ORIGINAL ARTICLE

Impact of ATLS guidelines, trauma team introduction, and 24-hour mortality due to severe trauma in a busy, metropolitan Italian hospital: A case control study

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ABSTRACT

BACKGROUND: Advanced Trauma Life Support (ATLS) guidelines are widely accepted for use in initial management of trauma patients. The application of ATLS guidelines and introduction of management by means of trauma team (TT) both took place in April 2011. The aim of the present study was to evaluate related effects on mortality in the shock room (SR) and at 24 hours after admission.

METHODS: Data were retrieved by administrative software based on patient admission for trauma of at least 48 hours. Study period was from April 2011 to December 2012, and control period was from January 2007 to March 2011. All admitted patients were identified by first diagnosis (ICD 9-CM), excluding traumatic brain injuries, and only patients admitted to the general intensive care, general surgery, and orthopedics units were included.

RESULTS: The control group (CG) included 198 patients; the study group (SG) included 141. Differences were determined in patient age, which was mean 45.2 years (SD: 19.2) in the CG and mean 49.3 years (SD±18.3) in the SG (p=0.03). Differences were not found regarding gender, length of hospital stay, or Injury Severity Score (ISS). Among the patients who died, no differences were found in terms of systolic blood pressure, metabolic acidosis, or packed red blood cell consumption. Mortality was significantly higher in the CG, compared to the SG (14.1% vs 7.1%, respectively; p=0.033; confidence interval [CI]: 0.21–0.95). Mortality in the shock room was significantly lower in the SG, compared to the CG (0.7% vs 7.1%, respectively; p=0.002; CI: 0.004–0.592).

CONCLUSION: The introduction of ATLS guidelines and TT had a positive impact on mortality in the first 24 hours, both in the SR and after admission.

Keywords: Advanced trauma life support; fatal outcome; trauma centers; trauma system; trauma team.

INTRODUCTION

The Advanced Trauma Life Support (ATLS) program has been a mainstay in the treatment of severe trauma for almost 30 years in the US.[1,2] It was imported to Europe in the late '80s and readily spread throughout the continent. The first course in Italy was held 20 years ago, and the program has gained popularity since. Moreover, the management of severe trauma by means of a team, the trauma team (TT), has recently been shown to conclusively improve outcome.[3] If correctly implemented, management by TT may have beneficial impact on functional results,[4] as well as mortality.[5]

The present aim was to compare 24-hour mortality, shock room (SR) mortality and length of stay (LOS), transfusion rate, and times of first surgical maneuver before and after implementation of ATLS and TT in a busy general hospital in northern Italy.

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MATERIALS AND METHODS

The present study was retrospective, with historical controls and level IV evidence.[6] Pope John XXIII is a big metropolitan hospital in Bergamo, serving a population of over 1 million. Cases of major trauma are referred from throughout the province, as well as from local minor hospitals. Casualties in the accident and emergency department are around 90000 per year, while hospital admission, including urgent and elective admissions, is approximately 50000 per year.

In April 2011, after having drafted a series of diagnostic and therapeutic protocols in accordance with the literature, ATLS guidelines and TT management were implemented. Yearly ATLS courses have been taught since 2010 at the institution, and 60% of all physicians have attended. In late 2011, and in an effort to establish the hospital as a top high-level trauma center, a trauma system for pre-hospital triage was designed in accordance with the ATLS algorithm, to implement TT management.[7]

In the present observational study, due to the lack of a trauma register, data for patients admitted to the intensive care unit, or the general surgery or orthopedics wards were retrieved from the discharge chart database using ICD9-CM codes (800–959.9, excluding 905–909.9, 910–924.9, and 930–939.9, which account for chronic post-traumatic problems, in accordance with Resources for Optimal Care of the Injured Patient[8]). Admitted patients who experienced trauma no more than 3 hours before arrival should have had a minimum 48-hour LOS. Due to differences in triage, transferred patients and elderly patients who experienced domestic trauma were excluded.

Hence, data from the period of January 2007–March 2011 in the control group (CG) and from April 2011–December 2012 in the study group (SG) were retrospectively compiled. Patients who were not admitted, who died in the SR, were identified as deaths due to trauma by accident and emergency software. All patients were older than 18 years. Mortality that occurred in the first 24 hours of admission was included. The entirety of clinical charts were reviewed. Only patients with Injury Severity Score (ISS) >15 were included.

In the CG, cases of severe trauma were initially managed by an anesthesiologist, who could call for consultation from a surgeon, orthopedist, or neurosurgeon. Minor trauma could be managed in the accident and emergency department independently by an emergency physician, a surgeon, or an orthopedist, according to existing triage guidelines. In the SG, patients were managed by a team composed of a surgeon with an interest in trauma, an anesthesiologist, and an emergency physician. All decisions were made collectively, with possible referrals from neurosurgery and orthopedic specialists. All members of the team performed the primary survey, as per ATLS guidelines. Pure traumatic brain injury was not considered for admitted patients, as ATLS and TT impact on cases of multitrauma and/or bleeding were considered. Age, gender, LOS, and ISS were used to compare the groups. Other parameters, shown in Table 1, were considered for deceased patients. Traumatic deaths that occurred in the SR were included, even if ISS could not be estimated because computed tomography (CT) or autopsy could not be performed. It is not believed that this impacted final results, and the authors wish to stress the impact of the new guidelines on initial management of severe trauma in the first hours.

Statistical analysis was performed with SPSS software (version 20.0; SPSS Inc., Chicago, IL, USA). Continuous variables not normally distributed were expressed in median and interquartile range (IR), while normally distributed variables were expressed in mean and SD, and were compared with Student's t-test or Mann-Whitney U test, as appropriate. Discrete variables were analyzed with Pearson's chi-square test and Fisher's exact test, as appropriate. Differences in mortality rate were expressed as odds ratio (OR) with 95% confidence interval (CI). Statistical significance was defined as $p<0.05$.

RESULTS

From the retrospective review, 345 patients were identified, 198 in the CG and 147 in the SG (Fig. 1). Demographics are reported in Table 2. No significant difference between the groups was found in gender, overall LOS, or ISS. The only statistically significant parameter was age – patients in the SG tended to be older. Patient burden increased since April 2011 due to centralization; patient-per-month mean increased from 3.9 to 6.7. At the end of the selections, median ISS of 14 (9–25) was observed in the SG, and 16 (9–25) in the CG, signifying that cases of severe trauma were included in both groups.

Ten deaths occurred in the SG and 28 in the CG (7.1% vs 14.1%, respectively; p=0.033; OR: 0.446; CI: 0.21–0.95), while all other parameters were identical, with the exception of hemoglobin (11.0 in the SG vs 7.7 in the CG, p=0.001) (Table 3). Patients were severely injured, with a median ISS

Table 1. Measured parameters in deceased patients

Initial systolic blood pressure
First available gas analysis and hemoglobin
Time spent in the shock room
Time to CT (when applicable)
Time to first emergency maneuver (surgery, angiography, when applicable)
Packed red blood cell units
Injury Severity Score (ISS)

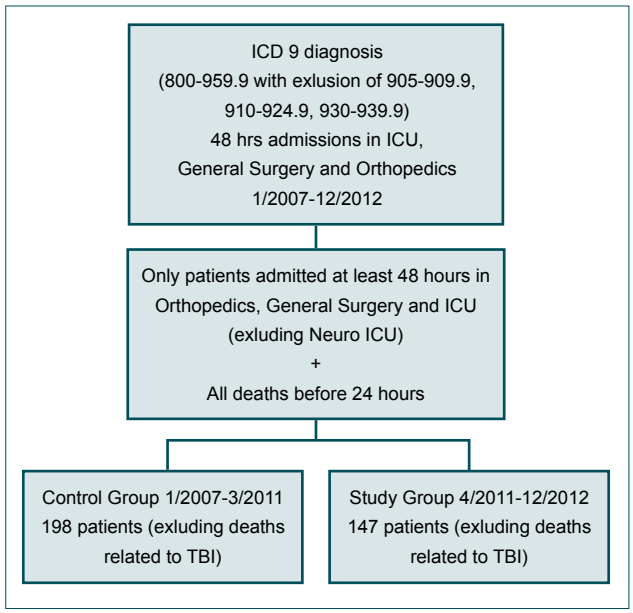

Figure 1. Study design.

of 30 (25–37) for deaths in the SG and 26 (25–33) in the CG. While there was no statistically significant difference between groups (p=0.42), deaths among patients with ISS<15 only occurred in the CG (4 patients). Among patients with ISS>15, 14.5% mortality occurred in the SG and 24% in the CG (p=0.14; OR: 0.538; CI: 0.23–1.24). Among mortalities that occurred in the SR, 0.7% was observed in the SG, and 7.1% was observed in the CG (p=0.002; OR: 0.08; CI 0.01–0.62).

In the SG, SR LOS tended to be shorter (59 min vs 118 min in the CG), though the difference was not statistically significant (p=0.221). In addition, time to CT scan also tended to be shorter in the SG (47.5 min vs 70.3 in the CG, p=0.59). Median time to first surgical procedure was shorter in the CG (35 min, 34–99), compared to the SG (54 min, 25–58), though the IR of the SG was narrower, due to a patient who waited more than 120 minutes at the beginning of the period of study. A trend toward more aggressive resuscitation, with a median of 12 packed red blood cell units in the SG (vs 6 in the CG) was evident, but not statistically significant (p=0.82).

DISCUSSION

Trauma centers are regarded as the optimal regional environment for severe trauma care and evaluation of trauma ca-

Table 2. Group demographics

	Study group (4/2011–12/2012)	Control group (1/2007–3/2011)	p
Patients	141	198	
Gender (M/F) % of male	(113/28) 80.1%	(158/40) 75.4%	0.9
Mean age, years, Mean±SD	49.3±18.3	45.2±19.2	0.03
Length of hospital stay, days, Mean±SD	14.9±14.1	14.0±11.9	0.72
Injury Severity Score (IR)	14 (9–25)	16 (9–25)	0.59
Patient per month, mean	6.7	3.9	//

SD: Standard deviation; IR: Interquartile range.

Table 3. Characteristics of deceased patients

	Study Group	Control group	p
Initial systolic blood pressure (mmHg), Mean±SD	90±17	88±22	0.87
First hemoglobin (g/L)	11.0 (9.8–13.3)	7.7 (5.7–10.2)	0.001
Base excess	-9.3 (-7.5–-11.7)	10.0 (-5.0–-15.5)	0.301
pH	7.08 (7.08–7.26)	7.17 (7.06–7.33)	0.522
Time in the Shock Room (minutes)	59 (74–159)	118 (19–121)	0.221
Time to CT (minutes), Mean±SD	47.5±45	70.3±40	0.59
Time to first emergency maneuver (surgery, angiography) (minutes)	54 (25–58)	35 (34–99)	0.756
Red blood cell units	12 (2–14)	6 (8–16)	0.82
Injury Severity Score (ISS)	30 (25–37)	26 (25–33)	0.42
Mortality, % (n)	7.1 (10)	14.1 (28)	0.033

SD: Standard deviation; IR: Interquartile range; CT: Computed tomography.

sualty.[9] Recent opinion and studies have clearly established the advantages of ATLS guidelines and multidisciplinary TT, which include better organization, improvement of clinical and non-clinical skills, adherence to guidelines,[10] and priority approaches, if correctly implemented.[11] Strong evidence of a positive effect on mortality and morbidity is still lacking, though a trend toward improvement has been shown.[12–14]

At the time, in 2010, that the present hospital administration acknowledged the need for improvement, ATLS was not yet included in local guidelines. There was no team-centered management of moderate to severe trauma, and patients could have been managed in the emergency department for hours before a physician took definitive charge, and then only after several consultations. In early 2011, surgeons, emergency physicians, and intensive care unit doctors drafted several diagnostic and therapeutic protocols, which in some cases were published.[15] Though this certainly contributed to the present results, we are confident that implementation of ATLS provided the necessary improvement. Surgeons were the first to complete the ATLS provider course, followed by emergency physicians, and intensive care and anesthesiologist teams. An extensive annual ATLS training program is ongoing, in an effort to broaden a common language among physicians. Currently, more than 50% of TT members are ATLS-certified. The delay in the certification of all is due to the large number of anesthesiologists who are on TT duty, a number in the emergency on-call rotation that will hopefully be reduced in the near future. In early 2015, nurses began to attend Advanced Trauma Care for Nurses certificate training.

Presently, the TT leader is the surgeon, due to the relatively low number of attending surgeons, 10 with an interest in general, emergency, and trauma surgery. Another reason is that we believe a surgeon-led team is the best way to achieve timely decisions regarding diagnosis and course of treatment.[16]

A huge effort was made to change behavior and attitude toward the course and functioning as a team, initially regarded as a source of hurdles and time-consuming on-site consultation. The present results indicate that SG mortality was significantly lower, as was time spent in the SR, even if not statistically significant. Moreover, the present data show that unstable patients no longer undergo CT scan, a critical issue prior to the introduction of the new rules. Two patients had sustained cardiac arrest and died during the scan, and 3 had worsened during radiological examination and died in the SR without receiving surgical or interventional treatment.

In the CG, 4 deaths were observed in patients with ISS<15, while no such deaths were observed in the SG. ATLS and TT introduction likely had an impact on preventable deaths, a major concern of every medical system.[17]

The only statistically significant difference between groups was in hemoglobin, which is presently believed to be a later effect of bleeding, though no differences in base excess or pH were observed. Levels are thought to have been higher in the SG due to shorter stay in the SR and faster primary evaluation.[18,19] Another explanation could be a trend toward damage control resuscitation in a prehospital setting (i.e., less crystalloid infusion used). Unfortunately, no data is available to confirm this hypothesis.

Several limitations affected the present study, including the retrospective design. No existing registry was used, potentially complicating patient selection and impairing statistical significance of mortality. Fewer patients were included in the CG, as centralization had not yet been implemented. In early 2011, a shared protocol between the Emergency Medical System and the hospital led to a steep increase in per month patient case load (mean of 3.9 patients per month in the CG, vs 6.7 patients per month in the SG). It is believed that more pronounced centralization, accounting for more than 80% of severe trauma patients in the local area, explains the difference in mean age of groups. It is of great value that, in spite of the older age of the SG, a lower mortality rate was observed. Time spent in the SR was significantly lower in the SG. It is believed that this is one of the main contributions of ATLS and TT implementation, with a better focus on decision-making and priority of treatment. On the contrary, some aspects, due to low numbers (namely time to CT and mortality in the SR) showed better trends in the SG without reaching statistical significance, as has been recently confirmed.[20] Further study is required to confirm these promising results, but we strongly believe that ATLS and TT implementation provided a great improvement in the treatment of severe trauma.

Conclusions

Implementation of ATLS guidelines and TT had a strong impact on 24-hour mortality, and led to further expediting of initial management of multiple trauma patients. Low numbers mandate further study, to confirm these favorable trends.

Conflict of interest: None declared.

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ORİJİNAL ÇALIŞMA - *ÖZET*

Yoğun bir metropol hastanesinde ağır travmada 24 saat içindeki ölüm oranlarına ATLS kılavuzlarının ve travma ekibinin etkisi: Bir olgu kontrollü çalışma

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AMAÇ: Travma hastalarının başlangıç tedavisinde ATLS kılavuzları geniş ölçüde kabul görmüştür. Hastanemiz Nisan 2011'de ATLS ve travma ekibi uygulamasını başlatmıştır. Bu çalışmanın amaçları şok odasında ve kabulden sonraki 24 saat içinde ölüm oranlarındaki değişiklikleri değerlendirmektir.
GEREÇ VE YÖNTEM: Travma sonrası en az 48 saat içindeki hasta kabullerinin kaydedildiği idarenin bilgisayar yazılımından hastalara ait veriler alındı. Çalışma dönemi Nisan 2011 ila Aralık 2012 ve kontrol dönemi Ocak 2007 ila Mart 2011 arası idi. Kabul edilen hastaların tümü ilk tanılarına (ICD 9-CM) göre tanımlandı, travmatik beyin travmaları dışlandı, yalnızca genel yoğun bakım ünitesi, genel cerrahi ve ortopediye kabul edilen hastalar göz önüne alındı.
BULGULAR: Kontrol grubunda (KG) 198, çalışma grubunda (ÇG) ise 141 hasta vardı. İki grup cinsiyet, hastanede yatış süresi ve Travma Şiddet Derecesi Skoru açısından benzer olmasına rağmen yaşları farklıydı (yaş ortalamaları: KG, 45.2±19.2 yıl ve ÇG 49.3±18.3 yıl [p=0.03]). İki grupta eks olan hastalarda sistolik kan basıncı, metabolik asidoz veya eritrosit süspansiyonu kullanımı açısından herhangi bir fark yoktu. Kontrol grubunda ölüm oranları anlamlı derecede daha yüksekti (KG I %4.1, ÇG, %7,1; p=0.033, Güven Aralığı [GA] 0.21–0.95). Şok odasında mortalite çalışma grubunda anlamlı derecede daha düşüktü (ÇG, %0.7 ve KG, %7.1 (p=0.002, GA 0.004–0.592).
TARTIŞMA: Hem şok odasında hem de hastaneye kabul sonrası ATLS kılavuzları ve travma ekibinin kullanılmaya başlanması hem şok odasında hem de hastaneye kabulden sonraki ilk 24 saat içindeki mortaliteyi azaltmıştır.

Anahtar sözcükler: Ölümcül sonuç; travma ekibi; travmada ileri yaşam desteği; travma merkezleri; travma sistemi.

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