Haemostasis of a right ventricle-gunshot wound using a novel haemostatic vacuum device

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Abstract

Heart wounds are frequently fatal. The haemorrhage from a right ventricle-gunshot wound in a male patient was successfully controlled using a novel haemostatic vacuum device. This case report shows how this simple, quick and efficient method can be used to control critical bleedings.

Keywords: Heart wound • Gunshot • Haemostasis • Medical device • Vacuum • Tamponade

INTRODUCTION

Heart wounds are life-threatening emergencies for which the prognosis depends mostly on the precocity and the quality of the surgical and medical management, as well as the site of injury and the extent of the wound [1]. The decreasing order of frequency of the heart wounds is right ventricle, left ventricle, right atrium and left atrium. To a smaller extent, the coronary arteries or the cardiac valves can be damaged [2]. In most cases, especially with gunshot wounds, the wound leads to rapid death by haemorrhage or to a pericardial tamponade. In cases where treatment can be achieved, controlling a stab wound or a gunshot wound affecting the heart or the large vessels is one the most difficult situations a surgeon has to manage [3, 4].

We present the case of an 82-year old patient with a right ventricle gunshot wound after attempting suicide. After the emergency sternotomy and evacuation of pericardial blood and clots, the bleeding was immediately controlled by applying a haemostatic vacuum device over the wound of the right ventricle’s anterior wall. After 45 min of application, a dry wound was obtained, which was secured by two pledged sutures.

The objective of this case report is to show how a critical bleeding can be managed using a simple-to-use instrument.

MATERIALS AND METHODS

An 82-year old male patient presented at the emergency operating theatre of the Grenoble University Hospital. Three hours earlier, the patient attempted suicide at his home located 200 km away from the hospital. During the transport by a helicopter, the patient was stable. A few minutes before his arrival, his status worsened and got critical as he arrived in the emergency operating theatre with the signs of a pericardial tamponade. A 9-mm rifle bullet had penetrated the sub-mammary region, in the left 7th intercostal space, no exit wound was found. A trans-thoracic sonography showed a circumferential pericardial effusion, 25 mm thick, compressing the right cavities. An emergency sternotomy enabled the evacuation of the compressive effusion leading to a rapid haemodynamic improvement.

An active bleeding was immediately visualized on the anterior wall of the right ventricle (Supplementary video 1), 10 mm away from the distal part of the left anterior descending (LAD) coronary artery. Closer examination of the ventricular massif revealed a single tortuous, oval-shaped wound measuring 8 × 40 mm (Fig.1a). An immediate haemorrhage control was achieved by applying a bell-shaped vacuum device over the wound and the LAD. Once the bleeding was controlled, the device was connected to a vacuum Redon bottle (Fig. 1b). The patient recovered from a haemodynamic standpoint after red blood cells and blood plasma transfusions. During this time, a trans oesophageal sonography showed no major intra-cardiac lesions, normal kinetics for the cardiac valves and ventricles, but did not visualize the bullet. Further systematic exploration of the abdomen and the left thorax showed no evidence of further active bleeding and no exit wound. The bullet was later visualized on chest X-rays and located in the posterior mediastinum. Despite the device covering the LAD, the EKG showed no signs of myocardial ischaemia.

The vacuum device was removed 45 min after the initial application. The wound was found dry (Fig. 2a). Due to the close location of the LAD, only two superficial pledged sutures (5 × 0) were used to close the wound (Fig. 2b). Consolidating the repar- tion was achieved using two layers of fibrillar Surgicel® with Bioglue® in between (Supplementary Video 2). The chest was closed up and the patient transferred to the ICU. Despite the
total absence of post operative bleeding and no cardiac dysfunction, the patient died after 5 days from a multi-organ failure due to a prolonged preoperative low cardiac output.

**DISCUSSION**

The technical means to control a haemorrhagic cardiac wound are limited; it is usually and mainly the surgeon who ensures haemostasis. This haemostatic vacuum device was previously described in a publication concerning its experimental and clinical use [5], but this is the first time it is used in a real-life emergency situation on a cardiac gunshot wound.

This situation was paradigmatic: the patient was in haemodynamic shock when arriving in the emergency operating theatre. Despite the fact that the operator was a cardiac surgeon, the procedure took place in a non-specialized operating theatre without the availability of extracorporeal circulation. The vacuum device was placed within a minute and the bleeding was immediately stopped. This simple and efficient gesture dramatically changed the operating theatre’s atmosphere, with a rapid haemodynamic improvement allowing the placement of the equipment and an
efficient reanimation. The completion of the surgery, exploration of the abdomen and thorax, was then achieved on a perfectly stable patient. After 40 min, the removal of the device revealed a dry wound. The ventricle was only superficially sutured due to the close location of the LAD, but the repair was consolidated with patch-and-glue. The absence of post operative bleeding confirmed the persistence of haemostasis.

CONCLUSIONS

This case report points out that the device is capable of quickly stopping a haemorrhage, without any particular skills in delicate situations. The device frees the surgeon’s hands, thus making it possible for him to plan his procedure, or call for additional specialized help to manage the bleeding. It is also a relief for anaesthetists as it allows them to adapt their reanimation, compensate the blood loss and get prepared for the repair phase.

The case perfectly illustrates this novel haemostatic concept: first, a simple and fast bleeding control despite fragile tissues, without clamping. Secondly, an extended device placement most often leads to a dry wound. Finally, this dry wound can be sutured or glued depending on the affected tissue. Different devices have been developed for various tissues such as fat tissue, muscle, thoracic and abdominal large vessels, the liver, spleen, lung and uterus.

SUPPLEMENTARY MATERIAL

Supplementary material is available at ICVTS online.

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REFERENCES