Aortic Root Dissection In A Patient With Previous Aortic Valve Replacement Due To External Automated Chest Compression Device For Cardiac Arrest

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Abstract

Myocardial damage from external cardiac massage can occur with either manual massage or with an automatic external device. We report the case of a patient with an aortic valve bioprosthesis undergoing advanced resuscitation with an automated external device for out-of-hospital-cardiac arrest, in whom the prolonged compressions caused an aortic root dissection.

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ABSTRACT

Myocardial damage from external cardiac massage can occur with either manual massage or with an automatic external device. We report the case of a patient with an aortic valve bioprosthesis undergoing advanced resuscitation with an automated external device for out-of-hospital-cardiac arrest, in whom the prolonged compressions caused an aortic root dissection.

CASE REPORT

Given the nature of the case report, the hospital's IRB waived the consent; in addition, the treatment performed was not part of a clinical trial and therefore a registration was not necessary. A 72-year-old patient arrived at our center's shock room in refractory cardiac arrest; he was intubated, ventilated, and underwent automatic external cardiac massage using the LUCAS device. The underlying rhythm was low-voltage ventricular fibrillation and EtCO₂ of 23 mmHg. The no-flow time was less than 5 minutes and the low-flow time was 45 minutes. Given these parameters, the patient was deemed eligible for resuscitation with extracorporeal circulatory support (ECPR). Under echocardiographic guidance, the left femoral vein and artery were percutaneously incannulated using the Seldinger method with a 7 Fr introducer. An arterial blood gas (ABG) was performed demonstrating a pH of 7.1, PaO₂ of 65 mmHg, PaCO₂ of 25 mmHg, and a lactacidemia of 15 mmol/L.

Thus, 100 IU/kg unfractionated heparin (UFH) was administered; the femoral artery was cannulated with Biomedicus (Medtronic, Minneapolis, USA) 17 Fr cannula and the femoral vein with Biomedicus (Medtronic, Minneapolis, USA) 25 Fr cannula. The CardioHelp (Getinge, Goteborg, Sweden) system circuit was connected and support started progressively up to a flow of 3.5 L/min, adjusting FiO₂ and gas blender to avoid hyperoxia, with a target PaO₂ of 100 mmHg.

Support with Lucas was then discontinued. Approximately 5 minutes after reperfusion, an organized heart rhythm emerged, characterized by a third-degree atrioventricular block with a rate of 35 bpm.

A transthoracic echocardiogram was then performed and showed neither the presence of interventricular defect nor free wall rupture; moderate aortic insufficiency and the presence of pericardial effusion of approximately 2 cm was present.

The patient, after left radial artery catheter placement, was transferred to the catheterization lab for coronary angiography.

The interventional cardiologist established access from the right radial artery. After advancing guidance, an attempt to cannulate the left main was done, without success. An aortography was performed after exchanging the left Judkins catheter for a pig-tail. As can be seen in Figure 1, there is aneurysmal dilatation of the noncoronary sinus, associated with prosthesis rocking and paravalvular insufficiency. The left main was then incannulated: angiography showed that this was intact and that there was a subocclusive stenosis of the left anterior descending (LAD) artery followed by occlusion (Figure 1B). A HeartTeam consultation deemed it appropriate to perform a disobstruction of the LAD in the first instance. The revascularization procedure, although with full VA-ECMO support, did not lead to reperfusion, resulting in a TIMI 1 (Figure 1C). On final angiography, root dissection was increased (Figure 1C) and on transesophageal echocardiogram the aortic root was completely disconnected, associated with massive paravalvular aortic insufficiency and tamponade. Due to the extent of the pathology, the previous surgery, the absence of reflow, the lack of cardiac contractility and the unknown neurological status, the Heart Team decided to suspend any further maneuver for futility.

DISCUSSION

Cardiac injuries from external cardiac massage is described in the literature, both in case of manual and automatic massage, with a percentage ranging from 2% to 8.5% and 7.9% to 12.5%, respectively(1). Notable is the case report of a complete crush of a SAPIEN XT (Edwards, Irvine, CA - USA) after manual external cardiac massage(2). In general, a 2-fold risk of CPR-related injuries conferred by the use of a mechanical CPR device has been found(3). Forces developed during manual massage, in a study of paramedics, reached an average of 431 N(4), whereas automated devices can generate 530 N to 600 N at a frequency of 100

compression per minute for essentially indefinite periods without any modulation from feedback of rib cage and internal organ resistance.

In the reported case, the presence of a stented valve represented an area of increased resistance that during cardiac massage by LUCASTM produced traction on the surrounding tissues, tearing them. There is no relation between the event of cardiac arrest and the root dissection because it was determined by the subocclusive stenosis of the anterior descending artery and confirmed by the integration of the left main; therefore, it is not an extension of the dissection to the coronary arteries.

To our knowledge, this represents the first report of aortic root dissection resulting from automated external cardiac massage. A history of previous cardiac surgery with implantation of valve prostheses should raise suspicion of potential damage in case of application of automatic massage devices and potentially consider it a contraindication, moving towards manual massage.

Author contribution

Giacomo Bianchi MD, PhD: concept/design, drafting article, approval of article

Giovanni Concistré MD: drafting article, approval of article

Anees Al Jabri MD: drafting article, approval of article

Cecilia Bianchi MD: drafting article, approval of article

Elisa Barberi: drafting article, approval of article

Sergio Berti: approval of article

Paolo Antonio Del Sarto: approval of article

Marco Solinas: drafting article, approval of article

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FIGURE LEGEND

FIGURE 1

A) Aortography showing the tear in the aortic root (arrow) with paravalvular leakage and the subocclusive stenosis of the LAD followed by occlusion. On the left-hand side, the venous drainage cannula (§) of the ECPR system. B) left coronary angiogram showing intact left main and LAD occlusion (*). C) Post-PCI angiogram with TIMI 1 final flow; aortic root laceration (#).