Miniaturized Mechanical Chest Compressor for Cardiopulmonary Resuscitation

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During CPR, effective and uninterrupted chest compression provides blood flow to the vital organs and improves the success of CPR, especially when the duration of untreated cardiac arrest is prolonged.1-3

For manual chest compression, current guidelines emphasize a sternal compression depth of at least 2 inches/5 cm. Though there is no specific recommendation for the use of the mechanical devices, the same depth has been adopted. Experimental and clinical studies have reported that incidence of rib fractures and lung injury was higher with the recommended compression depth.4-8

In this study, we investigated the hemodynamic efficacy of a newly developed pneumatically driven miniaturized mechanical chest compressor (MCC) in a porcine model of CPR.

Introduction

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Hypothesis

Our hypothesis was that because of the design of the MCC (Fig 1), it should provide better hemodynamic efficacy with lesser compression depth.

Methods and Results

VF was induced in 20 domestic pigs weighing 35 ± 2 kg. CPR was initiated after 7 mins of untreated VF. Animals were randomized to receive mechanical chest compression with either the MCC or the conventional device (Thumper). Both compressors provided the same compression rate of 100/min. The initial compression depth was adjusted to achieve a CPP of above 12 mm Hg. Epinephrine (20 µg/kg) was injected after 2.5 minutes of chest compression. After 5 mins of CPR, a single 150J DF was delivered. If ROSC was not achieved, CPR was continued for 2 mins before the next DF. The protocol was continued until successful resuscitation or for a total of 15 mins.

All animals were resuscitated except 3 from the Thumper group. During CPR, significantly greater CPP and ETCO2 with less compression depth was observed in the MCC group (Fig 2, Table). Significantly greater intrathoracic systolic and diastolic pressures were observed in MCC treated animals (Fig 3). Significantly shorter durations of CPR and lesser numbers of DF that were required for achieving ROSC were observed in animals treated with MCC, this was associated with significantly fewer rib fractures compared with Thumper treated animals (Table).

Conclusions

MCC substantially improved hemodynamic efficacy and successful CPR with significantly less depth of compression and injuries.

References


Table. Outcome of CPR

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<thead>
<tr>
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<th>MCC</th>
<th>Thumper</th>
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<tr>
<td>Depth of Compression, cm</td>
<td>3.3±0.5*</td>
<td>5.6±0.6</td>
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<tr>
<td>Duration of CPR, minutes</td>
<td>5.4±0.8*</td>
<td>10±5.0</td>
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<tr>
<td>Number of DF for ROSC</td>
<td>1.22±0.42*</td>
<td>3.1±2.2</td>
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<td>Incidence of recurrent VF</td>
<td>0.5±1.0*</td>
<td>8.1±7.8</td>
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<tr>
<td>Rib Fractures</td>
<td>0±0*</td>
<td>2±1.6</td>
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* p<0.05 vs Thumper group. Values are presented as mean±SD.

Fig 1

Fig 2

Fig 3

Disclosures

Funding: This project was funded by the Resuscitation International, LLC, Scottsdale, AZ.

Disclosures: None of the authors has conflicts of interest.

All benefits of this invention are totally reserved for research support and none accrue to the personal benefit of any authors.