

# MANAGEMENT GUIDELINE FOR THE TRAPPED TRAUMA PATIENT

Luciana Rotaru<sup>1</sup>, Cosmin Ciulu<sup>2</sup>

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The integrated management of the trauma patient represents an extreme complex and sequential medical and paramedical action, multidisciplinary, standartised, and specially with temporal terms and conditions, which starts to the accident scene and stops with the rehabilitation and social reintegration of the patient.

In this complex system, the extrication represents an important medical part of the prehospital intervention with medical - legal value and standards which requires professionalised prehospital trauma teams trained to manage either the risks and the facilities and options to maximize the benefits for the patient.

**1. Incarceration**, locking a patient in hostile areas of life as a situation where you can find a traumatized patient may have multiple medical and physical aspects, to which specific decisions are made for the extrication of the patient.

**1.A. Absolute incarceration** - the patient can not leave the space, this being very narrow or distorted - a „lucky" situation, and quite rare in trauma, since the deformation itself of space, is on the one hand a cause of the patient's trauma and on the other hand, a witness to the impact force and energy released during the accident, of which, inevitably some is sent to the patient. In this context it is always recommended that the patient be consi-

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*1 UMF Craiova*

*2 General Inspectorate for Emergency Situations*

*Correspondence:*

*Luciana Rotaru, email: lucianarotaru@yahoo.com, Craiova, Tabaci str. no.1, Dolj*

dered traumatized, and not only,"a captive into a hostile space, therefore he will be evaluated and extricated with all the precautions (1,2) and the maximal management imposed by the appreciation of traumatic context and not its lesion appearance. Also, it is important that long-term absolute imprisonment, following the accidents with many victims or catastrophic may lead to the development of a syndrome type, „crush syndrome - like"caused by prolonged immobilization (2.3), which requires appropriate management before, during and after the extrication. (4.5). It is the type of incarceration that is most frequently, left to small and untrained enough teams to underestimate the severity of trauma, thus the further cascade of failures and, „superficialities" which can ultimately lead to a large percentage of „avoidable deaths." (6)

- these events usually occur as a result of the following causes:
- the patient is often conscious but under the influence of the vegetative shock and extreme cortical alert and can not specify specific subjective elements, especially in regard to any visceral lesions (especially abdominal)to which any suggestive signs and symptoms are absent by up to 40% (7)
- the care for the management of cervical spine is often reduced if the patient is conscious and does not spontaneously complain or there are no suggestive signs of alarm (1.2).
- the appearance (only) of well-being of the patient - with fatal injuries in 2-steps - induces an early relaxation for the team, who is focused
  - on removing the patient from the scene and transfer to hospital.
- the post traumatic shock often confused with hypovolemic shock, especially in youngsters (8.9)
- the difficult assessment of the traumatized child (10:11) - signs difficult to interpret immediately after the accident (12).
- the assessment of the fetus with pregnant trauma is also hard to predict (13)
- psychological reaction insufficiently professionalized and trained teams who were required to take part in a predicted and announced difficult intervention and which at the first glimpse much simpler, perhaps only technical and not medical, situation which may produce early relaxation for the team members, especially for its leader and lead to shorting some essential stages of work.

In addition to sometimes irrecoverable damage that this kind of action can bring for the development and the prognosis of the traumatized patients directly, there is also the risk of inaccurate leading of these patients to inadequate trauma centers (14) (with performance levels too low) with ina-

dequate means of escape and also undersized supervision. Finally, the team receiving the patient in the emergency unit will be deprived of a number of medical data concerning the patient's condition at the scene, the evolution of signs and symptoms during the pre-hospital stage, having to recover not only the "golden standards" but also the time and management wasted as well as the lack of relevant information about the case, especially in patients whose consciousness declines progressively before they reach the UPU.

Especially for this type of situation, but not limited to, the medical team will always take maximum possible gravity and will proceed accordingly (7), although this conduct may sometimes lead to some degree of invasive maneuvers, irradiation, later proved unnecessary or laparoscopy, white." (7). It is the price paid in order not to omit those who have severe injuries, initially occult suggested more by the lesional mechanism than by the anatomical or clinical signs of injury found at the scene. (8,10)

**1.B. Relative incarceration** - can not leave the patient due to trauma, even if the inside is not too distorted - is also a relatively rare situation, especially in traffic accidents, accidents with the highest rates of precipitation type or combined with other events (crashes). For the traffic accidents, this situation is often the expression of the patient using submaximal active protection systems of the vehicle, in which case the patient is violently traumatized by effects of the blow type- riposte and deceleration and less crash - compression or twisting. In this situation the medical team is in - a better defined situation, the primary and secondary assessment usually providing most of the arguments for an "aggressive and energetic management", without the risk of serious underestimation. Elements of risk in this situation are found in three factors (15)

- the risk to medical staff whose attention is captured entirely by the severity of trauma and protection issues are neglected in the (16) staff's attempt to quickly access the patient.
- the risk that the attention of the medical team is captured by a series of obvious lesions, and lose the chance to highlight the hidden, sometimes more serious, such as parenchymal abdominal visceral lesions (11, 17). On the one hand, some very obvious lesions are themselves life-threatening injuries (amputation of limbs), on the other hand, systematic assessment and reassessment can limit this risk. (15)
- the risk that the extrication is precipitated in terms of tactical solutions for finding not necessarily good, but apparently faster extraction methods, because apparently the structure allows these things; usually this behavior brings little benefit of time, sometimes even negligible but suits the risk of later finds that the solution,"to minimize" initially

desired does not provide enough work comfort and safety to perform all maneuvers in order to stabilize and secure the victim before and during extrication.

**1.C. Mixed imprisonment** - is on the one hand the most common condition in traumatized patients, and at the same time is one of the most formidable factors for altering the vital and functional prognosis of the trauma patient. At the same time, mixed imprisonment is also one of the most intractable medical problems for mixed teams, medical - paramedical assisting the patient who must identify quickly, "the most favorable compromise as well as applicable for each accident and for each victim in particular, so as to obtain the maximum benefit for the patient, with minimal additional risk to the patient and also as far as possible, with the best time enrollment standards for the pre-hospital phase management of the traumatized patient.

Incarceration, as it has already been pointed out, is a serious condition in the trauma often associated with hypothermia (18.19) plus the risk of additional trauma to the patient, adding additional risks to the scene and, not least, increasing the time intervention, thus forcing the adaptation after prehospital management of the other stages (preparation for discharge and transfer) in order to comply with „the golden time" (7). At the same time, it is certainly true that every accident involving incarceration of people is a unique event with many irreproducible variables with an infinity of possible solutions among which the proper knowledge, experience and perfect orientation in time and space make the difference in performance.

**2. The extrication** is a technical - medical intervention with multiple risks that require complex teams, medical - military, cooperation, experience and competence, requiring both technical- tactical solutions - conventional and of circumstances (individualized according to the case)

**2.A. Extrication Team** (16) consists of military link - Fire paramedics Class 1.2, (commander of the crew and 2-4 servants) and the medical - resuscitation crew

Extrication includes a series of standard working steps (16)

- research and evaluation of the accident site - the crew commander and chief of medical intervention.
- establishing and ensuring the working area and the external security perimeter, buoyage, illumination.
- preparing the equipment.
- stabilizing the vehicle, technically possible in several ways to achieve both the high security provided for the crew, and also not to move if at all vehicle from the initial position, a situation that might cause un-

controlled worsening of the lesional profile of the victims (on the place, on another car, on the roof, the wheels, on one side). For each of these situations the extrication team has available a wide range of technical solutions to stabilize and lift, that differ depending on the environment on which the vehicle is found, the slope position the vehicle extrication tactics. Thus, for the vehicle on wheels a stabilizing system in 3 or 4 points can be used, with a stabilization method in steps, preferably, placed in two contrary directions. For the overturned vehicle on the side a support struts hydraulic, pneumatic or wood, can be used, ensured with feathers and rested on padstied with straps. For the vehicle overturned on the roof, the space between the back of the car and the soil is stalled, as well as the space between the engine compartment and windshield. (16)

### **2.B. Extrication protocol. Sources of risk in extrication operations**

The protocol, different according to the types of accidents, includes initial steps required to secure the scene (stop battery contact - the negative terminal first, provide airbags - lock the steering wheel airbag, establish their priorities for access to the patients (rapid initial triage) development of the first access - removal of glass, ACBD evaluation and resuscitation of vital functions, widening the access - cutting doors, seatbelts, resuscitation and stabilization of the vital functions (16). For each of these work phases there are different features. The modern vehicles are equipped with battery safety circuits, represented by the possibility of maintaining a low amperage current even after the terminals, which maintains on the one hand the risk of fire during the extrication maneuvers, but also that of accidental triggering of the airbags that did not expand on the impact. Also, in what the airbags are concerned, on the one hand many of these are made on constructive systems with the pyrotechnic seal placed under the airbag, triggered by the computer at impacts of different scale. On the other hand, these systems operate independently of the electricity supplied by the battery, which means that the battery exclusion does not exclude the risk of accidental triggering of the airbag (16).

At the same time improving the active safety means of the passenger in modern cars also involved a better complementarity between the seatbelt and airbags, to provide greater security and lower level of the side effects of each system. Thus increasing the speed of the airbag opening is combined with a certain level of safety belt pretensioners, so that the meeting of the passenger airbag is perfectly modulated by the seatbelt, case in which the facial lesions that can be caused by airbag injury and intestino - mesenteric induced by seat belts are minimal, but with greater severity factors in preg-

nancy (7,8,9) and the air bag opening may be made fast enough to minimize both the direct impact with the frontal structures and the deceleration, and the riposte also. This makes these types of car airbag system to be automatically inactivated if the belt is not in use, so as not to risk major injury by just opening them. It is also possible that the airbag opening is provided to perform successive steps, all of which were not exhausted during the initial impact. Meanwhile, the belt tensioners, supported by the gas cylinders, are elements of variability and potential risk that need to be controlled and specifically inactivated. (16) In this case, the extrication team must quickly identify the type of airbags and also their position and number, especially for special curtain airbags whose distribution is in columns, case in which cutting is practiced by stripping. Once discovered they must be brought in safely, otherwise accidental triggering during technical maneuvers can cause death of any person within range, including medical team.

Running subsequent extrication operations will target the following objectives:

- partial - completely access - total or partial stripping of the vehicle by cutting posts and protect the sharp edges
- secondary examination, monitoring complex systems, management(4, 6.7, 8, 9).
- lifting board, releasing the legs, bucking bracket, removing, sectioning chairs etc.
- immobilization - detailed examination of the limbs (6).
- extrication.
- tertiary examination (4.6) and complete management, completion of the immobilization, installation of wells, completion of monitoring. In the absence of tertiary assessment it is likely that some clinical lesions less obvious in earlier stages because of the particular conditions in which the patient or the team were, may not be noticed after the extrication (2), thus affecting the management perspective.
- preparation for disposal (deciding the means and destination where the patient will be discharged, in compliance with discharge protocol for patients critics and especially the fundamental principle - the patient will go to the nearest appropriate trauma center) (4,5,6,8, 9).

## 2. C. Extrication equipment (16)

- Hydraulic - most currently used due to the safety in operation, the rapid achievement of optimum working pressure, reduced weight, increased maneuverability and autonomy, ability to be used in extreme temperatures, and not least, with an acceptable noise level.
- autonomous rescue tools - electric or manual powered, are ideal for

- working in tight spaces or remote, can be handled by one rescuer.
- electric – the cutting disc - increased risk in operating due to sparks and metal splinters

### 3. Extrication and transport

The extrication is practically performed step by step as the extrication progresses and it is gained access to different segments of the patient, but the extraction itself of the patient from the scene is a special time of the pre-hospital management of the trauma patients

**3.A. Principles and extrication techniques.** These can vary from situation to situation depending on many factors, such as: land features (water, rescue from height, collapse of structures, mountain rescue), depending on vehicle position and that of the patient, the arrangement of the sources of risk and the degree of imminence of its physical space available, estimated lesion profile, number and distribution of victims. Finally, the extrication tactics and technique is committed to the preparation, training, experience and equipment level of the team performing the procedure (15,17). It is extremely important that the joint team leader have a good perspective on the scene and it is preferably not to be physically involved at this point in the working procedure, so that he can coordinate effectively. It is imperative that the extrication is made while the patient is completely immobilized (2,7,20), best in horizontal position, especially in case of removal from water or after prolonged attempts, in small steps and carefully synchronized, only at the medical intervention chief's order with major precautions not to deploy a range of medical devices already placed in position. (venous catheters, chest drainage tubes, intubation probe, different immobilization).

It is also preferable that during extrication, with the rare exception of the need to cooperate with less traumatized patient (absolute imprisonment), the patient is sedated and analgesied (2,12,13) at least if not complete even under general anesthesia (5,8,9,15). The benefits of this approach (5,8,9) materialized in increased survival and rehabilitation chances, consists primarily in the cancellation of the nociceptive stimulation as the first link of triggering the post-traumatic shock (17), the possibility of optimal control and stability of the cervical column, of the catheters and drain tubes (15), control of oxygenation, ventilation, and through this of the hemodynamics, thus, making possible the optimal pain control of the secondary brain (21), agitation, seizure threshold (5,7) intracranial pressure (5,7,8) and to start controlled hypothermia (22). It goes without saying that the initiation, „on the field“ of the complete general anesthesia and controlled ventilation requires the presence of a high-performance medical team, properly

sized and equipped specifically to induce, maintain and manage this process and not last, to monitor and control events such as transient episodes of desaturation during laborious IOT (23), complications and side effects (24) in an unknown, patient who is in completely non-standard conditions (25) for an ideal general anesthesia - major anesthetic risk, limited time (14) full stomach, lesional polymorphism, completely unknown, exposure to weather, high PIC (4,5,8,9).

The technical equipment for the extrication are represented by different stretchers and devices such as Kendrick Extrication Device (KED), scoop stretcher, rigid column stretcher. (4,6)

Throughout the extrication of the patient a series of related items should be suspected and assisted early to prevent a series of pathological cascades that are primed early but are clinically expressed in later phases.

**3.B. The prophylaxis stress syndrome** begins before lifting the pressure if it is considered that it was sufficiently intense and sustained to trigger it (3) (ca. 20-25') at the level of a well represented muscle mass (eg thigh) with concomitant impairment of vascular package or under prolonged concomitant hypovolemia (8). Crush syndrome is a phenomenon dependent of time and pressure (7). Muscle damage caused by a combination of three fundamental factors (vascular compression, direct muscle destruction and progressive increase in pressure by supported external compression) (9), ultimately lead to rhabdomyolysis with systemic major consequences due to cardiac, renal impact on hemodynamics and due to the acid-base balance in particular. The key to treatment is to anticipate and adequately resuscitate a traumatized with conditions of inducing the stress syndrome,

Mannitol may be useful, given the free formed radicalii trained and pressor amines reserved for the situation in which despite adequate resuscitation the urine flow does not reach 2 ml/kg/h (5).

### **3.C. The issue of hypothermia**

Hypothermia - one of the most formidable opponents of survival in major trauma, especially if generalized, progressive, sustained and severe and associated with hypoxia and hypovolemia, accompanying in most of the severe traumas (ISS over 16) (19). It is extremely important that hypothermia should be suspected and therefore the central temperature should be monitored not only in cold weather conditions but also in patients with submersion injury (18), since the body heat is lost faster in water than in air (especially in children who have a more disadvantageous report between the surface and the volume of their body, the smaller they are). It is also the situation of patients exposed to moisture and air currents acting simultaneously (6,19,) of those whose burnt injuries were cooled (4) and patients with massive loss

of blood / plasma (26) to whom inevitably in added the quick infusion with a large liquid volume, which is not always warmed to the body temperature (27). Last, but not least, the general anesthesia is an important factor in inducing hypothermia both the controlled(22) and the accidental one(18, 19) so that the central temperature monitoring (14) is standard for monitoring patients to whom - general anesthesia were induced in pre-hospital, since it can generate even in the operating room conditions a cooling of about 1grd. / hour.

Hypothermia causes extreme mess defense mechanisms and repair tissue balancing of the coagulation system - fibrinolysis (28) in the sense of hypercoagulation initially by increasing the viscosity (29), decreasing the platelet activity, platelet inhibitors - the production of thromboxane B2 is temperature dependent - (extension PTT) (31), and the activation of the complement, followed by DIC (18,19) (thromboplastin released solid) and severe hypothermia massive defibrillation (decreased platelets, mainly by inhibiting the formation and splenic sequestration) and within 24 - 36 hours of reheating, particularly in heavily transfused trauma patient. (9, 27). Finally, the disruption of protein synthesis, including synthesis of antibodies, extreme vasoconstriction (18), decreased cardiac ejection fraction by decreasing the force of contraction and heart rate (24), precipitation of arrhythmias (18) by hyperkalaemia-induced cardiac toxicity in the acidosis and crushing - (18) leads to impaired flow in vital organs or regional role in priming subsequent MODS as splanhnic territory, plus mixed acidosis and electrolyte imbalances and rhabdomyolysis. On the other hand, hypothermia can easily mask the hemorrhage due to the haemoconcentration that appears under hypothermia and increase the hematocrit by about 2% for every 1 deg. (24). Also,, cold diuresis"( the decrease in reabsorption of sodium and water in the kidney) can cause false security of the proper infusion of kidney and therefore hemodynamic normality. (18, 24).

The hypokalemia and the decrease in transcellular glucose transport associated with the decrease in the insulin release under 30 degrees will considerably lower the cellular metabolism, emphasizing the potential disruption of post traumatic hypoxia or hypovolemia. The only benefit of a medium hypothermia, yet this short, fine and suddenly is induced is the cerebral protective effect (22), especially under HTIC by decreasing the oxygen demand and by lowering the basal metabolism. (5,7,8,9,21)

After the extrication - complete reassessment and management are required (2,4,6) since it is possible that during the extrication, a range of devices already placed in position, may require repositioning (15) or refitting.

## Conclusions

- incarceration is always an element of outstanding trauma severity
- extrication is part of a complex management of the trauma patient.
- determines the chance of survival.
- determines the functional prognosis and the chance of recovery

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