ARRESTING TECHNOLOGY: A NOVEL APPROACH TO MONITORING CPR PERFORMANCE DURING CARDIAC ARREST MANAGEMENT

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INTRODUCTION

Cardiopulmonary Resuscitation (CPR) is a lifesaving skill that is performed by paramedics and other health care providers in a variety of settings. However, CPR performance and efficacy are difficult to estimate in clinical settings including the pre-hospital environment, due to limitations in technology. Understanding the physiological and biomechanical forces involved in CPR can inform educators, researchers and service providers on strategies to deliver optimal CPR. The purpose of this study was to examine the physiological and biomechanical parameters in two settings using novel wearable technology. The first setting was an actual paramedic attended cardiac arrest and the second was a re-creation of this arrest in a simulation setting, adding in the ability to correlate paramedic biomechanical data with that measured by the mannikin. We believe this is the first time in the world this has been done.

RESEARCH QUESTIONS

1. Can a hip mounted rescue accelerometer data correlate with a mannikin mounted accelerometer?
2. What is the relationship between rescuer physiology and CPR quality?

METHODOLOGY

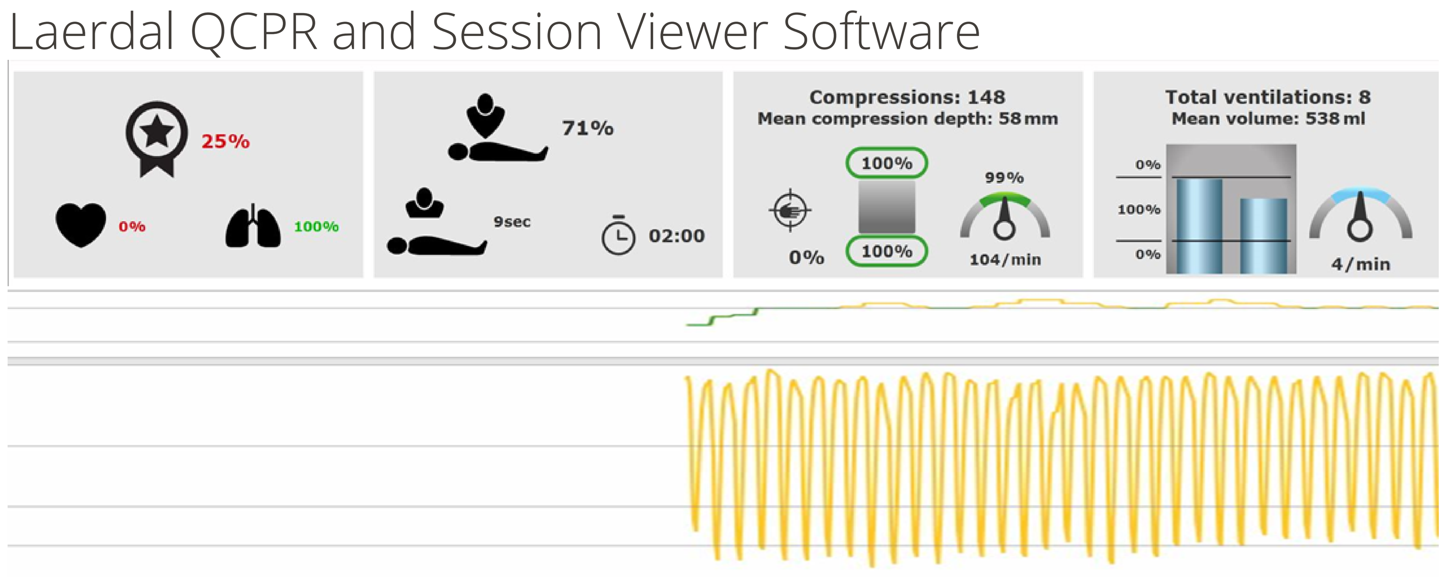
A paramedic fitted with a Hexoskin biometric shirt on an emergency callout performed multiple bouts of CPR on a patient. The paramedic's heart rate, respiratory rate and accelerometry from a hip mounted triaxial accelerometer (expressed as g-force and separately as x, y and z vectors) were recorded continuously. The paramedic's rate of perceived exertion and blood pressure was measured before and after the arrest.
We then recruited a paramedic with similar somatotype and gender to "recreate" the arrest in a simulation setting, also wearing a Hexoskin, to measure the same variables. Additionally, metrics of CPR efficiency recorded on the mannikin (rate and depth of compressions, hand position, flow fraction and time on chest). We examined the data sets for relationships between the physiological, self-reported and in-mannikin accelerometer data.

RESULTS

Descriptive Statistics

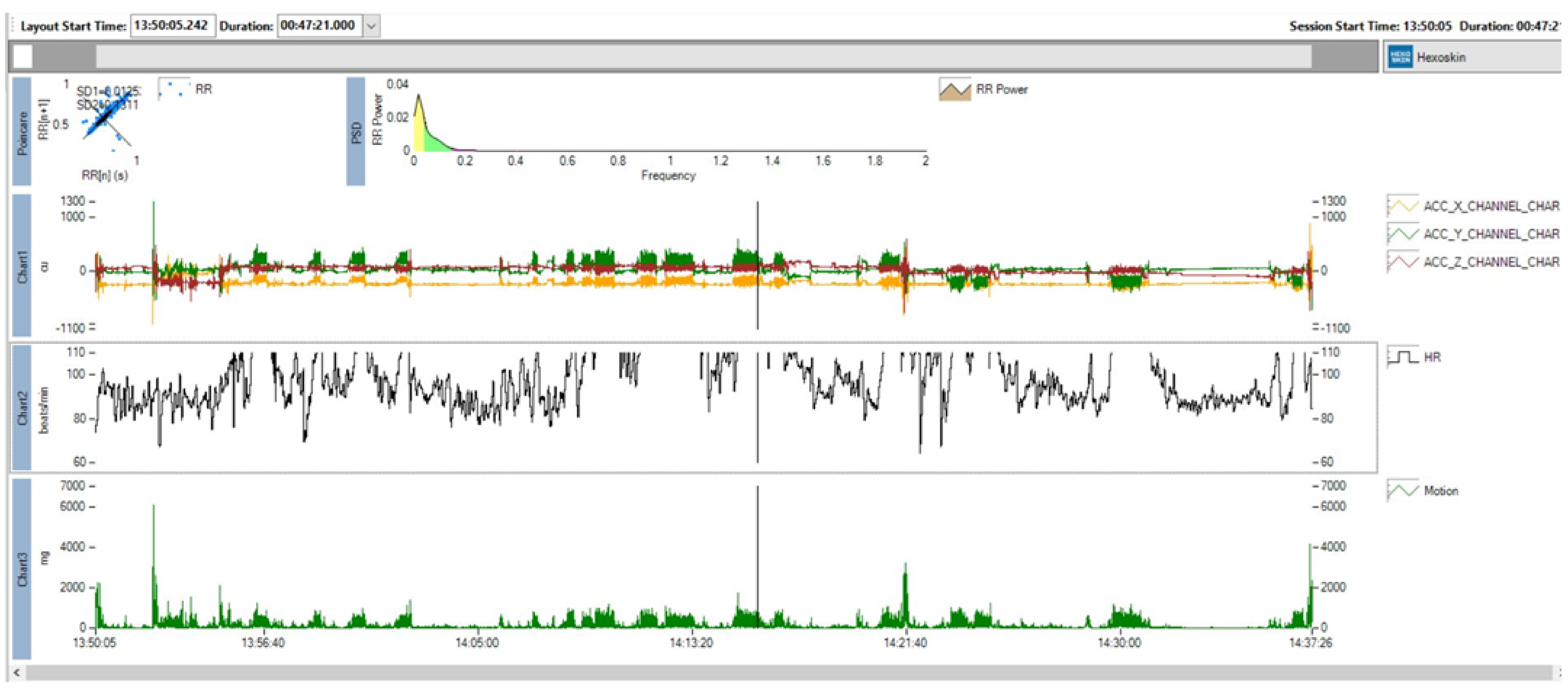
	Mean	Std. Deviation	N
Mean HR	119.17	13.81	17
Mean RR	20.15	2.55	17
Mean G-force	0.23	0.02	17
Mean X	-687.59	223.13	17
Mean Y	296.22	496.11	17
Mean Z	104.63	250.98	17
Total Compressions	67.65	36.62	17
Total compressions too shallow	54.94	40.66	17
Percent too shallow	74.27	29.07	17
% correct compression rate	5.51	6.79	17

Laerdal QCPR and Session Viewer Software



Correlation Analysis

Variable	G-force	Total Compressions	Total Compressions too Shallow	% Correct Compression Rate
Heart rate		.499 (p=0.04)	.578 (p=0.01)	-.538 (p=0.02)
Respiratory rate	.628 (p<0.01)			
G-force				-.815 (p<0.001)



Regression Analysis

Model		Unstandardized Coefficients B	Std. Error
1	(Constant)	-147.896	74.383
	Mean HR	1.702	0.620

For every 1 unit change in HR, there is a 1.7 unit change in shallow compressions

CONCLUSION

Technology in the form of wearables now enables researchers and others to explore physical and physiological performance in applied settings. In emergency situations where provider performance of skills such as CPR is critical, these technologies provide "real world" data that can be compared with other settings. This ability to compare and correlate the real world with that of simulation will enable a better understanding of the relationships between provider physiological response and their ability to deliver lifesaving skills.