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LETTER TO THE EDITOR

Cardiac arrest animal model: a simple device for small animals' chest compression

Modelo animal de parada cardíaca: um dispositivo simples para a compressão torácica em pequenos animais

Dear Editor:

Based on the poor outcome of Cardiac Arrest (CA), many animal models have been proposed to better understand the pathophysiology of this event. Animal models have also been used to understand the effects of Cardiopulmonary Resuscitation (CPR) in patients with CA. However, development of CA models is difficult, especially when dealing with small animals. Small animals are more economic compared to large animal, but they have far more complex instrumentation, poor survival, monitoring difficulties and some specific purposes devices are not available.

One of the main difficulties, especially when dealing with CA for small animals, is the chest compression. Most of the studies use either manual or expensive designed machines for chest compressions.[1,2] The main problem with manual chest compression is the lack of consistency of the CPR, resulting in differences of the chest compression (i.e. depth and frequency), fatigue of the CPR performer, and possible internal organ damage from over compression. Thus, the use of a mechanical device is highly desirable for a great consistency. However, there is not a machine available that is designed for this purpose, then adaptations or development of new machines are necessary. Gazmuri et al. developed a custom-made pneumatic chest compression that allows for frequency and depth regulation.[1] The main problem with this machine is the price, as it needs to be customized parts.

One solution that our lab has adopted recently was the use of a modified sewing machine that was able to provide mechanical chest compression with low cost. The machine had all sewing-related parts removed (throat plate, bobbin housing, loop taker and bed shafts) and a speed controller substituted the pedal (Fig. 1). The presser foot was removed and the needle bar was cut. A small pistol head was fitter to the needle bar in order to adequately compress the heart. These modifications allowed good chest compression and rate control. By removing the bobbin housing, the animal could be fitted under the piston for chest compression. The depth of the chest compression could be adjusted by the height of table which the animal is laying.

In order to test the machine, seven male Wistar rats (300 g) were submitted to femoral artery and right external jugular vein cannulation. After cannulation, the right ventricle was stimulated with 1 mA at 60 Hz to induce and ventricular fibrillation. The stimulation was kept for 3 minutes in order to prevent spontaneous defibrillation. The CA was also noted by the absence of arterial blood pressure on the monitor. After five minutes of CA, the machine was turned on to a rate of 200 chest compressions per minute, a dose of 20 mcg/kg of epinephrine was injected and a diastolic blood pressure greater than 20 mmHg was aimed. The chest compressions depth was calculated to maintain one third of the antero-posterior chest diameter. In order to minimize possible intrathoracic organ lesion, the depth of chest compression was kept to less than 17 mm.[1] With three minutes of chest compressions, the rhythm was checked and if ventricular fibrillation or ventricular tachycardia was present, biphasic defibrillation with 7J was performed and CPR was promptly returned. With 6 minutes of CPR, the rhythm was rechecked and defibrillation with 7J was performed if ventricular fibrillation or ventricular tachycardia was present. Every 3 minutes, epinephrine was repeated until Return of Spontaneous Circulation (ROSC).

If the mean arterial pressure was greater than 25 mmHg, ROSC was achieved. Sustained ROSC was considered once the animal could maintain a mean arterial pressure greater than 25 mmHg for more than 10 minutes. If ROSC was not present for more than 20 minutes, death was declared.

Data were evaluated descriptively. Of the seven animals, six achieved sustained ROSC and one animal did not achieve ROSC. The adaptations on the sewing machine provided a stable and consistent chest compression with a very low cost. In this study, the machine was able to maintain a diastolic blood pressure of 26.4 ± 7.7 mmHg during the whole CPR period, which had a mean duration of 704 ± 390 seconds. There were no macroscopic lesions to the heart when using the device.

Thus, the modified sewing machine had a very good cost-effective relation and was adequate for CPR of small

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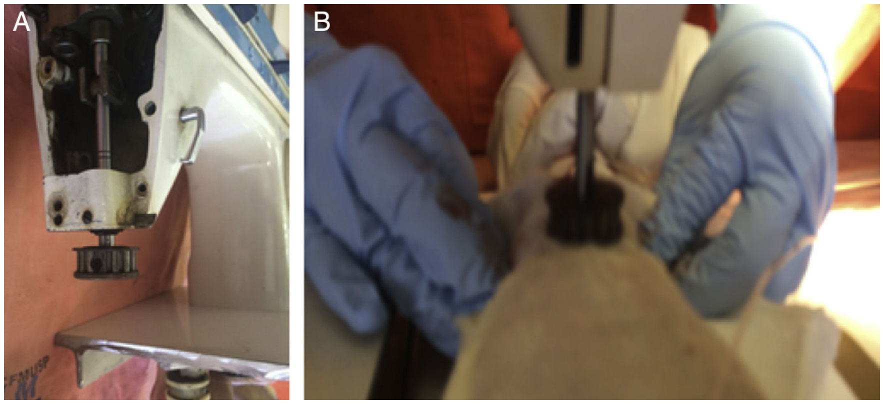

Figure 1 (A) Chest compression device. (B) Animal positioned under the device.

animals. Additional studies are being performed to evaluate the new device in experimental CA protocols.

Conflicts of interest

The author declares no conflicts of interest.

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