

SHORT COMMUNICATION

Stabilisation of thoracic wall in patients with chest injury

Zelenak J, Kutarna J, Hutan M, Kalig K

*Surgical Department, Faculty Hospital, Ruzinov, Bratislava, Slovakia. bll@fmed.uniba.sk***Abstract**

The authors analyse a group of 38 polytraumatised patients with unstable thoracic injury who were subdued to internal surgical stabilisation of the thoracic wall during the period from 1st October 1994 to 30th September 2001. The average period of controlled pulmonary ventilation (CPV) was 3 days and the average period of hospitalisation at the Anaesthesiology and Intensive Care Department (AICD) was 10 days. In indicated cases, the authors recommend an active surgical approach in the treatment of patients with unstable thoracic injuries. (Tab. 2, Fig. 2, Ref. 3.)

Key words: stabilisation, thoracic wall, chest injury.

The injuries of thoracic organs with concomitant skeleton injuries have a significant position in the current traumatology, and their diagnosis and treatment represent one of the most responsible tasks of traumatic surgery. The survival of patients with severe thoracic injury depends mainly on efficient first aid, early assessment of the diagnosis of concomitant injuries, and on the evaluation of the dynamics of the clinical state of the injured. Severe thoracic injuries disturb the functions of cardiorespiratory organs. This is fully proved right in the treatment of unstable thorax with concomitant injuries.

The analysis of various causes of thoracic injuries indicates that traffic accidents and falls from height are the main causes increasing the incidence of unstable thoracic injuries. In our series, the injuries due to traffic accidents occurred in 92 % and falls from height occurred in 8 % (Tab. 1).

Patients and methods

During the seven-year period from 1st October 1994 to 30th September 2001, 440 patients with thoracic injuries were treated at the Ruzinov Hospital in Bratislava. Thirty-eight patients were subdued to surgery. The patients were admitted at AICD of our hospital where they were subdued to general clinical, laboratory, x-ray and sonographic examinations, and in indicated cases to CT examination, while the emphasis was laid on the analysis of blood gases indicating the necessity of controlled pulmonary ventilation. The group was formed by 31 (82 %) males and 7 (18 %) females. The average age was 42 (22–65) years, the fact of which corresponds with the age range of life activity, while the major-

ity of cases were young patients (Tab. 2). The number of unilaterally broken ribs was 6 (3–8), in bilateral fractures the average number of broken ribs was 8 (7–10). Three broken ribs were stabilised in average, and this internal fixation was performed in 2 days after the admittance.

Surgical technique

Indication for thoracic wall stabilisation (Voggenreiter, 1998):

1. Flail chest with necessary surgical intervention due to internal thoracic injury.
2. Flail chest without significant pulmonary contusion.
3. Paradoxical movement of the chest segment after CPV.
4. Severe deformation of thoracic wall.

The examination of the dynamics of clinical changes includes the evaluation of laboratory, sonographic, x-ray and CT findings being part of complex intensive care. Early stabilisation must be indicated deliberately in cases with flail chest, paradoxical ventilation, fractures of 3 or more ribs damaging the lungs by rib fragments thus increasing pneumothorax and hemothorax, and

Surgical Department, Faculty Hospital, Bratislava Ruzinov, Department of Anaesthesiology and Intensive Care, and Department of Anaesthesiology and Intensive Care, Medical Faculty, Comenius University, Ruzinov Hospital

Address for correspondence: J. Zelenak, MD, Surgical Dept, Faculty Hospital, Ruzinovska 6, SK-826 06 Bratislava-Ruzinov, Slovakia.
Phone: +421.2.43339500
Fax: +421.2.43336433

Tab. 1. Group of investigated patients.

Number of patients	38
Males	31 (82 %)
Females	7 (18 %)
Average age (years)	42 (22-65)
Number of ribs broken	
— unilaterally	6 (3-8)
— bilaterally	8 (7-10)
Number of stabilised ribs	3 (3-4)
Duration of stabilisation (days)	2 (1-4)

in cases of dislocated sternal fractures. This procedure is beneficial when compared with long-term pulmonary ventilation due to the fact that it ideally stabilises the thoracic wall from the beginning. In addition to the latter, the method is simple, quick and practically excludes complications that sometimes occur in coincidence with the method of internal pneumatic splint. The surgical stabilisation is performed in general endotracheal anaesthesia while the patient is positioned on his healthy side. The vertical approach is used, namely from the anterior or posterior part of the axillary line. After the surgery, the patient stays connected to the ventilator during the inevitable period, which lasts for 1–3 days in average. We use rib splints produced by Beznoska. By means of this method, the thoracic wall is ideally stabilised, moreover we can treat pneumothorax, hemothorax or torn lungs, replace rib fragments, injured pleura and damaged soft tissues. The surgery is terminated by ideal drainage of the pleural cavity and surgical incision.

Results

The key indicator of results evaluation was based on the duration of controlled ventilation necessity and the duration of treatment at AICD. The surgically treated patients required ventilation assistance lasting 3 days in average and the average treatment at AICD lasted 10 (5–33) days in average. The average treatment at the surgical department took 12 (6–18) days.

The average duration of controlled pulmonary ventilation in seven patients who have undergone ARDS was 23 (22–24) days. In these patients it was necessary to perform tracheostomy. In reality, 31 (82 %) out of 38 patients were disconnected from ventilation after the average period of 1.5 days and the rest of patients required a longer period of ventilation support. Pulmonary infection was recorded in 4 (10 %) of patients. It was classified on the basis of clinical and x-ray signs with positive microscopic and cultivation findings in sputum or bronchoalveolar lavage. Septicaemia was observed in 7 (18 %) patients. It was classified by positive hemoculture with the presence of organ affliction (inflammation markers).

Complications in form of splint release were recorded in 2 (5 %) restless patients. The appropriate prevention of splint release resides in ideal adaptation of the splint to the rib by means of special forceps and fixation of the splint by thick nylon fibre.

Tab. 2. Results.

Duration of controlled pulmonary ventilation	3 (1-7)
— ARDS	23 (22-24)
Hospitalisation at AICD	10 (5-33)
Hospitalisation at Surgical Department	12 (6-18)
Tracheostomy	7 (18 %)
Pulmonary infection	4 (10 %)
Septicaemia	7 (18 %)
Antibiotic treatment — preventive	27 (73 %)
— change	10 (27 %)

No barotrauma, severe deformation of the thoracic wall or death were recorded in the presented series of patients.

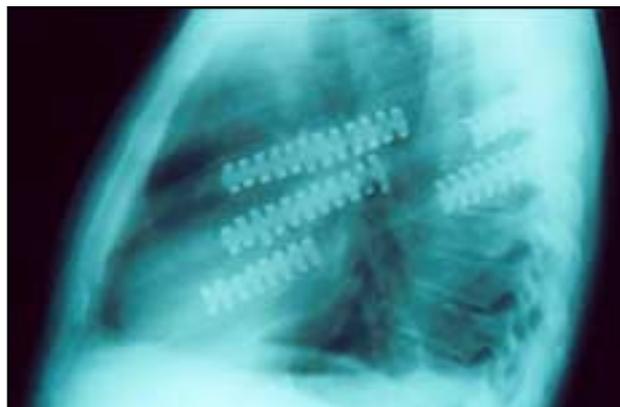
Discussion

Respiratory insufficiency is the most significant damage caused by thoracic injury. The aim of early ventilation support in patients after such injury is to improve alveolar ventilation, issue oxygenation, elimination of increased carbon dioxide production and pH normalisation. The respiratory movements in coincidence with flail chest injury of thoracic wall cause paradoxical respiration and pain causing shallow tidal respiratory volume, the fact of which can lead to alveolar collapse, opening of arteriovenous shunts and hypoxemia. This state lasts until the causal factors are surgically removed. The problem is intensified by concomitant traumatic shock that interferes the supply of oxygen. Such patients with unstable thoracic injury are potential candidates for supported ventilation.

The therapy of unstable thoracic injury by prolonged ventilation support by pneumatic splint with intermittent positive pressures brings about several disadvantages:

- Rib fractures require a certain period for becoming stable.
 - The inevitable ventilation support is of long-term character, expensive and brings about many complications (1).
- The advantages of thoracic wall stabilisation:
- Osteosynthesis of ribs by means of splint does not disable bone healing.
 - Should good technique be used, splints do not release.
 - Analgesia and the duration of intubation are substantially decreased.
 - Early rehabilitation of the injured can be performed.
 - The percentage of complication, and mortality are decreased.
 - The periods of hospitalisation at AICD and at the Surgical Department are shortened.
 - After stabilisation, the physical and mechanical parameters of the thoracic wall improve thus eliminating the occurrence of severe chest deformations.

The surgical stabilisation of the thoracic wall recovers the chest shape to normal, the fact of which is the main presumption for the recovery of physiological pulmonary functions. In addi-



Figs 1 and 2. A 51-year-old patient with a segmental fracture of five left ribs with paradoxical respiration, back-to-front and lateral x-ray projection after stabilisation of the chest wall.

tion to the latter, it provides also the possibility of cleansing the pleural cavity by removing blood coagula and thus preventing pulmonary empyema or pleural fibrosis (2).

The technique of internal fixation of broken ribs with the possibility of treating the damaged pulmonary parenchyma, pleura, devastated thoracic wall and extraction of bone sequesters represents a method of choice in the treatment of unstable thoracic injury.

Reference

1. **Ahmed Z, Mohyuddin Z.** Management of Flail Injury: Internal Fixation versus Intubation and Ventilation. *J Thorac Cardiovasc Surg* 1995; 110: 1676–1680.
2. **Michek J, Zelnicek P, Kubacak J, Vrstyak J.** Unstable Chest in Polytraumatised patients: Stabilisation Set. *Acta Chir Orthop Traum Czech* 1996; 632: 91–94.
3. **Waydhas C.** Thoraxtrauma. *Unfallchirurg* 2000; 103; 871–889.

Received March 12, 2002.

Accepted April 15, 2002.