Short Communication

Urgent pulmonary lobectomy for blunt chest trauma: report of three cases without mortality

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Background: The majority of patients with severe blunt chest trauma is successfully treated with supportive measures and thoracostomy tube; only few cases need urgent thoracotomy. Lung-sparing techniques are treatments of choice but major pulmonary resections are necessary in case of injuries involving hilar vessels or bronchi. Currently the mortality associated with pulmonary lobectomy performed for chest trauma is 40%.

Methods: Over a 2-year period [2013–2014], 210 patients with chest trauma were hospitalized at our Institution. Mechanism of injury was blunt in 204 (97.1%) patients and penetrating in 6 (2.9%). In 48 (22.8%) patients was necessary a ventilatory support and 37 (17.6%) patients were treated with thoracostomy tube. Nineteen (9%) patients needed urgent thoracotomy: 4 (1.9%) cases for penetrating injury and 15 (7.1%) cases for blunt trauma. Three (1.4%) patients treated with urgent thoracotomy required concomitant laparotomy for intra-abdominal injuries. The overall mortality rate was 1.4%.

Results: We report three cases of urgent lobectomies for chest trauma without mortality and with postoperative complete restoration of respiratory function. The anatomical lobectomies were performed for: massive hemothorax with bronchial disruption, expanding pulmonary hematoma with hypovolemic shock, and massive hemothorax in deep parenchymal laceration.

Conclusions: Mortality rate after major pulmonary resections for trauma is very high and increases with the presence of multivisceral injuries, the severity of hypovolemic shock and extent of lung resection. Anterolateral thoracotomy was the approach employed in case of cardiac arrest. In hypovolemic patients a posterolateral incision with a double lumen intubation was performed. The absence of mortality in this series may be related to the prompt diagnosis, short operative time and absence of associated severe neurological or abdominal injuries.

Keywords: Urgent pulmonary lobectomy; chest trauma; surgery

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Introduction

In the European Union, trauma is the most frequent cause of death in the population between 15 and 45 years (1). It is estimated that about 25% of traumatic deaths are secondary to thoracic injuries (2) and blunt chest trauma is associated with a higher mortality rate than penetrating chest injuries (3-5).

Generally patients with severe chest injuries are treated with supportive measures and only a minority of these patients need urgent thoracotomy (5-8). According to the "damage control" strategy, pneumonorrhaphy and tractotomy are treatments of choice (9-11); pulmonary resections, including wedge resection, lobectomy and pnemonectomy, are necessary in selected cases (6,8,12). Currently, the survival of patients that underwent major

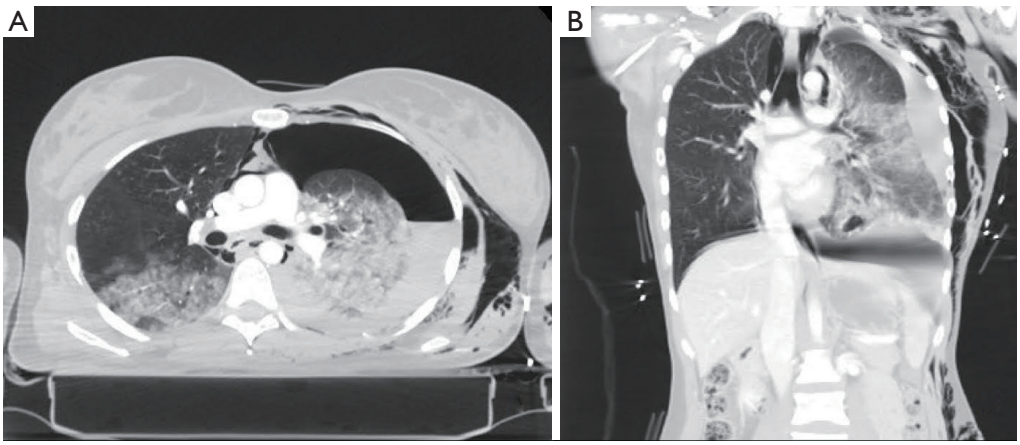

Figure 1 CT scan axial view (A) and coronal view (B) showing a wide left hemo-pneumothorax with subcutaneous emphysema and left lung contusion areas. CT, computed tomography.

lung resections performed for thoracic trauma is very low and the mortality rate associated with lobectomy reaches 60% (4,5).

We report three cases of urgent thoracotomies with inferior lung lobectomies for blunt chest trauma without mortality and with postoperative complete restoration of respiratory function.

Methods

Over a 2-year period [2013–2014], 210 patients with chest trauma were hospitalized at Manzoni Hospital-Lecco: 158 (75.2%) in the Department of Surgery and 52 (24.8%) in the Intensive Care Unit. Mean age was 42.3 years (range: 3–84); 176 (83.8%) patients were males and 34 (16.2%) females. Mechanism of injury was blunt in 204 (97.1%) patients while penetrating in 6 (2.9%). In 42 (20%) cases, there were concomitant extrathoracic lesions. In 48 (22.8%) patients was necessary a ventilatory support and 37 (17.6%) patients were treated with thoracostomy tube. Nineteen (9%) patients needed urgent thoracotomy: 4 (1.9%) cases for penetrating injury and 15 (7.1%) cases for blunt trauma. In the blunt group 5 pneumonorrhaphies, 5 wedge resections, 3 lobectomies, and 2 rib fixings with concomitant hematoma evacuation were performed; in the penetrating group 2 myocardial wound repairs and 2 tractotomy were performed. Three (1.4%) patients treated with urgent thoracotomy required concomitant laparotomy for intra-abdominal injuries. The mortality rate was 1.4% (3 patients): 2 (0.9%) patients with penetrating myocardial wounds and 1 (0.5%) patient with associated abdominal trauma. We describe the clinical course of 3 female patients treated with anatomical pulmonary lobectomies. All patients gave written consent for the publication of personal data.

Patient 1

A 28-year-old woman was admitted to Emergency Department for severe car crash. Chest X-rays and thoraco-abdominal computed tomography (CT) scan showed multiple left ribs fractures, left hemo-pneumothorax and multiple lung contusion areas (*Figure 1*). A spleen laceration of grade 2 according to American Association for the Surgery of Trauma (AAST) and left humeral fracture were also found. The Injury Severity Score (ISS) was 29. Patient underwent chest tube insertion with blood (1,500 mL) and air output. Severe haemoptysis followed by a fast onset of hemorrhagic shock and cardiac arrest required emergent anterolateral thoracotomy with a single-lumen endotracheal tube. Left inferior bronchial disruption needed inferior lung lobectomy and thoracoplasty for repair multiple rib fractures. Operative time was 160 minutes. Splenic laceration was non-operatively managed. Endotracheal tube was removed 30 days after surgery. After 43 days the patient was shifted from Intensive Care Unit to Surgery Department and discharged from the hospital on the 58th post-operative day.

Patient 2

A 35-year-old woman was admitted for a thoraco-abdominal trauma after a motor cycle crash. Thoraco-abdominal

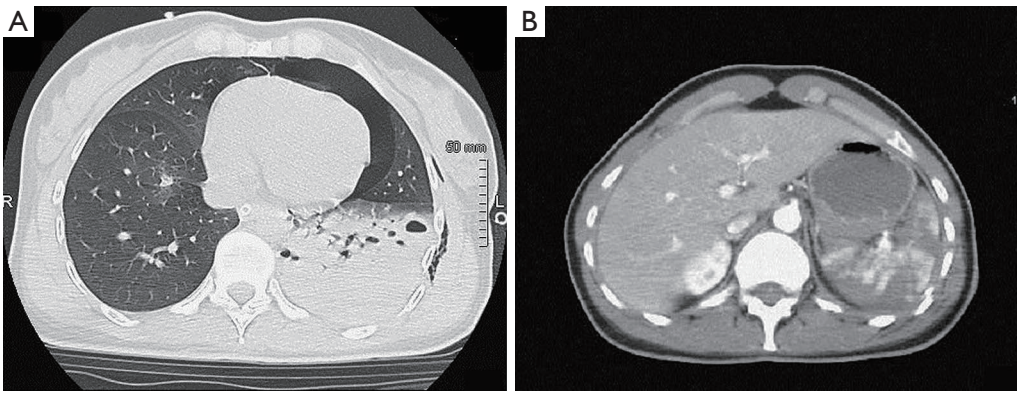

Figure 2 Thoraco-abdominal CT scan demonstrating an expanding left lung hematoma (A) and splenic lacerations (B). CT, computed tomography.

Figure 3 Chest CT scan showing a left hemo-pneumothorax with several left lung lacerations and right lung contusions. CT, computed tomography.

CT scan revealed an AAST grade 4 spleen laceration with hemoperitoneum and left hemo-pneumothorax associated with left lung hematoma (ISS =26) (*Figure 2*). Patient underwent emergent splenectomy and left chest tube insertion with blood (800 mL) and air output. Four hours after surgery the patient developed a hypovolemic shock. A following CT scan revealed an expanding left lung hematoma with hemothorax requiring urgent posterolateral thoracotomy with double lumen intubation; a left lung inferior lobectomy was performed. Operative time was 168 minutes. Postoperative course was uneventful; endotracheal tube was removed in 2nd postoperative day. The patient was discharged on 13th post-operative day.

Patient 3

A 14-year-old woman attempted suicide falling from a height of six meters. Total body CT scan demonstrated left hemo-pneumothorax caused by several lung lacerations and right lung contusions (*Figure 3*). Moreover the patient had AAST grade 2 splenic laceration, two uncomplicated lumbar transverse process fractures and bilateral feet fractures (ISS =43). A chest tube was inserted and 1,000 mL of blood were drained. Hypovolemic shock required prompt surgical intervention. A posterolateral thoracotomy was performed after the placement of a double lumen tube. An inferior lobectomy for a deep lung laceration involving hilum and a pneumonorrhaphy for superior lobe laceration were carried out. Operative time was 165 minutes. Splenic laceration and lumbar spine fractures were non-operatively managed, while feet fractures required delayed several surgical operations. Patient maintained endotracheal intubation for 13 days. She was discharged from Intensive Care Unit on 16th postoperative day and from the hospital on 68th postoperative day.

No post-operative complications were observed. Spirometry performed four months after surgery demonstrated no functional deficit with complete recovery of respiratory function in each patient.

Discussion

The majority of patients with blunt chest trauma are managed non-operatively by supportive measures and tube thoracostomy; thoracotomy is required in only 7–10% of cases (5-8).

The "damage control" strategy has been applied also to lung injuries: simple and rapid surgical treatments not involving pulmonary tissue resection have been developed for reducing operative times and decreasing blood loss

in patients with metabolic damage (9-13). Consequently, pneumonorrhaphy and tractotomy are the surgical techniques preferred in chest trauma (7,9). Pulmonary resections are needed in 17% of patients that underwent urgent thoracotomy for blunt chest trauma and range from wedge resection to pneumonectomy (5). In case of extensive injuries involving major hilar vessels or bronchi, an anatomic pulmonary resection is necessary (6,8).

In our series 3 anatomic lobectomies were performed for massive hemothorax with bronchial disruption and consequent cardio-circulatory arrest (case 1), quickly expanding pulmonary hematoma with hypovolemic shock (case 2), and massive hemothorax due to a deep parenchymal laceration involving lung hilum (case 3).

Overall mortality rate after major pulmonary resections for trauma is very high and increases with the presence of multivisceral injuries, the severity of hypovolemic shock and the extent of lung resection (4,5,7,12). In multicenter series, the mortality associated with lobectomy ranges from 35% to 43% and in case of pneumonectomy varies from 50% to 62% (4,5). The low survival rate associated with major lung resections may be partly explained by the frequent association with extrathoracic multivisceral injuries (5). However the multivariate analysis of two large multicenter series demonstrated that the extent of lung resection is an independent predictive factor for intrahospital mortality in patients with thoracic trauma (4,5).

Early diagnosis and consequent specific interventions are fundamental issues in traumatic injury of the lung (14). CT scan plays a key role in the management of chest trauma and it has a considerable impact on the following therapeutic decisions (14). The introduction in the clinical practice of multidetector CT allows rapid and complete definition of all lesions in polytrauma patients (15). Multidetector CT scan can be performed right after the primary survey without any complications and it can be repeated subsequently if the patient's conditions are worsening (14,15).

The delay of the surgical treatment is one of the most important factors influencing negatively the outcome of these patients (3,8). Hypovolemic shock, massive hemothorax with chest tube output greater than 1,500 mL and not controlled airway leak are the standard indications for urgent thoracotomy in blunt chest trauma (3,6-8). For reducing mortality, some authors suggest to perform urgent thoracotomy when the output of thoracostomy tube reaches 1,000 mL (8). In patients with massive hemothorax for blunt chest trauma, the surgical hemostasis must to be achieved quickly: pneumonorrhaphies and wedge resections are preferred but if more conservative interventions do not control hemorrhage, anatomical lobectomy must be performed without delay (6,8). The duration of surgery seems to influence the outcome of patients with lung injuries (16). In a series the mean operative time of conservative treatments (tractotomy) was 2.3 hours, while the mean operative time of anatomic resections (lobectomies and pneumonectomies) was 4.7 hours (7): the disparity of mortality between conservative and non-conservative lung resections for traumatic lesions may be related to the difference in the length of surgery.

In our series the operative time was shorter (2.7 hours) compared to that present in the literature: lobectomies were carried out by two expert thoracic surgeons (GV, MC) of our surgical team that routinely perform elective pulmonary surgery.

In chest trauma anterolateral thoracotomy in the supine position is the more frequently used approach because it permits a fast access to the contralateral hemithorax with a clamshell incision (11,12). Posterolateral thoracotomy is employed in stable patients with injuries localized to one hemithorax: this incision permits a wide exposure of the hilum and the inferior lobe (6,8,12). In unstable patients it is preferable to intubate with a single-lumen endotracheal tube while in relatively stable patient a double lumen intubation allows selective pulmonary exclusion (6,8,12).

We used posterolateral incision with a double lumen intubation in relatively stable patients (patient 2 and patient 3) with preoperative CT negative for contralateral thoracic injuries: the wide surgical field allowed us to perform a rapid assessment of traumatic injuries and a timely operative hemostasis.

The present series is too small to draw any definitive conclusions. Major lung resections are performed rarely in chest trauma but are associated with a high mortality directly related to the extent of resection and extra-thoracic injuries. A fast diagnosis and timely intervention are the keys to success in trauma patients. No major morbidity, including complete functional respiratory recovery, reflects the young age of our patients and intensive postoperative rehabilitation. The absence of mortality in this series may be related to prompt diagnosis, short operative time, and absence of associated severe neurological or abdominal injuries.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Informed Consent: Written informed consent was obtained from the patient for publication of this manuscript and any accompanying images.

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