

# Prehospital Trauma Care

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## ABSTRACT

The global human population is spread all over the world, but cities, towns, and large villages have dense concentrations of human habitation. The inhabitants of cities and towns do have easy and satisfactory access for the management of traumatized patients. However, trauma victims in remote and distant regions, generally, do not have ambulance services or treatment centers nearby to deal effectively with injuries. Even on highways, at accident sites, the injured may succumb to the injuries due to delay in rescue and nonavailability of vital basic life support compounded by delay in transportation of the patient to appropriate hospital or dedicated trauma center. Other factors which add to mortality are nonavailability of trained and experienced personnel at the accident site, inadequate and improper resuscitation during transportation, and referral to a hospital ill-equipped to treat traumatized patients. Trauma is the leading cause of death for patients in their first four decades of life. Prehospital trauma care to save life has not received the necessary attention in developing world due to diverse reasons, including lack of trained staff, inadequate funding, lack of awareness, ignorance, lack of will, and unpredictability of occurrence of accidents. Trauma management remains neglected in third world countries; however, the developed countries have made continuous efforts to save lives of traumatized patients by systematized prehospital care at the site of accident, rescue, and extrication of victims, rendering life-saving resuscitation on the spot and quick and safe evacuation of the patients to trauma centers by surface and air ambulances depending upon the terrain and distance of the site of occurrence from hospital with continuous monitoring of the patient onboard. Prehospital trauma care needs focused attention to evolve a system and institutions which would impart care to the wounded inclusive of rescue, resuscitation, stabilization of vital parameters, and safe transportation to a dedicated hospital to save life and prevent morbidity.

**Keywords:** Basic life support in trauma, Emergency surgical care, Prehospital trauma care, Trauma.

**How to cite this article:** Sharma SM. Prehospital Trauma Care. *Int J Adv Integ Med Sci* 2016;1(4):158-163.

**Source of support:** Nil

**Conflict of interest:** None

## INTRODUCTION

Trauma is the leading cause of death for patients in their first four decades of life.<sup>1</sup> With rapid industrialization,

urbanization, and increased volume of traffic on roads, about six million people lose their lives annually due to injuries and 90% of these injured belong to underdeveloped world. In addition, an overwhelming proportion of these deaths occurs before patients even reach the hospital.<sup>2</sup> Due to nonavailability of basic care, 30% of deaths occur at the site of accident and 80% of remaining patients die in the first hour after the injury, the golden hour, the timeframe during which patients could have been saved had they reached the trauma center safely. The traumatized may die on the spot due to injury to heart, major vessels, vital organs, including brain, and crush injuries. These deaths occur due to airway obstruction, failure of breathing, massive hemorrhage, and polytrauma. Prehospital basic life support after rescue of the injured and quick and safe evacuation to a trauma center by trained paramedics within 1 hour after the occurrence of injury may save the patient in first golden hour. The "golden hour" as summarized by the 3R rule of Dr Donald Trunkey, an academic trauma surgeon, is: "Getting the right patient to the right place at the right time."<sup>3</sup> Evacuation of patients to hospital safely at the earliest definitely improves survival and outcome.

The concept of prehospital trauma care has emerged after the experiences of injuries sustained by soldiers in wars. Napoleon's Army had in service the flying ambulances which carried surgeons and medical supplies to the battle field and transported wounded soldiers to rear. These horse-driven carriages were put to use by Napoleon's surgeon Dominique-Jean Larrey in 1792. The battles and wars have consistently strengthened the importance of prehospital trauma care. Each and every war inclusive of Gulf War, Korean Peninsular Conflict, and Vietnam War has highlighted the importance of on-the-spot rescue, resuscitation, basic life support, and evacuation of severely wounded back to appropriate hospital by quickest possible means by helicopters and fixed wing aircrafts with trained and experienced emergency medical personnel traveling with casualties as attendants. This concept of evacuation of the casualties made stable by life-support measures and fit to travel from battle field to rear has definitely helped to save lives. No patient in an unstable condition or inadequately supported to sustain and undertake long journey be transported till declared fit to undertake journey.

Indian Armed Forces, especially the Indian Army, has evolved an exceedingly successful system of prehospital

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trauma care for the traumatized patients due to gunshot wounds, shell blast injuries, accidental falls into crevices in glacier, avalanche injuries sustained in remote regions of India in high altitude battleground of Siachen glacier, and other heights of Ladakh since 1984, which includes basic life support at the front line by a trained medical officer and his team, quick stabilization, and evacuation by small or large helicopters depending on the condition of the patient and necessity of sick attendants. Patients with mild to moderate injuries travel in sitting position without an attendant, whereas severely wounded lying patients who require trained attendants travel by larger helicopters to base camps where they are resuscitated and comforted. The patients can also be evacuated to General Hospital (GH) or the Medical Aid Complex, i.e., located within an hour's reach by helicopter flight through and above tall snow-covered mountains in rarified air. Aerial evacuation can only be carried out during daylight and in good weather conditions. It is not uncommon for pilots to spot the injured in glacier after the last light and evacuate the patients from Karakoram ranges in adverse weather conditions to hospitals beyond Ladakh ranges. The survival rate of the injured evacuated by air reaches 100% because of highly satisfactory initial life support, quick air evacuation, and early corrective intervention. The GH has comforts of controlled temperature and facilities of specialized intervention. From GH, the patients can be shifted to tertiary care hospitals in plains by fixed-wing aircrafts. The system of chain of rescue, basic life support, evacuation, resuscitation, intervention, and onward transfer for highly specialized management is institutionalized with no scarcity of human and material resources. The aerial evacuation is easy, simplified, and available on demand from not so distant multiple helipads.

## AIMS AND OBJECTIVES

The injured may be left unattended and unnoticed at the site of accident and patient may be damaged further by ignorant and untrained bystanders who by improper but good-intentioned handling of the victim may cause more harm, a situation far worse than getting delayed due to want of resuscitation and transfer to hospital. Aim of prehospital care is to save the life of acutely traumatized patient by prompt rescue and extrication of injured, provide basic life support by experienced personnel, resuscitation, and early evacuation to appropriate hospital.

Trauma occurs due to diverse reasons like road traffic accidents, falls, interpersonal violence, industrial accidents, wars, battles, fires, physical agents, cold injuries like frost bite and sports injuries. There is direct relationship between occurrence of trauma deaths and illiteracy, lack of awareness about safety precautions, poor governance, and mismanagement, lack of respect for norms, undisciplined

conduct, and irresponsible behavior. Trauma deaths have trimodal distribution. Nearly 50% of victims lose their lives immediately or a few minutes after injury called the first peak. Second peak results in 30% deaths within the first 4 hours after injury and third peak with 20% deaths occurs days and weeks after resuscitation and treatment in hospital due to complications.

During major accidents involving large number of casualties, role of prehospital trauma management and hospital services are stretched to maximum. In such situations, those patients who need immediate resuscitation, evacuation to trauma centers for surgery must be sorted out or prioritized from less traumatized to focus on the most needy patients both for resuscitation, transfer, and surgery. Trauma accounts for occupation of 10% of hospital beds, and is the fourth most common cause of death and results in loss of many years of productive life.

Objectives of prehospital trauma care involve prompt communication and activation of the system, proper actions at the scene of the crash by first responders, and the prompt response of the system or simply offer fastest possible basic life support that includes airway, breathing, control of bleeding, and transportation of the right patient to the right place at right time.<sup>4</sup> The main objectives and steps involved in prevention of deaths and morbidity due to trauma should involve detection of accidents and injury, the site of accident, duration and time of accident, mode of injury, the number of casualties affected, established mechanism to report the accident at the earliest to nearby hospitals, administrative authorities, nearest ambulance services, calling for help of trained paramedics and emergency medical technicians. The next step should be to resuscitate the injured by basic life-support measures like arrest of hemorrhage, maintenance of airway, protection of cervical spine, restoration of breathing, infusion of intravenous or intraosseous fluids, endotracheal intubation, splintage of fractured bones, and early evacuation to a trauma center or a hospital equipped to treat traumatized patients. Level of care, offered at the site, varies according to the facilities available in a given situation.<sup>5</sup>

## PREHOSPITAL TRAUMA CARE IN INDIA

India remains one of the countries having large number of deaths due to trauma, which is preventable and also manageable provided an effective prehospital trauma care system is in practice. Level of care, offered at the site, varies according to the facilities available in a given situation.<sup>5</sup>

Currently, there is no uniform policy or a system to direct the management of traumatized before they reach the appropriate and designated hospital for trauma management. In India, half a million patients sustain injuries

due to road traffic accidents alone annually and about 150,000 lose their lives in such accidents. Despite such a grave loss of precious lives and immense loss of productive years and working hands, no prehospital trauma care exists in India except in the Armed Forces which has been able to successfully utilize resources to provide an excellent world class or even the best prehospital care to wounded even in remotest regions like snow bound high mountains of Ladakh inclusive of location of casualties in desolate places, picking them up safely by small and large helicopters, bring them to resuscitation centers, and transferring them onward to designated hospitals by helicopters and even by fixed-wing aircrafts to tertiary care hospitals in North Indian plains. However, no such policy or a health service exists for traumatized on easily accessible highways. There is no system of mobile clinics replete with life-saving equipment and trained man power to locate and pick up the injured.

### CREATING AWARENESS AMONG MASSES

India is a developing state with a large expanding population, migration, industrialization, and increasing network of surface transport resulting in more and more accidents. The trauma services have not been developed to keep pace with the needs for ever-increasing traumatized patients. There is urgent need to educate and enlighten the masses about the necessity to prevent accidents and injury, enforce law and discipline to check the offenders on workplace, roads, and industrial units. All-out attempts must be put in to educate people to provide first aid to injured people. Simple steps for stopping bleeding from external wounds, application of tourniquet, jaw thrust can be provided by bystanders before the arrival of trained paramedics or technicians. Media too can play a role in disseminating such useful techniques. All citizens can be advised and trained or even guided as how to pick up wounded with spinal injury. Interested citizens, police personnel, fire fighters, unemployed youth, students, shopkeepers, and petrol pump personnel can be trained to help patients by the skills they would learn from educators.

### PREHOSPITAL CARE TRAUMA SERVICES AND NATIONAL CADRE

A national prehospital trauma care cadre should be developed particularly to cater for the injured on highways and roads. Mobile ambulance services must be organized which should be operationalized by trained paramedics and emergency medical technicians and the mobile ambulances should be self-sufficient in life-saving equipment like endotracheal tubes, ambu bags, drugs, infusion fluids, and defibrillators besides having

tourniquet, dressing material, and devices for rescue. The reporting of occurrence of trauma should be entrusted to passersby, local self-government leaders, and local officials. In high-volume road traffic injuries, doctors and nurses too should form the dedicated team for prehospital trauma care. All large hospitals must have quick reaction teams of highly trained staff including doctors trained as intensivists who should be ready to move to accident site and manage the severally injured and escort them to hospitals for definitive management. Therefore, a state and national-level institutionalized prehospital trauma care service be evolved under a single autonomous authority both at national and state level adequately funded, resourceful, and manned by experienced trained human power. The rural and remote regions too should be similarly covered under prehospital trauma care health service. Nongovernmental organizations, volunteers, and traditionally devoted bodies too can be involved in such humane tasks. The prehospital trauma care services can be selectively outsourced to private parties to lessen the burden on state services.

### Air Ambulances

Western countries started developing prehospital trauma care for civilians decades back inclusive of mobile ambulances, paramedics, and emergency medical technicians and moving further to undertake air evacuation of injured by helicopters and even by fixed-wing aircrafts. Such services have been made functional by state in a few countries, and in some countries air ambulances are being financed by charity organizations and private parties (Fig. 1).

India too must have air ambulances financed by state and private parties to evacuate the patients to definitive centers to treat trauma. Evacuation by air not only reduces the time interval between occurrence of injury



**Fig. 1:** Injured patient can be airlifted by air ambulance from remote regions during first golden hour in a sitting position by small helicopters

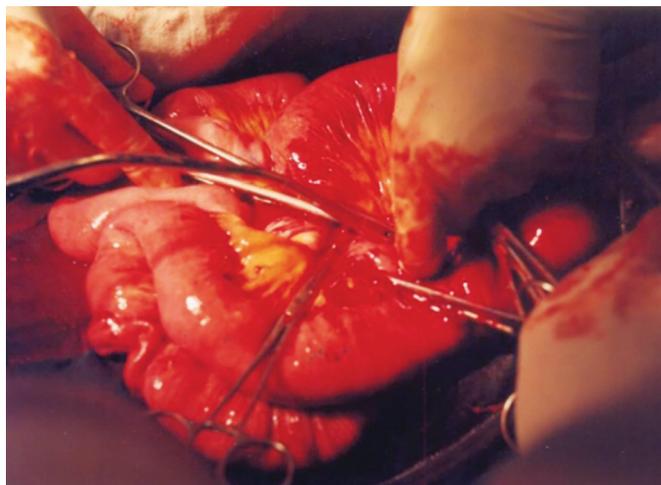
and definitive treatment at designated trauma center or a hospital but is also cost-effective comparable to on-road ambulance services. Only those patients should be airlifted who are fit to undertake journey, and the traumatized patients must be stabilized before airlift to hospitals. The paramedics or the first responders must not waste valuable time in resuscitating the traumatized at accident sites like trying to do central venous catheterization or conducting difficult intubation which may turn out to be beyond their capabilities. Air evacuation of traumatized means saving valuable time to preserve the patient within first golden hour and reducing mortality.

### Trauma Centers

Trauma centers came into existence in the United States five decades back and we too need these. These centers are dedicated to traumatized patients and are open 24 hours and has a trauma team to manage such patients. The exclusive care for injured is directed only to trauma and, therefore, is focused on resuscitation and injured parts by a dedicated team of anesthesiologists, surgeons, orthopedic surgeon, maxillofacial surgeon, and others. Trauma centers reduce mortality and save lives five to eightfold. India must have trauma centers at high-volume injured turnout cities and towns. Personnel living near the highways too must be trained in basic life support and first aid to augment subsequent management by trauma centers (Fig. 2).

### Basic Life Support and First Responders

First responders are the persons who reach the scene of accident first and assess the situation, call for help, try to extricate the injured without causing further damage. These bystanders help trained paramedics who are trained to give life support in maintaining the airway,



**Fig. 2:** Patients with gunshot wounds must be evacuated at the earliest to hospitals after basic life support to save their lives

protecting the cervical spine, maintain breathing, controlling bleeding by external compression, give oxygen therapy, assist in ventilation and improving circulation, and helping in early and safe evacuation to hospital.

### Advance Life Support

Advance life support to injured is provided by highly trained and skilled paramedics, who can intubate the patient, infuse fluids by intravenous fluids, perform cricothyroidotomy, stabilize the spine, and prevent further injury. However, the question of attempted "Stay and play" vs "scoop and run" approach in the management of trauma has no clear-cut answer.<sup>6</sup>

#### Stay and Play

Stay and play means that patient may be delayed at the accident site for evacuation to a hospital and is being revived and resuscitated. Undue delay in sending the patient to a definitive hospital may result in loss of valuable time compromising the patient safety. Therefore, too much time should not be spent in undertaking procedures which may go wrong. The patient can be given life-support help and transferred to hospital if fit to undertake journey safely. Air evacuation may be called to save time and life by quick transfer.

#### Scoop and Run

Scoop and run involves immediate to early evacuation of the patient to hospital. A seriously wounded patient must be given life-saving help and resuscitation before premature transfer of the patient to hospital. The decision to hold back or immediately transfer the case to hospital must be taken by an experienced doctor. Scoop and run is a good practice for a patient unlikely to benefit by retention at the accident site or who does not require life-saving measures. Such patients may have a bony trauma, or a patient with brain injury who may need early decompression. The scoop and run decision reduces the time for definitive surgery which may save the life; however, stay and play may be required in a patient who is in urgent need of basic life support like airway restoration, breathing, and arrest of hemorrhage. In such a situation, valuable time should not be wasted in unnecessary manipulations which may be without reward and fruitless. A strong medical commander of experience must in either of the procedure take a decision in favor of scoop and run or stay and play. It is, therefore, vital that rescue team and the initial basic life support and advanced life-support system should have provision of inclusion of highly experienced doctors, nurses, and technicians.

## Airway Management

Airway management had been advocated in patients with traumatic brain injury, cervical spine, or thoracic trauma before evacuation unless the same can be performed easily en route.<sup>7</sup> Despite the claimed advantages, prehospital endotracheal intubation (ETI) and rapid-sequence induction performed by less-experienced paramedical staff lead to higher mortality and poorer neurologic outcomes.<sup>7</sup> Patients with brain injury do benefit by prehospital ETI but it may turn out to be inappropriate in a patient with hemorrhage. Endotracheal intubation needs skill and experience and may be of much harm in the hands of inexperienced paramedic. Laryngeal airway mask is valuable for its simplicity and safety.

## Intravenous Fluid Management

Prehospital fluid resuscitation for major trauma is controversial.<sup>8</sup> Traumatized patients with blood loss may need intravenous fluids in shocked state. At scene, intravenous infusion with crystalloids in optimum volume will be of immense value when the patient may be anticipated to reach the trauma center after the first golden hour. Too much infusion of fluids may provoke bleeding from open wounds resulting in loss of clotting factors. Prime importance must be placed first in arresting bleeding from open wounds. Closed cavity hemorrhage cannot be managed at accident site. At scene, intravenous cannulation may not be possible due to collapsed veins and, therefore, central venous catheterization or simpler intraosseous infusion may have to be resorted to. Infusion of drugs like tranexamic acid is useful. Central venous catheterization should be done by an experienced and confident person preferably an anesthesiologist. Too much time should not be compromised at scene for a procedure which may utilize precious time. After injury and during transportation patient must be guarded against hypothermia, acidosis, and coagulopathy.

## Control of Bleeding and Pain Management

Bleeding should be controlled by direct and indirect pressure, elevation, wound packing, tourniquet, and hemostatic agents. Quick clot granules will arrest the hemorrhage by absorbing water when it comes in contact with blood and concentrates the clotting factors and platelets, thereby it stops bleeding. The patient must be kept free from pain by analgesia and sedatives. The pain can be reduced by stabilization of spine and splintage of fractured bones.

## CONCLUSION

Trauma is preventable and should not occur if all precautions are taken to avoid it. High speed, indiscipline,

lack of regulatory control, lax laws, drunk driving, bad roads, old vehicles, overloaded vehicles, inexperienced driving, teen driving, lack of proper training for driving, ignorance of traffic rules, lack of perseverance and haste in pushing the vehicles ahead, lack of prehospital trauma care, and virtual absence of trauma centers are principal causes of mortality due to injuries on roads.<sup>9</sup>

Prehospital trauma care needs an institutionalized nationwide dedicated service under single authority at national and state levels. A mechanism has to be evolved for immediate reporting of occurrence of injury at any geographical location in India by local officials and people. Mass education of entire eligible population must be done as first aid providers, which should include training in rescue and extrication of victims, arrest of hemorrhage by pressure or packing, and airway restoration. Help of voluntary organizations and mass media should be taken in reaching out to masses for awareness. The first responders should have a dedicated team of trained paramedics and highly experienced technicians. Ideally, there should be a quick reaction team which should have on its panel dedicated doctors and nurses for initial care at scene who should provide advance life support to injured patients. All hospitals again should have Quick Reaction Medical Team manned by critical care intensivists who should reach the scene to provide necessary care before the transportation of patients to hospital.

Nation should usher in a network of mobile and air ambulances for quick on-board resuscitation and transportation of patients to hospitals. Large cities and towns should have exclusive trauma centers to render focused care to injured traumatized patients.

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