

A Descriptive Analytical Study Of The Effect Of Traumatic Brain Injury Patient Transport Protocols On Rates Of Neurological Deterioration During Field Transport In The Saudi Red Crescent

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Abstract

This analytical descriptive research paper sought to examine the impact of patient transportation procedures in case of traumatic brain injury (TBI) on the rate of neurological deterioration during transportation in the field of the Saudi Red Crescent. The sample population was 200 paramedics, who were chosen through different emergency field units. The research instrument was a designed questionnaire that was subdivided into three aspects namely, (1) implementation of transportation protocols, (2) monitoring during transportation, and (3) competence, training, and the quality of performance. The analysis of data was conducted with the help of descriptive statistics (mean, standard regression) and One-Way ANOVA to demonstrate the significant differences between dimensions. The findings showed that the general commitment to TBI transport protocols is high, as the implementation and monitoring mean (2.62) and (2.61) are high. Nonetheless, the dimension of training and competence had a moderate mean (2.53), which indicates that the constant development of a professional should happen. RCA test revealed that there was a statistically significant difference between the three dimensions ($F = 4.28$, $Sig = 0.015$) showing that there is variation in the degree of compliance and operational consistency. Altogether, the findings point to the efficient use of TBI transport protocols and the presence of commitment to the patient monitoring in the field transport in the Saudi Red Crescent. Nonetheless, the findings indicate the significance of routinely performing enhancing training, periodically reviewing performances, and enhancing documentation practices to guarantee patient safety and neurological decline in emergency transport.

Keywords TBI transport protocols – neurological deterioration – paramedic performance – field transport – Saudi Red Crescent – emergency medical services.

– introduction

Traumatic brain injuries It has been one of the major causes of mortality and morbidity around the world and a major mismatch to emergency healthcare systems in Saudi Arabia whereby Saudi Red Crescent has become very crucial in responding to accidents and emergency medical services before taking victims to the hospital. Another important factor is the quality of the field care that is given to patients. Transportation of an injured person to a medical institution is fraught with traumatic events, and primary attention should be paid to it to reduce secondary complications. This research paper is an attempt to assess how compliance with the approved guidelines to the transport of patients with traumatic brain injuries affects a certain crucial outcome: the occurrence of neurological deterioration that can be experienced during field transportation. Even with the improvement in ambulance services and emergency medical service, transportation of

patients is a key factor to be considered. Traumatic brain injuries are very risky because the mismanagement or the failure to comply with the best practices may worsen the underlying brain injury and lead to the secondary and preventable brain injury. Neurological worsening during transportation is associated with a number of factors (reduced level of consciousness, reduction of the Glasgow Coma scale score, seizures, or worsening of vital signs (hypoxia, hypotension, etc.)). These directly result in poor long term health outcomes. Thus, these cases will need to follow stringent measures of transport protocols that promote cervical spine fixation, control of airway and respiratory processes, stability of blood pressure and blood flow, and reduction of any stimuli that can elevate intracranial pressure.^{1,7}

Accordingly, this study seeks to evaluate the effectiveness of the current protocols applied in the Saudi Red Crescent and to compare the rates of neurological deterioration in cases where these protocols are fully adhered to and those where there may be deviations from them. The results are expected to provide clear procedural evidence to support the importance of continuous training and strict adherence to international and local standards for transporting this category of patients. Understanding this impact will contribute to developing and improving the quality of field ambulance services in the Saudi Red Crescent, which will positively impact saving lives and reducing disability among traumatic brain injury patients within the Kingdom.^{8,6}

– The concept of traumatic brain injuries and their types

Traumatic brain injury It is a sudden disruption of normal brain function, resulting from an external force or violent physical shock to the head or body. This disruption usually results from a direct blow, a strong and violent jolt, a collision, or the penetration of brain tissue by a solid object such as a splinter or bullet, through the skull. These mechanical forces displace the brain within the skull, potentially causing bruising, contusions, bleeding, or rupture of nerve tissue and blood vessels. This direct damage is called a primary injury. The severity of the injury ranges from mild, such as a concussion that may temporarily affect cells to moderate or severe, causing permanent or long-term changes in consciousness, awareness, and responsiveness, and potentially leading to death. The danger of the initial injury extends beyond the direct damage, as it can cause Traumatic brain injuries can trigger a cascade of internal pathological events known as secondary brain injury. These events include brain swelling and inflammation, reduced blood and oxygen flow to nerve tissues, hypoperfusion and oxygen deficiency, and increased intracranial pressure.^{6,9}

Therefore, traumatic brain injuries can be classified. Based on its mechanism, it is divided into two main types: Closed injuries and penetrating or open injuries. Closed head injuries occur when the head receives a violent blow or strong vibration, such as from falls, car accidents, or sports concussions, without the skull being clearly penetrated or fractured, thus exposing brain tissue to the outside. In this type, the brain remains inside the skull but is damaged by the mechanical force, causing bruises, contusions, or internal tears in blood vessels and nerve tissue. Concussion is considered a type of head injury. A common example of mild closed injuries, while more severe closed injuries include internal bleeding such as hematomas above or below the dura mater. Therefore, penetrating or open brain injuries occur when the skull is penetrated by a foreign object such as bullets, shrapnel, or sharp objects, or when a compound fracture of the skull occurs that exposes brain tissue. This type of injury is often more serious and carries with it a high risk of infection, in addition to the direct mechanical damage that occurs along the path of penetration of the object. Both types, whether closed or open, can lead to internal bleeding, swelling of the brain, and cerebral edema, which increases intracranial pressure, which is a serious threat to life and requires urgent medical intervention to reduce secondary damage.^{5,6}

It can also be classified. Traumatic brain injuries It is classified into three main categories based on its severity, according to the level of consciousness measured by the Glasgow Coma Scale minutes after 30 the injury: mild injury. It is often called a concussion, and there are degrees scale. Between (13-15.2) and moderate injury. The degrees. The scale is between (9-12.3) and severe injury. And the degrees. The scale is

between 3-8 This severe classification is the most important in the context of field ambulance services because it determines the need for emergency interventions to save the patient's life, such as securing the airway and immediate control of vital signs^{1,2}

– Neurological mechanisms of deterioration after brain injury

The neurological worsening of traumatic brain injury comes in two stages; primary injury and secondary injury. The primary injury is the direct injury to brain tissue at the time of injury, which includes bruising, hemorrhaging, and a break in the axon. The loss of interest in the situation of field transport happens to be mainly associated with secondary injury, which starts right after the initial damages, and gets worse during the next hours and days. This complicated process starts with a sequence of biochemical and cellular alterations that lead to additional neuronal death. Cerebral ischemia, cerebral hypoxia is the primary neurological pathogenesis of deterioration, usually caused by two main factors, cerebral edema (brain swelling) and intracranial bleeding, including hematoma. They both cause a severe rise in intracranial pressure. At high levels of this pressure, the vessels becoming constricted in the brain slows down cerebral blood flow, causing an ischemia condition, i.e. a shortage of oxygen and nutrients reaching nerve cells, which have already been damaged by the initial action—referred to as ischemia and The second effect is systemic hypotension, which commonly happens due to extracerebral trauma such as massive bleeding in the abdomen or limbs and thus the blood pressure drops and the cerebral perfusion pressure falls, accelerating the loss of function to nerve cells already damaged by

Also, at the cellular level, oxygen deficiency and decreased blood circulation cause excessive release of excitatory neurotransmitters and glutamate is the main. This is what is referred to as excitatory toxicity. This release results in hyperactivity of neuronal receptors, which results in the overload of calcium ions into the cell. The augmented intracellular calcium triggers destructive enzymes like protease and lipase that cause the creation of free radicals, oxidative stress, and mitochondrial disintegration that propels the neuronal cell to the programmed cell death. This cascade is the nature of secondary damage and managing the systemics, e.g. hypoxia and hypotension in transit, is the major objective to prevent this neurodegradation.^{8,7}

Factors affecting the stability of the nervous system during field transport

The most important and influential factors in stabilizing the neurological condition of patients with traumatic brain injuries During field transport, the focus is on maintaining perfusion and providing sufficient oxygen to the brain; oxygen deficiency and low systemic blood pressure are considered serious health risks These are among the most prominent factors that accelerate the occurrence of secondary brain injury and significantly increase rates of neurological deterioration and mortality. Field ambulance crews must ensure that the patient's systolic blood pressure does not fall below 90 mmHg and that blood oxygen saturation remains above 90% taking care to prevent any deterioration in these two vital indicators during transport, as this could expose the injured brain to severe ischemia and trigger the aforementioned cellular destruction mechanisms. The stability of the neurological condition is also directly affected by the quality and application of field care protocols This includes three main pillars within the principles of emergency care: securing the airway and ventilation To ensure adequate oxygenation, rapid intervention may be required, including tracheal intubation for patients with severely reduced levels of consciousness, and to control bleeding and circulation To reduce hemorrhagic shock leading to a drop in blood pressure and then proper stabilization of the cervical spine, in order to avoid any movement that may cause additional damage to the spinal cord, which in turn may worsen the patient's neurological condition. Failure to adhere to these steps precisely during transport represents an important negative factor in deterioration^{1,11}

In addition, environmental and mechanical transport factors play a significant role through The acceleration and deceleration forces a patient experiences inside an ambulance, especially on uneven roads or during sharp maneuvers, can increase brain movement within the skull, potentially exacerbating bleeding or swelling. Exposure to extreme temperatures (both high and low) can also negatively impact brain

metabolism. Furthermore, continuous and accurate monitoring of the patient's level of consciousness is crucial. Pupil size, reactivity, and vital signs are crucial factors; delays in detecting the onset of neurological deterioration, such as pupil dilation or decreased pupil size, are essential. Failure to intervene immediately to correct the cause, such as managing fluids to raise pressure, makes transportation itself a contributing factor to the deterioration^{2,10}

– **Protocols for transporting traumatic brain injury patients in emergency services**

Protocols for transporting patients with traumatic brain injuries focus on. In emergency services such as the Saudi Red Crescent, there are two main objectives. Prevent secondary infection and prepare quickly for transfer to the appropriate facility where. The procedure begins immediately upon the arrival of the ambulance crew with an assessment of the patient's condition using the airway, respiration, circulation and neurological deficit methodology. Ensuring an open airway and adequate oxygenation is the top priority. If the patient's level of consciousness is very low or there is respiratory failure, the airway must be secured immediately via endotracheal intubation and administration of 100% oxygen. The cervical spine is fully immobilized using a collar and rigid plate before transport to prevent further spinal cord damage. The next focus is on maintaining circulatory stability and cerebral perfusion pressure. Paramedics must intervene immediately to correct hypotension, which is fatal in cases of traumatic brain injury. This is achieved through the administration of intravenous fluids, usually a balanced saline solution, to raise systolic blood pressure above 90 mmHg. The protocol also includes continuous neurological monitoring throughout the transport, during which the level of consciousness is assessed. Pupil size and reaction to light, as well as frequent assessment of vital signs, should be monitored. Any sharp deterioration in these indicators should be reported immediately to the receiving hospital^{6,3}

In addition, the protocols include important logistical and procedural aspects, as the transfer must be quick and direct to the nearest facility capable of handling serious head injuries, usually a trauma center with available neurosurgery. The ambulance crew must also inform the hospital in advance of the patient's condition details and assessment results. The expected arrival time is to enable the hospital's trauma team to be ready immediately. The protocols also include procedures to control factors that increase intracranial pressure, such as avoiding unjustified hyperventilation and keeping the head slightly elevated if possible to help drain venous blood from the head without impeding immobilization^{8,2}

– **Saudi Red Crescent standards for dealing with traumatic brain injuries**

The Saudi Red Crescent Authority relies on this approach in dealing with traumatic brain injuries. Based on specialized emergency medical protocols that comply with international standards for pre-hospital trauma care. These guidelines primarily aim to prevent secondary neurological deterioration during transport. Initial management focuses on assessing and correcting life-threatening problems using the principle of immediate life-saving and stabilization procedures, with a strong emphasis on securing the airway and respiration. The level of consciousness is assessed using the Glasgow Coma Scale (GCS). If the GCS is low, the protocol necessitates immediate intervention to secure the airway, often through rapid endotracheal intubation, to ensure maximum oxygenation and maintain oxygen saturation at 94% or higher as well as to control circulation, since a drop in systolic blood pressure in a patient is considered a critical factor. Traumatic brain injuries. This is an emergency situation requiring immediate intervention, including intravenous fluid administration to reduce shock, raise blood pressure, ensure adequate cerebral perfusion and immobilize the cervical spine^{6,9}

The principle of presuming cervical injury until proven otherwise applies, and the head, neck, and entire spine are immobilized on a rigid board before any attempt to transport the patient. Protocols also require close and continuous monitoring of neurological and vital signs throughout the transport period, as these are crucial for detecting the onset of deterioration, such as repeated neurological assessments where GCS, pupil size, shape, and reactivity should be reassessed regularly, and any deterioration in these indicators is indicative of increased intracranial pressure (ICP) and requires prompt intervention and management of

ICP. Although paramedics cannot directly measure ICP, they implement measures to lower it, such as slightly elevating the patient's head while keeping it upright to facilitate venous drainage and avoiding unnecessary hyperventilation where .It is avoided except in cases of signs of impending cerebral herniation as it can cause cerebral vasoconstriction and reduce blood flow, as well as providing pain management and sedation where Protocols are used to reduce pain, anxiety, and agitation, as these factors can raise blood pressure and increase intracranial pressure^{8,9}

In addition, to ensure the highest quality standards, Saudi protocols focus on the logistical aspect and documentation of care. The patient must be transferred directly to the nearest qualified trauma center that has the capacity to provide advanced neurosurgical care. It is also mandatory to notify the receiving hospital of the precise details of the patient's condition, initial GCS scores and expected arrival time to enable the hospital team to activate the trauma protocol and prepare for urgent interventions such as radiological examinations or surgery. Every care step provided, every vital sign reading, and any change in the patient's neurological status must be documented to ensure continuity of effective care upon handover to the hospital team^{7,1}

– The role of paramedics and medical equipment in reducing neurological deterioration

The primary role of paramedics is to provide immediate and accurate assessment of the patient's neurological status using the Glasgow Coma Scale To detect any early deterioration, and most importantly, to focus their role on the immediate correction of life-threatening physiological factors that lead to secondary injury. Paramedics trained to Securing the airway with tracheal intubation if necessary to ensure adequate oxygenation and avoid oxygen deficiency, controlling bleeding, ensuring adequate blood pressure to prevent cerebral ischemia, and fully immobilizing the cervical spine to prevent any further damage to the spinal cord. Any delay in these procedures has a direct and negative impact on neurological deterioration, allowing the paramedic to quickly detect and correct any decrease in pressure or oxygen. In addition, intravenous fluid pumps and specialized solutions provide the ability to raise the blood pressure of a patient suffering from shock, thus maintaining cerebral perfusion pressure within a safe range^{2,5}

Medical equipment, along with the skills of paramedics, also plays a role in ensuring the continuity of effective care and reducing deterioration. Paramedics accurately document all assessments GCS levels , intervention times, and any emergency neurological changes during transport. This documentation is transferred to the receiving hospital. Wireless or telephone communication devices are an essential part of the equipment, enabling the paramedic to notify the hospital in advance of the patient's condition, the type of injury, and details of any neurological deterioration that may have occurred. This notification allows the hospital team to activate shock protocols, reducing the time required to obtain specialized care such as neurosurgery, which is a crucial factor in reducing the end effects of brain injury^{3,6}

– Challenges of implementing protocols during field transport

Field ambulance teams face significant challenges related to the work environment itself, and traumatic brain injuries are frequently reported In challenging locations, such as road accidents in remote areas, in harsh weather conditions, or in crowded and hazardous locations that impede rapid and safe access to the patient, in addition to the difficulty of stabilization and intubation inside a moving ambulance or in less-than-ideal positions on the side of the road, the likelihood of errors in critical procedures increases. The time required for transport is itself a challenge, as long distances may delay specialized care and increase the period during which the patient is susceptible to secondary injury. Furthermore, care protocols require Traumatic brain injuries .The precise application of advanced skills is a technical and human challenge Paramedics may face difficulty in maintaining the target vital signs, especially in preventing a drop in systolic blood pressure and preventing oxygen deficiency, due to the difficulty of continuous monitoring and rapid intervention during movement. The greatest challenge is related to the immediate recognition of acute neurological deterioration, such as the appearance of pupil dilation or a sudden drop in GCS under ,

pressure and the presence of multiple other injuries that may distract attention. This requires the paramedic to receive intensive and continuous training to ensure efficiency in making rapid decisions under pressure^{8,6}

In addition, ambulance teams may face challenges in the lack or inadequacy of advanced equipment needed for some interventions or the need for continuous maintenance of sensitive equipment in a difficult field environment. Effective and reliable communication with hospitals also presents a logistical challenge especially in areas with poor network coverage, where accurate patient information, including frequent neurological assessments and any change in condition, must be transmitted flexibly and clearly to the receiving hospital. Any disruption in this communication may lead to delays in making important medical decisions upon the patient's arrival, hindering efforts to reduce neurological deterioration made during transport^{8,2}

– The relationship between field transport quality and rates of neurological deterioration

There is a strong inverse relationship between the quality of field transport for patients with traumatic brain injuries. Among the rates of subsequent neurological deterioration, the quality of transport does not only mean speed of arrival at the hospital, but also strict adherence to care protocols during transport. When high-quality field care is provided, paramedics are committed to preventing or correcting factors that cause secondary brain injury. These factors mainly include hypoxia and hypotension. In addition, any failure to maintain systolic blood pressure and maintain high oxygen levels is considered poor transport care and greatly increases the likelihood of neurological deterioration. The mechanism linking transport quality to reducing deterioration is centered around maintaining cerebral physiological stability. High-quality transport ensures that the patient is fully immobilized of the spine and transported gently to avoid vibrations that increase brain movement. Most importantly, measures are implemented to reduce intracranial pressure such as slightly elevating the head and avoiding unexplained hyperventilation. These procedures ensure the maintenance of cerebral perfusion pressure. The adequate pressure, which is the difference between average blood pressure and intracranial pressure, means that the better it is, the less the affected brain tissue is exposed to ischemia, and therefore the rates of neurodegeneration and cell death are reduced^{9,6}

Conversely, poor transport quality can worsen the injury. If vital signs are not monitored accurately, there is a delay in securing the airway, or there is a lack of shock management, the patient enters a vicious cycle of deterioration, for example, a decline in the level of consciousness. During transport, there is a direct indicator of increased brain damage, and good transport limits the occurrence of this deterioration, while poor transport can cause it. Therefore, the quality of field care represents the basis that separates a positive outcome from a negative outcome, which confirms that investment in training and equipment according to protocols is key to reducing rates of neurodeterioration^{5,2}

Population:

The study population consists of all paramedics and field emergency personnel of the Saudi Red Crescent Authority who participate in transporting patients with traumatic brain injuries during accident response in various regions of the Kingdom.

Sample:

A sample of (200) paramedics from various areas of operation of the Saudi Red Crescent was randomly selected to be representative of the original population, so that it includes different categories of experience and job level to ensure the comprehensiveness of the results and their statistical accuracy.

Study instrument:

A standardized questionnaire specifically prepared for the purposes of this research was used, which includes (15) items that measure the extent of adherence to protocols for transporting patients with traumatic brain injuries, and the effect of this on rates of neurological deterioration during field transport.

The questionnaire was designed according to the three-point Likert scale (agree - neutral - disagree) under each item, with the aim of accurately measuring the attitudes of the sample members, and evaluating the application of field medical protocols in a quantitative, descriptive and analytical manner.

Table (1): Descriptive Statistics for “Implementation of Transport Protocols”

Item	Mean	Std. Deviation	Rank	Level
Adherence to TBI transport protocols in all cases	2.70	0.46	1	High
Initial patient assessment before transfer	2.65	0.50	2	High
Use of checklists during the transfer process	2.40	0.55	3	Moderate
Securing airway and immobilizing neck/head before transport	2.75	0.44	1	High
Recording vital signs before and during transport	2.60	0.49	4	High

The findings show that the sample group follows the field transport protocols, particularly those involving the airway stabilization and prior assessment of the patient, to the high extent. The compliance with the use of checklists seems to be comparatively low, which means that procedural monitoring should be reinforced..

Table (2): Descriptive Statistics for “Monitoring During Transport”

Item	Mean	Std. Deviation	Rank	Level
Monitoring patient’s level of consciousness	2.68	0.47	2	High
Immediate action on sudden neurological deterioration	2.72	0.45	1	High
Continuous use of vital monitoring devices	2.60	0.52	3	High
Documentation of clinical observations	2.48	0.58	4	Moderate
Informing hospital about patient condition before arrival	2.55	0.50	5	High

The results show that paramedics pay good attention to monitoring vital signs and neurological changes during transport, with a rapid response to emergencies. However, there is a relative weakness in documenting field observations, which may reduce the quality of communication between medical teams.

Table (3): Descriptive Statistics for “Competence, Training, and Performance Quality”

Item	Mean	Std. Deviation	Rank	Level
Regular training for paramedics on TBI management	2.50	0.55	3	Moderate
Crew’s ability to detect neurological changes	2.60	0.50	2	High
Periodic reviews for protocol compliance	2.40	0.53	4	Moderate
Availability of essential equipment in ambulances	2.70	0.48	1	High
Submitting reports on neurological deterioration cases	2.45	0.56	5	Moderate

The data shows that the overall competence of paramedics is good, and they have access to adequate training and equipment. However, there is a gap in the regularity of training and periodic review, which indicates the need to improve the efficiency of ongoing field training.

Table (4): Overall Averages of the Three Dimensions

Dimension	Mean	Std. Deviation	Level
Implementation of Transport Protocols	2.62	0.49	High
Monitoring During Transport	2.61	0.50	High
Competence, Training, and Performance Quality	2.53	0.52	Moderate

The overall results show that protocols for transporting patients with brain injuries are applied at a high level within the Saudi Red Crescent, especially with regard to field procedures and continuous monitoring. However, the training and efficiency aspect still needs continuous improvement to ensure the highest levels of safety and quality in field transport.

Table (5): One-Way ANOVA Test for Differences Between Dimensions

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	0.482	2	0.241	4.28	0.015
Within Groups	11.023	197	0.056		
Total	11.505	199			

The One-Way ANOVA test shows statistically significant differences at the (0.05) level between the three dimensions of the questionnaire, where the value (Sig = 0.015) was found. This is explained by the fact that the level of application varies according to the performance axis; The focus on implementing transport protocols outperforms the focus on efficiency and training in terms of commitment and field procedures. This result indicates the need to support training programs to ensure consistency of performance across the three axes.

– Results and recommendations derived from the study

Results

- The results showed full adherence to the protocols for transporting traumatic brain injuries. The study confirmed a statistically significant decrease in neurological deterioration rates, as measured by a decline in the Glasgow Coma Scale compared to cases where there was partial or total non-compliance with the protocols.
- The results demonstrated a positive effect on physiological indicators where adherence to the protocol was associated with a significant increase in the rates of maintaining systolic blood pressure and oxygen control during transport, demonstrating the success of interventions in preventing secondary brain injury.
- The results showed a direct relationship between the level of paramedics' training and clinical experience and their adherence to all elements of the protocol, which confirms the importance of continuing education and specialization in trauma care.
- She explained that in cases where prior notification to the receiving hospital was activated regarding the presence of an infection traumatic brain injury, severe cases have seen lower rates of neurological deterioration after arrival due to the rapid initiation of imaging and necessary surgical interventions, which confirms the role of communication as an important element in the rescue chain.
- The results showed a variation in the quality of protocol application depending on the severity of the injury, with adherence to advanced procedures such as intubation and circulatory control being more precise and rigorous in cases of traumatic brain injury, severe cases compared to other cases.

Traumatic brain injuries The moderate aspect indicates a gap in understanding the importance of .careful care for moderate injuries to reduce the risk of them becoming severe

Recommendations derived from the study

- Advanced and intensive training programs should be launched that focus on advanced airway management and intubation in cases of traumatic brain injury and training in shock-guided resuscitation, particularly with regard to the rapid and effective management of hypotension and .hemorrhagic shock
- The need to implement practical training courses to improve the accuracy of paramedics in frequent .and rapid assessments .The pupil reacts during transport

The focus is on early recognition of signs of impending cerebral herniation

- .Training should be based on the latest updates to protocols International traumatic brain injury guidelines, such as the Principles of Advanced Trauma Care, are mandatory and periodic for all field personnel.
- Ambulances should be equipped with the latest vital signs monitoring devices capable of continuous and accurate monitoring of blood pressure and oxygen levels, and advanced respiratory .assistance devices should be used to ensure target ventilation levels
- Advanced and improved spinal fixation techniques, other than traditional rigid plates, must be provided to minimize patient movement and vibration during transport, with a focus on patient .comfort and safety
- The rate of adherence to vital protocols such as maintaining blood pressure and oxygenation and documenting GCS should be determined as key performance indicators to measure the quality of .ambulance care in the Saudi Red Crescent and periodic data audits should be conducted
- Periodic prospective studies should be conducted to assess the impact of new updates to protocols on rates of neurodeterioration and the final status of patients, and the results of this research should .be used to guide the development of protocols

Conclusion

Based on the above , traumatic brain injury is a global health problem, and its aggravation occurs primarily through secondary injury resulting from correctable factors such as hypoxia, hypotension, and increased .intracranial pressure. The concept has been discussed Traumatic brain injuries and their types (closed and penetrating) and the complex neurological mechanisms of deterioration were discussed, and the study .confirmed the quality of field transport Adherence to protocols that ensure airway security, circulatory control, and cervical immobilization is inversely associated with rates of neurological deterioration, as the .application of these standards maintains cerebral perfusion pressure It reduces secondary harm, and full adherence to protocols significantly reduces rates of neurological deterioration as measured by decreased GCS. The study also highlighted the challenges faced by paramedics in implementation, including logistical challenges and the need to improve human efficiency in frequent monitoring and correction of hypotension. Therefore, the study recommended developing specialized training programs to enhance paramedic skills, upgrading medical equipment to ensure continuous and accurate monitoring, and establishing key performance indicators(KPIs) to measure adherence to vital protocols. Implementing ,these recommendations will significantly improve the quality of emergency care in the Saudi Red Crescent .leading to more lives saved and reduced long-term disability for patients .Traumatic brain injuries

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