ORIGINAL ARTICLE

The Role of Performing Life Support Courses in Rural Areas in Improving Pre-hospital Physiologic Conditions of Patients with Penetrating Injuries

Masoud Saghafi Nia[1], Nahid Naffisi[2], Hassan Ali Mohebbi[1] and Yashar Moharamzadeh[1]

ABSTRACT

Objective: To evaluate the impact of animal model based medical training courses for village healthcare workers on pre-hospital physiologic condition and prognosis of patients with penetrating injuries.

Study Design: Experimental study.

Place and Duration of Study: This study was carried out in Mehran city and its neighbouring rural districts in western part of Iran from 2002 to 2004.

Methodology: Seventy-six village healthcare workers were trained and equipped to deliver in-field medical first cares. First group (226 patients) consisted of those who received this cares by the trained group and second group (245 patients) were those who received no in-field cares and were transported directly to the trauma center in provincial capital, Ilam. Physiologic Severity Score (PSS) was calculated to determine the physiologic condition of patients in both groups.

Results: The most prevalent cause of trauma in both groups was car accidents (61.6%). Controlling of hemorrhage was the most frequent provided initial medical care (40.6%). A significant improvement regarding the PSS score was observed in the first group of patients compared to the second group (7.505 vs. 6.799, 95% CI for difference: 0.3 to 0.9). The mortality rates of the first and second group of patients were 3% and 7.3%, respectively (p=0.051).

Conclusion: Performing life support courses in rural areas of low-income countries where there is no pre-hospital triage and emergency medical system and provision of classic resuscitative measures are limited, has a significant impact on improvement of pre-hospital physiologic condition and prognosis of patients with penetrating injuries.

Key words: *Training, Penetrating injury. Physiologic Severity Score (PSS). Prognosis. Low-income countries .*

INTRODUCTION

According to the reports from the World Health Organization (WHO), almost 90% of deaths due to injuries occur in low/middle-income countries, and this situation will continue to represent an important global health problem in the upcoming years.[1] Among the many reasons why trauma is so devastating in many low/middle-income countries are the inadequate systems of hospital and community-based emergency care in place in these countries.[2-4]

Due to the lack of pre-hospital triage and emergency medical systems in developing countries, especially in their rural areas, casualties don't receive necessary medical first aids in the field, and are often transferred by their relatives to the nearest urban hospitals. In the mentioned rural districts, there are only small healthcare facilities, while their staff do not have formal medical training and in case of a traumatic patient, they are unable to perform necessary pre-hospital initial medical cares.

One of the most important causes of morbidity and mortality in patients with traumatic injury is hemorrhage, which is considered as the second most common cause of death in the pre-hospital settings.[5,6] Massive hemorrhage can lead to hypovolemic shock, which can cause permanent damage to essential organs and may result in multiple organ failure and death.[7] Time is one of the most critical parameters for a patient with a penetrating trauma who has internal or external bleeding. Delay in receiving emergency care may lead to irreversible situations like hypovolemic shock.

In response to high mortality rate in rural areas of low-income countries and insufficient pre-hospital trauma care systems, different investigators have developed training courses for villagers in accordance to local conditions and resources to improve trauma survival. Husum *et al.* in their study, which lasted 4 years inside the rural areas in Cambodia and Kurdistan (Northern Iraq), reported a significant reduction in trauma mortality after conducting grass-root training programs for local villagers.[8,9]

[1] *Trauma Research Center, Baqiyatallah Medical Sciences University, Tehran, Iran.*

[2] *Iranian Mine Victim Research Center, Tehran, Iran.*

Correspondence: *Masoud Saghafi Nia, Trauma Research Center, Military Medicine Institute, Baqiyatallah Medical Sciences University (BMSU), Molla-Sadra Avenue, Vanak Sq, Tehran, Iran.*
E-mail: dr_sagafi@yahoo.com

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The aim of this study was to evaluate the effect of animal model based medical training courses for local health care providers and educated villagers of "Mehran" city; on improvement of the physiologic conditions and the prognosis of patients with penetrating trauma injuries.

METHODOLOGY

This study was conducted in Mehran and its five rural districts during a 3-year period (2002-2004). Ilam province, especially Mehran city and its neighbouring rural districts, located in western Iran on the border line between Iran and Iraq, has been one of the major battle fields during Iran-Iraq war (1980-1988) and postwar casualties from landmines.[10]

Initially, the project's investigators performed basic and advanced life support courses in two separate sessions for 76 local healthcare providers and educated villagers who had ability of writing and reading as rural first responders. Each of these course lasted for nearly 40 hours during a week period.

Essential basic life support procedures were instructed through lectures and after finishing this stage, advanced life support training was performed, using animal models. Because all participants in this study were Muslims, a goat was anesthetized at first and then slained. After laparotomy and finishing of the education course, the meat of the animal was distributed to the contributors and the poor people. Then, different interventions such as Cardiopulmonary Resuscitation (CPR), controlling of hemorrhage, fluid resuscitation, venous line access, and other procedures were practiced by the trainees. At first, CPR was practiced and educated on a plastic mannequin by anesthesiologist. The practical aspects of CPR like intubation, cardiac massage, cricothyrotomy etc. were practiced on the animal. At the end of the course, all of participants were given a first aid bag containing necessary equipments like regular and elastic bandages, sterile gauze pads, irrigation syringe, crystalloid solution, splint, and angiocath. There were no medications in those bags.

For evaluation of the physiologic condition of each casualty, Physiologic Severity Score (PSS), which has been applied in previous similar researches and is an easy index for calculation was used.[11] It is a summarized form of Revised Trauma Score (RTS, Table I). To determine the severity of injuries, AIS (Abbreviated Injury Scale) and ISS (Injury Severity Score) were used. The abbreviated injury scale is a simple numerical method for ranking and comparing injuries by severity. The AIS divides the body into six separate regions (head and neck, face, thorax, abdomen, visceral pelvic contents, bony pelvis and extremities) and assigns each a severity value

Table I: The simplified PSS in which the Glasgow Coma Scale component is replaced by a five-level scale of consciousness.

	4	3	2	1	0
Respiratory rate (breaths/min)	10-24	25-35	>35	1-9	0
Systolic blood pressure (mm Hg)	>90	70-90	50-69	<50	No pulse
Level of consciousness	Normal	Confused	Responds to sound	Responds to pain only	No response

(from 1 for minor to 6-nearly always fatal). The score is calculated by squaring and summing the three highest severity scores on the abbreviated injury scale from different body regions (1-8, mild; 9-15, moderate; >15, severe; range of 1-75).[12-14]

Casualties were classified in two groups. The first group received pre-hospital in-field medical first cares by the trained group in this study before transportation to Mehran's emergency center and then Ilam University Hospital, which is the main provincial trauma center. The second group consisted of patients who had no chance of receiving initial medical cares and were taken directly to the Ilam's hospital by their relatives, mainly using private car.

Data collection was performed by using two separate checklists for each of two studied groups. The gathered information concerned patients' demographics, mechanism of injury, received initial first cares, vital signs, consciousness level. For the patients in the first group, needed information for calculating PSS was gathered twice (at Mehran's emergency center and then at Ilam's central hospital); whereas for the second group PSS was calculated only in Ilam's central hospital. Information collection was performed by skillful and trained nurses; then PSS and ISS calculations were done by a single surgeon. Descriptive indices including frequency (percentage), mean and Standard Deviation (SD) was used to express data. For comparing the variables between two groups, the paired t-test and Chi-square test were used to calculate p-values. Confidence Interval (CI 95%) was also calculated for significant differences of PSS and ISS between two studied groups. All analyses were performed by SPSS software for windows (ver. 11.5).

The Ethics Committee of the Baqiyatallah Medical Sciences University confirmed the protocol of the study.

RESULTS

This study involved a total of 641 casualties. Thirty persons died at the scene and did not receive any medical care. In addition, 140 injured people who were transferred to the Mehran's emergency center after receiving in-field first medical cares were discharged due to mild or moderate severity of their injuries and were not transferred to the Ilam University hospital. As a result, 471 injured persons were followed until the end of

the study. There was 226 (47.9%) cases in the first group [210 men (93%), 16 women (7%)] and 245 (52.1%) patients constituted the second group [187 men (76.3%) and 58 women (23.7%)]. The mean age of casualties in first and second group was 30 and 28.5 years, respectively.

Table II represents the mechanism of injury in two groups, separately. As shown, vehicle accidents were the major cause of injuries in both groups.

Different initial medical cares, which were provided in the field by the trained local first responders for the first group of casualties, are presented in Table III.

Table II: Mechanisms of penetrating injuries in both groups during the study period.

	The first group (n=226)	The second group (n=245)	Total
Car accident	94 (71.6%)	196 (80%)	290 (61.6%)
Landmine explosion	83 (36.7%)	26 (10.6%)	109 (23.1%)
Gunshot injury	49 (21.7%)	23 (9.4%)	72 (15.3%)
Total	226 (100%)	245 (100%)	471 (100%)

Table III: Distribution of different in-field first medical cares provided by local first responders before transportation to the Mehran's emergency center.

First medical cares	Frequency	Percentage
Controlling of hemorrhage	308	40.6%
Warming-up the casualty	226	29.8%
Changing of position	205	27%
Opening airway	19	2.6%
Total	758	100%

In the first group, the mean (SD) measured PSS on arrival to the Mehran's emergency center was 6.408 (0.785). After transportation to the Ilam's central hospital, the second measurement of PSS was done, which revealed mean (SD) of 7.505 (0.799). This increase was statistically significant (95% CI: 0.9 to 1.2).

As mentioned earlier, for the second group, PSS variables were recorded only once on arrival to the Ilam's hospital. The mean (SD) PSS in this group was 6.799 (1.246) which had a significant difference in comparison to the measured PSS at Ilam's hospital of the other group (95% CI: 0.3 to 0.9).

Different levels of ISS (mild, moderate, and severe) in two groups are presented in Table IV. The mean (SD) ISS of the first and second groups were 10.36 (6.02) and 10.6 (9.08), respectively, which didn't show any significant statistical difference (95% CI: -1.2 to 1.8).

Table IV: Distribution of injured patients in two studied groups according to the severity of their injury.

ISS	The first group (n= 226)	The second group (n=245)
Mild (< 8)	75 (33.2%)	117 (47.8%)
Moderate (8-15)	98 (43.4%)	64 (26.1%)
Severe (>15)	53 (23.4%)	64 (26.1%)

Blood was transfused to 15% and 20% of first and second group patients, respectively. According to the findings, 83 patients (17.6%) of all referred patients to the provincial trauma center received between 1 to 5 units of whole blood. Of those patients, 40 (48.2%) cases sustained injuries from car accident, 25 (30.1%) from landmine explosions, and the remaining 18 (21.7%) patients had penetrating injuries as a result of gunshot.

Seven patients (3%) in the first group died during hospitalization 3 from car accident, 3 from gunshot injury, and one patient with injuries due to landmine explosion. In the other group, 18 (7.3%) patients died, 16 of whom had suffered from injuries as a result of car accident, and 2 other patients had been shot (p=0.051).

DISCUSSION

Every day around the world 16000 people die from injuries. For every person who dies of injuries, several thousand injured persons survive and many are left with permanent disabling sequelae.[15] This problem is even more serious in rural areas of low/middle-income countries which have been war zones for long periods and where large unmapped fields of landmines are concentrated. Furthermore, the lack of trained health-care providers, inadequate access to emergency response systems, unpaved roads for transferring the casualties, constrained resources, etc. have made these areas the most reported casualty areas with pre-hospital mortality rates as high as 40-50%.[16,17] So any decision to create or improve trauma systems should be in accordance to the conditions and available resources of the region. In addition, it should be affordable, sustainable and immediately transferable to other similar locations and situations.

The main purpose of this study was to perform life support training courses for healthcare workers and local villagers to improve their ability to handle patients with penetrating trauma injuries. Controlling hemorrhage is the most commonly performed medical care. Thus, it is necessary to implicate the importance of appropriate training and learn suitable ways of bleeding control during such courses. In the present study, lack of medical first cares in early stages of an accident, which led to penetrating injuries, resulted in more bleeding and blood transfusion become absolutely necessary. The first group, which received first medical care, needed less blood transfusion in comparison to the other group.

According to the results of this study, the casualties which received first medical cares in the field, before transportation to a hospital, had higher PSS than the ones who were carried to hospital directly without receiving any care.

Regarding ISS measurement, no significant difference was observed; it means that there was similarity in the severity of sustained injuries between two groups.

It is necessary to set up CPR training courses in order to decrease mortality of penetrating injuries with bleeding. In our experience, practical activities on animal models and providing simple interventions like intravenous fluid therapy had notable effects in reducing the mortality and improving physiologic condition of a traumatic patient before he arrives to a hospital. However, ethical aspects of such trials must be tailored to the socio-cutltural norms of the concerned society.

Causes and consequences of injury and trauma vary from country to country. Thus, prevention and treatment strategies should be tailored accordingly.

CONCLUSION

Performing life support courses in rural areas of low-income countries, where there is no pre-hospital triage and emergency medical system, and providing classic resuscitative measures are limited, has a marked impact on improving the prehospital physiologic condition of patients with penetrating injuries.

REFERENCES

1. Hofman K, Primack A, Keusch G, Hrynkow S. Addressing the growing burden of trauma and injury in low- and middle-income countries. *Am J Public Health* 2005; **95**:13-7.
2. Razzak JA, Kellermann AL. Emergency medical care in developing countries: is it worthwhile? *Bull World Health Organ* 2002; **80**: 900-5.
3. Goosen J, Bowley DM, Degiannis E, Plani F. Trauma care systems in South Africa. *Injury* 2003; **34**: 704-8.
4. Joshipura MK, Shah HS, Patel PR, Divatia PA, Desai PM. Trauma care systems in India. *Injury* 2003; **34**: 686-92.
5. Potenza BM, Hoyt DB, Coimbra R, Fortlage D, Holbrook T, Hollingsworth-Fridlund P. The epidemiology of serious and fatal injury in San Diego County over an 11-year period. *J Trauma* 2004; **56**:68-75.
6. Sauaia A, Moore FA, Moore EE, Moser KS, Brennan R, Read RA, *et al.* Epidemiology of trauma deaths: a reassessment. *J Trauma* 1995; **38**:185-93.
7. Dretzke J, Sandercock J, Bayliss S, Burls A. Clinical effectiveness and cost-effectiveness of pre-hospital intravenous fluids in trauma patients. *Health Technol Assess* 2004; **8** (23): iii,1-103.
8. Husum H, Gilbert M, Wisborg T. Training pre-hospital trauma care in low-income countries: the 'Village University' experience. *Med Teach* 2003; **25**:142-8.
9. Husum H, Gilbert M, Wisborg T, Van Heng Y, Murad M. Rural pre-hospital trauma systems improve trauma outcome in low-income countries: a prospective study from North Iraq and Cambodia. *J Trauma* 2003; **54**:1188-96.
10. Jahunlu HR, Husum H, Wisborg T. Mortality in landmine accidents in Iran. *Prehosp Disaster Med* 2002; **17**:107-9.
11. Husum H, Gilbert M, Wisborg T, Van Heng Y, Murad M. Respiratory rate as a pre-hospital triage tool in rural trauma. *J Trauma* 2003; **55**: 466-70.
12. Baker SP, O'Neil B, Haddon W Jr, Long WB. The injury severity score: a method for describing patients with multiple injuries and evaluating emergency care. *J Trauma* 1974; **14**:187-96.
13. Maurer A, Morris JA Jr. Injury severity scoring. In: Moore EE, Feliciano DV, Mattox KL, (edi). Trauma. 5th ed. New York: *McGraw Hill*; 2004.p.88.
14. Hussain LM, Redmond AD. Are pre-hospital deaths from accidental injury preventable? *BMJ* 1994; **308**:1077-80.
15. Kurg EG, Sharma GK, Lozano R. The global burden of injuries. *Am J Public Health* 2000; **90**: 523-6.
16. Husum H. Effects of early pre-hospital life support to war injured: the battle of Jalalabad, Afghanistan. *Prehosp Disaster Med* 1999; **14**: 75-80.
17. Ascherio A, Biellik R, Epstein A, Snetro G, Gloyd S, Ayotte B, *et al.* Deaths and injuries caused by landmines in Mozambique. *Lancet* 1995; **346**:721-4.