Diagnostic, therapeutic and health-care management protocol for major abdominal trauma at the "Santa Maria" Hospital of Terni.

Analysis of the results after two years

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Diagnostic, Therapeutic and health-care management protocol for major abdominal trauma at the "Santa Maria" Hospital of terni. Analysis of the results after two years.

BACKGROUND: *Trauma is the fourth leading cause of death and is more common in people under 45 age. Abdominal trauma is cause of death in 7-10% of traumatized patients. Aim is to evaluate the effectiveness of the diagnostic, therapeutic and health-care management protocol for major abdominal trauma.*
METHODS: *A prospective study called DGR Azienda Ospedaliera S. Maria Terni n. 159. was registered on February 2014. Patients with abdominal major trauma admitted at Santa Maria Hospital of Terni from January 2015 to December 2016 were considered in this paper. Patients' demographics, comorbidities, application of the operative and non operative management (OM-NOM), Mortality, effectiveness of diagnostics were investigated.*
RESULTS: *The most of the patients were the elderly. Staff members were compliant and operated in conformity to the protocol for abdominal trauma. Non operative management (NOM) was performed in 63% of patients, according to data from the literature. On the other hand data with respect to the performing of diagnostic examinations as Focused assessment with ultrasonography for trauma (FAST), chest X-ray, Computed Tomography (CT) were discordant with literature. No patient underwent damage control surgery (DCS). Number of missed injuries (3.3%) and overall (13.3%), daily and weekend mortality were similar to those from the available literature. In our experience, the best results were found regarding the sensitivity of the FAST and CT in unstable and stable patients respectively, and the lower incidence of: NOM failure (NOM 0%, NOM plus endovascular treatment 14.4%) , mortality in stable patients (2.3%) and night mortality (5%).*
CONCLUSIONS: *Despite the application of trauma protocol at Terni Hospital has been effective it can be further improved.*

KEY WORDS: Diagnostic, Emergency surgery, Major Abdominal Trauma, Therapeutic and health-care management protocol

Introduction

Trauma can be considered as a part of serious complexity pathologies with a mortality rate that can reach 10%. It is the fourth leading cause of death. The most of the people involved are under-45 age. In particular abdominal trauma is the most common cause of death occurring in 7-10% of traumatized patients. In patients subjected to multiple traumatic injuries (polytrauma), abdominal trauma is frequently associated with musculoskeletal, thoracic and central nervous system (CNS) injuries [1-5]. The health-care management of major trauma required an integrated network of hospitals based on the model "Hub & Spoke" (hub and spokes system). In Umbria Region (Italy), the prehospital Emergency

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ABBREVIATIONS

CNS: central nervous system;
EMS: Emergency Medical Service;
ER: emergency room;
ATLS: advanced trauma life support;
FAST: Focused Assessment Sonography for Trauma;
NOM: Non-Operative Management;
EMS: emergency medical services;
GCS: Glasgow Coma Scale;
CT: Computer Tomography;
DCS: Damage Control Surgery;
ICU: Intensive Care Unit;
HBP: High Blood Pressure;
OR: Operating Room

Medical Service (EMS) recorded 279 red code trauma during 2015. In Italian EMS and Emergency Room (ER) RED code stands for life-threating conditions and identifies patients who need immediate medical care within 1 hour; YELLOW code stands for potentially life-threatening conditions and identifies patients who are in stable conditions but need medical assistance since they require frequent re-triage and have dalyed priority with respect to Red code patients. Of these 279 patients with red code trauma, 65.23% were admitted at the Emergency and Acceptance Department of second level (Hospital of Perugia and Hospital of Terni), as "Hub" of Umbria Region; the other patients were admitted at the Emergency and Acceptance Department of first level (31.54%: Hospital of Branca, Hospital of Città di Castello, Hospital of Foligno, Hospital of Orvieto), who have the role of "spoke", and at the territorial Hospitals (3.23%: Hospital of Castiglione Del Lago, Hospital of Assisi, Hospital of Narni, Hospital of Spoleto).
The aim of our study is to evaluate the patients admitted at Emergency and Acceptance Department of Terni Hospital between 01.01.2015 to 31.12.2016 with the diagnosis of major abdominal trauma, intended as trauma in the abdominal region presenting with an Abbreviated Injury Scale >3, and analyse their characteristics, the effectiveness of the diagnostic, therapeutic and health-care management protocol (PDTA) for major abdominal trauma, , and the conformity of clinical staff to the protocol.

Materials and Methods

On February 24th, 2014, the Government of Umbria Region approved the establishment of a Regional Integrated Management of Major Trauma (Regional Council Resolution N°. 159 in 24/2/2014). According to such a resolution, in 2014 at the Hospital" Santa Maria" of Terni a multidisciplinary working group was set up to process the diagnostic, therapeutic and health-care management of the major abdominal trauma. This Working Group defined an operational program, presenting an intervention strategy and tracing the management of each patient hospitalized for major abdominal trauma. This working group consists of representatives of the following units: ER, Anesthesiology, Intensitive Care Unit (ICU), Emergency Surgery, Neurology, prehospital EMS "118" and Radiology. In this analysis, we evaluated the characteristics of patients with major abdominal trauma, the medical staff conformity to the PDTA and its effectiveness. Indicators for each different diagnostic, therapeutic and health-care step of the management were developed.
To assess conformity to the diagnostic, therapeutic and health-care management protocol we considered the following indicators: the number of patients triaged as code red and code yellow in ER, the different steps of the primary survey according to the ATLS (Advanced Trauma Life Support) guidelines, the number of patients undergoing FAST (Focused assessment with sonography for trauma), the number of patients undergoing chest X-ray, the number of patients undergoing pelvic X-ray, the treatment performed in unstable patients and timing of the secondary survey in stable patients. In order to assess the effectiveness of the diagnostic, therapeutic and health-care management protocol, we evaluated the

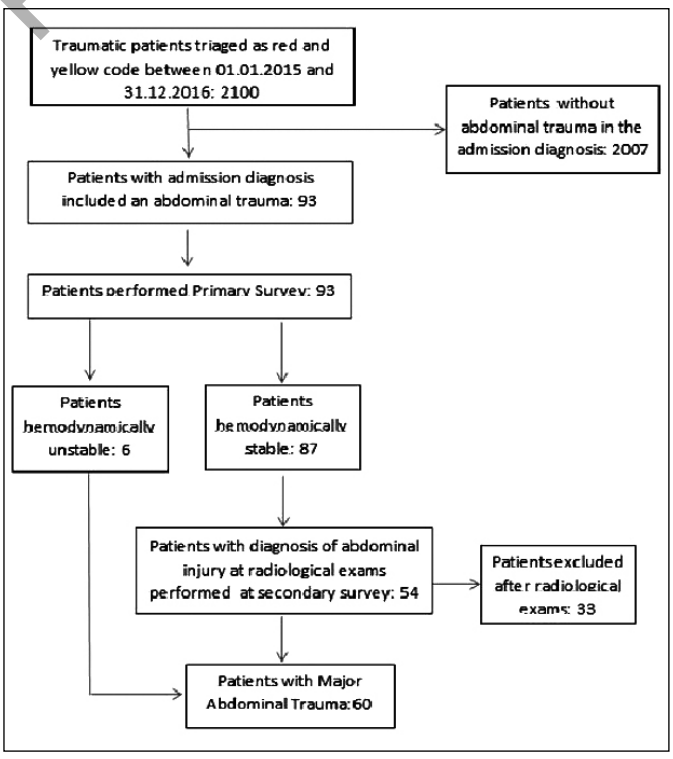

Fig. 1: Study Flow Diagram.

following indicators: the number of Non-Operative Management (NOM) failure, the number of missed injuries, overall mortality rate, daytime mortality rate and night mortality rate.

We performed an analysis of the prospective database (JHIS Hospital Informative System) ER Admission at the Hospital of Terni from 01.01.2015 to 31.12.2016. Data of the patients presenting to the ER with abdominal injuries and classified with the trauma triage codes red and yellow on the ER discharge diagnosis were extracted. Using this data, we evaluated the diagnostic, therapeutic and health-care management performance. Full data of patients with major abdominal trauma were the only extracted from the emergency room database. Finally, using the other hospital databases, the treatment to which the patients were subjected was analysed (Fig. 1).

The data were independently extracted by a resident in General Surgery (VG) and a graduating student in order to reduce the margin of error. An experienced surgeon (RC) then reviewed the extracted data. Results of the analysis were compared with those of the current available literature.

Results

From the ER database search 2,100 cases were identified of which 14.1% (298 patients) was triaged as code red and 85.9% (1,804 patients) was as code yellow (Fig. 2).

In 93 patients, the diagnosis of the nursing triage of ER Admission included only an abdominal trauma and in 1,965 patients, the trauma involved other districts. After the complete evaluation at Emergency and Acceptance Department, only 60 patients presented with major abdominal trauma (Fig. 3).

71.7% of cases (43 patients) were male, the average age was 50 years, 58.3% (35 patients) had entry code red.

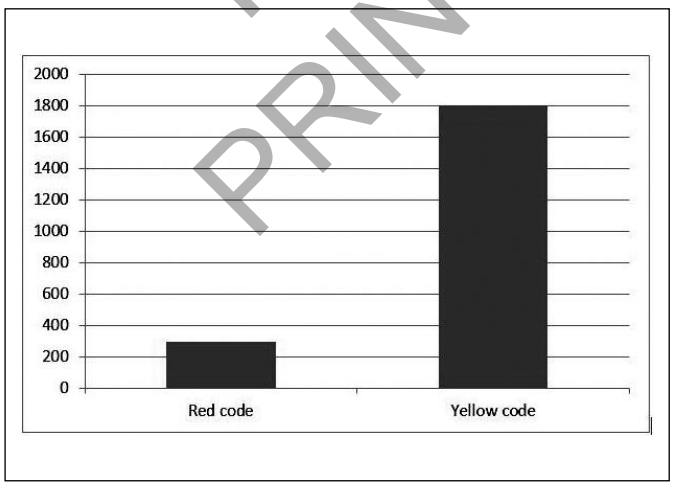

Fig. 2: Traumatic red and yellow code.

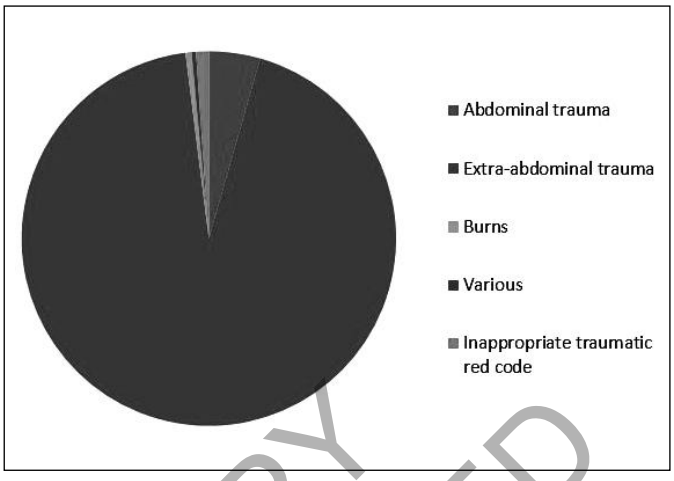

Fig. 3: Type of trauma admitted in ER with Red and Yellow Code.

The cause of trauma was from the most frequent one a car accident (58.3%: 35 patients); Other causes: 4 falls from height, 2 accidental gunshot wounds, 1 accidentally fall, 1 hit by a cyclist, 1 trauma by a kick calf; in 13.3% (8 patients) a domestic accident; self-harm, aggression, accident at work, in 1.7% (1 patient) accident during sport activities (Table I).

Type of trauma

In 20% of cases (12 patients) the trauma was neurological-orthopedic-thoracic-abdominal, in 18.3% (11 patients) a simple abdominal trauma, in 18.3% (11 patients) a thoracic-abdominal-orthopedic trauma, in 11.7% (7 patients) a neurological-thoracic-abdominal trauma, in 10% (6 patients) an abdominal-orthopaedic trauma, in 8.3% (5 patients) an abdominal-thoracic trauma , in 3.3% (2 patients) an abdominal-orthopedic-maxillo-facial trauma, in 3.3% (2 patients) a neurological-abdominal-orthopedic-maxillo-facial trauma in 3.3% (2 patients) a neurological-abdominal trauma, in 1.7% (1 patient) a neurological-thoracic-abdominal-maxillo-facial-orthopedic trauma and in 1.7% (1 patient) a neurological-abdominal-maxillofacial trauma.

In 93.3% of cases (56 patients) the transport in ER occurred by ground emergency medical services (EMS) Only 8 patients (18.3%) had comorbidities of which the most frequent was high blood pressure: HBP.

Time of admission in ER: 25 patients (41.7%) arrived in the afternoon (14: 00-20: 00), 21 patients (35%) arrived at night (20:00 -8: 00), and 14 patients (23.3%) arrived in the morning (8: 00-14: 00).

Day admitted in Hospital: 42 cases (75%) was admitted between Monday and Friday, 30% (18 patients) between Saturday and Sunday.

Table I - *Characteristics of patient with Major Abdominal Trauma*

Gender	**17 F (28,3%)**						**43 M (71,7 %)**					
Age	**Average: 50 years**						**Mean SD: 4925,6**					
Hemodynamically assessment	6 Unstable (10%)						54 Stable (90%)					
Access Code	35 Red (58,3%)						25 Yellow (41,7%)					
Causes of trauma	35 Car accident (58,3%)	9 Accident in other places *(15%)		8 Domestic accident (13,3%)	3 Self-harm (3,3%)		2 Aggression (3,3%)	2 Accident at work (3,3%)		1 Sports accident (1,7%)		
Type of trauma	12 Neurological orthopedic thoracic abdominal (20%)	11 Abdominal (18,3%)	11 Thoracic abdominal orthopedic (18,3%)	7 Neurological thoracic abdominal (11,7%)	6 Abdominal orthopedic (10%)	5 Abdominal Thoracic (8,3%)	2 Abdominal orthopedic maxillo facial (3,3%)	2 Neurological abdominal orthopedic maxillo facial (3,3%)	2 Neurological abdominal (3,3%)	1 Neurological thoracic abdominal maxillo facial orthopedic (1,7%)	1 Neurological abdominal maxillofacial (1,7%)	
Transport in Emergency Room	56 by ground EMS (93,3%)			2 by using their own cars (3,3%)			1 transfer from other hospital by ground EMS (1,7%)			1 aeromedical and ground EMS (1,7%)		
Comorbidity	52 no comorbidities (86,7%)						8 with comorbidities (18,3%)**					
Hemoglobin value (g/dl)	Average: 12,8						Mean SD: 13 1,9					
Time admitted in ER	Morning : 14 (23,3%)				Afternoon: 25 (41,7%)				Night: 21 (35%)			
Day admitted in ER	Between Monday and friday: 42 (75%)						Between Saturday and Sunday: 18 (30%)					
Prognosis [days]	Died: 8 (13,3%)	guarded prognosis: 28 (46,7%)		40 days: 2(3,3%)	30 days: 8 (18,3%)		20: 7 (11,7%)	15: 4 (6,7%)		10: 1 (1,7%)	2 NR (3,3%)	

*4 falls from height, 2 accidental gunshot wounds, 1 accidentally fall, 1 hit by a cyclist, 1 trauma by a kick of a calf.
**1 patient with renal cysts and blood hypertension, 1 with renal cancer, 1 with bipolar syndrome, 1 with anemia, 1 with blood hypertension, benign prostatic hyperplasia and hepatic cysts, 1 with blood Hypertension, 1 with blood hypertension, hypercholesterolemia and anxious-depressive syndrome, 1 patient with glaucoma.
NR: Not Reported

Indicators to Conformity Evaluation in the Common Practiceto Diagnostic-Therapeutic and Health-Care Management at Emergency Room Admission

1. *Number of patients triaged as code red and code yellow in er*
In case of abdominal trauma, 46 patients were triaged as code red (15, 5% of all traumatic code red) and 47 as yellow (2.6% of all traumatic code yellow) (Fig. 4)

2. *Primary survey atls*
Airway: 6.4% of cases (6 patients) underwent oro-tracheal intubation; no patient was treated with an emergency tracheotomy.
Breathing: 1.1% of cases (1 patient) underwent emergency chest tube (thoracic decompression for hypertensive PNX).
Circulation: In 6.4% of cases (6 patients) resuscitation therapy with catecholamines was necessary.

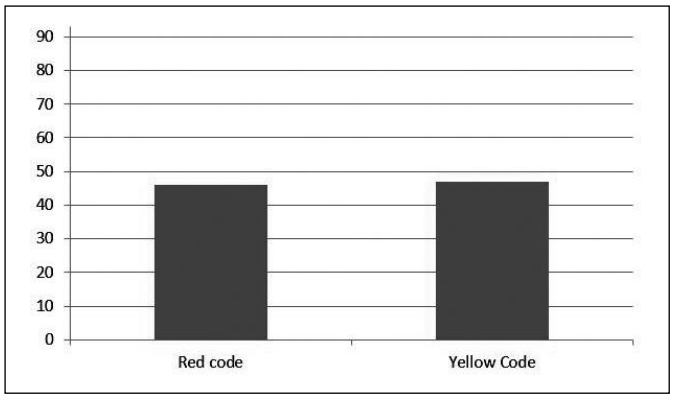

Fig. 4: Abdominal Traumatic patients color code.

TABLE II - *Type of surgical treatment performed in hemodynamically unstable patients.*

Type of treatment performed	N° of patients
Splenectomy	1
Repairing colon injury	1
Aortic suture repair and resection of the ileum	1

Disability: 7.5% of cases (7 patients) presented a GCS (Glasgow Coma Scale) <8 (severe brain injury).
Exposure: 7.5% of cases had severe visible injuries (7 patients: 4 abdominal stab wounds, 2 abdominal gunshot wounds, 1 head injury with leaking brain tissue). Based on standardized protocols during the primary survey, the main sources of bleeding must be investigated by instrumental tests including: FAST exam, anteroposterior chest x-ray and pelvis x-ray. During the primary survey, 38.7% of cases (36 patients) underwent FAST exam, in 58.3% of cases (21 patients), the text results were negative, and in 41.7% (15 patients), the exam detected free intraperitoneal fluid. The FAST exam revealed no report of false positives or false negatives in unstable patients, while among stable patients there were 2 false negatives and 3 false positives.
Number of patients underwent chest X-ray: 18.3% (17 patients)
Number of patients underwent pelvic X-ray: 2.1% (2 patients)
Number of patients hemodynamically unstable: During the primary survey patients were assessed for their hemodynamic status. In our study 6 patients were hemodynamically unstable at their admission in the ER.
Age: The average age of these patients was 48.7 years (mean ± SD 53 ± 21.1).
Gender: All patients were males.
Type of treatment performed: Half of these patients (3) underwent an emergency surgery with a mortality of 100%. The remaining half of them died during resuscitation .
Type of surgical treatment performed: A patient underwent splenectomy and conservative technique for superficial liver laceration, 1 patient underwent colon repair and 1 had an aortic suture repair and resection of the ileum (Table II)
Number of patients hemodynamically stable: 87 patients (93.5%) hemodynamically stable were identified (93.5%). In these patients secondary survey was performed in order to identify those presenting with major abdominal trauma.

SECONDARY SURVEY ATLS

In hemodynamically stable patients a secondary survey and more radiological exams have been performed. The choice of the type of radiological examination depended on the patient's clinical condition.
Number of patients underwent abdominal CT (Computer Tomography) scan and US (Ultrasonogapy): 87.3% (76 patients) of hemodynamically stable patients underwent abdominal CT with contrast (in 30.2% of cases preceded by ultrasound abdomen). 12.6% of cases (11 patients) underwent only abdominal ultrasound.
After secondary survey in 62.1% of hemodynamically stable cases (54 patients) were detected traumatic abdominal injuries.
Number of patients underwent specific treatment of abdominal injury: Treatment performed in stable patients with major abdominal trauma was in 63% of cases (34 patients) NOM with only medical therapy, in 12.9% (7 patients) NOM with endovascular treatment, in 24.1% (13 patients) surgical treatment (Fig. 5).
Type of surgical treatment: (DCS vs definitive treatment). All patients underwent definitive surgical treatment, while none of them underwent Damage Control Surgery (DCS).
Type of definitive surgical treatment: 38.5% of cases (5 patients) underwent splenectomy, 15.4% (2 patients) underwent conservative technique for superficial liver lac-

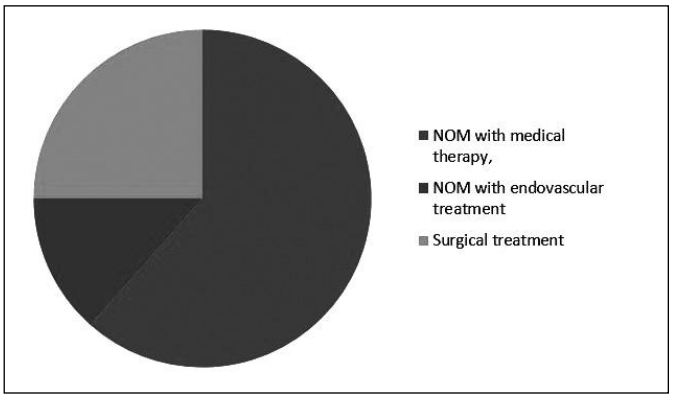

Fig. 5: Type of treatment in Major Abdominal Trauma.

TABLE III - *Type of surgical treatment performed in hemodynamically stable patients.*

Type of surgical treatment	N° of patients
Splenectomy	5
Liver hemostasis	2
Small intestine repairing	2
Colon repairing	2
Hemostasis of mesoileum and omentum	1
Exploratory laparoscopy	1

erations, 15.4% (2 patients) small intestine repairing, 15.4% (2 patients) colon repairing, 7.7% (1 patient) haemostasis of mesoileum and omentum, and 7.7% (1 patients) underwent explorative laparoscopy (Table III). 9.2% of cases (5 patients) hemodynamically stable with abdominal trauma underwent deferred surgery for non-abdominal pathology (orthopaedic, maxillo-facial, neurosurgical treatment).
– *The mean age*: The average age was 62.6 years (mean ± SD: 52 ± 19.8).
– *The mean hospital length of stay:* The average hospital stay was 40.4 days (mean ± SD: 32 ± 23.5).
– *Complications*: No patient developed complications.

EVALUATION OF THE EFFECTIVENESS OF THE DIAGNOSTIC, THERAPEUTIC AND HEALTH-CARE MANAGEMENT

To evaluate the effectiveness of the diagnostic, therapeutic and health-care management we used the following indicators.

NUMBER OF NOM FAILURE

No failure of NOM in patients treated with only medical therapy.
– *Hospital Stay:* The average hospital stay was 14.3 days (mean ± SD: 16 ± 9.5).
– *Mortality:* No patients died
In 3.7% of cases, (2 patients), after NOM for abdominal injury, was performed a neurosurgical emergency treatment.

NUMBER OF NOM FAILURE (MEDICAL THERAPY AND ENDOVASCULAR TREATMENT)

The failure of endovascular treatment occurred in 14.3% of cases (1 patient with recurrent bleeding undergone surgery; patient with a hematoma anterior wall bladder, initially treated with inferior right epigastric artery embolization, because of a recurrent bleeding, a vascular operation by suturing femoral artery bifurcation was performed).

Mean hospital length of stay: The average hospital stay was 32.1 days (mean ± SD: 27 ± 11.5).
Complications: Complications after endovascular treatment occurred in 42.8% of cases (1 patients with recurrent bleeding, 2 patients with pulmonary embolism).
Mortality. No patients died.

PATIENTS UNDERWENT SURGICAL TREATMENT

Mean hospital length of stay: The average hospital stay was 16 days (mean ± SD: 37 ± 21.5).
Complications: Post-operative complications occurred in 23.1% of cases: systemic complications in 2 patients and abdominal in 1 (respiratory failure in 1 patient, inferior vena cava thrombosis with pulmonary embolism in another patient and one patient presented an abdominal wall hematoma treated initially with arterial embolization then with surgery).
Mortality: No patient died.

Missed injures: 3.3% of cases (2 patients) had undiagnosed lesions; one patient was diagnosed with a perforated colon while he was hospitalized in ER Observation Unit and the other one was diagnosed with pneumothorax while admitted to the appropriate department.
Gender: A male and a female patient
The mean age: The average age was 49 years.
The mean hospital length of stay: The average hospital stay was 23.5 days.
Complications: One patient resulted in an abdominal wall hematoma.

MORTALITY

General Mortality. The mortality of patients with major abdominal trauma was 13.3% (8.3% ER, 3.3% ICU, 1.7% in the OR, no deaths about inpatient).
Gender: 87.5% (7 patients) who died were male, 12.5% (1 patient) were female.
Mean age of patients who died: The average age was 50 years (mean ± SD: 53 ± 22.8).
Mortality unstable patient: The mortality in the emergency room was 50% (3 patients), in the operating room of 16.7% (1 patient), in ICU of 33.3% (2 patients).
Mortality stable patients: Mortality in the ER was 2.3% (2 patients), no deaths occurred in the operating room and inpatient.
Daytime mortality (8: 00-20: 00): 8.3% (5 patients).
Night mortality (20: 00-8: 00): 5% (3 patients).

Discussion

In Europe, the majority of abdominal trauma are blunt and due to motor vehicle collision [6,7]. The percentage

of penetrating trauma in Europe is roughly 5%; in Switzerland there is the lowest percentage in the world of hospitalization for intentional penetrating trauma, 0.2%. Excluding war zones, the highest percentage of penetrating trauma is reported in The USA and South Africa [8,9]. In a retrospective analysis of the Maggiore Hospital Trauma Registry of Bologna (1989-2008), only 10.6% of the thoracic-abdominal trauma was penetrating [10]. At Sant' Andrea University Hospital of Rome, the blunt trauma was reported in 97% of patients, while in 3% of patients there was a penetrating trauma [11]. These data are consistent with our outcomes: many patients with abdominal major trauma had blunt trauma (90%), while only 10% had penetrating trauma. Costa et al. reported that abdominal trauma was 9.3% of all types of trauma, (83.6% men and 16.4% women with an average age of 38.7 years) [11]. Even in our analysis, abdominal trauma was diagnosed in a small percentage of cases (4.4% of all patients admitted with traumatic code red or yellow). The abdominal trauma was mainly diagnosed in male patients (71.7%) than female (28.3%), the average age of patients was 50 years (mean ± SD, 49 ± 25.6). In our study, the average age is higher because of very elderly patients (> 80 years) who had an abdominal trauma as a result of accidental falls. In the study performed at Sant' Andrea Hospital of Rome, the main cause of trauma was the motor vehicle collisions (75.9% of cases), then industrial accidents (6.3%), domestic accidents (5.3%) and aggressions (5.1% of cases) [11]. Similarly, in our study the leading cause of the trauma was motor vehicle collisions (58.3% of cases), then accidents in other places (15%), domestic accidents (13.3%), the self-harm (3.3%), aggressions (3.3%), industrial accidents (3.3%), and sport accidents (1.7%). In Gad et al. study, abdominal trauma in 66.1% of cases was associated with extra-abdominal injuries: 51.2% located in extremities, 34.1% involved the thorax, 14.1% with head and neck lesions [12]. In our study, 81.7% of abdominal trauma was associated with extra-abdominal injuries: in 38.5% of cases with thoracic injuries, in 35.4% extremities lesions, in 26% with head and neck injuries; these results are consistent with the literature. 9.2% of hemodynamically stable patients with abdominal trauma underwent to surgical treatment for delayed extra-abdominal pathology (orthopaedic, maxillo-facial, neurological). Gad et al. study showed that 19.4% of abdominal trauma was associated with comorbidities: 50% represented by HBP [12]. In our study, patients with comorbidities were few (13.3% of total) and 50% of these was affected by HBP (Table IV).

There is substantial variation in the percentages of trauma patients undergoing emergency tracheal intubation among and between aeromedical, ground EMS, and trauma center settings.

The prehospital EMS studies indicate that the rate of patients undergoing tracheal intubation is 4.0%, but varies from 2 to 37%. For aeromedical settings, the percentage of patients undergoing tracheal intubation is 18.5%, however, the variation among studies ranges from 6 to 51%. For trauma center settings, the percentage of patients undergoing tracheal intubation is 24.5%, however, the variation among studies ranges from 9 to 28% [13]. In our study differently, only 6.4% of patients was treated with tracheal intubation in ER department; of these only a patient was intubated during transport with ground EMS. No patient in our study was treated with cricothyroidotomy. In second priority Breathing must be assessed; at this step it must be detected the presence of a tension pneumothorax or a massive hemothorax that are life treatening conditions which need an immediate treatment. In Davis et al. study 27% of patients with blunt abdominal trauma also presented thoracic trauma, and in 8.5% of cases placing a chest tube drainage or practicing a thoracotomy were necessary. Among patients who underwent both an abdominal and thoracic procedure the mortality was 27% [14]. Similarly, in our study 6.4% of patients was treated with a chest tube (3 patients in ICU and 3 in Operating Room, OR) while only 1.1% of the patients (1 patient) in ER. As third priority must be assessed the circulation status and must be recognized and treated any internal and external bleeding. According to the literature, in our study 6 patients (6.4%) were admitted in ER with diagnosis of abdominal trauma and presented hemodynamic instability. Of these 6 patients, 3 were undergoing surgery which showed hemoperitoneum caused by splenic, hepatic and great vessels

TABLE IV - *Comparison between our experience and literature on patients characteristics.*

Patients characteristics	Our experience	Literature
Number of patients with penetreting abdominal trauma vs blut	10% vs 90%	Casali et al. [10]: 10,6% vs 89,4% Costa et al [11]: 3% vs 97%
Gender	71,7% M, 28,3% F	Costa et al. [11]:83,6%M, 16,4% F
Average age	50 years	Costa et al.[11]: 38,7 years
Main cause of trauma	58,3% Car Accident	Costa et al.[11]: 75,9% Car Accident
Type of trauma	Simple: 18,3%Complex: 81,7%	Gad et al [12]: Simple: 33,9%Complex: 66,1%
Comorbidity	13,3%	Gad et al [12]: 19,4%

lesion. All these 3 patients who underwent surgery died (1 in OR, 2 postoperatively ICU). The other 3 unstable non-operated patients died in ER during resuscitation. The basic instrumental examination in unstable patients with abdominal trauma is the Eco FAST. This method is a fast diagnostic examination for evaluating a patient with a potential thoracic and/or abdominal injury [15]. In Sheng's study FAST was performed at doctors' discretion in 28.3% of patients with abdominal [16]. In Ghafouri et al.' study, all the patients admitted for abdominal blunt trauma (hemodynamically stable and unstable) underwent Eco Fas [17]. FAST detected free intraperitoneal fluid in 27.5% of patients. Of these patients 8.3% underwent emergency surgery, 67.5% required an abdominal CT and 24.2% didn't need for further diagnostic examinations in the first 24 hours observation. The FAST gave false positive results in 6 patients [18]. Unlike recommended by our protocol and literature, we found that in our clinical practice the FAST was carried out both for stable and unstable patients [19]. In fact, 38.7% of patients admitted for abdominal trauma required a FAST. In 58.3% of patients, the examination gave a negative result, in 41.7% it detected free intraperitoneal fluid. The Eco Fast gave no false positives or negatives in unstable patients, while among the stable ones there were 2 false negatives and 3 false positives; these values are consistent with the [17]. Of the patients undergoing FAST only 3.2% underwent emergency surgery without performing additional diagnostic exams, 23.6% required a CT abdomen after FAST, 10.7% did not carry out additional diagnostic tests in ER. The 56.9% of patients required an abdominal CT without a prior FAST. Chest x-ray remains the primary screening method for the detection of mediastinal bleeding, consequence of chest blunt trauma and this exam is included in most of the primary assessment protocols of polytrauma patients [18,19].
Thus, only 18.3% of the patients received a chest x-ray. In the secondary survey of the ATLS, CT is the gold standard for the assessment of hemodynamically stable patients with blunt abdominal trauma with potential intra-abdominal lesions [20]. In Garber study 36.7% of patients underwent abdominal CT, which was positive for abdominal lesions in 36.7% of cases and 12% of them underwent laparotomy [21]. In Ghafouri study in 67.5% of patients was carried out an abdominal CT [17]. In our clinical practice we found that the percentage of abdominal CT performed was higher compared to the literature data in fact, 81.7% of patients admitted in ER for abdominal trauma required an abdominal CT with contrast. However, the performed CT showed a greater number of abdominal organs injuries (with a positive result in 58.1% of cases) than reported in the literature. In hemodinamically stable patients in selected cases when Ct is diagnostic for injury laparoscopy can be employed with curative intent thus avoiding unnecessary laparotomies [22]. During the last Years for Currently the NOM of abdominal blunt trauma is the most common treatment for 85%, 70-90% and 85% of splenic [23-27], hepatic [28-33] and renal injuries respectively, as confirmed by Tinkoff's assessments data at the American Trauma Data Base [34]. Raza et al. show a percentage of patients with abdominal trauma who underwent NOM reaching 89.9%, NOM failure occurred in 10.08% of cases [35]. In literature, the liver trauma success rate is more than 90% [36,37], splenic trauma success is more than 80% as reported [11]. In a Boese et al. systematic review was detected a NOM failure rate of 9.5% (with percentages varying among the studies from zero to 24%) [39].
According to what above reported, 65% of our cases (39 patients) underwent NOM, 82% of them was treated with medical therapy alone and 18% with endovascular treatment only. The NOM failure occurred in 2.5% of cases. From literature data emerges that the surgical treatment, according to the principle of DCS, is the best approach reducing post-operative mortality rate of patients who need an immediate resuscitation in the ICU for prevention and eventually treatment of "Trauma's Lethal Triad" (hypothermia, coagulopathy and [40]. In literature, with regard to patients undergoing surgical treatment, there are percentages ranging from eight to 51.9% [11,41,42]. In our study, no patient underwent DCS, although 26.7% of cases (16 patients) underwent urgent abdominal exploration (three patients underwent emergency surgery and 13 received an urgent surgical treatment); these values are in conformity with those reported in the literature. The treatment of severe abdominal trauma concludes with the "Tertiary Survey". The American College of Surgeons' ATLS course provides guidelines for both diagnosis/treatment of injuries that pose an immediate threat to the life of the patient and a systematic detection of lesions to be treated definitively. However, a number of injuries can result missed at the first assessment; in the literature it is shown a variable percentage of missed injuries between 1.4% and 14% [43]. In our study, 3.3% of patients presented missed injuries; a patient was diagnosed with a perforated colon while he was hospitalized in ER Observation Unit and one patient was diagnosed with pneumothorax while he was hospitalized in inpatient department; these data are in conformity with the lowest values among those reported in the literature. Yadollahi et al. [44] analysed the intrahospital mortality for trauma showing a peak in the first 24 hours (41.6%) and another after 24 hours (58.6%). The study shows no differences in the distribution of mortality in both genders, but it points out that the elderly has a higher late mortality, while young people has a greater mortality in the first 24 hours. Even the trauma dynamics affect the temporal distribution of mortality; In fact, trauma due to gunshot wounds and aggression has a higher early mortality rate, while road accidents and falls has a later mortality. Gad et al. reported a mortality for abdominal trauma of 25.8%, with a higher prevalence for penetrating trauma than blunt [43].

Lund et al. reported a mortality superior to 56% in hemodynamically unstable patients with abdominal lesion treated with emergency laparotomy, especially in those with BP ≤ 60 mm/Hg [45]. Costa et al. reported a general mortality for abdominal trauma of 24.1% and 31.2% for severe trauma (ISS> 15 [11]. According to literature, in our analysis the mortality of patients with major abdominal trauma was 13.3% (8.3% in ER, 1.7% in OR, 3.3% in ICU, no deaths in Inpatient), during the first 24 hours and no later mortality. Of the patients who died in ER, two died after one hour, 2 after 2 hours and 1 after 3 hours from the admission to the ER. The mortality of unstable patients was higher than that reported in the literature; it is likely due to the higher speed with which the traumatized patients are transported to Terni Hospital's ER in relation to a minor extension of the of 118's territory competence. The mortality of stable patients was 3.7%. The causes of trauma in patients who died were: 50% of cases motor vehicle collision, 12.5% aggression and battery, 12.5% domestic accident, 12.5% industrial accident and 12.5% fall from height. Some studies reveal that the mortality for trauma is greater during the night; Egol et al. recorded a greater relative risk of hospital mortality between 6pm and 6am than between 6am and 6pm despite an equivalent distribution of the trauma severity in 24 hours [46]. This disparity in mortality rates between day and night may be due to a greater exhaustion of the staff with an increased risk of error. It was demonstrated that the circadian rhythm disorders determine a decrease in performance [47]. There are also studies on ER physicians, which, while not pointing out a fall in performance during the night shift, show a slight increase of early mortality rate [48]. Another possible reason for these data could be a reduced number of shift workers during the night shift [46]. Carmody et al. showed significant difference in terms of mortality among patients hospitalized during the daily time and those hospitalized at night of 10.1% and 13.1% (P <0.01) respectively, however, there is a difference in the number of admissions, severity and trauma dynamics of the two groups [49]. In our study we recorded a mortality rate of 10% between Monday and Friday and 3.3% on weekends; daytime mortality (8am-8pm) was 8.3% while in the night (8pm-8am) was 5%. Dalton et al. showed a greater mortality rate in patients operated at night (7%) compared to those made during the daytime (2.6%) [50]. Instead Zafar et al. revealed no significant differences in mortality among patients undergoing surgery during the day and night [51]. In our study, 6 patients were operated at night and 10 in daytime; all patients who underwent surgery at night died. This analysis shows that, even at night and on weekends, our Emergency System maintains the same quality standards and gives the same results compared to some studies whose reported results show worsening in terms of mortality [49] (Table V and VI).

Conclusions

From our analysis comes to light a higher number of abdominal trauma in the elderly, it is probably due to a greater number of elderly in our community compared to the number mentioned in literature. In addition, there was a significant conformity to the protocol by staff's members; in fact, the indicators relating to the frequency

TABLE V - *Comparison between our experience and literature on conformity to the protocol.*

Conformity indicator	Our experience	Literature
Number of abdominal trauma	4,4%	Costa et al. [11]: 9.3%
Number of emergency tracheal intubations	6,4%	Eastern Association For The Surgery of Trauma [13]: 13,6%
Number of chest drains	6,4%	Davis et al.[14]: 8,5%
Number of hemodynamically unstable patients	6,4%	Collège Français de Chirurgie Générale.[15] 5%
Number of FAST	38,7%	Sheng et al [16]: 28,3%
Number of TC	81,7%	Ghafouri et al. [17]:67,5%
Number of surgical treatment	26,7%	Costa et al. [11]: 51,9%; Garber et al [21]: 36,7%
Number of NOM	65%	Costa et al [11] : 48,1%; Raza et al [35]: 89,9%

TABLE VI - *Comparison between our experience and literature on protocol effectiveness*

Effectiveness indicator	Our Experience	Literature
NOM failure	2,5%	Boese et al [39]: 9,5% (0-24%)
Number of missed injures	3,3%	Biffl et al [43]: 1,4-14%
Overall mortality	13,3%	Costa et al [11]: 24,1% Gad et al [12]: 25,8%
Daily Mortality	8,3%	Carmody et al [49]: 10,1%
Night Mortality	5%	Carmody et al [49] 13,1%

of chest drains placed and number of patients undergoing NOM were concordant with the literature. On the other hand, we detected discordant data with respect to the indicators related to the frequency of performing examinations as Eco FAST, chest X-ray, CT abdomen and DCS. Finally, we found a smaller number of emergency tracheal intubations without any cricothyroidotomy. As for the effectiveness indicators, we found similar results to the literature in terms of missed injuries and the overall, daily and weekend mortality. In our experience, the best results compared to literature were found regarding the FAST sensitivity in unstable patients, the sensitivity CT in stable patients and the lower incidence of: NOM failure, mortality in stable patients and night mortality [52-54]. In conclusion, we can assert that in the two years of the diagnostic, therapeutic and health-care management's application at Terni Hospital, there was a good conformity to the protocol and therefore there were good results in terms of effectiveness.

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Riassunto

INTRODUZIONE: I traumi sono la quarta causa di morte nel mondo e interessano prevalentemente persone sotto i 45 anni. In particolare i traumi addominali portano all'exitus circa il 7-10% dei pazienti traumatizzati. Obiettivo di questo studio è valutare l'efficacia del protocollo diagnostico-terapeutico per il trauma addominale maggiore.
PAZIENTI E METODI: lo studio di natura prospettica è stato registrato presso l' Azienda Ospedaliera S. Maria Terni (DGR n. 159) a Febbraio del 2014. Sono stati arruolati tutti i pazienti giunti presso la Strutture con la diagnosi di trauma addominale maggiore da gennaio 2015 a dicembre 2016. I parametri demografici e comorbidità dei pazienti, il tipo di trattamento applicato, differenziando tra operativo e non operativo (OM-NOM), la mortalità ed efficacia delle procedure diagnostico-terapeutiche sono stati analizzati.
RISULTATI: La maggior parte dei pazienti erano anziani. I membri dello staff multidisciplinare che ha accolto i pazienti al Pronto Soccorso hanno operato rispettando il protocollo per la gestione del trauma addominale. Il trattamento non operativo è stato attuato nel 63% dei casi, in accordo con i dati della letteratura. D'altro canto le principali procedure diagnostiche ovvero l'ecografia FAST (Focused assessment with ultrasonography for trauma), la radiografia del torace e la Tomografia Computerizzata (CT) sono state impiegate in tendenziale discordanza con la pratica più diffusa presente nella stessa letteratura. Nessun paziente è stato sottoposto a chirurgia di controllo del danno (damage control surgery -DCS). Il numero di mancate diagnosi (3.3%) e la mortalità globale (13.3%), insieme con quella giornaliera e durante il fine settimana sono risultate non si sono discostati da quanto riportato dalla letteratura. Nella nostra esperienza l'ecografia FAST per i pazienti instabili e la CT nei traumatizzati instabili hanno dato ottimi risultati in termini di sensibilità. Gli unici fallimenti del trattamento non operativo che complessivamente sono risultati inferiori alla media generale mondiale hanno riguardato i pazienti sottoposti a trattamento endovascolare (14.4%). La mortalità notturna e nei pazienti stabili sono rimaste anche esse sotto la media. (2.3% e 5% rispettivamente).
CONCLUSIONI: I dati raccolti propendano per l' efficacia del protocollo di gestione del trauma addominale. Altri studi sono necessari per rafforzare questo modello organizzativo.

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