The Role of Heart Team Approach in Penetrating Cardiac Trauma: Case Report and Review of the Literature

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Abstract
Penetrating cardiac trauma has been increasing in clinical experience and is joined to important morbidity and mortality. A case of a 38-year-old female with history of postpartum depression was reported, admitted to our department for cardiac tamponade due to penetrating self-inflicted multiple stab wound of the chest complicated by rupture of anterior left ventricular wall and traumatic ventricular septal defect. Following the unstable hemodynamic instability, a combined therapeutic strategy was chosen: surgery and transcatheter implantation to correct free wall ventricle damage and traumatic ventricular septal defect, respectively.

Keywords: Wounds, penetrating. Heart septal defects, ventricular. Cardiac Tamponade. Cardiac surgical procedures. Heart injuries. Septal occluder device.

INTRODUCTION
A very rare and uncommon case of penetrating cardiac injuries was reported, due to multiple self-inflicted stabs in a young female with a history of postpartum depression and causing cardiac tamponade due to free ventricular wall rupture and iatrogenic ventricular septal defect. The particularity of combined therapeutic choices in the same time – surgical drainage of blood pericardial effusion and endovascular closure of traumatic ventricular septal defect (tVSD) with ventricular septal defect (VSD) occluder device – was described.

CASE REPORT
A case of a 38-year-old female with a history of post-partum depression was presented, referring to our hospital for penetrating self-inflicted multiple stab wounds of the chest. Vital signs of arrival were systolic blood pressure of 80/45 mmHg, tachypnea (30 breaths/min) with low oxygen saturation (89%), cyanosis and jugular vein distension (central venous pressure of 15-16 cmH2O).

The echocardiography (ECG) documented raised ST, J waves. The fast-transthoracic echocardiogram (TTE) revealed a cardiac tamponade (maximum diameter 3.2 cm) and a VSD (about 1.5-1.8 cm from left ventricle side) with ventricular left-right shunt (Qp:Qs=2, Figures 1A to D). Following the critical hemodynamic deterioration, the norepinephrine and epinephrine infusions were started (0.1 mcg/kg/min) and the patient was immediately operated. Combined unusual therapeutic strategy has been chosen: surgery for the pericardial effusion drainage and transcatheter closure of the tVSD. Median sternotomy and a T-inverted pericardiotomy were performed to remove all clots and pericardial effusion from mediastinum. After the detection of the heart, we found a single left ventricle anterior wall wound, hence we directly closed with...
Fig. 1 – Transthoracic echocardiography, parasternal view showing interventricular traumatic defect in the median septum (a), and evidence of left-to-right shunt (b). Transthoracic echocardiography, apical view of iatrogenic interventricular defect (c) and color-doppler image of the L-R shunt (d). Transthoracic echocardiography, longitudinal view of the successful implanting Amplatzer device to close the tVSD (e-f).
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The patient could be presented with a stable tamponade (hypotension, elevated central venous pressure [CVP]) or unstable ones (shock with critical hypotension, tachycardia, dyspnoea, raised CVP, pulsus paradoxus with distant heart sounds and impalpable apex). Our patient fitted in the unstable patient type: the decision needed to be made very quickly. The first step was the diagnostic workout (chest X-ray, ECG, computed tomography scan, TTE) that identify and describe the size, type and setting of the lesion and general assessment. In our case, the patient had a cardiac tamponade due to stab complicated to iatrogenic VSD. Therefore, we decided to proceed with combined therapeutic path in the same time: 1) surgical approach to suture ventricular wound and 2) endovascular approach to close iatrogenic VSD with an occluder device. This case is the first reported in scientific literature because the most of the previous article describe single procedure for closure of VSD with occluder device after surgery or only endovascular approach or first endovascular and then surgery correction, but there are not combined procedures in the same time (Table 1), following some of the most important experience in the literature.

According to Degiannis et al.[21], surgical approach could be fundamental and the primary step to control the bleeding, in particularly the best is median sternotomy approach which gives an effective and extensive vision of heart, great vessels, to other structures in the mediastinum and to both pleural cavities[1-9,13-16]. On the other hand, left antero-lateral thoracotomy provides rapid access to the right and left ventricles and to the pulmonary artery; this is our approach of choice for emergency room thoracotomy[21]. In case of penetrating cardiac injuries complicated by iatrogenic VSD, the combined therapeutic choice with surgery and percutaneous device was described by Argento et al.[12], in 2002. Afterwards, only three cases by Berry et al.[13] and Ali et al.[17], with good results (low postoperative recovery, total cardiac function restore without any interventricular septum shunt) were published. The use of minimally surgery (opening, controlling and treating the cause of bleeding) associated with the percutaneous occluder device implantation in penetrating cardiac injuries with iatrogenic VSD may be a complete and safe approach to this trauma patient. The tVSD exclusion by percutaneous device avoided long surgical timing hence less invasiveness, no cardiopulmonary bypass, less anesthesia time and recovery time.

CONCLUSION

The combined therapeutic choice of surgery and interventional approach in case of penetrating cardiac trauma with limited tVSD is indicated and optimal for rapid clinical stabilization.

The rapid and early diagnosis associated with an organized and available cardiac staff (interventional cardiologists and cardiac surgeons) may be a productive collaboration.

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### Table 1. Review of previous ventricular septal defect (VSD) after cardiac wound stab described in scientific literature and their treatments. The traumatic VSD was diagnosed immediately, deferred VSD diagnosis was not considered.

| Author             | Year | Type of Paper | Patient | Gender | Complication                                                                 | Therapeutic choice                  |
|--------------------|------|---------------|---------|--------|------------------------------------------------------------------------------|--------------------------------------|
| Lui et al.[1]      | 1965 | CR            | 1       | Male   | Cardiac tamponade                                                            | Surgery                              |
| Pejaković & Mileusnić[2] | 1967 | CR            | 1       | Male   | Cardiac tamponade                                                            | Surgery                              |
| Kieny et al.[3]    | 1975 | CR            | 1       | Male   | Cardiac tamponade                                                            | Surgery                              |
| Asfaw et al.[4]    | 1975 | RL            | 12      | Male   | HF, injury of tricuspid valve, injury of left anterior descending coronary artery | Surgery                              |
| Bande et al.[5]    | 1980 | CR and RL     | 1       | Male   | Cardiac tamponade                                                            | Surgery                              |
| Bryan et al.[6]    | 1988 | CR            | 1       | Male   | Cardiac tamponade                                                            | Surgery                              |
| Voronov et al.[7]  | 1989 | CR            | 1       | Male   | Cardiac tamponade                                                            | Surgery, suture                      |
| Take et al.[8]     | 1993 | CR            | 1       | Female | Rupture of papillary muscle                                                  | Surgery                              |
| Carvalho et al.[9] | 1994 | CR            | 1       | Male   | Cardiac tamponade                                                            | Surgery                              |
| Doty et al.[10]    | 1999 | CR            | 1       | Male   | Tricuspid valve injury                                                       | Surgery                              |
| Gölbasi et al.[11] | 2001 | CR            | 1       | Male   | Cardiac tamponade                                                            | Surgery, suture                      |
| Argento et al.[12] | 2002 | CR            | 1       | Male   | Cardiac tamponade                                                            | Thoracotomy and percutaneous device  |
| Berry et al.[13]   | 2006 | CR            | 1       | Male   | Cardiac tamponade                                                            | Surgery and percutaneous device      |
| Topaloglu et al.[14] | 2006 | CR            | 1       | Male   | Cardiac tamponade                                                            | Surgery                              |
| Choi et al.[15]    | 2008 | CR and RL     | 1       | Male   | Atrioventricular valves rupture                                               | Surgery                              |
| Antoniades et al.[16] | 2011 | CR            | 1       | Female | Pneumothorax and cardiac tamponade                                            | Surgery                              |
| Ali et al.[17]     | 2013 | CR            | 1       | Male   | Cardiac tamponade                                                            | Surgery and percutaneous device      |
| Caffery et al.[18] | 2014 | CR            | 1       | Male   | Hemothorax                                                                   | Percutaneous device then surgery     |
| Tang et al.[19]    | 2016 | CR            | 1       | Male   | Congestive heart failure                                                     | Percutaneous device then surgery     |
| Kharwar et al.[20] | 2016 | CR            | 1       | Male   | Cardiac tamponade                                                            | Percutaneous device                  |
| Cottini et al.     | 2018 | CR and RL     | 1       | Female | Cardiac tamponade                                                            | Surgery and percutaneous device      |

CR=case report; RL=review of the literature; HF=heart failure

### Authors’ roles & responsibilities

**MC** First Author, revision and corresponding author; final approval of the version to be published

**AP** Writing and revision; final approval of the version to be published

**FR** Revising; final approval of the version to be published

**FM** Revised critically; final approval of the version to be published

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