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Emergency Mitral Valve Replacement in Blunt Cardiac Injury

Abstract

Blunt Cardiac Injury (BCI) is a collective term that includes cardiac contusion, myocardial contusion, cardiac rupture, pericardial rupture, heart luxation, intracardiac structure injuries, coronary artery injuries, and injuries of the main vessels. Mitral valve injury due to blunt thoracic trauma is a very rare condition, accounting for only 0.01% of BCI cases. The clinical picture of hemodynamic instability in cases of mitral valve injury leads to pulmonary oedema (wheezing over the lung fields during auscultation) and progressive heart failure. Fluid overload increases the risk of death. Additional injuries can obscure the true cause of hemodynamic instability and shock. In the largest review of 82 patients who underwent surgery for mitral valve injury, only 15 patients (18%) were operated on within 24 hours.

Aim. To present and analyze the case of emergency mitral valve replacement in first 24 hours in blunt chest trauma.

Case report. In this study, we report the successful outcome of a blunt cardiac injury with mitral valve replacement performed within the first 24 hours. A 27-year-old male, a restrained driver, presented to the hospital in a state of shock. Hemorrhage as a cause of shock was excluded. Pulmonary oedema and worsening of the clinical picture despite resuscitation led to the diagnosis of an intracardiac injury as the cause of refractory shock. Urgent surgery with mitral valve replacement was performed within 24 hours of admission. The postoperative period was complicated by sepsis and ischemic stroke. The patient was discharged on the 44th day with mild right-sided hemiparesis. At the 24-month follow-up, clinical examination revealed no mitral insufficiency on cardiac echocardiography, and the patient had returned to his everyday activities.

Conclusions. Surgical repair of mitral valve injuries is indicated when therapeutic or conservative treatment is unsuccessful. In other words, these patients have no chance of survival if surgery is not performed under such critical circumstances.

Keywords*: mitral valve, blunt thoracic trauma, blunt cardiac injury, enhanced recovery after surgery (ERAS), severe mitral regurgitation, mitral valve replacement, echocardiography.*

Introduction. The development of hemorrhagic or cardiogenic shock are the typical picture of severe blunt cardiac injury (BCI). In the state of severe blunt chest trauma you should rule out significant blood loss, try and provide adequate resuscitation. If this is done cardiogenic factors as a cause of refractory shock should be considered and excluded as a next step. Urgent surgery in BCIs can be indicated in cases of cardiac rupture with hemopericardium and tamponade, significant intracardiac injuries, pericardial rupture with heart displacement and herniation.

Case report. A 37-year-old male, a restrained driver in a motor vehicle collision, which happened at 09:15. On admission to the hospital at 09:45, the Glasgow Coma Score (GCS) was 14/15, tachypnea (respiratory rate was 32 to 36/minute), crepitating wheezes over the whole lung surface, tachycardia (heart rate was 120 to 140 bpm), with

systolic blood pressure of 70 mmHg and oxygen saturation (Sat O_2) of 55% to 60% with oxygen supplementation of 15 L/min. The patient was intubated immediately, which led to Sat O_2 of 75% and BP of 75/40 mmHg. A performed eFAST was negative.

At 10:05, BP dropped to 40/20 mmHg, and Sat O_2 to 50%, while carotid pulsation was undetectable. Simultaneous ECG revealed complete AV block with HR of 27/minute, with repeated negative eFAST. Epinephrine IV and cardiopulmonary resuscitation (CPR) were started. After 2 minutes of CPR, sinus rhythm at 100-112/min was restored, with BP at 110/70 mmHg, central venous pressure (CVP) at 150 mm H_2O, Sat O_2 at 100%, and no signs of lung oedema. Invasive BP monitoring was established.

At 10:30, BP was 85/45 mmHg. Dobutamine at 6.3 mcg/kg/min was added, and BP increased to 115/65 mmHg.

At 11:10, the patient was transferred to CT, where fractures of the sternum and 1st-6th ribs bilaterally, as well as bilateral lung contusions/oedema, were found (Figure 1).

At 13:00, the patient was transferred to the ICU. Hemodynamics remained unstable and were maintained with dobutamine at 15 mcg/kg/min, norepinephrine at 0.6 mcg/kg/min, and epinephrine at 0.18 mcg/kg/min, resulting in BP of 100/70 mmHg with CVP of 150-250 mm H_2O. Interstitial lung oedema, arrhythmia, anuria, and uncontrolled metabolic acidosis were developing dramatically.

At 18:05, whole ECG monitoring registered AV block, and CPR for 0.5 minutes resulted in sinus rhythm restoration. At 21:25, cardiac ECHO revealed a rupture of the posterior leaflet of the mitral valve with severe mitral insufficiency. The rapid deterioration of the patient despite intensive resuscitation, together with cardiac ECHO findings, was considered by cardiac surgeons as an indication for emergency surgery.

Corrected version with only grammatical and punctuation corrections: This required the patient's transfer to a higher-level hospital, and at 03:40, the patient was admitted directly to the OR with BP of 40/20 mmHg. Emergency sternotomy and replacement of the mitral valve with a Hancock № 25 bioprosthesis were performed (Figure 2). Mitral valve repair was not possible due to tissue necrosis of the ruptured papillary muscle.

On the 1st postoperative day (POD), chest X-ray showed resolution of lung oedema, and troponin I was 95 ng/ml (normal range: 0 – 0.04 ng/ml).

On the 3rd POD, the patient became hectic, with a fever of up to 39°C, and procalcitonin levels elevated to 4.54 ng/ml. On the 6th POD, the patient was transferred to the ICU of the initial trauma centre, and percutaneous tracheostomy was performed on the 7th POD due to prolonged ventilation requirements. Microbiological testing revealed Klebsiella pneumoniae in blood cultures and Klebsiella pneumoniae, Pseudomonas aeruginosa, and Acinetobacter baumannii in the respiratory tract. Treatment of sepsis was initiated with meropenem, linezolid, and colistin. Conservative flail chest treatment was conducted with CPAP ventilation for 10 days under sedation and muscle relaxation.

On the 8th POD, the patient had a GCS of 9-10, and brain CT showed extensive ischemia in the right occipital and left temporal lobes. The patient gradually improved, reaching a GCS of 14 on the 12th POD, and spontaneous respiration was allowed on the 18th POD. On the 21st POD, the patient was transferred from the ICU, and intensive rehabilitation was started.

On the 44th day after trauma, the patient was discharged from the hospital with mild right hemiparesis.

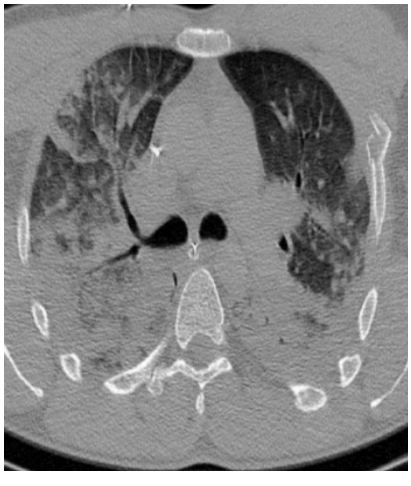

Figure 1. *Chest CT 1 hour after admition*

Figure 2. *Posterior leafleat of mitral valve*

Follow-up for 24 months showed no mitral insufficiency on cardiac ECHO, complete restoration of the initial neurological deficit, and the patient had completely returned to his everyday activities.

The most common cause of cardiac trauma is motor vehicle accidents (83%), followed by crush injuries (5.7%) and bicycle accidents (2.9%) [1]. The first case of traumatic rupture of a papillary muscle of the left ventricle was reported in 1936 by Glendy and White. Experiments have shown that intraventricular pressures greater than 320 mmHg are required to cause any form of cardiac wall or valve rupture [2].

Mitral valve (MV) injury in the setting of trauma was described in the largest review of a total of 192 cases in a 2019 publication [3]. The first successful repair of a mitral valve after blunt trauma was performed by McLaughlin and colleagues in 1964 [4]. Pasquier M., in his review of the literature, found 82 patients with mitral valve injury due to blunt chest trauma. He mentioned that only 15 patients (18%) underwent urgent surgery within 24 hours after admission [5].

The basic mechanisms of acute mitral valve injury include papillary muscle rupture, ruptured chordae tendineae, and injury to the valve leaflets [6].

BCI with intracardiac structure damage should be treated as a life-threatening condition according to Advanced Trauma Life Support guidelines initially, and Enhanced Recovery After Surgery (ERAS) protocols should be followed to provide the patient with an evidence-based chance to survive and begin recovery as early as possible. In the case described in 2024, the worsening of the clinical picture took two days and required urgent surgery and mitral valve replacement [7].

Further studies should be conducted to fill the gap, standardize the diagnostic criteria of BCI, and develop an algorithm and indications for urgent surgery in patients with severe trauma [8].

Conclusions. According to the available data, the incidence of myocardial injury is approximately 30% in severe car crashes. Mitral valve injuries in BCI account for 0.01% of cases and present the most acute clinical picture among valve injuries.

The clinical state of the patient may vary from asymptomatic to life-threatening cardiogenic shock. In patients with severe blunt cardiothoracic trauma, hemorrhage should be ruled out as a cause of shock. Cardiac injuries could be the cause of refractory, ongoing shock.

Echocardiography in BCI is a feasible and appropriate tool for diagnosing intracardiac injuries.

In cases of severe mitral valve injuries, lung oedema, and unsuccessful conservative treatment, surgical repair of mitral valve injuries is the only acceptable option that provides a chance for survival in such critical conditions.

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Ургентна заміна мітрального клапану при тупій травмі серця

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Резюме

Тупа травма серця є збірним поняттям, яке включає забій серця, забій міокарду, розрив серця, розрив перикарду та вивих серця, пошкодження внутрішньосерцевих структур, пошкодження коронарних судин, пошкодження магістральних судин. Пошкодження мітрального клапана при тупій торакальній травмі — рідкісне явище і складає 0,01% серед випадків тупої травми серця. Клінічна картина гемодинамічної нестабільності у випадках пошкодження мітрального клапана призводить до набряку легень (свистячі вологі хрипи, аускультативно над поверхнею легень) та прогресуючої серцевої недостатності. Перенавантаження інфузійними рідинами підвищує ризик смертності. Супутні пошкодження маскують справжню причину гемодинамічної нестабільності та шоку. У найбільшому огляді, що охоплює 82 пацієнтів, яким було виконано хірургічне втручання з приводу травматичного пошкодження мітрального клапана, лише 15 пацієнтів (18%) були прооперовані в перші 24 години.

Мета. Представити та проаналізувати випадок ургентної заміни мітрального клапана в перші 24 години при тупій торакальній травмі.

Клінічний випадок. У цьому дослідженні ми представили клінічний випадок тупої травми серця з позитивним результатом заміни мітрального клапана в перші 24 години після травми. 27-річний чоловік, пристебнутий водій, надійшов до лікарні в стані шоку. Кровотечу як причину шоку було виключено. Набряк легень та прогресуюче погіршення клінічної картини, незважаючи на інфузійну терапію, призвели до діагнозу інтракардіальних пошкоджень як причини рефрактерного шоку. Ургентне хірургічне втручання із заміною мітрального клапана в перші 24 години після травми було виконано. Післяопераційний період ускладнився сепсисом та ішемічним інсультом. Пацієнт був виписаний на 44-ту добу з легким правобічним геміпарезом. Через 24 місяці, під час клінічного огляду, у пацієнта не виявлено мітральної недостатності за даними ЕХО-кардіографічного дослідження, пацієнт повернувся до своєї повсякденної активності.

Висновок. Хірургічне лікування пошкоджень мітрального клапана показане при неуспішності терапевтичних та консервативних методів лікування. Іншими словами, ця категорія пацієнтів не має жодного шансу на виживання, якщо хірургічне лікування не буде виконано в цих критичних обставинах.

***Ключові слова**: мітральний клапан, тупа торакальна травма, прискорене відновлення після операції, важка мітральна регургітація, заміна мітрального клапану, ЕХО-кардіографія.*

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