Paramedic – Evidence Based Medicine (P-EBP) Program

Paramedic CAT (Critically Appraised Topic) Worksheet

Title: Does Mechanical Compressions Provide Better Quality CPR Than Manual Compressions During Prehospital Transportation?

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Clinical Scenario: You are on scene with a patient in cardiac arrest. CPR is being preformed and you have decided to transport to the nearest facility. CPR will need to be preformed on route. You have the option to use a mechanical CPR device or continue manually, but which will provide the best compressions on route.

PICO (Population – Intervention – Comparison – Outcome) Question:
Prehospital Cardiac Arrest – Mechanical CPR – vs. Manual CPR – better quality compressions during transportation

Search Strategy:
((((("prehospital" or "EMT" or "paramed*" or "emergency medical services" or "EMS" or "ambulance")) AND ("cardiac arrest" or "pulseless")) AND ("mechanical CPR" or "LUCAS" or "LUCAS device" or "mechanical compression")) AND ("manual CPR" or "manual compression" or "paramed*")) AND ("quality" or "best" or "transport"))

Search Outcome:
The above search in PubMed came up with 26 articles, of which I picked 3 pertaining to the PICO I was looking for.

Relevant Papers:

AUTHOR, DATE	POPULATION: SAMPLE CHARACTERISTICS	DESIGN (LOE)	OUTCOMES	RESULTS	STRENGTHS/ WEAKNESSES
Ong et. al., 2012	This article was a study of numerous articles that looked at mechanical and manual CPR. 4 of their studies looked at the quality. These were done on both manikin and on patients.	It was a retrospective study that looked back on other studies that were completed. This would be considered a level 2 study, as they look at both manikin and human trials.	They were looking for the outcome of mechanical CPR vs manual CPR in the prehospital setting for improved outcomes. They looked at quality and clinical outcome.	2 of the studies looked at manikins. Both found mechanical CPR preforms better quality during transport. Study 1 found correct compressions were preformed 97% of the time by mechanical, while only 37% in manual compressions. The mechanical compressions were consistent, while the manual varied in different vehicles and road conditions. The second study found that the mechanical CPR device provided better depth and frequency than manual CPR, and that manual varied during transportation. The next 2 studies looked at it performance on humans. The first found that hands off time was decreased with mechanical CPR being preformed and that chest	Strengths: Took 10 studies in total that fit their criteria, used human and manikin trials Weaknesses: Some of the studies used a small sample size, no data provided from each study in their results. This study used numerous other studies to come to their conclusion. Without the data being shown in the article, and both good and bad outcomes said to be found in the studies used, I would not fully trust the source without being able to see how the other studies were preformed and factors that may have affected the outcome.

				compression rate was closer to the guidelines on a consistent basis than manual. The second study found that average chest compression rate was lower in the mechanical ($p < 0.05$) although less variability in the rate than manual.	
J. Fox et. al., 2013	They looked at 1 simulation manikin, CPR preformed by 4 EMTs and 2 ERPs	It was a prospective study that used 2 control groups – manual vs mechanical – in a moving ambulance with 6 rounds each It was a level 3 study.	They were looking for the difference between the two for correct hand position, depth, rate, hands off time	Hands off time: Manual – 0-7 seconds Mechanical – 0 seconds Compression rate: Manual – averaged 103/min (93-112 ranges) Mechanical – 100/min Depth: Manual – 49.7mm (46.1-53.3mm ranges) 67% correct depth (>5cm) 22% moderate depth (4-5cm) 10% soft (<4cm) Mechanical – 43.2mm (42.7-43.6mm ranges) 99.96% correct depth, 2 compressions were too shallow, none too deep. Hand placement: Manual – 97.3% average correct placement Mechanical – no slippage noted.	Strengths: all compressors were of the same athletic ability, they did not know the route travelled, ages ranged from 27-54, same route driven each time with same driver Weaknesses: not a real person compressed -used a manikin, small sample size - 6 rounds for each method, braking/acceleration may be different each time, LUCAS was set at old guidelines of compressing at 4-5cm depth. They did take out all aspects that may cause delay or hands-off time, examples: drug administration, set up time, defibrillation, pulse checks etc., which is both a

					positive and negative in that it just looks at the compressions, but does not give a consideration real life use. I would trust this study in that it looks just at the compression factor, but the sample size is small which may make the data biased towards the LUCAS device.
H. Gassler et. al., 2012	They looked at only 1 resuscitation manikin in a total of 40 series of CPR. 3 different mechanical CPR devices were used, 1 manual group. Each did 10 series. The manual group consisted of 20 paramedics spilt into teams of 2.	It was a prospective study that used 4 control groups, 3 mechanical and 1 manual group, in a moving ambulance. It was a level 3 study as a manikin was used as the subject.	This study was looking for the frequency, depth and consistency of the compressions performed in the moving ambulance.	They took the averages for each data point they measured. Manual compression frequency: 117.2/min Manual compression depth: 43.7mm Manual fraction of compressions 5-6cm deep: 18.4% Manual wrong pressure point: 5.2% LUCAS frequency: 100/min LUCAS depth: 37.7mm LUCAS fraction: 0 LUCAS pressure point: 0 AutoPulse frequency: 80/min AutoPulse depth: 38.5mm AutoPulse fraction: 0 AutoPulse pressure point: 0	Strengths: 3 different types of mechanical CPR devices used, same route driven for the course, different manual CPR providers for each manual test, paramedics used in the manual CPR testing. Weaknesses: Small sample size of each test group, the mechanical devices were not programmed to the current guidelines depth/rate, braking/acceleration was adjusted in the manual group to be less forceful for safety. This study also took out all other aspects that would affect hands off time which is both a positive and a

				AnimaxMono frequency: 115.1/min AnimaxMono depth: 51.2mm AnimaxMono fraction: 51.9% AnimaxMono pressure point: 1.5%	negative as stated above. Taking the device settings into account, I would trust this article as it gives a look at the different types of mechanical CPR devices and how they preform compared to manual CPR during transportation.

Comments: In one of the articles I found, the study that was preformed on humans showed worse for compressions with mechanical CPR. The study did have a small sample group, making it not fully reliable. Without further information on this a conclusion can not be made about which preforms better in a human.

Consider: Given the information presented in the articles, the information about which would provide a better-quality compression during transportation on a manikin would be the mechanical device. These studies also did not consider the other procedures that take place during a cardiac arrest call that take time, ex. drug administration, pulse checks, respirations etc., and how they affect the compressions. With the human studies showing inconclusive results in the one article that had both manikin and human trials, without further research and studies on humans proving the same to be true as manikin, it would not be reasonable to change practice to accommodate these devices until proven to work and improve the outcomes.

Clinical Bottom Line: Based off these studies, mechanical CPR during transport has been shown to provide better quality compressions vs. manual compressions. Without further human studies, it can not be concluded to be of better quality in human cardiac arrest transports.

References:

Transport with ongoing resuscitation: a comparison between manual and mechanical compression. (H. Gassler et. al., 2012)

Mechanical versus manual chest compression CPR under ground ambulance transport conditions. (J. Fox et. al., 2013)

Mechanical CPR devices compared to manual CPR during out-of-hospital cardiac arrest and ambulance transport: a systematic review. (Ong et. al., 2012)