Paramedic CAT (Critically Appraised Topic)

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Title: Mechanical CPR vs. Manual CPR of Cardiac Arrest Patients

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Clinical Scenario:
Paramedics arrive on scene to a cardiac arrest in which they must travel up a flight of stairs to reach the patient. Paramedics confirm the patient is VSA. Should the Paramedics put the LUCAS device on the patient, or perform manual CPR?

PICO (Population - Intervention - Comparison - Outcome) Question:
In the pre-hosptial setting, does mechanical CPR compared to manual CPR result in more effective CPR, and better outcomes for cardiac arrest patients.

Search Method:
(paramedic or ems or emergency medical service or prehospital or pre-hospital or ambulance or emergency medical technician or emt) AND (manual compression) AND (mechanical compression). Limits: 2013 - 2020, English.

Search Outcomes: CINAHL - 39 results, MEDLINE - 76 results

Relevant Papers:

Author, Date	Population: Sample Characteristics	Design (LOE)	Outcomes	Results	Strengths/ Weaknesses
Perkins, G., et al. (March 14, 2015).	- Included non-traumatic, adult, pre hospital cardiac arrests - 4 UK services, 91 urban/semi-urban stations - 4471 patients	- 143 LUCAS devices - Randomized treatment, about 1:2 ratio of LUCAS device to manual CPR - Analyzed survival rates at 30 days, 3 months	- Survival Rates - Detrimental results	- LUCAS-2 group: 104 out of 1652 patients (6%) survived for at least 30 days after, 3 patients obtained chest bruising, 2 had chest lacerations and another 2 with blood in their mouth. Also had 15 incidents with device - Manual CPR group: 193 out of 2819 patients (7%) survived for at least 30 days after, no detrimental results	Weaknesses: - Couldn't measure effectiveness of the actual compressions - Only tested urban/semi-urban, not rural Strengths: - used all patients that fit requirements to prevent bias - large population size using various departments

Author, Date	Population: Sample Characteristics	Design (LOE)	Outcomes	Results	Strengths/ Weaknesses
Gyory, R., et al (2017).	- 13 Paramedics and 13 EMTs were paired together in teams of two to complete the scenario - Mock patient was a mannequin total of 50kg.	- Each team was put through the simulation twice (once manually and once using the LUCAS), which involved transporting down stairs and through hallways to get the patient loaded into the ambulance - Depth, rate and correct placement was measured by the mannequin software - Important transport events were timed manually	- Compression depth - Compression rate - Full release of compressions - Correct hand positions - Total time hands off	- LUCAS: compression rate was 112/ min, percent that received, adequate depth was 52%, percent of compressions fully released was 93%, amount with correct position was 91% and average time hands off was 15% - Manual: compression rate was 125/ min, percent that received adequate depth was 36%, percent of compressions fully released was 78%, amount with correct position was 96%, and averaged time hands off was 20%	Weaknesses: - unable to account for movement during ambulance ride - Couldn't use on a real person, so can't account for injuries the device may cause Strengths: - Simulated an accurate scenario of a pre-hospital arrest - High quality devices used to test quality of compressions

Author, Date	Population, Sample Characteristics	Design (LOE)	Outcomes	Results	Strengths/ Weaknesses
Magliocca, A., et al. (2018).	- 16 pigs in cardiac arrest - Two CPR certified, professional rescuers, switched performing CPR every two minutes.	- Performed CPR for 3 minutes while ambulance was stationary, then drove along a planned route. - After two minutes of VF without treatment, rescuers either performed manual or mechanical CPR for 18 minutes	- Survival - Coronary and arterial perfusion - ETCO2 - Arterial lactate	- Mechanical: 8/8 pigs obtained a ROSC - Manual: 6/8 pigs obtained a ROSC - Coronary and arterial perfusion, as well as ETCO2 was significantly higher in mechanical CPR than manual CPR	Weaknesses: - study was performed on pigs, not humans - Small sample number Strengths: - performed experiment while stationary, as well as while driving - Attempted to mimic a real life scenario as best as they were able to

Comments:
There are various different articles and studies that test the effectiveness of mechanical compressions versus manual compressions. Although there are many studies/articles, there are not many tests specifically done on humans. The one study performed on humans, the survival rates were slightly less when performing mechanical compressions over manual compressions, however the other studies show that mechanical compressions are more effective in other areas. The study performed on mannequins showed compression depth and rate that are closer to the CPR guidelines during mechanical compressions over manual compressions. Also, the study performed on pigs discovered the coronary and arterial perfusion, as well as ETCO2 levels, are much higher with mechanical defibrillation over manual defibrillation.

Considerations:
The studies performed that proved the mechanical compressions were more effective and efficient over manual compressions were not performed on actual humans. However, the results for the randomized testing experiment were not much different. As noted, there were some mechanical incidences, and a few more injuries to patients, but overall did not result in a large difference in survival rates. The other studies did prove mechanical compressions are more effective, although, it's unsure if emergency responders would want to take the risk of mechanical incidences or further injuries in order to obtain the more effective compressions. It also needs to be taken into account that it takes time to get the mechanical compression device on, but it will also allow more hand availability once it is on and performing compressions.

Clinical Conclusion:
There is a lot to take into account when determining whether to perform compressions manually or mechanically. While performing manually, there is a risk of ineffective compressions and less hands available, but mechanically, you risk further patient injuries, as well as mechanical incidents. Either way, pre-hospital responders need to take all risks into account and determine overall, what is best for the patient.

References:

Gyory, R. A., et al. (2017). The Efficacy of LUCAS inPrehospital Cardiac Arrest Scenarios: A Crossover Mannequin Study. Western Journal of Emergency Medicine, 18(3), 437–445. doi: 10.5811/westjem.2017.1.32575

Magliocca, A., et al. (2019). LUCAS Versus Manual Chest Compression During Ambulance Transport: A Hemodynamic Study in a Porcine Model of Cardiac Arrest. Journal of the American Heart Association, 8(1). doi: 10.1161/jaha.118.011189

Perkins, G. D., et al. (2015). Mechanical versus manual chest compression for out-of-hospital cardiac arrest (PARAMEDIC): a pragmatic, cluster randomised controlled trial. The Lancet, 385(9972), 947–955. doi: 10.1016/s0140-6736(14)61886-9