

Paramedic CAT (Critically Appraised Topic)

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Title: Efficacy of mechanical CPR devices versus manual CPR techniques on survival outcomes

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2nd Party Appraiser:

Clinical Scenario: Paramedics respond to a call for a 55-year old male who is VSA (vital signs absent) at a local gym. The dispatcher informs the crew that CPR is in progress by some gym members who witnessed the arrest. On route, one paramedic makes the suggestion to the other that they use the LUCAS device so that they can deliver shocks while compressions are in progress. The other paramedic disagrees and states that he read somewhere that “LUCAS devices don’t make any difference”. They disregard the LUCAS device idea and take over manual CPR upon arrival. Unfortunately, the crew does not obtain a ROSC on the patient. Could a mechanical CPR device have made a difference in the outcome of this patient?

PICO (Population - Intervention - Comparison - Outcome) Question: Are manual CPR techniques more effective than mechanical CPR devices at increasing survival rates in pre-hospital cardiac arrest patients?

Search Strategy: (out of hospital OR pre-hospital OR paramedic OR ems OR emergency medical technician) AND (mechanical CPR OR automated CPR OR LUCAS or Lucas device OR AutoPulse) AND (cardiac arrest OR heart arrest OR resuscitation OR ROSC OR return of spontaneous circulation OR VSA)

Limits: English, Humans, last 5 years

Search Outcome: 228 results found

Relevant Papers:

Author/Date	Population	Design(LOE)	Outcomes	Results	Strengths/Weaknesses
Westfall et al (2013)	- total of 6,538 subjects with 1,824 return of spontaneous circulation (ROSC) events - inclusion criteria: studies had to be human controlled investigations with confirmed OHCA cases	- meta-analysis of literature - 12 studies total (8 studies on load distributing band CPR device, 4 studies on piston driven CPR device) - LOE 3	- survival outcomes - ROSC	- difference in % of ROSC rates in mechanical devices: 8.3% for load-distributing band CPR(AutoPulse) and 5.2% for piston-driven(LUCAS) CPR - odds of a ROSC were 1.6 times higher with mechanical CPR compared to	Weaknesses - retrospective design, no comparison of medical versus traumatic cardiac arrest outcomes - no comparison of study results Strengths - good population / sample sizes - reviewed the common types of mechanical CPR devices and the effects of treatment on ROSC outcomes

Author / Date	Population / Sample	Design / LOE	Outcomes	Results	Strengths/Weaknesses
Zeiner et al (2015)	<ul style="list-style-type: none"> - enrolled 948 out of hospital cardiac arrest patients over a 12 months period - 655 patients (69.8%) received manual CPR, 283 patients (30.2%) received mechanical CPR - 343 (36.6%) of the patients were female - transported by the Municipal Ambulance Service of Vienna, Austria 	<ul style="list-style-type: none"> - single-center observational trial - patient data was gathered from run-reports and written event recordings - LOE 2 	<ul style="list-style-type: none"> - survival outcomes - ROSC - neurological outcomes 	<ul style="list-style-type: none"> - manual CPR resuscitation patients were more likely to attain sustained ROSC (n = 201, 30.6%) compared to those receiving mechanical CPR (n = 65, 23.0%) - 73.4% of the 30-day survivors reached a CPC 1/2 within the manual CPR subgroup - 56.8% of the patients within the mechanical cc subgroup had good neurological outcome 	<p>Weaknesses</p> <ul style="list-style-type: none"> - retrospective design, factors affecting ROSC outcomes varied between the control groups - some patients had physician and paramedic response, and others only had paramedic response <p>Strengths</p> <ul style="list-style-type: none"> - good population / sample sizes - reviewed the neurological outcomes of patients who did obtain a ROSC and compared the two groups outcomes - focused data collection

Comments

There were some challenges with the PICO question in regards to the comparative aspects and factors affecting outcomes. Most of the studies reviewed had very conflicting results and conclusions about which method of CPR delivery increases survival rates. The studies reviewed were all retrospective designs with varying sample sizes, factors, and populations. However, factors that were commonly agreed upon in regards to increasing survivability of cardiac arrests were: initiation of prompt CPR, minimum interruptions in time on the chest, and good CPR quality.

The two studies had two completely different conclusions about mechanical CPR improves outcomes for out of hospital cardiac arrest patients in comparison to manual CPR techniques. Westfall et al (2013) found that the odds of attaining a ROSC were 1.6 times higher in OHCA patients who received mechanical CPR in comparison to manual CPR techniques. However, Zeiner et al (2015) found that OHCA patients who received manual CPR were more likely to attain a sustained ROSC (n = 201, 30.6%) compared to those receiving mechanical CPR (n = 65, 23.0%).

Westfall et al's (2013) study cannot be related to our system due to the presence of emergency physicians on scene for some of the OHCA patients. Also, Zeiner et al's (2015) population and sample size was made up of Austrian patients who were only being transported to one healthcare centre in

specific. Based on the study results, it is difficult to determine which method of CPR delivery results in increased survival rates in out of hospital cardiac arrest patients. More research and studies need to be conducted in order to gain definitive knowledge and insight into which method of CPR delivery increases the survivability of cardiac arrest.

Consider (Why would you NOT change study, based on these articles?)

Both manual and automated CPR devices have their pros and cons, but there is no definitive proof that automated CPR devices are more effective at increasing survival rates and outcomes versus manual CPR. Manual CPR effectiveness depends on the efficacy of the caregiver's CPR because humans fatigue over time, whereas the automated devices do not. Moreover, mechanical CPR devices consistently provide a higher quality compression rate and depth than manual CPR. This is important because high quality CPR is shown to increase coronary perfusion pressure, which is a factor affecting patient survival. In one article, Shahinian et al (2017) emphasize that even though automated devices increase CPR quality and decrease the "time off chest" compared to manual CPR, they inflict the same amount of trauma, if not more, to the patient's thoracic cavity. Overall, it is still unclear as to which method is the most effective. The only way to determine which CPR method is the most effective at increasing survival outcomes of OHCA patients in the pre-hospital setting is to conduct more comparative research in the field.

Clinical Bottom Line:

Paramedics should always follow their standard operating procedures and BLS/ALS guidelines regarding cardiac arrest patient treatment and CPR protocols. There is no concrete evidence indicating that mechanical CPR devices are more effective than manual CPR techniques at increasing survival outcomes of OHCA patients. Therefore, there is no reason to change current practices. Further comparative studies and field research studies need to be done on this controversial topic to improve the understanding of each CPR method. Once researchers and medical professionals have a better idea of each method's strengths and weaknesses, they can then start to form better conclusions about which is more effective.

References

- Shahinian, J. H., Quitt, J., Wiese, M., Eckstain, F., Reuthebuch, O. (2017). Unexpected collateral impact after out of hospital resuscitation using LUCAS system. *Journal of Cardiothoracic Surgery*, 12(1), 1-4. doi:10.1186/s13019-017-0643-z
- Westfall, M., Krantz, S., Mullin, C., Kaufman, C. (2017). Mechanical versus manual chest compressions in out-of-hospital cardiac arrest: a meta-analysis. *Critical Care Medicine*, 41(7), 1782-9. doi: 10.1097/CCM.0b013e31828a24e3.
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