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Active Compression Decompression (ACD) CPR and the Impedance Threshold Device (ITD): A Summary of Support Data on these CPR Devices

Active compression decompression (ACD) CPR combined with the impedance threshold device (ITD) has been shown in animal and clinical studies to result in a 4- fold increase in blood flow to the heart and brain and a significant increase in survival rates in multiple randomized prospective clinical trials.

The ACD CPR device includes a suction cup and a handle. A gauge provides feedback on how much to push down and pull up and a metronome to guide the user in the proper rate of CPR. By itself, two in-hospital studies with this device have shown an increase in short-term survival rates. Multiple out-of-hospital survival studies have been performed with ACD CPR some have shown significant improvements in up to 1-year survival, whereas others have shown no significant benefit with the device. These differences are due to the rigor or training: with proper training and retraining ACD CPR results in higher blood pressures and survival rates. At present ACD CPR is recommended in the American Heart Association Guidelines as an alternative to manual CPR and it is used routinely in the care of patients in cardiac arrest in France, Israel, China, and in some part of Japan.

ACD CPR is best used with another CPR device, the impedance threshold device (ITD). When pulling upward with the ACD CPR device by itself, air rushes into the lungs. When the ITD is added to block the influx of air, the pressure within the thorax decreases relative to the rest of the body and this intrathoracic vacuum during the chest wall recoil phase draws more blood back in to the heart. With the next compression more blood is pushed out of the heart to the brain and other organs. Thus, this combination effectively refills and empties the heart with each decompression and compression cycle.

Use of the ITD in animals and patients during ACD CPR has been shown to significantly enhance venous return to the heart, increase perfusion of the heart and the brain, increase blood pressures to nearly normal levels, increase the circulation of drugs, and increase neurologically intact survival rates in animals and people. Blood flow to the heart and brain are 4-fold higher than with conventional CPR and survival rates are nearly doubled. This device combination has also been shown to increase the delivery of drug administration during CPR as well as markedly increase blood flow to the vital organs in a pediatric model of prolonged ventricular fibrillation. There have been no reported adverse device effects with the combination of ACD CPR plus the ITD.

Key Clinical Studies on ACD CPR by itself

1. Shultz JJ, Coffeen P, Sweeney M, Detloff B, Kohler C, Pineda E, Yakshe P, Adler SW, Chang M, Lurie KG: Evaluation of standard and active compression-decompression CPR in an acute human model of ventricular fibrillation. Circulation 89;684-693, 1994.

2. Lurie KG, Shultz JJ, Callaham ML, et.al: Evaluation of Active Compression-Decompression CPR in Victims of Out-of-Hospital Cardiac Arrest. JAMA 271:1405-1411, 1994.

3. Cohen TJ, Goldner BG, Maccaro PC, et al. A comparison of active compression-decompression cardiopulmonary resuscitation with standard cardiopulmonary resuscitation for cardiac arrests occurring in the hospital. N Engl J Med 1993;329:1918-21.

4. Plaisance P, Lurie KG, Vicaut E et al. A comparison of standard cardiopulmonary resuscitation and active compression-decompression resuscitation for out-of-hospital cardiac arrest. French Active Compression-Decompression Cardiopulmonary Resuscitation Study Group. New England journal of medicine 1999;341:569-75.

Key Animal Studies on ACD CPR with the ITD

5. Lurie KG, Coffeen PR, Shultz JJ, McKnite SH, Detloff BS: Improving active compression-decompression cardiopulmonary resuscitation with an inspiratory impedance valve. Circulation 91(6):1629-1632, 1995.

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7. Raedler C, Voelckel WG, et al. Vasopressor response in a porcine model of hypothermic cardiac arrest is improved with active compression-decompression cardiopulmonary resuscitation using the inspiratory impedance threshold valve. Anesth Analg 2002;95(6):1496-502.

8. Srinivasan V, Nadkarni VM, et al. Rapid induction of cerebral hypothermia is enhanced with active compression decompression plus inspiratory impedance threshold device cardiopulmonary resuscitation in a porcine model of cardiac arrest. J Am Coll Cardiol 2006;47(4):835-41.

Key Human Studies on ACD CPR plus the ITD

9. Plaisance P, Lurie KG, Payen D: Inspiratory impedance during active compression-decompression cardiopulmonary resuscitation: A randomized evaluation in patients in cardiac arrest. Circulation. 2000 Mar 7;101(9):989-94.

10. Plaisance P, Soleil C, Lurie KG, Vicaut E, Ducros L, Payen D. Use of an inspiratory impedance threshold device on a facemask and endotracheal tube to reduce intrathoracic pressures during the decompression phase of active compression-decompression cardiopulmonary resuscitation. Critical Care Medicine. May, 2005;33(5):990-4.

11. Plaisance P, Lurie KG, Vicaut E., Martin D., Gueugniaud PY, Petit JL, Payen D. Evaluation of an impedance threshold device in patients receiving active compression-decompression cardiopulmonary resuscitation for out of hospital cardiac arrest. Resuscitation 61(3):265-71, 2004 Jun.

12. Wolcke BB, Maurer DK, Schoefmann MF, Teichmann H, Provo TA, Lindner KH, Dick WF, Aeppli D, Lurie KG. Comparison of Standard Cardiopulmonary Resuscitation Versus the Combination of Active Compression-Decompression Cardiopulmonary Resuscitation and an Inspiratory Impedance Threshold Device for Out-of-Hospital Cardiac Arrest. Circulation. 2003 Nov 4;108(18):e9047-8.