

Child and adolescent chest injuries: epidemiology and clinical aspects

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Summary:

Introduction:

Isolated chest injuries are very rare. Usually they are a component of polytraumas. Regardless of the extent of the injury, patient's survival depends on prompt diagnostics and appropriate therapy.

Aim of the study:

Evaluation of periodical fluctuations of thoracic trauma incidence in paediatric patients.

Material and method:

Medical records of children hospitalized for chest injuries at the Nicholas Copernicus Voivodeship Specialized Hospital in Łódź, Poland in 2009 were subjected to a retrospective analysis.

Results:

The studied group consisted of 102 children (61 male, 51 female), aged 3 months to 18 years (avg. age 12.75 years), with isolated chest injuries or polytraumas with a chest injury component.

Conclusions:

Chest injuries in the studied group occurred more frequently in elder children (over the age of 12). Children with blunt thoracic trauma are at risk of heart and large vessel damage, despite the lack of rib fractures. Chest injuries occurred mostly in April and July, in the afternoon. Among the reported injuries, superficial ones prevail, which are not life threatening per se but are potentially accompanied by chest organ injuries, responsible for a case fatality rate of 4% of children with thoracic traumas treated at the Nicholas Copernicus Voivodeship Specialized Hospital in Łódź, Poland.

Key words: chest injury, hospitalization, children, emergency medicine.

Introduction

Chest injuries occur as a result of direct mechanical energy transfer which leads to tissue damage in the form of blunt or penetrating traumas. Chest injuries may also occur in the case of an indirect energy transfer, such as acceleration or deceleration.

Isolated chest injuries are very rare. Usually they are a component of polytraumas [1–4]. Regardless

of the extent of the injury, patient's survival often depends on prompt diagnostics and appropriate therapy received during the first several minutes after patient admission to the emergency department [1,4–8].

The greatest percentage of chest injuries in the Polish population are those sustained in traffic collisions [9]. A large group of patients is

represented by those who sustained chest injuries in falls from the same height. Notable are also traumas resulting from battery.

In children, the chest wall is very elastic thanks to its cartilaginous structure. It may undergo significant deformation under an external force and then return to its normal shape with no external signs of a sustained trauma [2, 6]. Therefore rib and sternum fractures occur very rarely in those patients and result from a significant amount of force applied to the chest.

The aim of the study was to evaluate periodical fluctuations of thoracic trauma incidence in paediatric patients at the Nicholas Copernicus Voivodeship Specialized Hospital in Łódź, Poland in 2009.

Material and method

Retrospective analysis was performed with 102 paediatric patients (up to the age of 18) treated for chest organ injuries at the Nicholas Copernicus Voivodeship Specialized Hospital in Łódź, Poland in 2009.

Medical records of patients treated for chest organ injuries were assessed with respect to: patient sex and age, time of injury occurrence, type and cause of the trauma. The analysis also took into consideration the time of hospitalization and case fatality rate due to the injuries sustained.

All data were gathered in a Microsoft Access database, while some calculations were performed using Microsoft Excel of the Microsoft® Office 2007 package.

Statistical analysis was conducted using the Statistica 10 software package (StatSoft®, Tulsa, USA). Distribution of variables measured at the nominal level was used to assess the differences referring to the operational type of emergency medicine unit along with the type of unit delivering aid. The results, taking into account the type of organ injuries, were visualized using line, column, pie, and radar charts.

Normality of variable distribution was assessed using p-value for the Shapiro-Wilk test. In the case of normal distribution, average differences were assessed with paired t-test. In other cases, non-parametric Wilcoxon test was used and the

obtained results were expressed and presented in charts as median values.

Relations of incidence among the variables in the analysed sections were assessed using the chi-square test of independence with the assumed level of significance (p) at 0.05. The generated contingency tables were additionally supported by V-Cramer coefficient estimating the strength of the relationship between the variables.

Results

Among the 102 analysed cases of paediatric patients treated at the Nicholas Copernicus Voivodeship Specialized Hospital in Łódź, Poland for chest injuries, 60% were male (n=61), while 40% were female (n=51) (p=0.0000).

Average age in the studied group was 12.75 ± 4.60 years and was somewhat higher in the male group (12.86 ± 4.64 years) than in the female group (12.58 ± 4.59 years; Figure 1). The comparison between the average age of the two sexes did not reveal statistical significance (p=0.7603). Most cases in the male group were observed in patients aged 16. No cases of chest injury were reported for boys aged 1 and 2 (p=0.0000). In the female group, most cases regarded patients aged 17, while no cases were observed for girls aged <2, 5, and 12 (p=0.0017). Complete age distribution of the studied population with reference to patient sex is presented in Figure 2.

The studied group was analysed for the incidence of chest injuries throughout the day. The analysis revealed that chest injuries occurred most frequently between 13:00 and 13:59 hours, and between 18:00 and 18:59 hours (n=11; 11% per period). No such incidents were reported between 1:00 and 1:59, and between 4:00 and 6:59 (p=0.00002). In the male group, most cases were observed within the time range of 17:00–17:59, while no cases occurred between 1:00 and 7:59 (p=0.0342). Peak incidence among girls was observed between 13:00 and 13:59, whereas the time ranges of no incidence were 1:00–1:59, 4:00–6:59, and 14:00–15:59 (p=0.0012). The Mann-Whitney U test of the male-to-female incidence ratio did not reveal a statistically significant difference in injury occurrence throughout the day (p=0.8350).

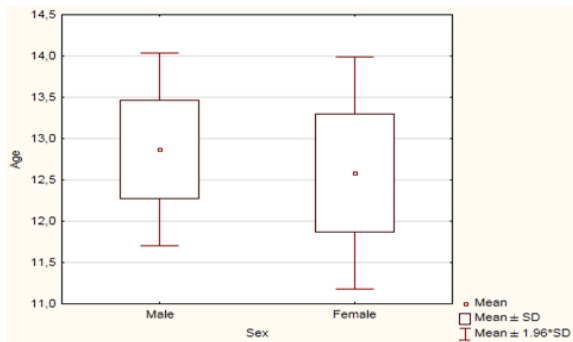


Figure 1: Box-plot presenting average age of male and female members of the studied group.

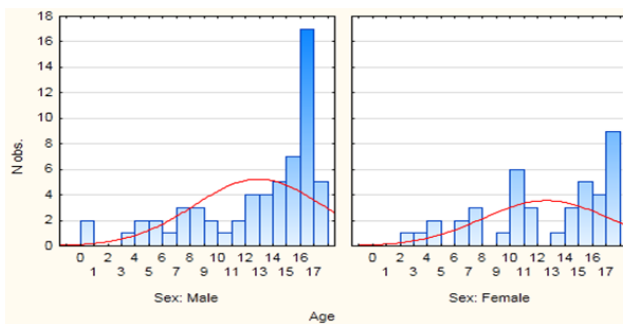


Figure 2: Age distribution of male and female members of the studied group.

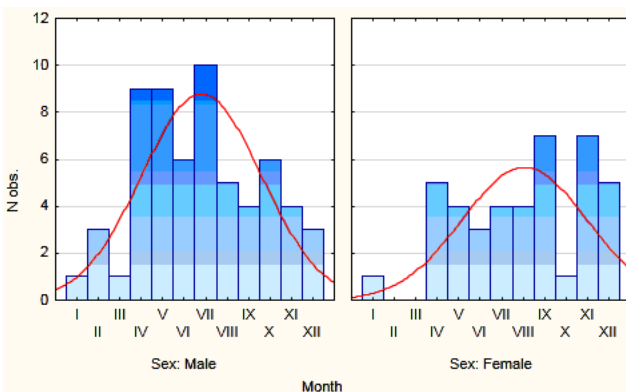


Figure 3: Distribution of injury occurrence throughout the year in the studied group with reference to patient sex.

Additional analysis conducted in four groups distinguished by the time of occurrence (0:00–5:59; 6:00–11:59; 12:00–17:59; 18:00–23:59) is presented in Table 1.

An analysis with reference to the month of occurrence was also carried out. Most cases of injury were observed in April and July (14 cases each), then in May (n=13; 13%), while only one case was reported in March (Fig. 3; p=0.0024). Among boys, most cases occurred in July (n=10; 16%), then in April and May (n=9; 15% each). The least

incidents took place in January and March (n=1; 2% each; p=0.0820). Girls were injured most often in September and November (n=7; 17% each). No injuries for this group were reported in February and March (p=0.0265).

Table 1: Distribution of injury occurrence throughout the day in the studied group with reference to patient sex.

Time of day	Male group (n=61)	Female group (n=51)	Total (n=102)
0:00 – 5:59	1 (2%)	5 (10%)	6 (6%)
6:00 – 11:59	11 (18%)	4 (8%)	15 (15%)
12:00 – 17:59	27 (44%)	12 (24%)	39 (38%)
18:00 – 23:59	22 (36%)	20 (39%)	42 (41%)

By analysing the data for months grouped into seasons of the year, it was found that most injuries in the studied group of paediatric patients occurred in the summer (n=32; 31%), then in autumn (n=29; 28%) and spring (n=28; 27%). Thirteen per cent of all injuries were sustained in the winter (p=0.0000). Distribution referred to patient sex revealed significant differences between the male and female groups (p=0.1537). Boys were mostly injured in the summer, then in spring, autumn and winter. Girls, however, sustained most injuries in autumn, then summer, spring and winter.

During the study, in 73% of cases superficial chest injuries were reported. Rib fractures appeared in 12% of cases. In 13 patients cardiac traumas were diagnosed, while thoracic vascular traumas were found in 2 patients. Other and undetermined chest injuries were reported in one case. The above mentioned results were statistically significant (p<0.001).

Case fatality rate until discharge in the studied group was 4% (n=4), with all cases regarding male patients. Ninety-six per cent of patients were discharged home or transferred to another hospital. Average hospitalization time for those patients who sustained fatal chest injuries was 2.4 days. Average hospitalization time for those patients who survived until discharge from hospital was 2.6 days, with a maximum hospitalization time of 33 days.

The main cause of chest injuries in the studied group were traffic collisions constituting 34% of cases (n=35), followed by falls from the same height (n=29; 24%), and battery (n=11; 10%). Other undetermined causes were reported for 32% of cases (n=21; p<0.001).

Discussion

Chest injuries in children are the third (after limb and head injuries) most frequent group of traumas [2, 10]. Due to their incidence, as well as different characteristics in children than in adults, chest injuries may cause many problems in both preliminary evaluation of paediatric patients and further assessment of their eligibility for hospitalization. As the thorax in children is characterized by high elasticity, damage to its osseous structure is rare. In the studied group, rib fractures were reported for only 12% of cases. Higher incidence of damage to the osseous structure of the chest was observed by Inan (20.5%) [11] and Samarasekera (23%) [12]. Rib fractures present in 60% of paediatric patients were reported by Debeugny [13]. An example of typical deceleration-related trauma is also the damage to aorta in the isthmus area, in which the relatively mobile arch of aorta passes into the descending aorta, characterized by low mobility [14]. Only two cases of such an injury were found in the studied group.

Superficial chest injuries which did not penetrate into the pleural cavity constituted the majority of the analysed cases (73%). In the case of a high-energy thoracic trauma, heart and large vessel injuries are likely to occur. Blunt chest trauma may result in myocardial contusion. The contused fragment of the heart, as in the case of myocardial infarction, exhibits functional impairment. Such dysfunction depends of the localization and the extent of contusion. Electrocardiography (ECG) waveform alterations recorded after both heart contusion and myocardial infarction demonstrate a considerable degree of similarity, therefore quick ECG diagnostics are indicated in patients with chest injuries. In the studied group, cardiac trauma occurred in 13 patients.

As internal structural damage may occur with no fracture to the osseous scaffold of the chest, quick imaging and ECG diagnostics are required

to allow proper assessment of the extent of injury sustained by the child [3, 5].

The majority of the studied group was represented by male patients (60%). This trend was also observed by other authors: Inan (61%) [10], Kumar (68%) [11], Deng (71.18%) [15], and Ceran (88.44%) [16].

Average age of paediatric patients with chest injuries in the studied group was higher than that reported by other authors and equalled 22.75 ± 4.6 years. In Inan's study [11], the average age of the studied group was 7.1 years, whereas in Al-Saigh's study, the average age was 9 [17].

Case fatality rate until discharge from hospital was 4%. Fatal injuries occurred in patients subjected to high-energy impact with cardiac trauma sustained. Average hospitalization time for those patients was 2.4 days and was insignificantly shorter than the average hospitalization time for those patients, whose therapy succeeded. Case fatality rate observed in the studied group was significantly lower than in the studies by other authors: Deng (6.78%) [15] and Demirhan (9.3%) [18]. The highest case fatality rate was reported by Black (22%) [19].

In both Polish and international literature, the main cause of chest injuries in children are traffic collisions, which constitute 66% of cases in the study by Demirhan [18], 81.8% in the study by Inan [11], and 93% in the study by Hanafi [20]. In this study, traffic collisions were the cause of 32% of the reported chest injuries.

Conclusions

- 1) Chest injuries in the studied group occurred much more frequently in elder children (over the age of 12).
- 2) Children with blunt thoracic trauma are at risk of heart and large vessel damage, despite the lack of rib fractures.
- 3) Among chest injuries, superficial ones prevail, which are not life-threatening per se but are potentially accompanied by chest organ injuries, responsible for a case fatality rate of 4% of children with thoracic traumas treated at the Nicholas Copernicus Voivodeship Specialized Hospital in Łódź, Poland.
- 4) Chest injuries occurred mostly in April and July, in the afternoon.

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