Manual Versus Mechanical Cardiopulmonary Resuscitation

A Case Against the Machine

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KEYWORDS

• Mechanical • Device • Manual • Compression • CPR • Quality • Survival

KEY POINTS

- Mechanical compression devices produce promising results with improved markers of perfusion in animal studies, but these do not translate to human survival.
- There are conflicting data on whether mechanical chest compression devices perform high-quality cardiopulmonary resuscitation (CPR), including compression rate, depth, and fraction, more reliably than humans.
- Mechanical CPR is associated with more traumatic injuries to patients, but these injuries are unlikely to have clinical significance.
- Ongoing CPR during transportation is unsafe for providers, but there is no evidence that mechanical chest compression devices improve its safety profile.
- In large, randomized, prospective, human trials, mechanical CPR is associated with equivalent survival and worse neuro-favorable outcomes when compared with manual CPR.

INTRODUCTION

Resuscitation science and practice made incredible advancements over the past 30 years. At the same time, progress in portable machine technology led to improved consistency, efficiency, and quality in an array of fields, and was thus integrated widely. By 2005, consensus among international leaders in resuscitation advised that chest compressions be performed hard and fast with minimal interruptions.[1] It follows that a mechanized compression device would be capable of delivering such high-performance cardiopulmonary resuscitation (HPCPR)[a] more predictably and reliably than humans, thereby meeting recommended standards and ultimately improving outcomes. Although randomized controlled trials (RCTs) in animal models consistently show favorable outcomes among physiologic markers of perfusion, and both manikin and some human studies have demonstrated superior ability to perform HPCPR with mechanical versus manual chest compressions, large RCTs of out-of-hospital cardiac arrest (OHCA) have failed to show a survival advantage. Furthermore, these

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[a] Or *high-quality CPR* refers to CPR that meets recommended standards for rate (100–120), depth (5–6 cm), fraction (>0.8), and peri-shock pause (<10 seconds); limits pauses in general; allows for chest wall recoil.

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trials have trended toward worse neurologic outcomes among patients treated with mechanical chest compression devices. Despite years of research efforts trying to convince ourselves otherwise, available evidence cannot support the widespread use of mechanical chest compression devices, at least in their current form.

Several key assumptions comprise the argument supporting the use of mechanical chest compression devices in OHCA:

- High-quality cardiopulmonary resuscitation (CPR) is associated with better outcomes in cardiac arrest.
- There is wide variability in and degradation of chest compression performance during manual CPR, especially during patient extrication and transport to the hospital.
- Mechanical devices are able to achieve more consistent, high-quality CPR than manual compressions, *and* this holds true in the prehospital environment.
- Consistency in CPR is desirable.
- Mechanical devices are safer (associated with fewer adverse effects) for both providers and patients.

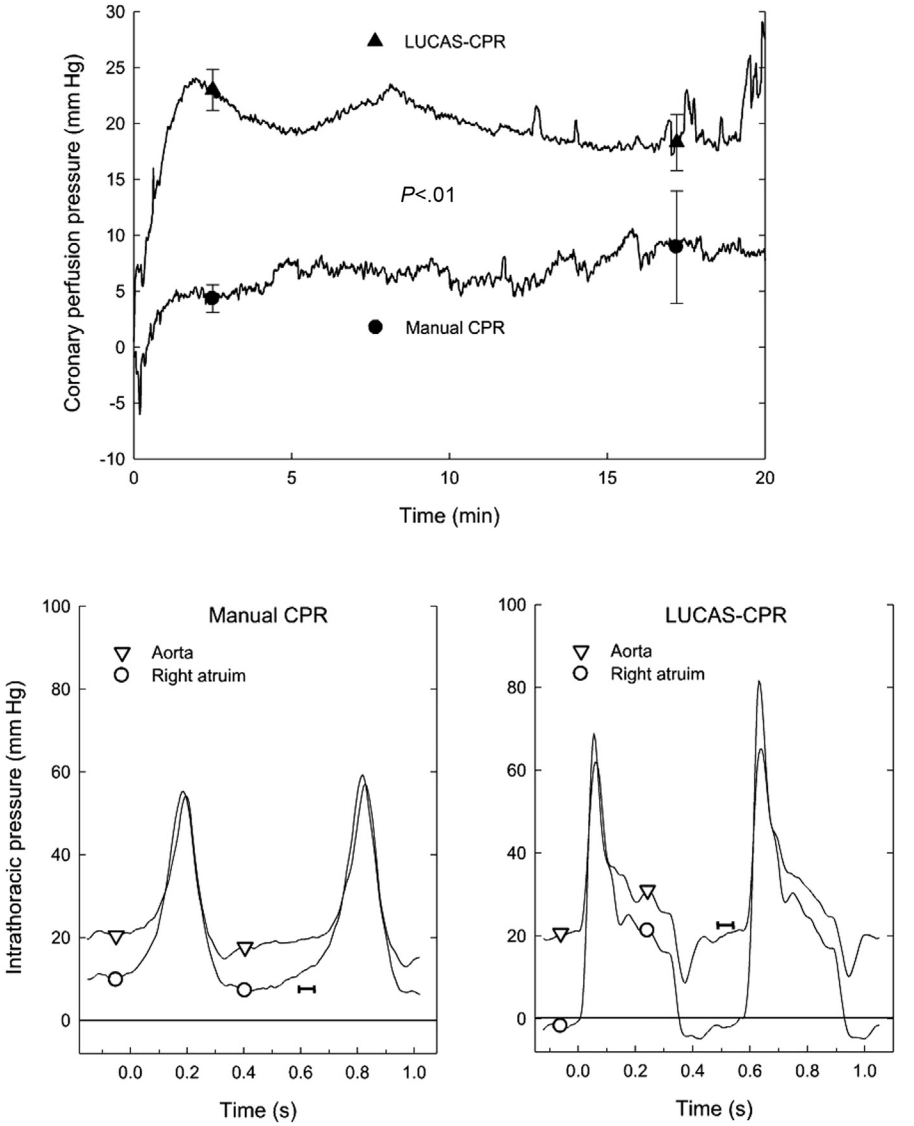

Fig. 1. Coronary perfusion pressure during manual versus mechanical CPR. (*From* Liao Q, Sjöberg T, Paskevicius A, et al. Manual versus mechanical cardiopulmonary resuscitation. An experimental study in pigs. BMC Cardio Dis 2010;10(1):4; with permission.)