Medical Direction and Practices Board
White Paper

Mechanical CPR (mCPR)

Background

The interventions with the highest improvement in neurologically intact survival in Out of Hospital Cardiac Arrest (OHCA) remain: bystander CPR, early defibrillation, and high quality chest compressions. To that end, Maine EMS, the American Heart Association, and several educational bodies have been promoting strategies to help providers maintain the focus on high quality chest compression delivery. These strategies are commonly referred to as "High Performance CPR", "Incident Command for Cardiac Arrest", or "Pit Crew CPR". The goals of which are: 1) compress the chest to appropriate depth, 2) allow full chest recoil, 3) maintain a rate of chest compressions of 100-120 compressions per minute, 4) minimize interruptions in chest compressions – only breaking at 2 minute intervals for rhythm checks while maintaining the highest possible chest compression fraction [CPR fraction = time on chest/total time of the code]. These goals remain the focus of the Maine EMS Cardiac Arrest Protocol.

Several services have requested the addition of mechanical CPR devices to support their mission of delivering high quality chest compressions for OHCA. While these devices have never been proven to deliver better chest compressions than EMS providers (note: the AHA still considers manual CPR the gold standard), there are situations where manual chest compressions are difficult or unsafe and mechanical devices can be used to supplement the team-based approach to care for the OHCA patient. Based on a thorough literature review and consideration of these situations, the MPDB has elected to allow mechanical CPR devices as an optional piece of equipment that services may elect to use.

When should mCPR be considered?

Mechanical CPR devices will best serve the EMS crew in the following 3 situations:

1. Few numbers of rescuers – smaller services in particular may benefit from the addition of these devices when very few rescuers are able to respond to the scene of OHCA or rescuers are arriving in a delayed fashion. Since the mCPR device does not need to perform other tasks like a manual rescuer, it frees up the available rescuers to accomplish other duties.
2. Prolonged resuscitation – Rescuer fatigue is of particular concern in rare but critical cases of prolonged resuscitation (i.e. Recurrent VF, refractory VF, or fast and narrow PEA). Implementation of mechanical CPR devices in these situations may be particularly helpful.

3. Resuscitation occurring during transport – While Maine EMS and the MPDB have advocated for all CPR to occur in a stationary and safe environment when possible (e.g. on-scene or in the back of a non-moving ambulance), there are rare scenarios when transporting a pulseless patient may be necessary. Manual chest compressions in this scenario are less effective and are dangerous for the unbelted provider. A mechanical device can also safely deliver chest compressions in a moving ambulance. Patients who achieve ROSC on scene may re-arrests during transport and CPR must be re-initiated. In this scenario, a crew may consider application of a mechanical device in "stand-by" mode for all patients with ROSC to be quickly initiated in the setting of re-arrest.

How should mCPR be applied?

The most important consideration in the implementation of mCPR is *training* how to apply the device in the context of the current cardiac arrest algorithm. Pauses in manual chest compressions should only occur at 2-minute rhythm checks and should be **as short as possible** (not to exceed 10 seconds). The placement and initiation of a mechanical CPR device must not cause any additional or prolonged pauses in chest compressions. This is a difficult task and takes regular team practice. In this scenario the first few cycles of CPR will be ***manual*** chest compressions (remember: manual chest compressions are the gold standard). For the first two cycles of CPR, the crew must focus on *quality* chest compressions and *early* defibrillation (if indicated). After 2 cycles of manual chest compressions, the crew may consider applying the mechanical device. It may take several cycles to fully apply the device depending on training and and the coordination of the team The mCPR device can be applied later during the cardiac arrest, (e.g. when other resources arrive or when prolonged resuscitation is being attempted)but the same principle of *minimizing* interruptions during CPR must apply.

One example of application timing is:

Time	Action
00:00	Arrive on scene – begin manual CPR
00:00 – 2:00	Manual CPR, cycle #1
02:00 – 02:10	Rhythm/pulse check – resume manual CPR
02:10 – 04:10	Manual CPR, cycle #2
04:10 – 04:20	Rhythm/pulse check - insert device under patient – resume manual CPR
04:20 – 06:20	Manual CPR, cycle #3
06:20 – 06:30	Rhythm/pulse check – attach/adjust remaining chest portion of device – resume manual CPR
06:30 – 08:30	Manual CPR, cycle #4
08:30 – 08:40	Rhythm/pulse check – begin mechanical CPR
08:40 – 10:40	Mechanical CPR, cycle #5

When should mCPR be avoided?

Mechanical CPR devices have not been studied in pediatric OHCA and should not be used on any patient less than 18 years of age. Additionally, all devices have patient body habitus restrictions. EMS personnel may refer to manufacturer recommendations but must still be aware that some adults may be too large or too small for application of the mCPR device.