EMERGENCY MANAGEMENT OF MULTIPLE TRAUMA PATIENTS IN A LEVEL I TRAUMA CENTER: "TIME" AS A QUALITY ASSURANCE

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SUMMARY

Background: We aimed to find out the present level of trauma care in our ED by evaluating time to determine standards of our trauma care and compare these standards with advanced trauma centers.

Methods: Between January 2002 and May 2002, 104 multiple trauma patients (age>15) bearing criterias for trauma team activation in advanced trauma life support (ATLS) protocols were randomly included in the study. Time needed to perform the routine trauma x-rays (lateral cervical vertabra, AP chest, AP pelvis radiographies), abdominal ultrasonography (USG), laboratory tests, if indicated cranial computerized tomography (CCT) and the length of stay (LOS) in the ED were recorded.

Results: Patients who needed emergency surgery were taken to the operation room within 30 minutes compatible with objective time of advanced trauma centers. The x-rays, abdominal USG, laboratory tests of all patients and CCT if required were performed within mean 47±20 minutes, 56±27 minutes, 91±23,5 minutes and 98±30 minutes, respectively. The average LOS in the ED was 162±87 minutes.

Conclusion: As a result, total ED stay of a multiple trauma patient in our ED was found to be significantly longer when compared to that of advanced centers. In constant quality improvement, assessment of structural features and the methods used, on the basis of lost time is a parameter that is important but not sufficient.

Key Words: Emergency department, multiple trauma, quality assurance, trauma management.

BIR DÜZEY I TRAVMA MERKEZİNDE MULTİ TRAVMALI HASTALARIN ACİL SERVİS YÖNETİMİ: KALİTE KONTROL KRİTERİ OLARAK "ZAMAN"

ÖZET

Giriş: Acil serviste multi travması olan hastaların tıbbı bakımlarındaki kalite düzeyimizi saptamak için zaman kaybını yani 'süreyi' seçerek bu açıdan travma bakım kalite standardımızı belirlemek ve gelişmiş travma merkezlerindekilerle karşılaştırmayı hedefledik.

Gereç ve Yöntem: Prospektif ve randomize olarak yapılan çalışmaya, Ocak-Mayıs 2002 tarihleri arasında ATLS protokollerine göre travma ekibi aktivasyon kriterlerine uyan 15 yaş ve üzeri 104 travma hastası alındı. Yapılan radyolojik travma rutinlerinin (yan servikal vertebra grafisi, ön-arka akciğer grafisi, ön-arka pelvis grafisi, abdominal ultrasonografi (USG)) ve endikasyonu varsa kranial bilgisayarlı tomografinin (BT) yapılma süreleri ile rutin travma laboratuar tetkiklerinin sonuçlanma süreleri ve acil serviste toplam kalma süreleri saptandı.

Bulgular: Acil ameliyata alınması gerekli hastalar gelişmiş travma merkezlerince hedeflenen süre olan 30 dakika içerisinde ameliyata alındı. Tüm hastaların ortalama x-ray grafileri 47±20 dakikada, kranial BT 98±30 dakikada, abdominal USG 56±27 dakikada ve laboratuar tetkikleri 91±23.4 dakikada elde edildi. Hastaların acil serviste toplam kalma süreleri ortalama 162±87 dakika olarak saptandı.

Sonuç: Multitravması olan bir hastanın acil servisimizde toplam kalış sürelerini gelişmiş merkezlerle karşılaştırdığımızda belirgin olarak daha uzun saptadık. Sürekli kalite geliştirmede önemli olan yapısal özelliklerin ve kullanılan yöntemlerin zaman kaybı açısından ve belli bir süre için değerlendirilmesi önemli bir kriter olmasına rağmen, tek başına yeterli bir kriter değildir.

Anahtar Kelimeler: Acil servis, multitravma, kalite kontrol, travma yönetimi.

As it is the case for the world, it is a fact that the required attention is not attached to trauma in our country, too, although it leads to deaths or being handicapped, it has destructive impacts on the socioeconomic structure of the country, and it gradually turns out to be a worldwide epidemics [1].

In order to have a high standard in providing care to trauma patients, continuous quality control is a must. Within the framework of quality control, the trauma patient should be defined and algorithms should be developed for such patients [2]. During the recent years, an algorithm called "Advanced Trauma Life Support, ATLS" developed by American College of Surgeons has been applied. Reduction in preventable morbidity and mortality, and shortened length of stay (LOS) hospitalization can only be realized through improved trauma care quality.

Main factors of health care quality management specified by Avedis Donabedian are structural status, process and outcomes [3-6]. Structural status comprises adequacy of all medical equipment and apparatus, and laboratory tests and radiological studies employed in all stages of patient care, as well as performance of physicians, nurses and other health personnel. Process refers to procedures that are / are not carried on by making use of the possibilities of the structural status, and the measures taken. Outcomes, on the other hand, includes elaboration on the results drawn from care. Examples of outcomes are cost, lost time, charge and patient satisfaction [4,5].

Emergency department (ED) is a division that is suitable for studies on quality assessment and improvement. "Time" is an important factor in the management of multiple trauma patients in the ED. For this reason, in this study, we took up the time factor as an important parameter of quality assurance. Before applying the principles of quality assurance to improve trauma care, trauma centers have to assess first their situation. We aimed to find out the present level of trauma care in our ED by evaluating time to determine standards of our trauma care and compare these standards with advanced trauma centers.

MATERIALS AND METHODS

This prospective and randomized study was conducted in a university teaching hospital ED with an EM residency program and a volume of over 25,000 annual visits between January, 2002 and May, 2002. The hospital is located in Bursa, which is the fourth largest city of Turkey with over 2 million persons, and is the only hospital with level I trauma center facilities in the South Marmara region. In our country, prehospital trauma patient care is provided by 112 emergency care system depending on Ministry of Health and then transported to hospital. However, this system is not mature yet and still developing. A triage system appropriate to Advanced Trauma Life Support (ATLS) program is not being fully operated due to social-economic problems (especially financial problems, problems regarding the capacity of the hospital and training problems). Therefore the patients given in *Table 1* appropriate for ATLS are accepted as serious trauma patients and primer and seconder surveys are completed multidisciplinary in our center.

Multiple trauma patients over the age of 15 and having the criteria in *Table 1* were randomly included in the study. Patients applied to the ED exceeded 24 hours after the trauma, isolated burned patients and dead on arrival were excluded from the study. The study protocol was approved by the hospitals' Institutional Review Board. The trauma team (General surgery residence in charge at the ED and emergency medicine residence within work hours, general surgery senior attending physician and emergency medicine attending physician within night shifts) was activated for all patients. The time elapsed until the trauma team and the team leader attended to the patient was recorded. Whether the ED have been informed of the patients before they arrival at the department, means of transportation to hospital (by ambulance, accident witnesses, other) and the place of departure (place of the incident, transfer from another hospital) were noted. The type of the trauma was marked as blunt (motor vehicle collision, pedestrian trauma, fall from heights, etc), penetrating trauma and other.

Patients were categorized as *Group I, Group II and Group III*.

Group I: Multiple trauma patients have life-threatening problems (usually airway and circulation), and who presented unstable hemodynamics and who did not respond to resuscitation during the primer survey (example: hemorrhagic shock, phase 3-4). The expected disposition time is within 30 minutes for such patients in advanced trauma centers [9].

Group II: Patients have urgent but not life-threatening problems (resuscitation is succesful, but surgical procedure needed). The expected disposition time is to operate on such patients or to take them to intensive care unit (ICU) within 2 hours [9].

Group III: Trauma patients with stable hemodynamics (example: isolated extremity fractures). The expected disposition time (admission or discharge) is within 4 hours [9]. A disposition is defined as the patient being either released or admitted to our hospital unit (operation room (OR), ICU, and clinics)

Time to perform routine trauma x-rays (lateral cervical spine radiography, AP chest radiography, AP pelvis radiography) and abdominal ultrasonography (USG) and for cranial computerized tomography (CCT) if relevant symptoms were recorded. Additionally, time to obtain routine laboratory tests concerning trauma (Complete blood count, sodium, potassium, AST, ALT, urea, creatinine, glucose, electrolytes, blood group and complete urine analysis), and LOS in the ED were recorded. Finally, the patients' dispositions (discharge, admission, transfer to another medical facility, death in the ED) were noted. All the data were entered to SPSS 10.0 computer program. In statistical analysis Kruskal-Wallis, Mann-Whitney U, Variation Analysis and Student-t test were used. Results were expressed as mean ± standard deviation (SD). A $p<0.05$ was considered as significant.

RESULTS

Of the 104 patients included in the study, 24 were females

Table I: Summary of the Uludag University Medical School Hospital trauma protocol inclusion criteria

Criterion	Details
Disturbed physical parameter	RTS<11, PTS<9, GCS<13
	Systolic blood pressure <90 mmHg, Respiratory rate<10 or >29
Penetrating injuries	All penetrating trauma to head, neck, thorax, abdomen, and extremities proximal to elbow and knee
Specific blunt injuries	Injuries in more than two regions
	Two or more proximal long-bone fractures Amputation proximal to wrist/ankle Unstable fracture of pelvic ring Spinal injuries Flail chest
High-energy trauma	Automobile crash>40 km/h
	Major auto deformity Bicycle/moped/pedestrian vs. automobile Fall >3 m Death of other crash victim Ejection from auto

RTS, Revised Trauma Score; GCS, Glasgow Coma Scale; PTS, Pediatric Trauma Score.
a The inclusion set is designed to include all patients with reasonable chance of severe injuries likely to require the attention of the trauma team.

(23%) and 80 were males (77%). Average age was found out to be 33 (15-58) for females and 32.7 (16-76) for males. Of the patients 26% (27 patients) arrived during work hours, while 29% (30 patients) arrived out of work hours during work days, and 45% (47 patients) arrived during weekends or holidays. We were informed beforehand only at 20% of the patients . Of the patients, 84% (87) were brought to the ED by ambulances and 16% (17 by accident witnesses. 44 patients (42%) were brought from the place of incident while 60 patients (58%) were transferred from another hospital. The trauma team leader attended to the patient within less than five minutes in 97 cases (93%) while this was more than 5 minutes but less than 10 minutes in 7 cases (7%).Of the patients, 89 (85.5%) were subjected to blunt trauma and 15 (14.5%) to penetrating.

Mean Glasgow Coma Scores (GCS) and Adult Revised Trauma Scores (RTS) were 7.7±4.6 and 5.5±3 respectively, for Group I patients, and these scores were quite low when compared to the other two groups (GCS 12.3, RTS 10.3 for Group II, GCS 14.6, RTS 11.9 for Group III) . Mean GCS and RTS for all patients were found out to be 13.8±3 and 11.2±2 respectively *(Table-2)*.On the basis of the severity of the injury, 7 patients (7%) were categorized as Group I, 17 patients (16%) as Group II and 80 patients (77%) as Group III.

Routine trauma x-rays were performed within 47±20 (14-143) minutes in all patients. Laboratory tests were obtained average time 91±23.5 (46-170) minutes. Of the 86 patients with blunt trauma, 83 were performed to abdominal USG and the remaining 3 patients to diagnostic peritoneal lavage (DPL). The average USG time for the 83 patients was 56±27 (10-165) minutes. It was found to be 69.4±34 (15-165) minutes for those patients who arrived during work hours and 52.2±25 (10-143) minutes for those patients who arrive out of work hours. When compared statistically, it was concluded that USG was completed in considerably ($p<0.05$) less time out of work hours. 27 patients were underwent to CCT. Performing CCT took 98.3±30 (47-165) minutes.

23 patients (22%) were discharged from the ED, 20 patients (19%) were directly transferred from the ED to OR while 19 (18%) and 25 (24%) patients were admitted to the ICU and clinics, respectively. 16 patients (16%) were referred to other hospitals, after hemodynamic stability was restored. One patient (0.96 %) died at the ED. The average LOS in the ED was found to be 162±87 minutes. This time was 32.5±14.6 minutes for Group I patients, while it was 162±109.7 minutes and 173.5±77 minutes for Group II and Group III patients, respectively. The average LOS in our ED of all trauma patients in comparison to the upper limit of the expected disposition time (9) is given in *Figure-1*. Although, not statistically significant, those patients, the arrival of whom, were informed beforehand (141±91 minutes), stayed 26 minutes less than the group of patients that we were not informed beforehand (167.5±86.6 minutes) ($p>0.05$).

Tablo II. GCS and RTS results of patientsby groups

Group	GCS	RTS
Group I	7,8	5,6
Group II	12,3	10,3
Group III	14,6	11,9
Mean	13,8	11,2

DISCUSSION

It has already been proven that implementation of continuous quality improvement in hospitals results in increased patient treatment quality and increased profitability [3,10,11]. Since patients with multiple trauma need a systematic, multidisciplinary and standard approach within a short time, quality control is a must, particularly

for such patients, so that adequate and suitable care can be given to them [12]. Setting out on the basis of this principle, we aimed to assess our structural status by studying the "time" parameter. During the study, the trauma team leader could attend to the patient within less than 5 minutes in 93% of the cases and was later than 5 minutes in 7% of the cases. The time elapsed until the team leader attended to the patient did not exceed 10 minutes although the ED was not informed of any of these patients. Following a study on quality management by Nast-Kolb et al, the time elapsed until the trauma team arrives at the trauma resuscitation room was reduced from 10 to 3 minutes [3]. The target is arrival of the trauma team leader at the trauma resuscitation room at the time of or before the arrival of the trauma patient [3]. In order to attain this target, informing the ED of the patient before her/his arrival is a prerequisite. In our study, the ED was informed of only 20% of the patients before their arrival. The reason for that is the lack of a communication line (a wireless telephone line independent from the pbx of the hospital) between our center, and other hospitals and emergency medical services (112 call center), and the lack of a beeper dedicated to the trauma team leader.

According to the trauma care principles applied in Trauma Centers in the United States, Group I patients are taken to definitive treatment units (OR, ICU) within less than 30 minutes. Admission to a clinic or an ICU, or discharge of Group II and Group III patients upon completion of their treatment in the ED within 2 and 4 hours, respectively, is a common practice in the trauma centers [9]. In our center, treatment of Group I and Group III patients in the ED could be completed within the expected disposition times, however this time was longer than expected for Group II patients.

The average LOS of all trauma patients in the ED was found to be 162±87 minutes. This time is reported to be 129 minutes in Germany, 125 minutes in Switzerland and 116 minutes in the USA [13]. Other authors also mention such shorter periods between 31-75 minutes but such data are relevant to the primer survey in the trauma resuscitation room and the resuscitation stage, and the time spent for the additional examinations and interventions (like x-ray, CT) made in the ED is not included [13]. The factor that had the most significant impact total stay of a multiple trauma patient in the ED was obviously the time spent for the radiological studies. The ideal situation is conducting such routine radiological studies in the resuscitation room within the ED [7,14-16]. In our study, routine trauma radiological studies were taken in the conventional radiology room, which is 50 meters away from the ED since there was no portable x-ray device in the trauma resuscitation room. The average time to obtain routine trauma x-rays was found to be 47±20 minutes. Waydhas et al. reduced this period from 24 to 14 minutes following the quality improvement studies they conducted [17]. The average time to obtain the laboratory tests was found to be 91±23,5 minutes. This period was reduced from 50 to 24 minutes following the quality improvement studies conducted by Waydhas et al [17]. The main reason behind such delay in our center is that there is neither an automation system, nor a personnel in charge of bringing the samples to be examined to the laboratory and the results to the physician, and the samples and results are brought by relatives of patients.

Performing abdominal USG took 56±27 minutes. Nast-Kolb et al [3], Waydhas et al [17], Ruchholtz et al [18] report this time as less than 20 minutes, however in these studies abdominal USG was applied in the trauma room. In our hospital, on the other hand, during work hours, patients with stable hemodynamics are performed USG in the radiology department, which is quite far from the ED and is at the underground level floor, and out of work hours in the room of the radiologist on duty within the ED. For patients with unstable hemodynamics, the radiologist on duty comes to the ED and the ultrasonography device is also brought to the ED, and then the patient is performed USG. When the time spent for USG for patients that came on work days was compared to the time spent for those who came out of work hours, the time spent out of work hours was significantly shorter. The reason for that was the close proximity between the room where the radiologist on duty stays and where USG is applied, and the ED. If there were a mobile USG device in the ED we could obtain results close to those stated in the literature.

In the present study, the average time to perform CCT was found to be 98,3±30 minutes. In a study they conducted, Zintl et al [13] reported this period as 55 minutes on the average. Aufmkolk M. et al., on the other hand, reported less than 60 minutes in a multi-center study they conducted [19]. In another study, Nast-Kolb et al. reported that the time spent for CT was reduced from 41 to 32 minutes on the average after the CT room was moved near to the resuscitation room from 30 meters away [4] The reason for the finding that significantly much time was spent for CT when compared to other studies is that, CT room and the ED are located at two points of the hospital which are quite far away from each other (12-15 minutes on the stretcher). The time spent will obviously decrease in case that a CT room is included in the ED.

In the light of the three main factors set forth by Donabedian and on the basis of the time parameter, our trauma care and management quality can be assessed as follows and the following suggestions can be made:

1) As regards the structural status, if a portable x-ray and a mobile USG device provided in the ED, if a personnel is assigned for bringing test samples to the laboratory and to receive the results or otherwise if a network is installed and the results can be seen on the monitors as soon as they are ready, and if the CT room is placed in the ED, the duration, which a critical factor in approaching to trauma patients, will be shortened which will result in reduced mortality and morbidity.
2) As regards the process, in order to assess the quality of trauma care and management, and to achieve increased quality, procedures that are carried on but unnecessary and procedures that are not carried on although they are necessary should be determined also considering the availabilities of the structural status. To this end, diagnostic and treatment protocols and algorithms for trauma patients should be developed. Procedures that are / are not carried out concerning the trauma patient should be marked on pre-designed

quality forms by someone who will be independent from the trauma team or such procedures should be recorded by video cameras, and all these should be assessed by a trauma assessment committee.

3) As regards the outcomes, establishing a trauma care evaluation committee that would assess the quality of patient care frequently; holding periodic meetings with that committee, the trauma team and the hospital administrators; and organizing educational programs for all the personnel involved may help futher in the continuous quality improvement of the trauma care.

In conclusion, we compared our quality standard with that of the advanced trauma centers on the basis of only the "time" parameter, and defined a standard for our ED. However, it is not sufficient to assess the structural factors that are crucial and process employed for continuous quality improvement on the basis of only the lost time. Structural factors and methods employed must also be continuously assessed on the basis of such parameters as adequacy of the employed care algorithms, adequacy of the training level of the trauma team, comparative study of mortality-morbidity results, cost analysis and patient satisfaction. Thus, both a better definition of the quality standard in the ED for approaching patients with multiple trauma, and a gradually and continuously increasing quality level could be attained.

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