CASE REPORT

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Use of the LUCAS mechanical chest compression device for percutaneous coronary intervention during cardiac arrest: is it really a game changer?

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ABSTRACT

Cardiopulmonary support including closed chest compression is a mainstay in the management of cardiac arrest. However, traditional means (i.e. manual) chest compression may be logistically challenging, especially in patients requiring emergent invasive procedures such as percutaneous coronary intervention for cardiac arrest due to acute myocardial infarction. The LUCAS mechanical chest compression device provides external and automated closed chest compression, thus enabling even complex invasive procedures without interrupting cardiopulmonary support. Nonetheless, no randomized trial has proved to date its benefit in comparison to standard manual chest compression, and to date only observational studies and consensus opinion support its clinical use.

Keywords: *cardiac arrest, chest compression, LUCAS, percutaneous coronary intervention, PTCA, resuscitation.*

Cardiac arrest has a dire prognosis, with an average of only 5% of patients being discharged alive without neurologic problems after an out-of-hospital cardiac arrest (1).

Despite improvements in medical therapy and other devices modifying ventilatory support (2, 3) cardiopulmonary support based especially on closed chest compression is pivotal to maximize survival chances. However, manual chest compression is energy consuming and operator-intensive.

Moreover, it cannot be performed successfully for a prolonged period of time by any individual healthcare provider nor in logistically challenging settings (e.g. helicopters).

Manual chest compression appears particularly challenging for patients in cardiac arrest who also require an emergent invasive procedure, such as primary percutaneous coronary intervention (PCI).

The LUCAS device (LUCAS 2, Jolife, Lund, Sweden) is a mechanical chest compression-decompression system which enabled automated and continuous closed chest compression, without unduly limiting other invasive procedures such as PCI (4-9).

It is unclear however whether the LUCAS device can really impact on the patient prognosis besides enabling uninterrupted PCI during a prolonged cardiac arrest, as exemplified by a recent case we have faced.

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A 40-year-old gentleman with long-standing type 1 diabetes mellitus was admitted to a spoke care center for suspected acute myocardial infarction, based on typical chest pain and diffuse non-ST-elevation myocardial infarction.

Shortly after admission to the emergency room, the patient developed cardiac arrest due to ventricular fibrillation: He was successfully defibrillated but then developed pulseless electrical activity (PEA) despite several boluses of adrenaline. After tracheal intubation and mechanical ventilation, and while still under continuous manual chest compression, he was transferred to our hub care center for further management. At arrival in our emergency department, systemic thrombolysis was attempted.

Given its lack of efficacy and the persistence of cardiac arrest due to (PEA), the LUCAS device was positioned and activated. The patient was thus transported to the cardiac catheterization laboratory, where selective coronary angiography was performed during continuous mechanical chest compression. A thrombotic subocclusion of the left main coronary stem was demonstrated, together with chronic total occlusions of the distal left anterior descending and distal right coronary artery (Figure 1). Thus, left main stenting was performed by means of PCI and 3.5x25 mm bare-metal stent implantation (Skylor, Invatec, Roncadelle, Italy) dilated at up to 20 atmospheres, achieving a satisfactory final result in terms of residual stenosis.

Despite this, no return of spontaneous circulation was possible, and the resuscitation efforts were interrupted 30 minutes after the end of the procedure. The following day, a post-mortem confirmed the acute myocardial infarction as the cause of death and the chronic occlusion of the distal left anterior descending and distal right coronary artery, as well as showing a good patency of the implanted stent.

Despite the promising features of the LUCAS device, the only available randomized trial on this topic, including 149 patients with out-of-hospital cardiac arrest, appears in agreement with our case study (10). Indeed, in this study Smekal et al did not

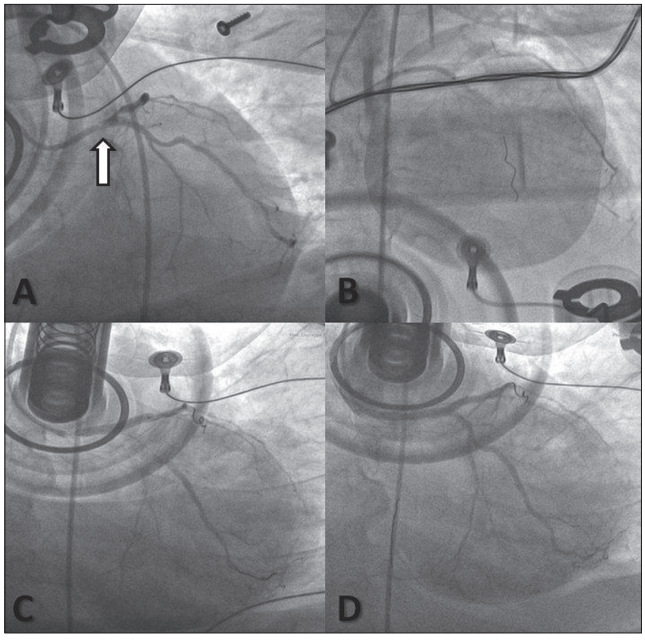

Figure 1 - *Coronary angiography and stenting during continuous chest compression by means of the LUCAS device in a 40-year-old patient with cardiac arrest. Angiography showed a thrombotic subocclusion of the left main coronary stem (panel A; arrow showing the subocclusive stenosis).*

After pre-dilation with a 2.5x20 mm semi-compliant balloon at 12 atmospheres at the left main-left circumflex level (panel B), a 3.5x25 mm bare-metal stent was implanted up to 20 atmospheres at the left main-left anterior descending level (panel C), with a satisfactory result in terms of residual stenosis (panel D).

Despite this and continuous cardiopulmonary support, the patient never achieved a return of spontaneous circulation and was declared dead 30 minutes after the end of the revascularization procedure.

show a statistically or clinically significant benefit from the use of the device (6 of those treated with the LUCAS system discharged alive versus 7 of those treated with manual compression, p = 0.8) (10).

Similar uncertainty stems from a negative prior study on the Autopulse Resuscitation System (Zoll, Chelmsford, MA, USA) (11), and an inconclusive recent Cochrane Collaboration systematic review including 4 trials and 868 patients (12). Whereas a combined use of LUCAS and extra-corporeal membrane oxygenation (ECMO) systems would have been appealing in our case and is under investigation, its purported benefits remain largely speculative and require further scientific proof.

Thus, awaiting the results of the upcoming 4000-patient Prehospital Randomised Assessment of a Mechanical compression Device In Cardiac arrest (PaRAMeDIC) trial (13), we believe that the LUCAS device should best be reserved to patients with cardiac arrest without an ominous prognosis per se.

REFERENCES

1. Aufderheide TP, Frascone RJ, Wayne MA, et al. Standard cardiopulmonary resuscitation versus active compression-decompression cardiopulmonary resuscitation with augmentation of negative intrathoracic pressure for out-of-hospital cardiac arrest: a randomised trial. Lancet 2011; 377: 301-11.
2. Biondi-Zoccai GG, Abbate A, Parisi Q, et al. Is vasopressin superior to adrenaline or placebo in the management of cardiac arrest? A meta-analysis. Resuscitation 2003; 59: 221-4.
3. Cabrini L, Beccaria P, Landoni G, et al. Impact of impedance threshold devices on cardiopulmonary resuscitation: a systematic review and meta-analysis of randomized controlled studies. Crit Care Med 2008; 36: 1625-32.
4. Steen S, Sjöberg T, Olsson P, Young M. Treatment of out-of-hospital cardiac arrest with LUCAS, a new device for automatic mechanical compression and active decompression resuscitation. Resuscitation 2005; 67: 25-30.
5. Larsen AI, Hjørnevik AS, Ellingsen CL, Nilsen DW. Cardiac arrest with continuous mechanical chest compression during percutaneous coronary intervention. A report on the use of the LUCAS device. Resuscitation 2007; 75: 454-9.
6. Agostoni P, Cornelis K, Vermeersch P. Successful percutaneous treatment of an intraprocedural left main stent thrombosis with the support of an automatic mechanical chest compression device. Int J Cardiol 2008; 124: 19-21.
7. Bonnemeier H, Olivecrona G, Simonis G, et al. Automated continuous chest compression for in-hospital cardiopulmonary resuscitation of patients with pulseless electrical activity: a report of five cases. Int J Cardiol 2009; 136: 39-50.
8. Smekal D, Johansson J, Huzevka T, Rubertsson S. No difference in autopsy detected injuries in cardiac arrest patients treated with manual chest compressions compared with mechanical compressions with the LUCAS device--a pilot study. Resuscitation 2009; 80: 1104-7.
9. Wagner H, Terkelsen CJ, Friberg H, et al. Cardiac arrest in the catheterisation laboratory: a 5-year experience of using mechanical chest compressions to facilitate PCI during prolonged resuscitation efforts. Resuscitation 2010; 81: 383-7.
10. Smekal D, Johansson J, Huzevka T, Rubertsson S. A pilot study of mechanical chest compressions with the LUCAS™ device in cardiopulmonary resuscitation. Resuscitation . Epub 2011. PMID: 21419560.
11. Hallstrom A, Rea TD, Sayre MR, et al. Manual chest compression vs use of an automated chest compression device during resuscitation following out-of-hospital cardiac arrest: a randomized trial. JAMA 2006; 295: 2620-8.
12. Brooks SC, Bigham BL, Morrison LJ. Mechanical versus manual chest compressions for cardiac arrest. Cochrane Database Syst Rev 2011:CD007260.
13. Perkins GD, Woollard M, Cooke MW, et al; PARAMEDIC trial collaborators. Prehospital randomised assessment of a mechanical compression device in cardiac arrest (PaRAMeDIC) trial protocol. Scand J Trauma Resusc Emerg Med 2010; 18: 58.

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