when there is a rush to transport, and we are not advocating a “scoop and run” strategy.
- Among ECPR candidates, the best strategy is likely to think of transport from the beginning of the resuscitation attempt. Involve the whole on-scene team such that those not actively involved in the resuscitation are preparing for extrication and transport, or calling to activate the protocol. In this way, when the decision is made to transport, this process can be quick and organized.
- While the optimal scenario is achieving rapid ROSC on-scene, if this is not possible then more efficient transport will yield improved outcomes.
- I would aim to transport *as soon as you can confidently continue high quality resuscitation* during extrication and transport.

References:

1. Grunau B, Carrier S, Bashir J, et al. A comprehensive regional clinical and educational ECPR protocol decreases time to ECMO in patients with refractory out-of-hospital cardiac arrest. *CJEM*. 2017;19(6):424-433. doi:10.1080/10903127.2017.1356412
2. Yannopoulos D, Bartos JA, Raveendran G, et al. Coronary Artery Disease in Patients With Out-of-Hospital Refractory Ventricular Fibrillation Cardiac Arrest. *J Am Coll Cardiol*. 2017;70(9):1109-1117. doi:10.1016/j.jacc.2017.06.059
3. Maekawa K, Tanno K, Hase M, Mori K, Asai Y. Extracorporeal cardiopulmonary resuscitation for patients with out-of-hospital cardiac arrest of cardiac origin: a propensity-matched study and predictor analysis. *Crit Care Med*. 2013;41(5):1186-1196. doi:10.1097/CCM.0b013e31827ca4c8
4. Lamhaut L, Hutin A, Puymirat E, et al. A Pre-Hospital Extracorporeal Cardio Pulmonary Resuscitation (ECPR) strategy for treatment of refractory out hospital cardiac arrest: An observational study and propensity analysis. *Resuscitation*. April 2017. doi:10.1016/j.resuscitation.2017.04.014



Canadian Resuscitation Outcomes Consortium
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BC ECPR STUDY ~ PHASE TWO ~

This study investigates the benefit of ECPR (ECMO) for refractory out-of-hospital cardiac arrest.

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If Eligibility Confirmed

1. **Call SPH Emergency Department (604-689-4455) to Activate CODE-ECPR.** Please ask to discuss with Physician.
 2. Apply Lucas CPR device.
 3. Ensure the patient has an **advanced airway** placed prior to transport
 4. Transport to St. Paul's Hospital for ECPR therapy
 5. Limit **total Epinephrine to 5 mg**
- ❖ Please notify ROC office (604-806-9977) after care is complete
 - ❖ Earlier arrival to hospital will result in improved outcomes
 - ❖ If patient ineligible, please indicate the reason on the chart.
 - ❖ **Hypothermia-related arrests** not fulfilling this criteria may still be ECPR-candidates. Please call to discuss.

- Age ≤ 65 with non-traumatic cardiac arrest**
- Pulseless after a **minimum of 3 cycles** of CPR by a professional
- No major co-morbidities** (CHF, COPD/significant lung disease, dialysis, liver failure, malignancy) or pre-existing major neurological deficits
- No history or evidence of recent recreational drug use**

↓ YES to all boxes

- Either:**
 - ✦ Rectal or oral temperature < 32 °C
 - ✦ Signs of life (movement or gasping) at time of protocol activation

YES →

↓ No

- Witnessed arrest (seen or heard)**
- One of the following:**
 - Initial rhythm shockable
 - Initial rhythm PEA **AND** had bystander CPR or was an EMS-witnessed arrest
 - Pupils ≤ 5 mm at time of protocol activation
- Cause** of arrest is either:
 - ✦ **No obvious cause**
 - ✦ **Overdose of cardiac toxins** (B-blocker, CC-blocker, Psych meds, digoxin)
- ETCO2 > 10 mmHg** at time of protocol activation
- Time from Paramedic Dispatch (or arrest if EMS-witnessed) to **SPH arrival < 50 min**

YES to all boxes →

ELIGIBLE FOR ECPR