Potential Blood Flow from Mechanical CPR Technologies: Comparison of Load-Distributing Band Versus Piston-Driven Systems

TECHNICAL REPORT NO. 1

Mechanical devices used as adjuncts to manual chest compressions continue to grow in popularity. Two types of technology are available today. Piston-driven technology, which dates back to the 1970s, seeks to reproduce sternal compressions following well-recognized global guidelines (e.g., ILCOR, ERC, AHA, etc.). More recently, a load-distributing band system was introduced that employs thoracic compressions to produce higher blood flow. The potential for these technologies to produce blood flow is in large part determined by the peak power of their compressions.[1,2]

Purpose: This test compared the blood flow capacity of different mechanical CPR technologies by determining the peak power produced by their respective compressions.

Method: Both a piston-driven system (Lucas™ 2) and a load-distributing band system (AutoPulse®) were tested on a mannequin. The systems were applied to a test mannequin in accordance with the manufacturer's recommendations (Figure 1).[3,4] The anatomical characteristics (chest circumference and stiffness) of the mannequin were calibrated to represent the 50th percentile patient.

The peak power produced by each technology was determined from its derivative components: depth, duration held, and force (Figure 2). Recordings of depth, duration at maximum compression, and force were made with a spring potentiometer (Dewetron Model No. 3200 - Vienna, Austria). The data were processed, plotted, and printed using Matlab® R2009a (Boston, MA).

1. Beyar, R.; Goldstein, Y. Model studies of the effects of the thoracic pressure on the circulation. *Ann. Biomed Eng.* 1987;15:373-383.
2. Pinchak AC, Hancock DE, Hagen JF, Hall FB. Chest wall acceleration and force measurements in simulated manual and mechanical cardiopulmonary resuscitation. *Crit Care Med.* 1988;16:151-160.
3. JoLife. LUCAS™ 2 Chest Compression System Instructions for Use (100666-00E). Lund, Sweden 2009.
4. ZOLL Circulation. AutoPulse Resuscitation System Model 100 User Guide (11440-001 Rev. 3). Sunnyvale, CA 2009.

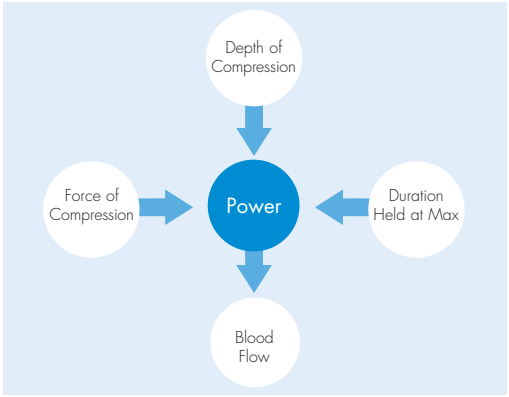

Figure 2: Key determinants of blood flow during CPR.

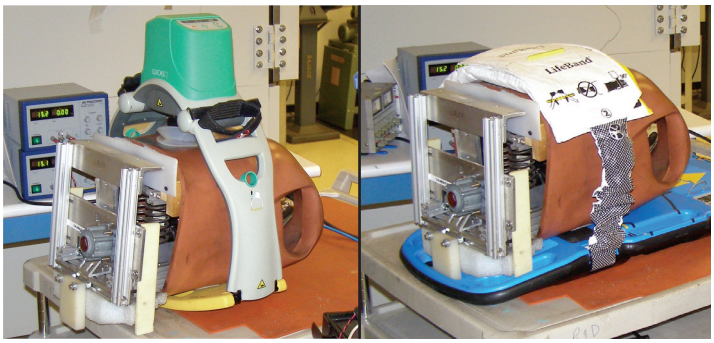

Figure 1: The piston-driven (left) and load-distributing band (right) systems shown applied to the calibrated mannequin.

Findings: The load-distributing band system outperformed the piston-driven system on all power-related variables measured:

- Compressions were 59% deeper for the load-distributing band system.
- The duration a compression was held at maximum depth was 33% longer for the load-distributing band system.
- The compression force delivered by the load-distributing band technology was 50% greater than that of the piston-driven systems.
- When compared to the piston-driven system, the peak power generated by the load-distributing band device was 78% greater (Figure 3).

Conclusion: This test clearly demonstrates the load-distributing band system (AutoPulse) is designed to deliver greater blood flow as it produces substantially more power per compression than the piston-driven system (Lucas 2).

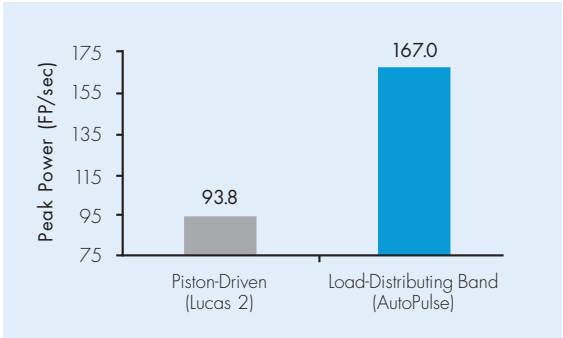

Figure 3: The peak power per compression is 78% greater for the load-distributing band system when evaluated on a mannequin representing the 50th percentile patient.

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