

The prognostic significance of thoracic and abdominal trauma in severe trauma patients (Injury Severity Score >15)



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The aim of the present study was to assess the prognostic significance of thoracic and abdominal trauma in severely injured patients. A retrospective analysis was performed based on data from the period from March 1 2006 to December 31 2007, taken from the Trauma Registry of the University Hospital "Sant'Andrea" in Rome. A total of 844 trauma patients were entered in a database created for this purpose, and only patients with an Injury Severity Score (ISS) > 15, (163 patients, 19.3%), were selected for the present study. These patients were divided into 2 groups: Group A (103 patients, 63.2%), consisting of patients with at least one thoracic injury, and Group B (46 patients, 28.2%) consisting of patients with concomitant thoracic and abdominal injuries. The impact of thoracic and abdominal trauma was studied by analyzing mortality and morbidity, in relation to patient age, cause and dynamics of trauma, length of hospital stay, and both ISS and New ISS (NISS). In a vast majority of cases, the cause of trauma was a road accident (126 patients, 77.3%). The mean age of patients with ISS>15 was 45.2 ± 19.3 years. The mean ISS and NISS were 25.7 ± 10.5 and of 31.4 ± 13.1 respectively. The overall morbidity and mortality rates were 18.4% (30 patients) and 28.8% (47 patients) respectively. In Group A the mortality rate was 23.3% (24 patients) and the morbidity rate was 33.9% (35 patients). In Group B mortality and morbidity rates were 36.9% (17 patients) and 43.5% (20 patients) respectively. It was shown that the presence of both thoracic and abdominal injuries significantly increases the risk of mortality and morbidity. In patients with predominantly thoracic injuries, NISS proved to be the more reliable score, while ISS appeared to be more accurate in evaluating patients with injuries affecting more than one region of the body.

KEY WORDS: Abdominal trauma, Morbidity, Mortality, Polytrauma, Severe trauma, Thoracic Trauma, Thoraco-abdominal trauma, Trauma.

Introduction

The most commonly used definition of a patient suffering from severe trauma or polytrauma is that of a patient with two or more injuries, at least one of which

is lifethreatening¹⁻³. In the initial phase of evaluation, a patient is considered to suffer from severe trauma if he has an injury that threatens his survival or functional recovery, or if the dynamics of the trauma lead one to suspect that he may have such an injury⁴. In a more general analysis, the terms polytrauma and severe trauma often become synonyms and refer to the comprehensive evaluation of a patient's injuries that results in a Injury Severity Score (ISS) value > 15^{1,2,5}. Thoracic injuries are found in 30-40%⁶⁻⁸ of these patients, especially after blunt trauma due to a road accident, and in a large number of cases are the cause of morbidity and mortality. Abdominal injuries due to blunt trauma are less common^{9,10}, often less serious, and currently, in most cases, non operative treated¹¹⁻¹³. Even abdominal

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injuries caused by penetrating trauma are now usually treated non surgically¹⁴. Abdominal injuries, when present, contribute to morbidity and mortality, especially because of the risk of underestimating their severity during primary and secondary survey¹⁵. The aim of the present study was to investigate the prognostic impact of thoracic and abdominal lesions in patients suffering from severe trauma, by analyzing their role in determining trauma severity and their effect on morbidity and mortality rates.

Materials and methods

The present study was performed by analyzing data from the trauma registry of the University Hospital "Sant'Andrea" in Rome which was set up in March 2006, when the Emergency Department was opened to the ambulances of the Emergency Health Service of the Lazio region (ARES 118). The registry, created by using a specific database with the 8.5 version of the FileMaker Pro program (FileMaker Southern Europe, Paris, France), for MacOSX, provided for the enrolment of patients admitted directly or transferred to another hospital, over 16 years of age, victims of either blunt or penetrating trauma, or burn injury using the following inclusion criteria:

- All penetrating trauma of the neck, thorax, and abdomen;
- Blunt trauma and burn injury with the following criteria as regards triage

RED OR YELLOW CODE

- Presence of at least one significant injury (Abbreviated Injury Scale - AIS \geq 2), regardless of the specialty in the 6 body regions used for calculating the ISS, (head or neck, face, chest, abdominal or pelvic contents, extremities or pelvic girdle, and external);
- Any death in the emergency room, if information about any epirises that occurred is available.

GREEN OR OTHER CODE

- ISS > 15;
- Presence of at least one injury rated AIS \geq 2, in the chest and/or abdomen

Trauma severity in each patient was evaluated in accordance with the following indices: The Revised Trauma Score (RTS); the Abbreviated Injury Scale (AIS), using the 2005 version of the AIS-CD manual, updated in 2008 (Association for the Advancement of Automotive Medicine (AAAM), Barrington, IL, USA); the Injury Severity Score (ISS) e the New Injury Severity Score (NISS). The NISS was calculated using the sum of the squares of the 3 highest AIS scores regardless of the body region involved¹⁶.

Trauma registry data recorded between March 1 2006

and December 31 2007 was considered for the present study. Out of a total of 82293 patients admitted to the emergency department, there were 25875 patients (31.4%) with chief complaints of trauma or burns, 219 (0.8%) with red code triage, and 2237 (8.6%) with yellow code triage. A total of 844 cases, that satisfied the inclusion criteria previously established, were entered in the database for the study. In order that the incidence of chest trauma and abdominal trauma in victims of severe trauma, could be studied and the clinical impact analyzed, only patients with an ISS >15 were further selected, and divided into 2 groups; Group A, consisting of patients with thoracic injuries, and Group B, consisting of patients with concomitant thoracic and abdominal injuries. Patient age, the cause and dynamics of the trauma, length of hospital stay, and both ISS and NISS values were analyzed. Patients transferred to other institutions were not considered in the evaluation of the length of hospital stay, if it was impossible to obtain adequate information about their clinical course and any deaths that occurred during the first 48 hours after admission. Morbidity and mortality were analyzed independently of how much time had elapsed since the trauma occurred, provided they could be logically linked to the event. If any data were missing, either a follow-up was conducted by phone, or information was requested from sources in the region such as hospitals patients were transferred to, general practitioners, anagraphic offices, and the police. Statistical analysis was performed using the 17.0 version of the PASW Statistics program (SPSS, Bologna, Italy), for MacOSX, and provided for the use of the chi-square test, Student's t-test, Pearson's test, and ANOVA when applicable. P values < 0.05 were considered significant.

Results

There were 163 patients with severe trauma (ISS>15), 19.3% of all trauma patients inserted in the database. Their average age was 45.2±19.3 years. The majority (128 patients, 78.5%) were men, and their average age was significantly lower than that of the women (43.1±18.7 vs 52.9±19.7 years, p<0.01). The most com-

TABLE I - Injuries observed in the 163 patients with severe trauma (ISS>15)

	Patients	%
Orthopedic	106	65,1
Thoracic	103	63,2
Central Nervous System (CNS)	80	49,1
Abdominal	61	37,4
Maxillo - Facial	45	27,6
Plastic	23	14,1
Vascular	12	7,4

TABLE II - Univariate analysis of morbidity and mortality (Group A: Thoracic trauma; Group B: Concomitant thoracic and abdominal trauma)

	Patients	Mortality N. (%)	p value	Morbidity N. (%)	p value
Group A	103	24 (23.3%)	0,057	35 (33.9%)	0,085
Control group	60	6 (10.0%)		12 (20.0%)	
Group B	46	17 (36.9%)	< 0,001	20 (43.4%)	0,017
Control group	117	13 (11.1%)		27 (23.1%)	
Thoracic and abdominal trauma	46	17 (36.9%)	0,007	20 (43.4%)	0,105
Thoracic trauma	57	7 (12.3%)		15 (26.3%)	

TABLE III - Thoracic injuries observed in the 103 group A patients (Thoracic trauma)

Group A injuries	Patients (n.)	%
Pulmonary contusions	75	72,8
Rib fractures	62	60,2
Pneumothorax (PNX)	40	38,8
Haemothorax	38	36,9
Haemo-pneumomediastinum	12	11,6
Sternal fractures	10	9,7
Diaphragmatic injuries	5	4,8
Pulmonary lacerations	3	2,9

mon causes of trauma were road accidents which had caused severe trauma in 126 patients, (77%), followed by domestic trauma (19 patients, 11.7%). Most cases (156 patients, 95.7%) involved blunt trauma. The incidence of different types of injuries is shown in Table I. The average ISS and NISS values were 25.7±10.5 and 31.4±13.1 respectively, and the difference between the 2 values was statistically significant (p <0.001). The average length of hospital stay was 23.2±26.1 days. The relationship between ISS and NISS values and the length of hospital stay (LOS) was, in both cases, directly proportional and statistically significant, (LOS/ISS r= 0.237, p=0.01; LOS/NISS r= 0.272, p<0.01). Overall morbidity and mortality were 18.4% (30 patients) and 28.8%

(47 patients) respectively. The univariate analysis of morbidity and mortality is shown in Table II.

The group of patients with thoracic injuries (Group A) consisted of 103 patients, 63.2% of those with severe trauma. Average patient age was 43.8±18.6 years. The majority were men (81 patients, 78.6%), with an average age of 42.6±18.2 years, which was lower than that of the women (48.0±20.0), but not to a statistically significant degree. The thoracic injuries are shown in Table III. In Group A the average ISS and NISS were 28.4±10.6 and 33.5±12.4 respectively, the difference between the 2 values was statistically significant (p<0.001). The average scores were higher than in patients who did not have thoracic injuries (Table IV), and this was found to be statistically significant. The average LOS for Group A patients was similar to that of the group of patients with severe trauma (22.4±25.6 days). The mortality rate was 23.3% (24 patients), equivalent to 80% of patients with an ISS>15 who died. The difference between the mortality rates of Group A patients and those without thoracic injuries almost reached statistical significance (p=0.057) (Table II). The average ISS and NISS of patients who died were significantly higher than those of the patients who survived (Table V). Morbidity was 33.9% (35 patients), with no statistically significant difference between Group A patients and those with an ISS >15. The average ISS and NISS of patients with complications were higher,

TABLE - IV - Comparison between Injury Severity Score (ISS) e New Injury Severity Score (NISS). Values are reported as mean ± SD (Group A: Thoracic trauma; group B: Concomitant thoracic and abdominal trauma)

	Patients	ISS	p value	NISS	p value
Group A	103	28,4±10,6	<0,001	33,5±12,4	<0,001
Control group	60	21,3±8,7		27,8±13,7	
Group B	46	34,3±11,6	<0,001	38,5±12,9	<0,001
Control group	117	22,4±7,9		28,6±12,2	
Thoracic and abdominal trauma	46	34,3±11,6	<0,001	38,5±12,9	<0,001
Thoracic trauma	57	23,6±6,7		29,4±10,4	

TABLE V - Injury Severity Score (ISS) e New Injury Severity Score (NISS) as regards mortality and morbidity. Values are reported as mean \pm SD (Group A: Thoracic trauma; group B: Concomitant thoracic and abdominal trauma)

	Mortality			Morbidity		
	Yes	No	p value	Yes	No	p value
Group A						
ISS	38,1 \pm 10,9	25,4 \pm 8,6	< 0,001	29,9 \pm 9,9	27,5 \pm 10,9	ns
NISS	44,9 \pm 11,9	29,9 \pm 10,3	< 0,001	37,1 \pm 12,3	31,6 \pm 12,1	ns
Group B						
ISS	41,7 \pm 10,3	29,9 \pm 10,1	< 0,001	33,5 \pm 10,5	34,9 \pm 12,5	ns
NISS	45,6 \pm 11,6	34,3 \pm 12,1	0,003	39,2 \pm 12,9	37,8 \pm 13,2	ns

and the difference was statistically significant for NISS ($p < 0.05$) (Table V), but not for ISS.

Group B consisted of 46 patients who had concomitant thoracic and abdominal injuries. These patients constitute 28.2% of all patients with severe trauma and 44.6% of patients with thoracic trauma. The average age in Group B was 38.3 \pm 17.5 years. The majority of patients were men (35 patients, 76.1%), whose average age, 38.3 \pm 18.1 years was virtually identical to that of the women (38.4 \pm 16.2 years). The abdominal injuries are listed in Table VI. In Group B the average ISS value was 34.3 \pm 11.6, and lower than the average NISS value of 38.5 \pm 12.9, and the difference between the 2 values was statistically significant ($p < 0.001$). The values of both scores were significantly higher in Group B than in the control group of patients with severe trauma ($p < 0.001$), and in Group A ($p < 0.001$) (Table IV). The average LOS was 26.1 \pm 30.8 days, longer than for all patients with ISS >15. (22.1 \pm 23.9 days), and patients with thoracic injuries (19.5 \pm 20.4 days), but not to a statistically significant extent. Mortality in Group B was 36.9% (17 patients). The differences between the mortality rate of Group B patients and the other patients with an ISS >15, and Group B patients and those in Group A, were statistically significant ($p < 0.001$ and $p < 0.01$ respectively) (Table II). The average ISS and NISS values for Group B patients who died, were sig-

nificantly higher than for the patients who survived ($p < 0.001$ and $p < 0.05$ respectively) (Table 5). The morbidity rate in Group B was 43.5% (20 patients). The difference between the morbidity rate in Group B and morbidity among all patients with an ISS >15 was statistically significant ($p < 0.05$), but the difference between the morbidity rates in Group B and Group A was not (Table 2). The ISS and NISS of Group B patients who developed complications are listed in Table V.

Discussion

Trauma considered as a disease, is currently a major public health problem, and it is therefore essential to carefully and accurately evaluate the importance it may have in modern society, especially because of the harmful short term outcome and disability in the long term. The clinical definition of trauma severity is made up of elements drawn from the dynamics and mechanism of the trauma, and physiological and anatomical parameters^{1,5,17}. Some of the severity scores^{18,19}, including the ISS, are used to codify the severity of a trauma, predict mortality, and perform statistical analyses comparing the most homogenous groups of cases possible. In recent years the ISS scoring system has often been criticized because it may omit information that is important in the overall evaluation of trauma severity, and for this reason other severity scores have been created, including the Trauma and Injury Severity Score (TRISS), the Revised Trauma Score (RTS), and the NISS^{17,19}. In the present study we compared the ISS and NISS, to determine how effective they were in defining trauma severity. We found that there was a directly proportional correlation between length of hospital stay and each score. This was especially true of the NISS which correlated with the length of hospital stay in a more significant manner than the ISS, and can therefore be considered more reliable. As regards mortality, we observed that both scores were notably higher in patients who died, and were a reliable way to evaluate both patients with severe trauma and

TABLE VI - Abdominal injuries observed in the 46 group B patients (Concomitant thoracic and abdominal trauma)

Group B Injuries (46 pts)	Patients (n°)	%
Spleen	27	58,7
Liver	24	52,2
Hollow viscus and mesentery	16	34,8
Kidney	7	15,2
Diaphragmatic injuries	5	10,9
Pancreas	2	4,3
Adrenal gland	2	4,3

those who had only thoracic injuries or both thoracic and abdominal injuries. When determining the severity of a trauma, it is moreover, essential to analyze the types of injuries of individual organs. Thoracic and abdominal injuries are found rather frequently in patients with severe trauma. The only injuries that are more common are orthopedic and CNS injuries. In our series thoracic injuries were found slightly more frequently than has been reported in the literature⁶⁻⁸; in approximately 60% of patients. The impact these injuries had on trauma severity was documented by the rise in the values of both scores evaluated, especially NISS, which was more sensitive in evaluating multiple lesions in a single region of the body¹⁶. This is due to both the mechanisms responsible for the trauma and the characteristics of the organ or system involved. Moreover when trauma to the thoracic cage, which is like a "closed box", is caused by direct impact, or deceleration forces, there is a very high possibility that there will be multiple injuries. It is, in fact, not uncommon to find, rib fractures, pneumothorax, pulmonary contusions and haemothorax, all in one patient. The impact of all these consequences of trauma might not be adequately evaluated by the ISS, since it is known that the ISS takes into consideration only one injury per body region. Our experience has shown that NISS was more accurate in evaluating thoracic lesions which rarely required emergency surgery^{20,21}, with the exception of chest tube insertion, but which significantly affected the patient's prognosis, as has been described by other authors²². In our analysis, the length of hospital stay of patients with chest trauma, did not increase significantly in the way the ISS and NISS did. These results, which seem to contradict common sense, might be due to the role played by concomitant injuries of other organs, like the CNS, which can influence and increase the average length of hospital stay. In the literature the mortality rates of patients with severe trauma who have thoracic injuries, are 20-40%⁶⁻⁸, and are very similar to the data we gathered. The clinical significance of chest trauma, also became evident in another way in our study, since the probability that a patient with severe trauma will die is almost double if the patient has one or more thoracic injuries, while the effect such injuries have on morbidity is also relevant, although less significant. The average ISS and NISS of patients who died were notably higher than those of the other patients, giving the two scores a high prognostic value. However when patients had complications, there was only an increase in NISS values, which shows that this score has greater overall accuracy in evaluating patients with chest trauma²³⁻²⁵. In patients with severe trauma the presence of an abdominal injury, a relatively common occurrence, increases significantly particularly if there was also a thoracic injury^{9,10}. In our experience, the ISS and NISS were higher in patients with both thoracic and abdominal injuries especially as regards to ISS. We hypothesize that this result, linked to the different methods of cal-

culating the two scores, is due to the fact that there were more concomitant injuries in diverse body regions, which is common in cases of abdominal trauma. In fact, these patients had longer hospital stays than the group of patients with severe trauma, and those with only chest trauma. The combination of thoracic and abdominal injuries, contributed to patient mortality in a significant manner, since it was responsible for more than half of the deaths that occurred among trauma patients. The most important data, however, was the high percentage of patients with thoracic injuries and an abdominal injury who died. The fact that the ISS and NISS of these patients was higher than the scores of the patients who survived, confirms the prognostic value of the both scores. Even considering the morbidity, the presence of concomitant thoracic and abdominal injuries was also found to be a negative prognostic factor.

Conclusion

The presence of thoracic and abdominal injuries and the evaluation of their severity are key factors in the evaluation and treatment of patients with severe trauma. These injuries, especially if combined, can cause a patient's risk of morbidity and mortality to increase significantly. The ISS and NISS have been shown to be reliable indices of trauma severity, and high scores have been shown to correlate in a significant manner with mortality and morbidity. However, it is important to note that NISS was a better index of trauma severity in patients who had mainly thoracic injuries. This upholds the criticism many authors have levelled at the scoring mechanism of the ISS, although the ISS still appears to be more accurate than NISS in evaluating patients with multiple injuries involving various regions of the body.²⁶⁻²⁸

Riassunto

Scopo di questa ricerca è stato quello di valutare l'impatto del trauma toracico ed addominale nei pazienti politraumatizzati o traumatizzati gravi. La ricerca ha preso in considerazione i dati del registro traumi dell'Azienda Ospedaliera-Universitaria Policlinico "Sant'Andrea" di Roma dal 1 marzo 2006 al 31 dicembre 2007. Sono stati arruolati nel database 844 casi e ai fini della presente ricerca sono stati presi in considerazione solo i pazienti che presentavano un Injury Severity Score (ISS) maggiore di 15 (163 pazienti, 19.3%). Questi ultimi sono stati ulteriormente suddivisi in due sottogruppi: il Gruppo A (103 pazienti, 63.2%) comprendente i pazienti con almeno una lesione toracica e il Gruppo B (46 pazienti, 28.2%) quelli che presentavano lesioni toraciche ed addominali associate. È stata ricercata l'incidenza del trauma toracico e del trauma addominale analizzando mortalità e morbilità rispetto all'età, alla causa

e alla dinamica del trauma, alla durata della degenza ed al valore di ISS e New ISS (NISS). L'età media di tutti i pazienti con ISS>15 è stata di 45.2±19.3 anni. La causa del trauma è risultata nella grande maggioranza dei pazienti un incidente stradale (126 pazienti, 77,3%). I valori medi di ISS e New ISS sono risultati rispettivamente di 25.7±10.5 e di 31.4±13.1. Gli indici di mortalità e morbilità complessiva sono stati rispettivamente del 18.4% (30 pazienti) e 28.8% (47 pazienti). Nel Gruppo A è stata osservata una mortalità del 23.3% (24 pazienti) e una morbilità del 33.9% (35 pazienti). Nei pazienti del Gruppo B i ratei di mortalità e morbilità sono stati rispettivamente del 36.9% (17 pazienti) e del 43.5% (20 pazienti). La presenza di lesioni toraciche e addominali associate aumenta significativamente il rischio di mortalità e morbilità. Nei pazienti che presentavano lesioni prevalentemente toraciche il NewISS si è dimostrato un indice maggiormente affidabile, mentre l'ISS sembra essere ancora lo score più corretto per la valutazione di pazienti con lesioni che interessano più regioni.

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