

## Golden hour – early postinjury period

Algimantas Pamerneckas, Andrius Macas, Dinas Vaitkaitis, Algimantas Vaitkaitis,  
Rima Gudėnienė<sup>1</sup>

Kaunas University of Medicine, <sup>1</sup>Kaunas Emergency Station, Lithuania

**Key words:** golden hour, multiple injury, high energy injury.

**Summary.** *Quality and adequacy of specialized first aid for patients affected by high energy trauma is extremely important factor in order to reduce postraumatic disability and mortality of polytrauma patients. Treatment strategies for high energy trauma management are in early stages of development. Adequate aid can be rendered only in a few centers of Lithuania. Pre-hospital and very early hospital stages of patients with high energy trauma, which significance is proven, are unsatisfactory and inadequate.*

*A retrospective study was performed in order to analyze efficacy and adequacy of pre-hospital (Kaunas Emergency Station, KES) and very early hospital (Kaunas University of Medicine Hospital Emergency Room, ER) management stages for 53 patients affected by high energy trauma and admitted to Kaunas University of Medicine Hospital during the period of 2001–2002. Averaged injury severity score, according to ISS, was 21.3, mortality rate was 34%.*

*It was established long duration of pre-hospital and early hospital stage of management (accordingly  $34 \pm 6.5$  and  $50 \pm 17.2$  minutes), extremely rare monitoring of vital signs in pre-hospital stage (breathing was evaluated for 1.9% of patients, heart rate for 26.4% of patients). Fluid therapy as a part of complex treatment was applied for 7.5% of patients in pre-hospital stage and 3.8% in very early hospital stage.*

### Introduction

In 2001 mortality rate of Lithuanian citizens due to accidents, injury and poisoning made up 13.6 % of the total mortality rate (next after deaths from diseases of the circulatory system and malignant neoplasms). Among the deaths due to injury - 68% account for able-bodied population, 26% – for pensioner people, and 6% – for children under 15 years of age. In 2001 the number of people who died due to accidents, injury and poisoning was 5498 (157.9/100000) (1). Casualty rate falling on 100 severe injury cases in Lithuania (14-19 people) 4 to 10 times exceeds analogous rates as compared to foreign countries (3). Data, reported by the Lithuanian Health Information Center for 2000, show that our country, according to common standardized male and female mortality rates due to accidents, injury and poisoning was in the 30<sup>th</sup> place among 35 European countries, significantly lagging behind of the average rates and remaining in a slightly better situation as compared to Russia,

Estonia, Latvia and Ukraine.

Mortality due to injuries depends on many factors, including rendering adequate medical aid. In some countries (the USA, Germany, Switzerland, Scandinavian countries) regional systems for trauma-case management have started operating since seventies or eighties of the 20<sup>th</sup> century. They are of a double purpose: to improve the process of medical care and to reduce mortality (4). Rational organization of trauma centers allows reducing mortality almost by half, especially in cases of high-energy injury (5, 6). In these cases several body regions are injured frequently. Patients with multiple injuries cause a lot of trouble in regard to diagnostics and treatment. While analyzing peculiarities of multiple injury management, firstly the selection of cases to be analyzed turns out to be a complicated issue. Lack of defined and uniform evaluation criteria of a status of such patients and the severity of their injuries sustained at different spells of time prevents a more detailed epidemiological analysis

of each case.

The community is rather ignorant and not adequately informed about important life-saving features of their injured members. Only consistent analysis of medical aid provision for the traumatized may feature optimal way for changing the actual situation.

*Goal.* To evaluate the early stage (the 1<sup>st</sup> hour after an injury) medical aid rendering characteristics for patients affected by a strong blunt kinetic energy.

*Concepts.* In the daily practice of the Western Europe, Scandinavian countries and the USA, which is rather strictly regulated by standards and Good Medical Practice requirements, the concepts of "golden hour" and high-energy trauma are applied (7-9). They both are very important from the point of view of medical as well as organizational aspects.

It is well known that mortality due to injuries is specific for its trimodular distribution (10). The first and the most considerable mortality peak makes more than half of traumatic deaths mentioned. The traumatized die on accident sites because of severe head, spinal column, heart and major blood-vessel injuries sustained. The progress in injury case management does not have influence on these mortalities. Since these death rates depend on severity of injuries, the number of their occurrence could be reduced only through effective injury prevention. Therefore it is important that those medical people, who do not face injury cases on everyday basis, should understand injury prevention concerns. The second peak regards the early deaths within the first-hour interval after an injury. The third peak accounts for late deaths, which occur after several days or weeks of an injury sustained, most often due to Multiple Organ Failure (MOF) or sepsis (11). Rationally organized and qualified medical system may reduce the second and the third peak related mortality rates (6).

*"Golden Hour"*. If a severely injured is not rendered emergency surgical help, the opportunity of a positive outcome critically lessens. This 60-minute post-trauma period is called the "golden hour". This term was introduced by R. Adams Cowley (12, 13) and is based on research that states that rendering an in-patient medical help for severely injured patients statistically increases their chances for survival. The concept of "golden hour" is relevant ever since because its importance in rendering emergency aid for severely injured is emphasized in the most updated standards (14). Experimental

research has been carried out in attempt to study the possibility to preserve vital functions for more than an hour (15). Such studies and status comparison against universally accepted standards are of an unquestionable practical value, since each country's health care provision has got its specific traditions and peculiarities.

High-energy trauma (10):

1. "Shooting off" a vehicle,
2. Death in a passenger compartment,
3. Knocked-down or run-over pedestrian,
4. A vehicle speed over 60 km/h,
5. Drastic vehicle deformation >50 cm,
6. Deformation inside a vehicle >30 cm,
7. "Pull-out" time >20 min.,
8. Falling from height >5 m,
9. A motorcycle accident when 30km/h speed is exceeded.

High-energy (or high kinetic energy) concept is used to choose management tactics while rendering pre-hospital medical aid in a trauma case. It is proven that during a high-energy trauma internal organs (liver, spleen, kidney, intestines) are frequently injured. These injuries are difficult to diagnose under non-hospital conditions. Besides, their treatment needs qualified trauma management that may involve several professionals. Therefore, according to the ATLS (Advanced Trauma Life Support), in case of such injury, it is recommended to transport the injured directly into a specialized (multiprofile) Trauma Center without any delay, avoiding any lower range hospitals (10). Since the time interval is a very important factor, statement of the right diagnosis is even less important than choosing the right transportation direction.

### Materials and methods

Analysis of diagnostics and treatment peculiarities at Kaunas University of Medicine Hospital (KUMH) during the period 2001-2002 (T 00- T 007 under TLK-10) was made. Cards of the official cases "StatisticCards of the Discharged" (F.006/a-LK) were selected with one of the injuries on a skeleton sustained. Such patients were brought by Kaunas Emergency Station (ES) transport and hospitalized at KUMH. Their "Clinical Histories" (F. No. 003/a) were ascribed to "Announcements about Patients Sent by KES" (F No. 114-1/a) alongside with all the documented actions of ES.

The patients, selected according to these criteria, were described according to their age and sex,

dominating injuries severity and the latest treatment results. For evaluation of the patients' condition the Injury Severity Score (ISS) and Abbreviated Injury Scale (AIS) were applied (16). Also the analysis of patients admittance to a hospital and the duration of staying at KUMH Receptions Department (HRD) as well as the number of consultants invited has been assessed.

Since it has been acknowledged that the "golden hour" has a determinant impact on high-energy trauma patients' survival, medical actions of ES and those at HRD were evaluated. While analyzing medical documentary actions that should be performed and registered according to the existing Standards and Good Medical Practice principles in cases of medium and severe injuries (ISS>15), the evaluation of vital functions (respiratory, cardiovascular and consciousness) as well as prescribed procedures (additional oxygen, peripheral vein catheterization, intravenous infusion, catheterization of urinary-bladder) were considered.

Statistic analysis has been performed according to SPSS program. To test statistic hypothesis, t- and z- tests have been used and 95 percent trustworthy intervals have been applied. The difference between groups, when  $p < 0.05$ , is considered statistically accountable.

### Results

In 2001-2002 over 300 multiply injured patients were treated at KUMH. Fifty-three cases, consistent with our established criteria, were selected for analysis. Average age of the analyzed group was 47.3 years, 66% of them – men (Table 1). It was documented that 68% of the patients sustained high-energy injuries, in other cases such trauma mechanism was predicted but not clearly indicated (e.g. "found on the road"). It is worth mentioning that most common cases are observed among employable and young people (2 out of 3).

While selecting for analysis, cases of suspected

skeleton injury according to ES committal was one of the criteria. According to the final diagnosis the injuries of this part of the body made 90.6% of all the cases. The fact that five patients (9.4% according to "final diagnose") were not reported to have skeleton injuries, allows imagining that precise diagnosis (and even suspicions) about such injuries are difficult to diagnose even for a medical person working within ES.

Almost 2/3 of high-energy injury patients have sustained simultaneous skeleton, neck (86.8%) and chest (60.4%) traumas. The injuries of these anatomic regions according to the AIS scale are evaluated by 3 score (Table 2). Having evaluated the severity of injuries of the selected group according to ISS, the average injury reached 21.3. Mortality rate within the analyzed group was 34%.

An average response time from registering calls at ES to a patient's arrival at HRD is  $34 \pm 6.5$  min; average stay at HRD -  $50 \pm 17.2$  min.

Patients' long stay at HRD should be questioned: "why is it so long?" Majority of such patients (81%) are directed from HRD to a mother-hospital only after consulting specialists examine a patient and the latter are stated pathology (diagnosis) within their own specific professional area. Finding no particular injury on a specific area and observing no deterioration of patients' status, they are kept at HRD and are awaiting further consultancy (Table 3).

Having compared procedure rate of ES brigades vs. HRD, it is apparent that ES tends to evaluate high-energy trauma patients' consciousness, respiration, pulse and arterial blood pressure more rarely (Table 4). The fact that among 53 high-energy trauma cases at ES only one patient's breathing function was measured speaks for itself. The main vital function (breathing) is undervalued and, therefore, is not guaranteed. Infusion therapy was applied by ES only in 7.5% of cases (4 patients) while additional oxygen was not given at all. These

**Table 1. Distribution of patients according to sex and age.**

Sex	Number of patients, % n=53	Average age	95 % confidence interval	
Females	34	54.4	45.0	63.8
Males	66	43.9	38.1	49.6
Total	100	47.4	42.4	52.5

**Table 2. Rates of injuries and evaluation of their severity at very early hospital stage (HRD)**

Injured region (acc. to ISS)	Injury rate (n=53) %	Injury severity score (acc. to AIS)		
		average	95 % confidence interval	
Head	86.8	2.9	2.65	3.22
Face	13.2	1.4	0.93	1.92
Chest	60.4	2.3	2.08	2.61
Abdomen	22.6	2.5	1.81	3.19
Skeleton	90.6	2.7	2.43	2.99
Superficial injuries	34	1.6	1.26	1.96

**Table 3. Number of consultants at Hospital Receptions Department (HRD)**

Number of consultants	Number of patients (%), n=53
1 consultant	22.6
2 consultants	41.5
3 consultants	13.2
4 consultants	3.8
Without consultancy	18.9

indexes are by far too low for the patients affected by high-energy injuries. The situation at HRD is no better: only in 3 cases (5.7%) the peripheral vein was catheterized, only in 2 cases intravenous infusion was administered.

It is worth mentioning that all 53 patients had absolute indications for various area splints (neck, limbs, and pelvis). Nevertheless, they were applied only in 15% of the cases, and HRD did not document this action.

### Discussion

Though survey coverage was not big, its contingent distribution according to sex and age corresponded the proportions indicated in literature (17). High mortality rate among this group of patients (34%) asks for a special consideration of the problem, since most injuries within the trial group were evaluated as those of average severity (close to severe, AIS $\geq$ 3.). On the grounds of literature data (19) such patients should be hospitalized immediately at multi-profile Trauma Centers equipped with

**Table 4. Procedure rate at Emergency Station (ES) and Hospital Receptions Department (HRD)**

Evaluation of status or procedure	KES, %	HRD, %	Disparity, %	P	Disparity confidence interval CI95 %	
Consciousness	5.7	75.5	69.8	p<0.001	56.7	83.0
Breathing	1.9	15.1	13.2	p=0.012	2.9	80.1
Pulse	26.4	64.2	37.7	p<0.001	20.2	87.4
BP	47.2	81.1	33.9	p<0.001	10.6	87.5
I/V infusion	7.5	3.8	-3.8	p=0.42	-12.5	78.6
Analgesics	20.7	Undoc.*	—	—	—	—
Immobilization	15	Undoc.*	—	—	—	—

\* – documentation not found.

modern reanimation –intensive therapy as well as surgical and diagnostic facilities. Being aware that individual 3 score injury system (according to AIS) is considered as “severe”, there is no doubt that successful treatment of such patients needs professional and timely (very early) efforts of both, medical people and community. Patients with skeleton, brain and chest injuries (that prevail) should be concentrated at economically strong hospitals, able to ensure timely and adequate health services. Hospitals lacking strong units for intensive therapy, neurosurgery and orthopedics should not be involved in multiple injury management.

Results of our observation on the duration of pre-hospital stage show that it exceeds one-hour interval in 95% of cases. This allows affirming that in these two positions – an emergency station and a hospital reception room the “golden hour” elapses. This confirms the assumption that these structures in particular ask for a special attention focussed on evaluation of patients’ status, optimization and monitoring of health care services. Those providing vital services should be professional, adequately equipped and providers of the service fairly rewarded.

Unfortunately it could be said that Emergency Station in some cases simply transfers casualty victims to hospitals (following the principle “scoop and run”). It is also apparent that carriage through a city is not so quick (an average 34.1 min). At this point it is worth mentioning that in “Emergency Station Committal” (form No. 114/a) – official document, approved by Ministry of Health, requirement to evaluate a patient’s status is not included. It is essential to indicate form data, the place from which a patient is transported and “Emergency Station doctor’s diagnosis”. For any other information, its content not clearly defined, some place is reserved under the title “Emergency Station Information about Patient”). Such committal does not comply with today’s requirements and must be changed. Being aware of the importance to urgently ensure vital functions of a severely injured, to our opinion, Emergency Station staff should not even be demanded to give injury diagnosis. In these particular cases such demands seem unrealistic if not unethical in regard to medical people. Diagnostic expectations are humble and each minute is very precious. The utmost important thing, according to the nature of injury environment and its mechanism, is to recognize a high-energy injury affected

patients; to evaluate precisely their most important vital functions and, without any additional harm to a patient (while taking a patient from a casualty place and transportation), to ensure vital functions throughout instant delivery to multi-profile hospitals. Such patients could be diagnosed as “affected by multiple injuries” with indications to the areas injured.

Another issue of a special concern is the fact that most of severe injury and hazardous cases are often not evaluated (and not documented) as to vital functions (Table 4). Such situation may have negative influence on rendering emergency aid as well as on a legal outcome.

The lack of professional aid is already attested and studied as regards the rates of high-energy injury patients with neck immobilization problems. According to elementary first aid rendering standards, in cases of such injuries neck immobilization is compulsory until a specialist denies any medulla or vertebra damage. The trial data prove that during the initial period of case management, neck immobilization cases by a rigid neckband was applied only in 5% of patients (18).

Evaluation of an injured is also worth commenting on. Relatively better situation is observed as regards evaluation of severely injured patients at HRD. Though difference in procedure frequency, rendered by ES and HRD, to evaluate a patient’s status, is statistically significant, frequency of urgent procedures rendered at HRD is, however, unduly low. Breathing condition at HRD evaluated only for 15% of patients, blood circulation (pressure and pulse) – only in two thirds-four fifths of all patients. It is absolutely clear that part of severely injured patients with serious brain and chest damages require additional oxygen to saturate blood with oxygen. Yet these procedures are not practicable even breathing is not being measured. It should be noted that irrespective of the time of stay at HRD, patients’ status is evaluated only once which is far from being a safe approach. It would be more secure to repeat status evaluation (or to monitor it) with necessary documented records. This would allow to notice deterioration of condition in potentially unstable patients at an early stage and to ensure immediate corrective actions.

While analyzing situation in attempt to get the reasons, one of those enumerated is that Hospital Receptions Department is inadequately equipped to render necessary help for the severely injured. Modern emergency departments in multi-profile



(university and regional) hospitals should be properly equipped as intensive care units. These units should be fitted to render primary radiology and ultrasonography examination without moving a patient, and at the same time to ensure monitoring/supporting of vital functions (including intubation and lung ventilation). We consider it a wrong practice when high-energy trauma patients are hospitalized (including transfer to intensive care units from HRD) only after providing, as far as possible, precise diagnosis of certain injuries. Consultant examination of such patients is usually time-consuming and not always safe. All high-energy trauma patients should be for a certain period of time followed-up at in-patient departments (or at adequately equipped Emergency Department) where they should get standard testing, monitoring and evaluation of possible changes in their condition.

The main limitation to this survey is the documentary material, where “unrecorded” does not necessarily indicate “unaccomplished”. Namely documentation of the accomplished actions is legally important since it allows unambiguous evaluation of the quality and timeliness of health care services

provided and to compare work results. The opinion of some of our colleagues that it is more important “to accomplish work than to do paper work” must be opposed. Undisputedly important are both, the work done and its records. From the juridical point of view denial of documentation of urgent procedures or condition evaluation in the patient group with mortality rate of 34%, is intolerable.

### Conclusions

Patients affected by multiple injuries and hospitalized at Kaunas University of Medicine Hospital had stayed through at Emergency Station and Hospital Receptions Room for on average longer time than it was recommended by universally accepted standards, over the “golden hour”. Four out of five patients with high-energy injuries from pre-hospital unit were hospitalized only after additional consultant examination.

Emergency Station and Hospital Receptions Room staff undermine the main vital functions in high-energy trauma patients and provides insufficient professional help for high-energy trauma victims due to lack of trauma management systems.

## Ankstyvasis potrauminis laikotarpis – auksinė valanda

Algimantas Pamerneckas, Andrius Macas, Dinas Vaitkaitis, Algimantas Vaitkaitis,  
Rima Gudėnienė<sup>1</sup>

*Kauno medicinos universitetas, <sup>1</sup>Kauno miesto greitosios medicinos pagalbos stotis*

Raktažodžiai: auksinė valanda, dauginė trauma, didelės kinetinės energijos trauma.

Santrauka. Ankstyvas reikiamos medicininės pagalbos suteikimas didelės kinetinės energijos traumą patyrusiems pacientams yra pagrindinis veiksnys, mažinantis jų potrauminį neįgalumą bei mirtingumą. Didelės kinetinės energijos traumą patyrusių pacientų gydymo strategija Lietuvoje tik pradėta kurti. Politraumą patyrusiems pacientams reikiama medicininė pagalba gali būti suteikta tik keliuose šalies ligoninėse. Ikistacionarinė (greitoji medicinos pagalba) ir labai ankstyva stacionarinė (ligonių priėmimo skyriai) grandys nepakankamai pasirengusios didelės kinetinės energijos traumą patyrusių pacientų gydymui.

Retrospektyviojoje studijoje analizuojamas ikistacionarinės ir labai ankstyvos stacionarinės pagalbos efektyvumas 53 didelės kinetinės energijos traumotiems ir gydytiems Kauno medicinos universiteto klinikose 2001–2002 metais pacientams. Vidutinis šios pacientų grupės sužalojimų sunkumas pagal sužalojimo sunkumo skalę – 21,3 balo, šių pacientų mirštamumas siekia 34 proc.

Tyrimo metu nustatytas ilgas ikistacionarinės ir ankstyvos stacionarinės pagalbos laikotarpis (atitinkamai – 34±6,5 ir 50±17,2 minutės), greitosios medicinos pagalbos medikai labai retai monitoruoja pacientų gyvybines funkcijas (kvėpavimas vertintas 1,9 proc., pulsas 26,4 proc. pacientų). Infuzoterapija, kaip sudėtinė gydymo dalis, teikta – atitinkamai 7,5 proc. greitosios medicinos pagalbos ir 3,8 proc. ligonių priėmimo skyriuose pacientų, kvėpavimas vertintas atitinkamai 1,9 proc. ir 15 proc. pacientų.

## References

1. Demografijos metraštis 2000. (Chronicle on demography 2000.) Vilnius: Statistikos departamentas; 2000.
2. Lietuvos gyventojų sveikata ir sveikatos apsaugos įstaigų veikla 2000 m. (Public health in Lithuania and work of public health institutions during the year 2000.) Vilnius; 2001.
3. Vaitkaitis D. Eismo įvykių traumatizmas kaip socialinė problema. (Car accident traumas as a social problem.) Medicina (Kaunas) 1997;33(11):65-8.
4. David A, Gabbott MA, Nolan P. The system approach to trauma care. Cur Opin Crit Care 1995;1:514-9.
5. West JG, Cales RH, Gazzaniga AB. Impact of regionalization. The Orange county experience. Arch Surg 1983;118:740.
6. Cales RH. Trauma mortality in Orange county: the effect of implementation of a regional trauma system. Ann Emerg Med 1984;13:1.
7. Alexander RH, Proctor HJ. Advanced trauma life support. Chicago: American College of Surgeons; 1993.
8. Sasada M, Williamson K, Gabbott D. The golden hour and pre-hospital trauma care. Injury 1995;26(3):215-6.
9. Meighan A, Gregori A, Kelly M, et al. Pelvic fractures: the golden hour. Injury 1998;29(3):211-3.
10. Alexander RH, Proctor HJ. Advanced trauma life support. Chicago: American College of Surgeons; 1999.
11. Sefrin P. Scoop and run or stay and play. Intern J Resc Disast Med 1998;1. Available from: URL: <http://www.ispub.com/journals/IJRDM/Vol1N1/scoop.html>
12. Cowley RA. The resuscitation and stabilization of major multiple trauma patients in a trauma center environment. Clin Med 1976;83:14-22.
13. Cowley RA. A new concept for the delivery of critical care. J Med Soc N Jersey 1977;74:979-86.
14. Lossius HM, Langhelle A, Sreide E, Pillgram-Larsen J, Lossius TA, Laake P, et al. Reporting data following major trauma and analysing factors associated with outcome using the new Utstein style recommendations. Resuscitation 2001; 50:263-72.
15. Leonov Y, Safar P, Sterz F, et al. Extending the golden hour of hemorrhagic shock tolerance with oxygen plus hypothermia in awake rats. An exploratory study. Resuscitation 2002;52(2): 193-202.
16. Pamerneckas A, Adukauskienė D, Macas A. Dauginė trauma: ligonio būklės ir lokalių sužalojimų vertinimas pagal traumų klasifikavimo sistemas. (Multiple trauma: evaluation of patient's condition and regional traumas according to systems of trauma classification.) Medicina (Kaunas) 2002;38(7):685-94.
17. Murry CJL, Lopez AD. Mortality by cause for eight regions of the world: Global burden of diseases study. Lancet 1997; 349:1269-76.
18. Vaitkaitis D, Kalesinskas RJ, Kontautas E. Ankstyvoji pagalba įtarus stuburo kaklinės dalies traumą. (Early life support when spine neck-part trauma is suspected.) Sveikatos mokslai 2002;7:60-4.
19. Haas NP, Hoffmann RFG, Mauch C, von Fournier C, Südkamp NP. The management of polytraumatized patients in Germany. Clin Orthop 1995;318:25-35.

*Received 10 April 2003, accepted 22 May 2003*