REPEATED PENETRATING CARDIAC STAB INJURY: CASE REPORT WITH 16-YEAR FOLLOW-UP

Opakované penetrujúce bodné poranenie srdca: kazuistika so 16-ročným sledovaním

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Abstract
Introduction: Cardiac stab wounds represent life-threatening injuries with mortality depending on various factors. While there is extensive literature on their management, we found no prior reports of a single patient sustaining repetitive cardiac stab injuries. Survival rates after penetrating injury of the heart are low. Therefore, the likelihood of experiencing a second such injury in one's lifetime seems extraordinary.
Case presentation: A case report of a patient who sustained repetitive heart stab injuries within a two-year period is presented to demonstrate an unusual recurrence of this life-threatening injury. The patient was stabilized in both injuries, showing minimal bleeding signs. In the second repetition, the patient's condition changed dramatically during surgery, but fortunately, resulting in a good outcome.
Conclusion: This case report highlights the unique challenges and potential pitfalls of managing repetitive heart stab injuries, emphasizing the careful consideration of the surgical approach (Fig. 5, Ref. 31). *Text in PDF www.lekarsky.herba.sk.*
KEY WORDS: heart injuries; wounds, stab.
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Abstrakt
Úvod: Bodné poranenia srdca predstavujú život ohrozujúce poranenia s mortalitou závislou od rôznych faktorov. Aj keď existuje rozsiahla literatúra o ich liečbe, nedokázali sme nájsť žiadne podobné články o pacientovi, ktorý by zažil opakované bodné poranenie srdca. Miera prežitia po penetrujúcom poranení srdca je nízka. Pravdepodobnosť, že človek zažije druhé takéto zranenie v živote, sa zdá výnimočná.
Prezentácia prípadu: Prezentujeme kazuistiku pacienta, ktorý utrpel opakované bodné poranenie srdca v priebehu dvoch rokov. Pacient bol pri oboch poraneniach stabilizovaný. Pri druhom sa však stav pacienta počas operácie dramaticky zmenil, ale výsledok bol našťastie dobrý.
Záver: Táto kazuistika poukazuje na potenciálne úskalia zvládania opakovaných bodných poranení srdca, pričom zdôrazňuje starostlivé zváženie chirurgického prístupu (obr. 5, lit. 31). *Text v PDF www.lekarsky.herba.sk.*.
KĽÚČOVÉ SLOVÁ: poranenia srdca; bodná rana.

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Introduction

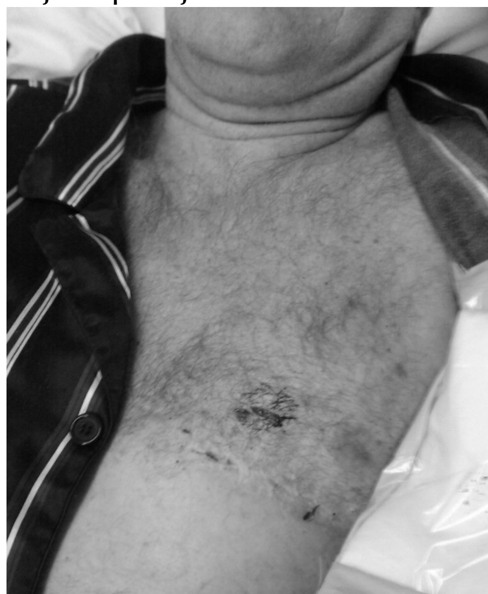
Penetrating thoracic trauma, commonly resulting from stab wounds or gunshot injuries, carries a significant risk of cardiac injury, which occurs in 15 – 20% of wounds localized in the anterior chest (6). Pericardial tamponade (PT) appears in approximately 50% of these patients (1, 6). Typical Beck's triad is present only in 10% of all cases, consisting of hypotension, muffled heart tones, and jugular venous distension (15). Jugular venous dilatation, upon inspiration, known as Kussmaul's sign, may be associated with pericardial tamponade as well. Another sign of the pericardial tamponade may be the aggravation of the patient's complaints when lying down. Traumatic injuries are responsible for only up to 2% of pericardial tamponade, and in acute situations, only 50 ml of blood may be clinically significant, in contrast to chronic situations (1). About 20% of injured present clinically silent, and diagnosis is verified by imaging or during surgery (6). The rest of penetrating cardiac injuries may range from complete or disturbed hemodynamical stability (systolic blood pressure <90 mmHg, heart rate >120 beats/min) to critical situations with cardiopulmonary arrest caused by wound bleeding (24). The severity of the presentation depends not only on the total volume of the tamponade but also on the speed of the hemorrhage. This is the reason why patients with significant volume but growing slowly can be asymptomatic, while patients with rapid pericardial

hemorrhage are often hemodynamically unstable. On the other side, large defects may promptly lead to exsanguination to the left thoracic cavity. Feliciano classifies patients with penetrating chest trauma into three distinct categories. The first group comprises hemodynamically stable patients who can undergo detailed evaluation, incorporating techniques outlined previously. The second group consists of hemodynamically unstable patients who require immediate transportation to the operating room and prompt volume resuscitation. The remaining patients, who present with cardiopulmonary arrest, necessitate emergency surgical intervention, including emergency department thoracotomy (5). In hemodynamically stable patients with precordial penetrating injury and negative thoracic ultrasound findings, further evaluation should be repeated in 6 hours (9). Tyburski et al. retrospectively analyzed 150 patients who underwent operating room thoracotomy, reporting a 74% survival rate. In contrast, among 152 patients who received emergency department (ED) thoracotomy for cardiopulmonary arrest in the ED or prior to arrival, only 20% of patients with stab wounds survived (12 from 59 patients). All patients with gunshot wounds and emergency department thoracotomy succumbed (93 patients). Overall survival rates were 23% for gunshot wounds and 58% for stab wounds (27).

Case report

A 57-year-old man was transferred to the emergency department of our hospital with an anterior chest stab injury. He confessed to a suicidal attempt with a kitchen knife approximately 50 minutes ago. The initial examination showed a single stab wound in the left chest area (Fig. 1), localized 3 centimeters above the scar, after a left thoracotomy that was performed two years ago due to a suicidal cardiac stab injury.

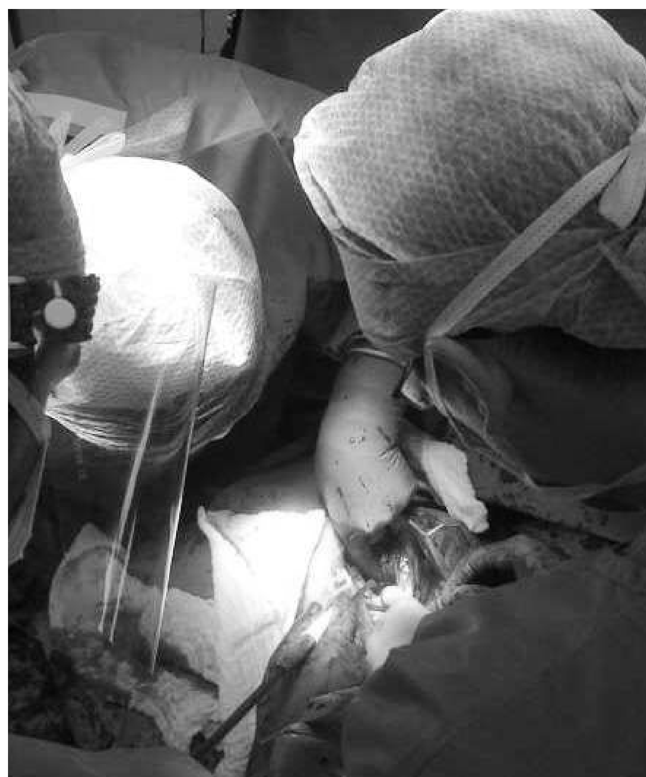
Figure 1. A single stab wound in the left chest area localized 3 centimeters above the scar after a left thoracotomy.
Obrázok 1. Bodná rana v ľavej oblasti hrudníka lokalizovaná 3 centimetre nad jazvou po ľavej torakotómii.



In the ambulance, a venous line was placed, and fluid resuscitation with 250 milliliters of saline was performed. On arrival at the emergency room, his blood pressure was 100/60 mmHg, pulse rate was 100 beats per minute, and he was awake and calm. A history of manic-depressive psychosis was present.

In a state of marginal hemodynamic stability, a CT examination showed minimal fluid volume in the pericardium and a one-centimeter large hematoma in the wound area near the cardiac apex. Subsequently, surgical revision was indicated and performed approximately 60 minutes after the injury. A left anterior thoracotomy was performed on the old scar. During the retraction of the ribs, the course of surgery turned to massive cardiac bleeding. We assumed that with retraction of the ribs, retraction of the cardiac wound also occurred. The reason was adhesions of the chest wall with the pericardium after previous surgery. The bleeding was stopped with finger tamponade (Fig. 2).

Figure 2. The bleeding was stopped with finger tamponade.
Obrázok 2. Krvácanie bolo zastavené tamponádou prstom.



Then, careful adhesiolysis and release of the pericardium from the chest wall were performed. During this procedure, we were unable to avoid considerable blood loss. After releasing the heart from adhesions, exploration of the cardiac wound was possible. The wound was located on the anterior heart wall, in the area of the right ventricle, with an extent of 1.5 centimeters. The repair was initiated with two mattress sutures. However, the heart wall was very fragile, and bleeding continued, necessitating an additional stitch. After closing the major cardiac wound, bleeding persisted

from the apical area. Subsequently, the apex was released from the diaphragm, revealing a secondary small wound in the apical area, approximately 5 millimeters in extent, repaired with one mattress suture. Substantial blood loss was estimated at approximately 3 liters. To restore intravascular volume during and immediately after surgery, 2400 milliliters of erythrocyte concentrate) and 1040 milliliters of plasma were transfused. A chest tube was placed in the left hemithorax. After surgery, the patient was transferred to the intensive care unit. Postoperatively, blood drainage from the left hemithorax was within expected limits, and the patient‘s condition stabilized. On the third postoperative day, ST-segment elevation was observed in leads V4–V6. Echocardiography revealed pericardial thickening in the apical area, with 80 milliliters of pericardial fluid around the left ventricle, without signs of cardiac tamponade or compression. The ejection fraction was 50%, and hypokinesis of the left ventricle was observed. A follow-up echocardiography on the 11th postoperative day demonstrated paradoxical movement of the interventricular septum. The chest tube was removed on the 10th postoperative day. The next cardiological examination was performed on the 14th postoperative day. The electrocardiogram showed ST-segment elevation and negative T waves in leads V3–V5 (Fig. 3). Echocardiography revealed a left ventricular ejection fraction of 55%. Paradoxical movement of the interventricular septum was observed, and the pericardium was free of fluid. Creatine kinase tests were negative. Five months post-injury, echocardiography demonstrated akinesis of the entire cardiac apex. The left ventricular ejection fraction had improved to 60%, and other findings were normal. The electrocardiogram showed persistent ST-segment and T wave changes (Fig. 4). Two years post-surgery, the patient was doing well with no

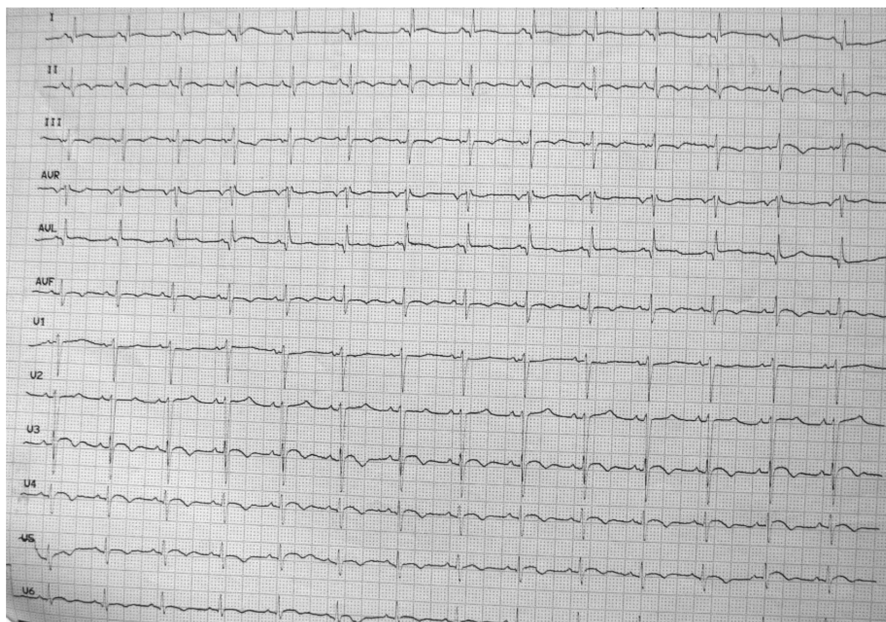


Figure 3. ST-segment elevation and negative T waves in leads V3–V5.
Obrázok 3. Elevácia ST segmentu a negatívne vlny T vo zvodoch V3–V5.

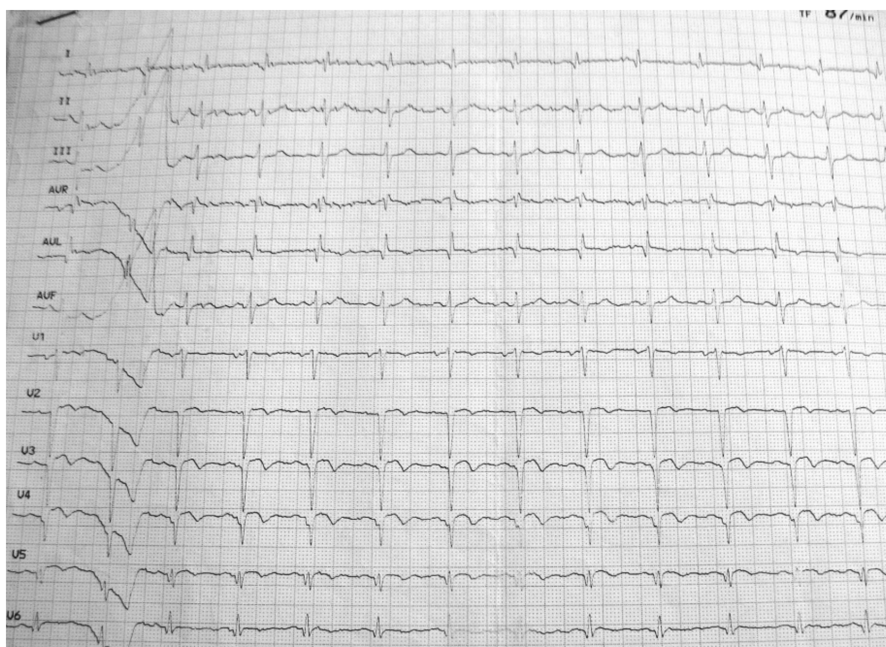


Figure 4. Persistent ST-segment and T-wave changes.
Obrázok 4. Pretrvávajúce zmeny ST-segmentu a T-vlny.

apparent complications. The last follow-up was performed 16 years after the second injury. The patient did not report cardiopulmonary difficulties. The ECG showed negative T waves in leads V2, V4, V5 and V6 (Fig. 5). An echocardiographic examination showed akinesis and thinning of the apex to 4 mm and akinesis of the apical part of the anterior wall and the anterior septum. Left ventricular dilatation and hypertrophy were present.

Discussion

Only about 20% of patients with penetrating cardiac wounds arrive at the hospital with vital signs, and of these, approximately 70% survive. Notably, gunshot wounds have a significantly higher mortality rate, exceeding 40%, whereas stab wounds have a lower mortality rate of up to 12% (13, 20). Patients with penetrating chest trauma and suspected cardiac injury are indicated for rapid transport to trauma centers. The only procedure that can be done in the field is endotracheal intubation (29). Intravenous lines and other advanced procedures are advised to be administered only during transport (12). Fluid administration must be carefully considered due to the potential risk of dislodging blood clots, which could exacerbate the bleeding (30). Neither in the first nor in the second penetrating heart injury, our patient did not develop a state of shock due to a massive hemorrhage or pericardial tamponade. In the preoperative period, the patient was stable in both cases.

Previously, invasive procedures such as pericardiocentesis and pericardial window creation were advocated for diagnosing hemopericardium. Even a small amount of pericardial fluid, as little as 100 ml, can lead to cardiac tamponade and subsequent cardiogenic shock (16). Even with the removal of a small volume of fluid, pericardiocentesis can lead to significant improvement. A subxiphoid pericardial window is an invasive method for evaluating fluid in the pericardium, and it can be done with local anesthesia. Based on the study of 101 patients, Trinkle advocates this technique instead of pericardiocentesis (26). It should be limited to hemodynamically stable patients and patients with laparotomy and suspicion of cardiac trauma (3).

Ultrasonography, specifically echocardiography, is a crucial diagnostic tool for evaluating suspected penetrating cardiac trauma. Focused assessment with sonography for trauma (FAST) examinations demonstrate moderate sensitivity about 40–50% and high specificity about 94–98% for detecting pericardial effusion (28). Two-dimensional echocardiography can detect as little as 50 milliliters of pericardial fluid and offers superior sensitivity exceeding 90%, with a specificity of around 97% in diagnosing penetrating cardiac injuries (8, 11, 14). Some limits of echocardiography appear in cases associated with pneumothorax or hemothorax, where decreased sensitivity of 56% and specificity of 93% are reported (19). Several authors advocate a subxiphoid pericardial window as a mandatory procedure in hemodynamically stable patients with anterior chest wounds and subsequent hemothorax when ultrasound findings are negative or inconclusive (8, 10, 18). In the reported case, a regular 24-hour echocardiography service was unavailable at the hospital. Computer tomography examination was performed due to the complexity of the case and history of previous injury and thoracotomy under the condition of circulatory stability. Given that the CT scan suspected pericardial injury, a pericardial window was not necessary to perform. The surgery was performed within one hour after the injury, not differing from the mean time interval as described in a retrospective cross-sectional case series of 240 patients with penetrating cardiac injuries (13).

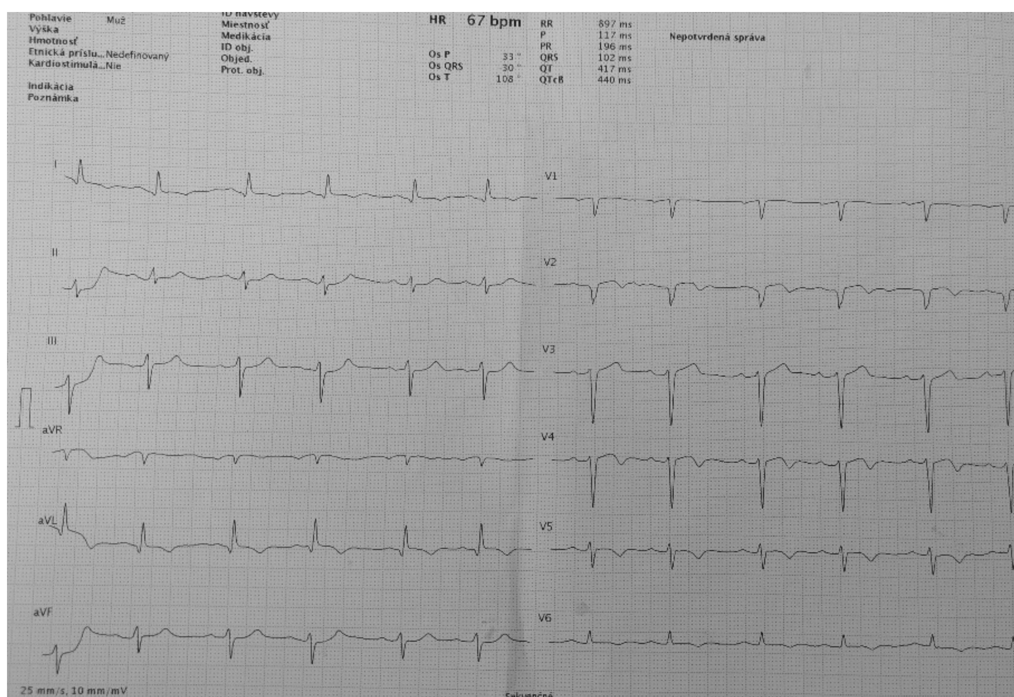


Figure 5. Negative T-waves in leads V2, V4, V5 and V6.
Obrázok 5. Negatívne T-vlny vo zvodoch V2, V4, V5 a V6.

The most dangerous acute complications are lesions of coronary arteries appearing roundly in 5% of all cardiac penetrating injuries (22). Stab injuries involving the coronary arteries are associated with a high mortality rate of around 64%, with the left anterior descending artery being the most commonly injured vessel (31). The right coronary artery can probably be ligated anywhere, but this may lead to resistant arrhythmias. In contrast, proximal ligation of the left anterior descending and circumflex arteries is contraindicated, as it would result in a large infarct. Suturing or bypass reconstruction is necessary to preserve cardiac function in such cases.

Follow-up complications after penetrating cardiac injury may be relatively frequent. Delayed complications occurring weeks to months post-injury may include septal defects and valvular injuries (2). Intracardiac thrombus and cerebral infarction resulting from systemic embolization have been reported (21). In another case, twenty-five years after sustaining multiple stab wounds to the heart, a left ventricular pseudoaneurysm was successfully repaired, presenting with acute angina (17). Aorto-right atrial fistula presenting 16 years post-injury, with symptoms of acute coronary syndrome, represents other possible serious long-term complications of penetrating cardiac injury (4). A longitudinal follow-up study of 49 patients who survived stab wounds to the heart, ranging from 1 to 9 years, revealed abnormal echocardiogram results in 19 patients. The abnormalities detected included pericardial effusions in 9 patients, abnormal wall motion in 9, decreased ejection fraction in 8, intramural thrombus in 4, valve injury in 4, cardiac enlargement in 2, conduction abnormality in 2, and one case each of pseudoaneurysm, aneurysm, and septal defect (25). None of the similar significant sequels were observed in our patient despite the repeated injury. In the short-term follow-up, ECG examinations showed non-specific persistent ST-segment elevation and negative T waves. Similar changes are characteristic for pericarditis, myocardial contusion, and infarction (7, 23). After 16 years, follow-up ECG examinations showed non-specific persistent negative T waves. On the echocardiography, non-relevant apical thinning, dyskinesis, ventricular dilatation, and hypertrophy were observed.

Indication for surgery was the finding of pericardial fluid and periapical hematoma on the CT examination. The proper selection of the surgical approach in such a case is questionable. We decided on an approach to the scar after the first operation, and therefore, we can´t exclude the contribution of the possible myocardial retraction to the worsening of the bleeding due to adhesions. A more appropriate approach would probably be median sternotomy. This exposure is more suitable for patients after clinical exploration (ultrasonography or echocardiography) and being circulatory stable. In contrast, anterolateral thoracotomy is often considered the method of choice in urgent situations, performed as emergency department thoracotomy. This approach can be extended to bilateral thoracotomy using transverse sternotomy, with the important caveat of ligating mammarian arteries (5).

Conclusion

This report presents a unique case of recurrent penetrating cardiac injuries sustained within two years. A comprehensive literature search yielded no comparable cases. Initially, the patient was stabilized and able to undergo further examination with computer tomography, revealing pericardial fluid and indicating surgical revision. Our most valuable experience has been the problematic surgical approach complicated with adhesions in old scar after a previous anterolateral thoracotomy, resulting in a very ambitious course of surgery and significant blood loss. Based on this experience, we advise against reoperation through existing scars when dealing with closely located wounds. Alternative surgical approach, such as median sternotomy, should be considered. Another interesting finding is how the heart was able to deal with repeated myocardial wounds, sutures, and massive blood loss without serious ischemia and late follow-up complications.*

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*__Compliance with Ethics Requirements:__ Authors declare no conflict of interest regarding this article. The authors declare, that all the procedures of this research respect the ethical standards in the Helsinki Declaration of 1975, as revised in 2008 (5), as well as the national law.

Conflict of interest: The authors declare no conflict of interest.

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