UNIVERSITY OF ZAGREB
SCHOOL OF MEDICINE

Leyla Mahmutovic

Acute Trauma Victim – Chest Injury

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ABBREVIATIONS

ABCDE's:	Airway, Breathing, Circulation, Disability, Exposure
ABG:	Arterial Blood Gases
AC:	Assist control
ATLS:	Advanced Trauma Life Support
ATOM FC:	Airway obstruction, Tension pneumothorax, Open pneumothorax, Massive haemothorax, Flail chest, and Cardiac tamponade
BP:	Blood Pressure
CMV:	Controlled mechanical ventilation
CPAP:	Continuous positive airway pressure
C-spine:	Cervical Spine
CT:	Computed Tomography
DPL:	Diagnostic Peritoneal Lavage
ECG:	Electrocardiogram
ED:	Emergency Department
eFAST:	Extended Focused Assessment with Sonography in Trauma
ETI:	Endotracheal intubation
GSW:	Gunshot Wound
HR:	Heart Rate
ICU:	Intensive Care Unit
IMV:	Intermittent mandatory ventilation
FAST:	Focused Assessment with Sonography in Trauma
LEMON:	Look externally, Evaluate, Mallampati score, Obstruction/Obesity, Neck mobility

LMA:	Laryngeal mask airway
LTA:	Laryngeal tube airway
MAC:	Macintosh laryngoscope
MEA:	Multi lumen esophageal airway
PSV:	Pressure support ventilation
PTO:	Percutaneous transtracheal oxygenation
PTV:	Percutaneous transtracheal ventilation
SIMV:	Synchronous intermittent mandatory ventilation
UEScope:	Video laryngoscope

TABLE OF CONTENTS

ABSTRACT

Acute chest trauma is a common and serious injury in trauma patients. According to the mechanism of injury, acute chest trauma can be divided into blunt or penetrating trauma. The thorax has three major anatomical systems: airway, cardiovascular and the lungs. Approach to trauma victim with chest injuries should be approached according to ATLS algorithm and assessment of the ABCDEs first. Primary survey is an initial assessment of a trauma patient. It is conducted in order to identify and treat the most imminent life threatening injuries. Primary survey adjuncts such as ECG, ABG, X-ray pelvis, Chest X-ray, eFAST exam, DPL, and pulse oximetry and IV lines should be placed and oxygenation prepared with monitors. Secondary survey is performed with complete history and physical examination. Chest trauma can lead to life threatening conditions such as airway obstruction, pneumothorax, tension pneumothorax, open pneumothorax, massive hemothorax, flail chest and cardiac tamponade. These injuries should be recognized in the primary survey and treated as soon as possible. Problem of acute chest trauma is hypoxia, hypercarbia, hypovolemia and acidosis due to hypoxia. Treatment is according to the injury sustained and establishment of normal gas exchange and hemodynamics.

SAŽETAK

Akutna trauma prsnog koša je česta i ozbiljna povreda kod pacijenata s politraumom. Prema mehanizmu ozljede, akutne trauma prsnog koša mogu se podijeliti na tupe ili prodorne traume. U prsnom košu su smještena tri velika anatomska sistema: dišni putevi, pluća i kardiovaskularni sistem. Pristup pacijentu s ozljedom prsnog koša i primarna procjena ABCDE se zasniva na ATLS algoritmu. Primarni pregled je početna procjena traumatiziranog pacijenta. Provodi se kako bi se otkrile i liječile ozljede opasne po život pacijenta. Primarni pregled ukljucuje primarne dijagnostičke procedure kao što su EKG, ABG, rentgenska slika zdjelice, rentgenska slika pluća, eFAST pregled, DPL i pulsna oksimetrija, otvaranje venskog puta i oksigenacija uz monitoring. Sekundarni pregled podrazumijeva kompletnu povijest bolesti pacijenta uz kompletan fizički pregled. Ozljeda prsnog koša može dovesti do po život opasnih stanja kao što su: opstrukcija dišnih puteva, pneumotoraks, tenzijski pneumotoraks, otvoreni pneumotoraks, masivni hematotoraks, flail chest i srčana tamponada. Ove ozljede treba prepoznati u primarnom pregledu i tretirati ih što je prije moguće. Posljedice akutne traume prsnog koša su: hipoksija, hiperkapnija, hipovolemija i acidoza zbog hipoksije. Liječenje je u skladu s oštećenjima i u cilju uspostavljanja normalne izmjene plinova i hemodinamskog statusa.

INTRODUCTION

Chest trauma is becoming the second most common traumatic injury in non-intentional trauma after head and extremity. Trauma to the chest comes with the highest mortality; in some studies, up to 60% (1). Risk for chest trauma affects all ages equally. Both types of chest trauma, blunt and penetrating chest trauma can result in mortality. However, blunt chest trauma occur more frequently than penetrating chest trauma in the ratio of 70:30 (2). Motor vehicle injuries (MVA) are the most common of these. Mechanism of injury such as in MVA; speed, position of patient, air bag deployment, seat belt usage, other passengers are important clues to working diagnosis. In penetrating trauma such as gunshot wound (GSW) the important information is the type of gun used, distance, and number of shots. Trajectory is determined by the number of bullet holes and number of bullets retained.

Acute chest trauma or any type of injuries in trauma should follow similar initial assessment and management. Management and assessment of trauma is divided into three levels of care; pre-hospital phase, hospital phase or emergency room/trauma life support phase, and surgical trauma phase. Approaching patient with any traumatic injury is important to assess and reassess the patient frequently in order to identify any changes in the patient's status that may require additional interventions. Since timing is of an essence, the initial assessment is important key factor that can be a matter of life or death to an injured patient. The initial assessment includes a number of elements that follow: preparation, triage, primary survey (ABCDEs), adjuncts to primary survey and resuscitation, considerations of patient transfer, secondary survey (head to toe evaluation and patient history), adjuncts to secondary survey, continued post resuscitation monitoring and reevaluation, and definitive care (2). Acute trauma victim - chest trauma care can be also divided on different levels such as access to patient with thoracic injury, reanimation measures at the site of injury, reanimation measures in the intensive care unit (ICU), maintenance and securing the airway, sufficient ventilation, and hemodynamic stability. The main problem in thoracic trauma is decreased tissue perfusion which lead to hypoxia and metabolic acidosis. Treatment of hypoventilation, hypovolemia and cardiac dysfunction are the cornerstone of good patient outcome.

Life-threatening injuries of patient with thoracic trauma, affecting airway, breathing and circulation, recognized and treated in primary survey will be the topic of this review.

The approach to patient with thoracic injury

Approach of patient with thoracic injury, the main algorithm of pre-hospital care and the preparation phase is the (ABCDE's) algorithm, which stands for; Airway, Breathing and ventilation, Circulation and hemorrhage control, Disability (Neurologic Evaluation), and Exposure/Environmental control. This algorithm is the gold standard and the staple of Advanced Trauma Life Support (ATLS). The injuries are identified in primary survey and are treated in the manner level of life-threatening injuries. The primary survey is followed by secondary survey that treats potential life-threatening injuries. There is a constant assessment and reassessment of the victim for change in status. Injuries that are an immediate threat to life are treated as quickly and simply as is possible. Most life threatening thoracic injuries can be treated with airway control or an appropriately placed chest tube or needle (1). The approach to patient with thoracic injury and trauma in general depends on whether the patient is on site of accident or in the hospital setting.

Approaching a patient with acute chest trauma before the ABCDE's algorithm first one has to think about safety. Depending on the situation on hand approaching a trauma patient always starts with at least basic life support (BLS). There should be general inspection of the patient, if the victim is awake then one can ask "What's your name?" If the patient responds and speaks normally than the patient has a patent airway for now and he has adequate breathing and brain perfusion. However, if the patient responds in short sentences or speaking is labored then patient might have a breathing issue and airway needs to be protected. There are two ways of airway opening: chin lift and jaw thrust and triple maneuver can be used if cervical spine injury is suspected. Inspection of breathing- look, listen, and feel- should be about 10 seconds. If the person is not breathing, one should always call for help. If the patient is unconscious and not breathing CPR should be started. If there is suspicion of chest trauma, then the identification of life threatening injuries is crucial toward lifesaving interventions. If possible start monitoring of vital signs such as ECG, pulse oximetry, blood pressure monitor, and inserting an IV as soon as possible.

In Cook County Trauma in Chicago the algorithm for chest is divided by anatomic boundaries. They are chest, cardiac box, thoraco-abdomen, and posterior-box. The injuries sustained are divided and treated according to the algorithm. Chest: All areas that are supported within the rib cage, is the chest. All penetrating wounds to the chest should have an admission CXR. All pneumothoracies or effusion should be treated with a chest tube. If the initial CRX is normal, a repeat inspiration/expiration CRX should be done 6 hours after the first CXR.

Primary Survey

Primary survey is a quick assessment of ABCDE and identification of life threatening injuries. Airway and breathing is quickly assessed by asking a patient for his/ her name. An appropriate response suggests no major airway compromise with adequate air movement in lungs. With this same question the level of consciousness is also quickly assessed by ability of patient to describe what happened. However, if the patient is unable to respond then that suggests abnormality in A, B, C, or D which indicates urgent assessment and management. Airway management is always the first priority. No matter what type of injury that is causing airway compromise the injury should be treated in order to secure the airway. Breathing and ventilation is assessed by visual inspection, auscultation of gas flow in lungs and use of pulse oximeter to measure the patient's oxygen saturation.

Circulation with hemorrhage control in primary survey is assessed by level of consciousness, skin perfusion, and pulses. With decreased blood volume, cerebral perfusion is impaired causing an altered mental status. Skin perfusion and skin color can be a fast clue to hypovolemia. Ash gray skin with pale extremities is usually a sign of hypovolemia. Palpating pulses such as carotid and femoral artery with bilateral observation of rate, quality, and regularity. Other arteries are also palpated such as radial and dorsal foot pulses. Identification of source of bleeding and whether it is internal or external bleeding is vital toward further critical care. External bleeding is managed by direct pressure on the wound while internal bleeding is managed by surgical intervention. IV access and two large-bore peripheral venous catheters are established for administration of fluid, plasma, and blood. Usage of volume resuscitation should be initiated if blood loss is suspected. However, volume resuscitation should not be looked at as a substitute for definitive control of hemorrhage.

Disability in primary survey is s rapid neurological evaluation that evaluates the level of consciousness. Glasgow Coma Scale (GCS) and in conjunction with pupil size and reaction one can assess the patient's neurologic status. It is always wise to assume that level of consciousness is the result of central nervous system injury until proven otherwise. If a patient has spontaneous eye opening and verbal response is oriented with obeying motor response the GSS is 15. If the patient is assumed to be in a MVA or any traumatic event that could potentially worsen over time the patient should be observed and GCS should be reassessed.

Exposure and environmental control in primary survey is done by completely undressing the patient and examining and assessing the injuries. The patient should be then covered with warm blankets to avoid hypothermia.

Chest trauma can lead to life-threatening conditions such as airway obstruction, tension pneumothorax, open pneumothorax, massive hemothorax, flail chest and cardiac tamponade. These injuries should be recognized in the primary survey and treated as soon as possible.

Secondary Survey:

Secondary survey does not begin until primary survey ABCDE is completed and there is an improvement of patient vital signs. The secondary survey is a head to toe evaluation with a complete history and physical examination. All vitals are also re assessed and each region of the body is examined. Head, maxillofacial, neck, chest, abdomen and pelvis, perineum rectum and vagina, musculoskeletal system and neurological system is examined. More emphasis given to the area where injuries are sustained. History of current medications used, allergies, past illness and pregnancy and all the events related to the injury sustained. Secondary survey is a lengthy survey that focuses on each area until a more definitive treatment is given. Adjuncts to secondary survey also include specialized diagnostic tests in order to identify specific injuries that might have not been apparent in the primary survey.

The secondary survey is marked with potentially life-threatening injuries. Besides physical examination, diagnostic tests include upright chest X-ray, ABG (pH, pO_2, pCO_2, lactate level), pulse oximetry, ultrasound and ECG. Simple pneumothorax, hemothorax, pulmonary contusion, tracheobronchial tree injury, blunt cardiac injury, traumatic aortic disruption, traumatic diaphragmatic injury and blunt esophageal rupture are potentially life-threatening condition that should be discovered and treated on time.

Preparation: Reanimation measures on site

The preparation care usually occurs in both- outside of hospital and in hospital settings. In the outside of the hospital setting, the incident is coordinated with receiving hospital and the medical staff. In the hospital phase, all the preparations are made to receive the patient for a successful handover from pre hospital care to hospital care. The preparation phase in the pre-hospital care the team notifies the receiving hospital about all of the necessary information about the patient's condition and any interventions taken before the victim is transferred to ensure adequate care. The information provided is usually the victims age, sex, mechanism of injury, vital signs such as (blood pressure, oxygen saturation and heart rate), and any apparent injuries. During this pre-hospital care the approach to acute trauma victim- chest injury should emphasize on ATLS, which includes the primary survey with simultaneous resuscitation.

Primary survey is up to a ten second assessment of ABCDE. In the approach to Acute Trauma Victim – Chest Injury the ATLS the pre-hospital phase should focus on airway maintenance and protection, immobilization of the victim, control of any external bleeding and shock, and coordination for transport to the closest trauma center (2).

During this preparation phase the approach to a patient with acute trauma chest injuries the team is assembled within the emergency room or trauma center in order to insure the best care possible. Before the patient arrives there is a checklist that includes an introduction to the team and assignment of key roles. Thesis a pre-briefing for an incoming trauma victim with information of patient age, sex, vitals, type of injuries and interventions already taken. Wearing of appropriate equipment and equipment check such as airway, warmed fluids and other necessary equipment needed is vital for preparing for trauma victim. Computer Tomography (CT) is notified along with the blood bank if required along with trauma team and mobilizing other appropriate resources. Upon the arrival of the trauma victim, there is a hand over of a patient where there is another arrival report which includes last set of vitals and type of injuries.

Reanimation in Hospital/ICU

When acute chest trauma victim arrives to the hospital or the trauma center the team should already be in place and proper equipment on hand for use. Reanimation measures inside the hospital or the intensive care unit (ICU) follows the protocols of the ATLS. As soon as the patient arrives and all the preparation is in place there is a primary survey of the victim with adjuncts to the primary survey with resuscitation. The adjuncts to primary survey include and are not limited to; continuous electrocardiography ECG, pulse oximetry, arterial blood gas (ABG), carbon dioxide monitoring(CO2), blood pressure monitoring (BP), pulse pressure, heart rate (HR), body temperature, and ventilatory rate. Other tests and procedures that are commonly used are: X- ray, blood lactate levels, focused assessment with sonography for trauma (FAST), and extended focused assessment with sonography for trauma (eFAST), diagnostic peritoneal lavage (DPL), IV lines, urinary catheters, and gastric catheters. Reanimation follows protocols of ABCDE and management and identification of life threatening injuries. Identification of possible life threatening injuries should be assumed if there is a known MVA (Motor vehicle accident) and or if the victim was or was not wearing a seatbelt. Injuries such as Airway obstruction, Tension pneumothorax, Open pneumothorax, Massive haemothorax, Flail chest, and Traumatic cardiac tamponade also known by the acronym 'ATOM FC' must be ruled out in primary survey as these are life threatening injuries. The life threatening injuries in primary survey should also be treated as they are identified. In hospital settings, one can do more for a patient, especially if there is a trauma unit available and a team that is trained to manage complicated injuries. In Trauma centers, trauma team is prepared for patients in the shock room, with a surgery team and operating room ready on standby. Higher survival has been shown for patients that are taken to trauma centers rather than a hospital without a trauma center.

Airway Management and Maintenance

Basics of ATLS in trauma the first priority is always securing the airway. Since hypoxia is the most serious issue in chest trauma proper maintenance and securing the airway is imperative. One should always observe the patient to see if the patient is cyanotic, or if there is use of accessory muscles, or even if the patient is agitated which can suggest hypoxia. The use of pulse oximeter will show inadequate oxygenation. While listening for abnormal breathing and palpating the trachea to establish its position will further help with patent airway recognition. In trauma victims, blood, loose teeth, and vomit should be always expected along with difficult airway. In these cases debris suctioning and aspiration prevention should always be done. Airway is assessed in the primary survey for patency and any signs of airway obstruction.

Airway obstruction is inspected for facial, mandibular, tracheal, and laryngeal fractures along with dislocation of posterior clavicular head that can cause upper airway obstruction. Palpation for clavicular dislocation in the anterior portion is managed by simple manual reduction. Any airway obstruction will lead usage of accessory muscles and labored breathing. The breath sounds are diminished or may sound noisy. Any airway compromise should be treated as a medical emergency. Oxygen should be provided and oxygen saturation maintenance aim of 94 to 98%.

Recognizing airway compromise:

The first step toward airway management is recognizing airway compromise. If the trauma victim is able to verbally communicate, then the airway is not in immediate life threat. However, this situation can change from minute to minute and airway patency should always be re-assessed and placement of a more definitive airway could be needed. In certain situations only a chin lift, jaw thrust, or oropharyngeal airway can be initially used until preparation for intubation is done. It is important to note that in all trauma, cervical spine injury (c-spine) should be assumed until proven otherwise. Therefore the head and neck is usually secured with cervical spine collar and secured to a rigid backboard with blocks (4). Cervical spine collar is usually placed in pre-hospital setting and airway management already in place. When approaching a patient with cervical collar, the collar is carefully opened and then a manual restriction applied while airway is inspected and managed. When in hospital trauma unit receiving a patient from pre hospital care a patient might or might not have an oropharyngeal airway. Oropharyngeal airway is inserted behind the tongue. This device must not be used in conscious patients because it can induce gagging, vomiting, and aspiration. It is important to note that patients who tolerate an oropharyngeal airway are highly likely to require intubation (6).

Recognizing a difficult airway is also important prior an intubation, if the airway is difficult one should call for help and get assistance. A difficult airway is assessed by observation of any facial and neck trauma and small mouth or jaw. The assessment is also made by the mnemonic LEMON (Look externally, Evaluate, Mallampati score, Obruction/Obesity, Neck mobility). Looking externally for any trauma to the maxillofacial area. Evaluate 3-3-2 Rule (distance between incisors should be 3 fingers, distance between the hyoid bone and chin is also 3 fingers, and distance between thyroid notch and floor of the mouth is at least 2 fingers). Mallampati classification where the hypopharynx is visualized and classified from 1 to 4. Obstruction is where any condition causes obstruction (obesity, trauma, peritonsillar abscess, or epiglottitis). Neck mobility (patients with neck brace or cervical spine trauma). All values for the LEMON criteria worsened significantly after cervical collar application (8). If there is a difficult airway and intubation has failed then a basic airway management is used such as: laryngeal mask airway (LMA), laryngeal tube airway (LTA) or multi lumen esophageal airway (MEA).

Airway obstruction is usually associated with trauma to the larynx, neck, face, posterior clavicular dislocations, and tracheal shift. Identifying such injuries immediately can be lifesaving by protecting the airway by suction, and early recognition of need for intubation (11). The presenting patient often might have subtle signs of airway compromise such as pain, tachypnea, and anxiety therefore, it is important to re assess the airway patency often. Helpful observations such as noisy breathing can indicate a partial obstruction that can quickly become problematic and develop into a complete obstruction. Other objective signs of airway obstruction is observing nail beds for hypoxemia and patients behavior such as abusive or aggressive patient. One should not assume intoxication and should check airway for possible obstruction. In a study by Bard (13) it has been found that in United States, language and communication barriers may lead to the unnecessary placement of an artificial airway with resultant patient risk. Data suggest that language and communication barriers led to potentially preventable intubations. Since in primary survey communication is key, it is important to take into consideration that a patient may or may not need intubation. One should always follow basic life support protocol. Always look and listen if the patient is breathing on his/her own. One should listen for dyspnea, stridor, hoarseness, hemoptysis, tachypnea, and crackles.

Definitive Airway maintenance:

If a more definitive airway maintenance is needed than the options include; orotracheal tube, nasotracheal tube, and surgical cricothyroidotomy. It is mentioned by Bernard **(5)** that patients with multiple trauma presenting with apnea or gasping breathing pattern (respiratory rate <6/min) require prehospital endotracheal intubation (ETI) and ventilation. Bernard **(5)** also mentions that additional indications are hypoxia, severe traumatic brain injury, trauma -associated hemodynamic instability, and severe chest trauma with respiratory insufficiency.

These indications are further defined as: hypoxia of a $SpO_2<90\%$ despite oxygen insufflation and after exclusion of tension pneumothorax. Severe traumatic brain injury with a

GCS<9. Trauma-associated hemodynamic instability [systolic blood pressure (SBP)<90 mmHg]. Severe chest trauma with respiratory insufficiency (RR >29/min).

As mentioned by Marino (7) hesitation invites trouble, there is a tendency to delay intubation in the hope that it will be unnecessary. However, delays in the intubation can create unnecessary issues later when the airway becomes more difficult to intubate.

With orotracheal intubation especially in trauma patients with GCS<9 require fast intubation and it should be done with a two-person technique with inline cervical spine immobilization. As mentioned by Patterson (9) in a retrospective study, intubation by Emergency Department (ED) medical staff did not worsen neurological outcome. In the controlled setting of an ED staffed by senior practitioners, patients with undiagnosed cervical spine injury can be safely intubated (9). Newer devices are more available and in another study intubation with the UEScope resulted in a better glottis visualization, a higher intubation success than a Macintosh laryngoscope (MAC). Moreover, in situations where the airway is difficult for ETI especially by the paramedic, the UEScope would be a better choice than the MAC (10).

Confirmation of correct tube placement after endotracheal intubation is mandatory. According to Call (12) tube placement and confirmation must be documented. If not absolutely sure that the tube is in correct position the tube should be pulled out and intubation started over again. First confirmation is to observe the endotracheal tube (ETT) pass the vocal cords. Then, the cuff is inflated. Fogging inside the tube is not safe sign. Subsequently, lung auscultation is main conformation of correct intubation. Lung sounds should be heard in both lungs and sounds should be equal. On the other hand, gastric contents on ETT is a sign that the tube is in an esophagus. Listening to the epigastric region and observation of abdomen distention can prove oesophageal intubation. Every time a patient is moved the tube placement should be re checked because there could be displacement of a tube (12). Third confirmation is the end tidal CO2. ETCO2 measures the amount of CO2 at the end of expiration expelled by the patient. Since CO2 is only expelled by the lungs it is a helpful tool for additional assessment of correct tube placement.

Once the tube is correctly inserted then it should be secured and marked with a permanent marker for a better visualization of any displacement during movement (12). However, in trauma or emergency situations performing an ETI is more difficult and rates of first time success will be lower.

If ETI is unsuccessful even with devices for difficult intubation like UEScope, then surgical intubation by needle cricothyroidotomy or tracheostomy is necessary. One should always have an alternate plan such as laryngeal mask, laryngeal tube, or surgical airway. Surgical airway (cricothyroidotomy or tracheostomy) is indicated in the presence of edema of the glottis, fracture of the larynx, severe oropharyngeal hemorrhage (1). In a case presentation by Ono and colleagues (15) in acute trauma patient with a penetration to the tongue root through to the epipharynx by a surfboard, open tracheostomy was preferred. This is because the percutaneous technique has severe potential complications, such as pretracheal false passage, and hypopharyngeal and esophageal intubation (15). Generally percutaneous tracheostomy is not preferred in acute trauma situations, due to the need of hyperextension of the neck in order for the procedure to be performed safely.

Failure to oxygenate by face mask or supraglottic device ventilation, occurring in conjunction with failed tracheal intubation defines a failed oxygenation, ‘‘cannot intubate, cannot oxygenate’’ situation where a surgical intervention is needed (16).

The needle cricothyroidotomy, is basically needle insertion through the cricothyroid membrane into the trachea. This is done in emergency setting for short term temporary oxygenation so intubation can be provided (1). Percutaneous transtracheal oxygenation (PTO) is done by extending the patient's neck and by observing and identifying the landmarks. The patient should be pre oxygenated by administering high flow oxygen by face mask or bag-valve- mask.

Location of cricothyroid membrane is determined by palpating the prominence of the thyroid cartilage. The finger should be moved inferiorly into the depression between the thyroid and cricoid cartilages (17). PTV provides less efficient ventilation than endotracheal intubation. Because of the concern for CO2 retention with PTV, the traditional approach was used as a short term (eg, less than 45 minutes) temporizing airway measure (17). In complete obstruction PVT might cause development of severe barotrauma, and distention of the lungs, and even death. Stothert and all have shown that shorter expiratory time or an increased inspiratory time results in significant hemodynamic compromise, barotrauma, acidemia, inadequate CO2 elimination and death (18).

Medications:

It is also important to note that intubation is usually done with medications, especially in patients who still have a gag reflex and are still fully awake. Patients who are not responsive medications might not be needed (20). If the medications are used then etomidate is preferred due to its minimal effects on hemodynamics. Midazolam is often used due to its fast onset and due to its more predictable properties. Propofol is used for trauma and mechanically ventilated patients however in major trauma with problems of hypotension one might look for an alternative choice. A meta-analysis of propofol use in the ED reported that in addition to rapidly providing adequate intubating conditions and causing frequent hypotension, subjects receiving propofol frequently became apneic (23% of propofol subjects, 28% of thiopental subjects, and only 7% of etomidate subjects). This should give clinicians pause if they are not confident that they will be able to provide successful positive-pressure ventilation for the patient (20). Ketamine another drug has been shown to be as efficacious as etomidate for rapid sequence intubation (RSI), with a similar lack of deleterious effect on hemodynamics. Neuromuscular blocking agents are used in rapid sequence induction (RSI). Study by Bozeman (21) showed “good” or “acceptable” intubation in 79% with RSI in contrast to only 13% of patients receiving only etomidate. In the study they showed that avoiding neuromuscular blockers may decrease the success of intubation. In the Trauma Cook County Hospital the guidelines for RSI calls for a simple algorithm. Medication for intubation are given in two different protocols according non head injury versus head injury. For non-head injury, the medication follows the sequence: ethomidate followed by succinylcholine. For adult or pediatric patient with suspected head injuries the sequence follows: lidocaine, pavulon, ethomidate, and then succinylcholine.

Breathing and Sufficient Ventilation

In acute trauma victim with chest injury, it is obligatory to assess breathing and neck veins. Respiratory movements, quality of respiration, signs of hypoxia as respiratory frequency, shallow breathing should be observed. Injuries such as Airway obstruction, Tension pneumothorax, Open pneumothorax, Massive haemothorax, Flail chest, and traumatic cardiac tamponade also known by the acronym 'ATOM FC' must be ruled out in primary survey as these are life threatening injuries. The life threatening injuries in primary survey should be treated when they are identified. The chest trauma can be a result of penetrating or blunt trauma. Blunt trauma, is a more common cause of traumatic injuries and can be equally life-threatening. It is important to know the mechanism as management may be different.

Most blunt trauma is managed nonoperatively, whereas penetrating chest trauma often requires operative intervention. It is important for visual inspection of the chest in order to identify open pneumothorax, flail chest, contusions, and hematomas. In chest trauma there needs to be a complete inspection and palpation of whole chest including clavicles, ribs, and sternum. Further inspection should include auscultation, percussion, and palpation. Certain findings can help eliminate life threatening conditions. However, in a noisy environment auscultation would be difficult but it may provide crucial information such as on anterior chest for pneumothorax and posterior bases for hemothorax. Percussion is also an important tool that can be helpful, however also difficult in noisy environment. The use of chest x-ray and eFAST is used to confirm the presence of hemothorax or pneumothorax.

In trauma and emergency situations a lot of patients present with conditions that might require tracheal intubation or positive pressure ventilation. The main problem is insufficient oxygen exchange. Mechanical ventilation and ETI are used to protect the airway, improve gas exchange, and relieve respiratory distress. When injuries are complex it makes it difficult to reach optimal oxygenation while protecting the lungs from further ventilator induced injury (22).

In acute trauma indications for intubation follow the RSI for protecting the airway, improve gas exchange, and relieve respiratory distress. In most cases of flail chest; adequate analgesia in the form of thoracic epidural, intercostal nerve blocks, paravertebral blocks, pleural catheter, and chest physiotherapy with regular clearance of secretions is sufficient. Mechanical ventilation is reserved for patients with pulmonary contusion and/or respiratory distress and blood gas abnormality (pO_2< 60 mmHg and pCO_2> 60 mmHg) (26). In respiratory failure intubation and ventilation of a patient is needed if there is a need for airway protection, hypoxic respiratory failure, and hypercarbia. If mechanical ventilation is needed there is an option of noninvasive and invasive ventilation. Noninvasive ventilation uses different types of face masks and invasive ventilation is mainly use of endotracheal intubation. Usually mechanical ventilation is used when the patient cannot maintain adequate airway or oxygenation. Mechanical ventilation is based on clinical findings for each specific patient. Not all acute chest trauma victims require mechanical ventilation, but it is important to consider the entire clinical picture and asses if the patient is unable to maintain an airway or properly oxygenate. Adequate ventilation improves gas exchange by improving ventilation-perfusion matching and helps with work of breathing allowing muscles to recover. Indications for mechanical ventilation is hypoventilation, acute respiratory acidosis, trauma, flail chest, massive pleural effusion, increased ventilatory demand such as sepsis, and severe metabolic acidosis. In emergency cases if there is a failure to oxygenate, failure to ventilate, inability to protect the airway, GCS <9 and other clinical suspicion, mechanical ventilation should be indicated.

In trauma care, it remains a challenge to provide optimal ventilation in cases of severe blunt chest trauma with lung contusion. The most severe forms of chest trauma need endotracheal intubation and mechanical ventilation due to hypoxemic or hypercapnic respiratory failure.

Several modes of ventilation have been studied, and no single mode has been proven more effective for patients with flail chest or pulmonary contusion. Management of ventilator modes should be intensivist choice.

In emergency situations there are three main strategies for mechanical ventilation: noninvasive positive pressure ventilation (NPPV), lung-protective invasive positive pressure ventilation (L-IPPV), and invasive positive pressure ventilation (IPPV). Selecting among the different approaches of ventilation depends on the patient disease and different situations.

NPPV may help bridge patients with some level of hypoxemia from chest injury. Close monitoring should be used by vigilant intensivist. If the oxygenation gets worse, the patient should be intubated and MV instituted. Non-invasive positive pressure ventilation (NPPV) can be used as continuous positive airway pressure (CPAP) or bilevel positive airway pressure (BiPAP), lead to normalise oxygenation and CO_2 removal. In patients with traumatic chest induced hypoxemia NPPV may prevent intubation. NPPV is associated with faster patients recovery.

The main characteristics of protective lung ventilation are low FiO_2, plateau pressure, low tidal volumes and optimal PEEP. The tidal volume should be 4-6 mL/kg of ideal body weight, plateau pressure less than 30 cm H_2O. Preventing lung overdistension with the use of appropriate tidal volumes and limiting plateau airway pressure to less than 30 cm H_2O will prevent volutrauma and barotrauma. FiO_2 should be maintained as low as possible (less than 60%) to achieve a PaO_2 of 60-80 mmHg or a saturation of 90%. Optimal PEEP (positive end expiratory pressure) will recruit alveoli and enable better oxygenation. Permissive hypercapnia can be tolerated if blood pH is above 7.2. Such ventilation shall protect the lungs from further injury.

General invasive positive pressure ventilation is mostly used in cases of trauma. However, patient on mechanical ventilation in trauma should be watched carefully due to potential increased intracranial pressure (ICP). Aggressive blood transfusion and volume supplementation should be avoided in patients with hypotension, hypoxemia, and hypercarbia due to chest trauma. Patients with hemorrhagic shock should be watched carefully because PEEP can make the hypotension worse and thus optimal PEEP should be used which will improve oxygenation with at least possible effect on stroke volume. Also patients with chest trauma should be watched carefully because these patients often are difficult to ventilate due to poor pulmonary compliance. In these patients higher oxygenation may needed but also to note that there is an increased risk of barotrauma. In review by Andrews (27) suggest that early airway pressure release ventilation prevents acute lung injury, especially in the high risk trauma patients. It has been also observed that there is a reduction of trauma related respiratory distress syndrome mortality.

Weaning from mechanical ventilation should also be done carefully and follow a protocol. Weaning of patients from ventilators is complicated process. To prevent the complications associated with prolonged mechanical ventilation and to predict successful weaning from the ventilator, certain criteria and indices are required. Parameters could be useful for weaning from the ventilator, especially when it is difficult to make decisions concerning weaning (28). There are clinical criteria that should be met in order to be considered ready for weaning off from mechanical ventilation. Among the criteria there should be an improvement of the condition that lead to the intubation, patient should have an effective cough, adequate oxygenation, the patient should be without fever, without sedatives, the patient should not be acidic, and no electrolyte disturbances and should have adequate fluid balance (28). There should be a stable cardiovascular status and minimal use of vasopressors. The patient should have adequate hemoglobin levels and the patient should be arousable and have ability to follow commands.

Tension pneumothorax and open pneumothorax

Pneumothorax is an accumulation of air in the pleural spaces that leads to partial or complete lung collapse (14). Injuries to the lungs create pleural injuries that result in collection of air in the pleural space that causes collapse to the lung. Most of all injuries of lungs that are penetrating and blunt trauma that lead to penetrating causes pneumothorax. Traumatic pneumothorax can be caused by iatrogenic or non-iatrogenic causes. Iatrogenic trauma is caused with common procedures such as central venous catheterization, thoracocentesis, or mechanical ventilation. Open pneumothorax, non-iatrogenic external trauma is also called "sucking chest wound". With each inspiration, air is enter through the chest wound what leads to inadequate ventilation, hypoxia and hypercarbia. Treatment is directed to closing the chest defect with occlusive dressing taped on three sides and thus prevent further air enter in pleural space during inspiration, and allow air escape through fourth untapped side during expiration. Definitive treatment is surgical wound closure. Also, penetrating pneumothorax usually is associated with hemothorax.

On percussion the pneumothorax would have hyperresonance and on auscultation reduced breath sounds. The initial test should be a Chest x- ray or a CT for all penetrating or blunt chest trauma. For associated pneumothorax and hemothorax diagnostic test should include and ultrasound FAST. In several studies indicate that ultrasonography might be better than CRX (30). Clinical signs of pneumothorax usually presents with chest pain that is usually pleuritic, dyspnea, diminished or absent breath sounds, hyperresonance to percussion, decreased SpO_2 levels, End- tidal CO_2 elevation. Therapy includes thoracic drainage and patients on ventilator should be placed on thoracostomy to prevent tension pneumothorax.

After injury that cause one-way valve air leak into pleural space, from the lung or thorax wall, tension pneumothorax will develop. Further, tension pneumothorax cause not only collapse of the affected lung, but also displacement of the mediastinum and compression of non-affected lung. Due to decrease venous return, it will lead to decrease cardiac output and obstructive shock. Besides classical clinical signs of dyspnea and absent breath sounds over the affected lung, tracheal deviation, elevated hemithorax and neck vein distension can be seen. Tension pneumothorax is treated with immediate needle decompression. Usually a 14 - 16G IV cannula is inserted into the second rib space in the midclavicular line. The needle is advanced till the air can be aspirated into the syringe connected to the needle. When the air leaks out, the tension pneumothorax is converted into a simple pneumothorax. Definitive treatment is insertion of a chest tube into the fifth intercostal space, anterior to the midaxillary line. In a study by Yoon (23) tension pneumothorax developed at about 16% out of 370 patients that is about 60 patients. It was defined as tachycardia, tachypnea, sweating, hypotension, and pallor.

Another case mentioned by Chada (24), tension pneumothorax presented as ST segment elevation. In the case a 65 year old with past medical history for chronic obstructive pulmonary disease presented to the emergency room with worsening symptoms shortness of breath and productive cough. He was initiated on bi-level positive airway pressure for respiratory acidosis after which he developed an alteration in mental status. Decision was made to initiate invasive mechanical ventilation. He was preoxygenated with bag-mask ventilation and intubated *via* direct laryngoscopy. Within minutes of intubation, he started becoming hypotensive to 80/60 mmHg, and hypoxemic with an oxygen saturation of 86% (24). On telemetry leads, he was found to have an acute change, with presence of ST elevations. ECG confirmed ST segment elevations with a right bundle branch in V1, V2, V3; concerning for an acute myocardial injury. Lung auscultation at the same time revealed decreased breath sounds on the right, concerning for pneumothorax. This was confirmed by an urgent portable chest radiograph. The patient underwent stat needle decompression in the second intercostal space followed by tube thoracostomy with a 18F chest tube. Interestingly, all his ECG changes reverted back to baseline with the placement of a chest tube, which resulted in resolution of his pneumothorax (24). There were more cases that were reported to have the ST changes following pneumothorax. The explanation is that the ECG changes are due to cardiac rotation, right ventricular dilatation from hypoxia, decreased preload due to increased intrathoracic pressure (24). The case shows that during ST elevation one should always think of pneumothorax having reduced breath sounds and hypotension. In trauma for a pneumothorax one should not let scans delay treatment with needle thoracostomy if the patient is clinically unstable (25).

One of the main cause of iatrogenic tension pneumothorax is ventilation with positive pressure in patient with unrecognized pneumothorax. Therefore, patients with pneumothorax who have to undergo surgery in general anesthesia, thoracic drainage should be done before anesthesia induction.

Massive hemothorax

Hemothorax can occur after blunt force trauma or penetrating trauma. These are injuries that are leading cause by massive bleeds such as aortic rupture, myocardial rupture or injuries to hilar structures, along with GSW, or stabbings. Haemothorax will induce ventilatory and haemodynamic changes as hypotension and shock due to quantity of blood accumulated volume and haemorrhage speed. 300 mL or more of blood is needed for a hemothorax to be seen on a CXR. Even US can diagnose a hemothorax but it is user specific. Massive hemothorax is defined as rapid bleeding in pleural space, more than 1500 ml of blood or at least one third of total blood volume. Hemothorax is treated using tube thoracostomy (chest tube) minimum 36 French chest tube at the nipple level, in anterior axillary line. Blood should be collected and autotransfusion can be done. Drainage of more than 20 mL/kg or 1500 mL is indication for surgical thoracotomy. Besides chest decompression, repletion of circulating blood volume (with crystalloids and concentrates of red blood cells) and early thoracotomy to identify and control source of bleeding are of utmost importance. Chest tube is left on until there is no air leak and no pneumothorax on CXR. Once the criteria are met the chest tube is placed on water seal and CXR is done. The chest tube is removed once it is on water seal and the previous 24hrs output is less or equal to 100mL.

In hemothorax the clinical presentation depends on the size of the hemothorax. However, it usually shows up as diminished breath sounds but in massive hemothorax it can cause shock. In trauma, hemothorax usually appears with pneumothorax or other trauma injuries. So having a pneumothorax one should rule out hemothorax with CXR or US. Percussion to both sounds of lungs should be done.

Flail chest and pulmonary contusion

Evaluation of thoracic trauma, includes evaluation of chest wall injury such as rib fractures (flail chest), cardiac contusion, blunt aortic injury (BAI), and pulmonary injuries. Factors associated with high risk thoracic injury in MVA are: high speed, not wearing a seatbelt, large vehicle damage, and steering wheel deformity. Any obvious rib fractures should be examined by palpation and observation from front to back in primary survey than a CXR. Flail chest is defined as two separate fractures in three or more separate ribs which represent chest wall segment separate from rest of chest wall. Diagnosis is made by observing the chest wall move paradoxically. Chest wall sucks in with inspiration and pushes out with expiration which is the opposite from the rest of the chest wall. It is important to notice that flail chest alone will not induce hypoxia. Problems usually arise with underlying pulmonary contusion. If this underlying pulmonary tissue injury is significant, hypoxia will developed. Initial treatment and management is oxygen administration and monitoring for any other respiratory compromise. Fluid administration should be optimal, between fluid restoration and volume overload that could aggravate ventilation. Pain treatment with local anesthetic (intercostal nerve block, interpleural block, epidural analgesia) or iv. opioids will enable adequate ventilation. Monitoring of ventilation can be done by obtaining a pulse oximeter readings and capnography along with clinical observation. Hypoxia should be prevented and sometimes treatment is intubation with positive pressure ventilation. The ribs usually heal on their own or they are fixed with rods for faster healing. When finding a flail chest, usually one should look for other injuries and obtain a full workup on lungs. Pneumothorax, hemothorax, pulmonary contusions, heart and great vessel injuries should be considered.

Hemodynamic stability:

In the ATLS primary survey in ABCDE's the C stands for Circulation. Hypotension in a trauma patient is considered as hemorrhage until proven otherwise. Hemodynamics is assessed by the level of consciousness, skin perfusion, and pulse. When a patient arrives with a reduced level of consciousness and tension pneumothorax is excluded as a cause of shock, it is important to consider that there is reduced cerebral perfusion due to blood loss (1). Observing a patient with traumatic injury with gray and pale skin is a good sign that there is a perfusion issue and a sign of hypovolemic shock. Amongst the skin perfusion and level of consciousness, pulse is a great indicator for hypovolemic shock. Assessment of bilateral quality, rate and regularity are crucial in first assessment. Checking for bilateral carotid, femoral, radial and dorsalis pedis pulse in trauma patients in order to estimate systolic blood pressure. The 80/70/60 rule for radial, femoral, and carotid pulse that suggests that if a radial pulse is found then the systolic blood pressure is at least 80 mmHg and femoral at least of 70 mmHg and carotid of at least 60 mmHg. In one study by McMannus (29) showed that weak radial pulse is an acceptable method for initial rapid evaluation of trauma patients. However in a study by Deakin (30) that was published in the British Medical Journal showed that 83% of patients with radial pulses had blood pressure of less than 80 mmHg. This study suggested that there is an overestimation of blood pressure in a patient with hemorrhage that could potentially put them at risk for delayed intervention. If the radial pulse cannot be palpated there should be a definite concern that the patient is hypotensive. In the primary survey one has to identify the source of bleeding and see if it is external or internal hemorrhage.

External hemorrhage, once identified is dealt with in the primary survey and direct manual pressure is placed on the wound. Use of tourniquet might be necessary when on the site and not in hospital setting. Placement of tourniquet is safe for up to two hours without the concern for amputation. Tourniquet should be tight enough that no blood passes beyond and once it is on it should not be loosened or removed once the source of hemorrhage can be controlled by some other way (31). It has been shown that civilian prehospital tourniquet application was independently associated with a 6-fold mortality reduction in patients with peripheral vascular injuries (31).

Internal bleeding is usually within the chest, abdomen, pelvis, long bones, and retroperitoneum. The source is identified by eFAST and CXR and pelvis X-ray. In cases of acute trauma and hemorrhage, there needs to be a vascular access usually two large bore peripheral venous catheters. If the vascular access cannot be initiated, then intraosseous line should be started along with large caliber central venous femoral, jugular, or subclavian vein access. There might be a need for a RIC - rapid infusion catheter along with rapid infusion device. These devices can deliver from 6 to 30 L/hour and usually has a blood warming device.

With established vascular access, one has to assess which stage of hemorrhage the patient is in. Class I of hemorrhage is loss of blood that is less than <15 %. This is close to one unit of blood that is similar to what one gives when one donates blood. In this instance heart rate and other clinical signs such as blood pressure are unchanged. However, in Class II with loss of anywhere from 15 to 30% of blood, there is a slight increase of heart rate. In Class II it has been observed that in younger individuals the heart rate is unchanged. The blood pressure is usually unchanged. However, the pulse pressure is decreased (1). This is called uncomplicated hemorrhage and crystalloid fluid is given. In Class III which is now a moderate hemorrhage also called complicated hemorrhage, the need of blood products is evident. The blood loss is now 31 to 40% and there is a definite increase of heart rate. There is unchanged to lower blood pressure and decrease of pulse pressure and increased respiratory rate. The patient presents with tachycardia, tachypnea, and changes in mental status.

In Class IV the blood loss is severe which is more than >40% and is considered a pre-terminal state. During this state (MTP) - massive transfusion protocol is initiated (1). There is a definite tachycardia, significant decrease in blood pressure, unmeasurable diastolic pressure or narrow pulse pressure, increased respiratory rate and decreased mental status. In urgent cases such as acute chest trauma once the vascular access has been established there is a draw of blood for cross matching and labs. Until the labs are received for cross matching type O- pRBCs blood is used.

Activating an MTP there needs to be a 2/4 present out of: penetrating mechanism, systolic BP of <90 mmHg, HR >120 pbm, positive ultrasound FAST exam or using clinical judgment of patients with rapid blood loss, patients that require more than three units of blood in one hour, patients with loss of >50% of blood volume within three hours. After the MTP protocol is initiated hypothermia is avoided by usage of blood warmer of all IV fluids.

Trauma induced coagulopathy accounts for increase by anywhere from 4 times risk in mortality of trauma patients. Therefore administration of (TXA) tranexamic acid of 1g IV over 10 minutes, then 1g IV as a repeat bolus or infusion over 8 hours is used. Administration of TXA within 3 hrs. of bleeding has been shown to reduce mortality (32). Once matched blood is available administration of plasma, platelets, and red blood cells are administered in 1 to 1 to 1 ratio in order to avoid dilatational coagulopathy. Additional cryoprecipitate of 10 units or fibrinogen concentrate of 4 g should also be administered. Monitoring of ABG, CBC, INR/PTT, fibrinogen, creatinine, and electrolytes is crucial. Based on monitored blood and labs, the products are prioritized and given according to deficiency. The ongoing blood loss should be addressed and surgery in place to control blood loss.

Hemodynamic stability is measured according to patients' response to fluid therapy. Initial fluid therapy is usually crystalloid solution and blood products to replace the lost volume. Usual dose is 1 L of warmed bolus crystalloid solution for adults. This initial amount of fluid is the fluid received in pre hospital setting along with the hospital setting. All fluids administered to the patient should be logged.

The response to fluid therapy can be rapid, transient, or minimal. The rapid response is observed where the vital signs return to normal. Transient response is when there is recurrence of decreased blood pressure and increased heart rate. These patients show signs of improvement and as the initial fluids are slowed down the deterioration is apparent again. These patients are in need of emergent surgery to control the bleeding, with minimal or no response to crystalloid and blood administration, shows the need for immediate surgery or angio embolization. With no response, one should be suspicious of: pump failure such as cardiac tamponade, blunt cardiac injury, tension pneumothorax or massive hemothorax.

Hemodynamic instability should be treated with optimal volume restoration with crystalloids through minimal two large bore peripheral iv line to ensure adequate cardiac output. Special state as massive hemothorax, tension pneumothorax or cardiac tamponade need directed, specific treatment to ameliorate and resolve the main issue.

Cardiac tamponade:

Cardiac tamponade is a life threatening medical emergency that is caused by an accumulation of fluid in the pericardial space. This fluid in the pericardial space results in reduced ventricular filling and hemodynamic compromise. The heart is compressed by the fluid surrounding it resulting in decreased cardiac filling which in turn causes a decrease in cardiac output. Cardiac tamponade can be caused by both penetrating and blunt thoracic trauma. Clinical findings usually include muffled heart sounds, dilated neck veins with hypotension (known as Beck's triad) and insufficient response to fluid therapy (1). Absence of any of these clinical findings does not exclude cardiac tamponade. In chest trauma one should always be suspicious of cardiac tamponade. From diagnostic procedure echocardiogram, FAST and/or pericardial window are used. FAST exam is 90 to 95% accurate in identifying the presence of pericardial fluid in an experienced operator (1). Cardiac tamponade can be acute, when there is a sudden development of chest pain, dyspnea, and tachypnea. Hypotension is associated with decreased cardiac output. On the other hand, cardiac tamponade can develop slowly and patients can be asymptomatic.

Once cardiac tamponade is diagnosed, emergency pericardiotomy via thoracotomy or sternotomy is performed as soon as possible by a surgical team. If surgical team is unavailable decompressive needle pericardiocentesis is performed but does not constitute as definitive treatment (47). Volume restoration is supportive measure.

In a case report presented by Wright (48) a young teenage male that sustained a stab wound to the left chest of the third intercostal space at the junction of medial and middle thirds of the clavicle (48). On the arrival of the medical team he rapidly deteriorated to cardiac arrest within seconds. The patient was placed on the floor. After he was intubated and cannulated, medical team doctor undertook a bilateral thoracostomy in the right and left 4th intercostal space, midaxillary line. This revealed the hemothorax on left side and pericardium that was look as "blue tense sack". The mosquito forceps were used to tent the pericardium and incised with scissors. A large clot was removed and the operator used own finger to occlude a hole in the posterior aspect of left upper heart. On arrival, he was maintained a heart rate of 100 beats per minute and a systolic blood pressure of between 60 and 90 mm Hg. A cardiothoracic response enabled haemostatic sutures placed while in the resuscitation room before transfer to theatre for definitive closure (48). He was then transferred to the intensive care unit.

The postoperative course was initially difficult requiring a second thoracotomy for intrathoracic bleeding. Sepsis caused a syndrome of renal failure requiring hemofiltration. However by day eight he was alert and appropriate neurologically, requiring no cardiovascular support and doing well. Subsequently he made a full recovery and was discharged from hospital with no neurological deficit (48).

In Some European countries doctors are a part of ambulance service and are trained in prehospital thoracotomy, where as in United States thoracotomy is only performed by experienced surgeons. Prehospital thoracotomy is an aggressive treatment that should be reserved for those patients likely to have cardiac tamponade. If a prehospital provider is not familiar with the technique then rapid transfer to the nearest institution capable of providing resuscitative thoracotomy should be undertaken (48).

DISCUSSION

Before the 1980 trauma care was inconsistent among the doctors around the world (41). Due to an accident that happened in rural Nebraska in 1969 when Styner family was flying on a small aircraft. Due to weather conditions, darkness and fog, the pilot had to make an emergency landing when he flew into some trees and barbed wire fence. Events that took place after the crash in the field to the hospital urged Dr. Styner to develop a training program in management of trauma. The course now named "Advanced Trauma Life Support" was first tested in Auburn, Nebraska, in 1978 (42). This course brought standardization and systematic protocol in treating the life threatening conditions. There are data from Trinidad and Tobago that suggests that there is a positive role of an ATLS program in third world countries (44). In Western countries it has been proposed that mortality was reduced by 15 -25% when severely injured patients were treated at a trauma center (45). Even among the trauma centers there is a difference when treating patients. In a retrospective cohort analysis (46) it has been shown that patients taken to Level I center had improved survival and better functional outcomes compared to patients taken to Level II hospital. Therefore, depending on the severity of the patients and trauma, the patient should be taken to Level I trauma center when possible (46).

In acute trauma victim - chest injury it has been shown that ATLS is the main starting point in any trauma injury whether it is on the field or in the hospital setting. The ABCDE coordination and standardization between the healthcare systems makes it easier for health care team to care for patients without missing any crucial steps of checking and rechecking all the points of care. It has been shown that standardization of care within ATLS protocol across the world insures the same quality care for each patient and optimizes care from outside hospital setting to hospital setting care.

CONCLUSION

In any trauma situation is important to follow the general standardized ATLS guidelines and take the patient to the appropriate hospital that can deal with such cases. The outcome of the patient depends on the level of care and the arrival of the first responders on site. It would be beneficial such as mentioned that in third world countries and rural areas that there are ATLS ready teams to assess and manage transport for further patient workups. Since most patient deaths occur due to unprotected airway or by massive hemorrhage the two can be addressed by ATLS until reaching the nearest hospital.

In chest injury hypoxia is the main problem caused by decreased oxygenation and inadequate perfusion. Hypercapnia resulted from inappropriate ventilation. Cell hypoxia lead to anaerobic metabolism what causes metabolic acidosis. Management of the chest trauma is dynamic process divided in primary and secondary survey where diagnostic and reanimation of life-threatening conditions are intertwined and should be done simultaneously.

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BIOGRAPHY

Leyla Mahmutovic was born July 9, 1981 in Sarajevo, BiH. She moved to USA, Chicago in 1990 to join the family that has been in the USA since 1960's. She has attended Loyola Academy in Wilmette a Catholic college preparatory high school. After high school she studied at DePaul University where she earned a Bachelors of Sciences in Biological Sciences. While attending the college Leyla has been a member of GHBH alumni. Leyla has been a part of volunteering committee at various soup kitchens, Amnesty international and various events. In 2012/ 2103 Leyla has moved to Zagreb to start at University of Zagreb School of Medicine. After the sixth year of studies, Leyla has completed a Clinical rotation at Swedish Covenant Hospital in Internal Medicine, Trauma Surgery at Cook County Hospital and Anesthesiology at Cook County Hospital and Rush Hospital in Chicago. Leyla plans to move back to Chicago and pursue Internal medicine or Neurology in the future.