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Original Article

Evidence Related to Predictive Scales for Trauma Patients' Outcome: Literature Review

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1. ABSTRACT

Background Trauma is a serious public health problem and one of the most common causes of disability and mortality all over the world. Globally, roads mortality continues to be unacceptably high, with an estimated 1.35 million people dying each year. This high prevalence leads to increased treatment costs, disease burden, and workload of treatment staff, particularly nurses. In intensive care units, numerous scoring systems are used to predict patients' morbidity and mortality which is significant for better treatment planning and improving the overall patient care quality. This review aimed to present an overview summary of trauma, its incidence, and the current evidence related to the use of the Glasgow coma scale and the full outline of unresponsiveness score in the prediction of traumatized patients' outcomes in intensive care units.

Keywords: Trauma, Glasgow coma scale, Full outline of unresponsiveness score, patients' outcomes.

2. Lierature Searching Strategy:

The authors searched electronic medical and health care databases, including Google Scholar, Science Direct, PubMed, Cochrane Library, Pro Quest, and Medline, to find appropriate relevant literature on this subject. As keywords, the following search phrases were used: "Trauma," "Glasgow coma scale," "Full outline of unresponsiveness score," "patients' outcomes," "Traumatic brain injury," "Scoring system in ICU," "outcomes prediction," and "Glasgow outcome scale,".

3.Review of Literature

This review will cover the following sections:

- Section I: Overview of trauma
- Section II: Overview of the Glasgow Coma Scale (GCS), Full Outline of Unresponsiveness (FOUR) Score, and Glasgow Outcome Scale (GOS)
- Section III: Prediction of patients' outcomes using the FOUR score and the GCS

<u>Section I: Overview of Trauma</u>

Trauma has been identified as a significant social and economic danger. It is the leading cause of death, hospitalization, and long-term disability (Beshay et al., 2020). It is one of the common causes of intensive care units (ICUs) admission in adults (Prin & Li, 2016). Trauma is defined as "a physical injury or wound caused by external forces that beyond the body's resistance to tolerate that source of energy" (Perrin & MacLeod, 2018, P. 209).

Some studies reported that males were at higher risk for trauma than females (Kashkooe, Yadollahi, & Pazhuheian, 2020; Kisat et al., 2016). Also, the majority of trauma victims are young adults (World Health Organization [WHO] , 2018). Trauma causes more deaths than cancer and heart diseases (Anwar, Husain, Ahmad, & Usmani, 2016). Traffic injuries are the 8th leading cause of death for people of all ages and the number of deaths has reached 1.35 million annually all over the world (WHO, 2018). The same report illustrated that these accidents are the leading cause of death at the age between 5 and 29 years especially among pedestrians, cyclists, and motorcyclists in the developed countries.

In the United States of America (USA), trauma accounts for 41 million visits in the emergency department and 2.3 million hospital admissions per year (Centers for Disease Control and Prevention [CDC], 2015). Death due to trauma is about 90% in the lower and middle-income countries which is three times higher than in high-income countries (WHO, 2014). This high prevalence leads to increased treatment costs, and workload of caring staff, particularly nurses (De Souza Nogueira, De Alencar Domingues, Poggetti, & De Sousa, 2014).

Trauma affects all body parts particularly the head, thorax, abdomen, and extremities depending on its mechanism (Anwar et al., 2016). Traumatic brain injury (TBI) is a leading cause of death and disability all over the world and has recently grown in all countries (Wang et al., 2018). In Egypt, TBI is a major public health problem, its moderate and severe form representing 17.2% of trauma patients (Montaser & Hassan, 2013). As a result, evaluating the clinical and pathological characteristics of head injury patients is extremely important (Wang et al., 2018).

Head Trauma

Head trauma or TBI is defined as “a disruption in the normal function of the brain that can be caused by a bump, blow, or jolt to the head, or penetrating head injury” (CDC, 2021, P.1). According to Dewan et al. (2019), head trauma is a major contributor towards trauma-related mortality and morbidity all over the world, particularly in low and middle-income countries. The authors also illustrated those 69 million individuals all over the world have TBI annually. In the same context, the CDC (2019) reported that from 2006 to 2014, the number of TBI-related emergency department visits, hospitalizations, and deaths increased by 53%.

Globally, the burden of this injury to patients, caregivers, and society is large and increasing (James et al., 2018). The effects of TBI can last a few days or the rest of the life. Such effects include impairments related to thinking or memory, movement, sensation, or emotional functioning as personality changes and depression (CDC, 2021; Nair, Surendran, Prabhakar, & Chisthi, 2017). Head trauma can be categorized as closed or penetrating. The most frequent causes for the closed type are motor vehicle accidents, falls, and assaults (Oyesanya, Bowers, Royer, & Turkstra, 2018). According to the CDC (2019), falls and motor vehicle crashes were the first and the second leading causes of all TBI-related hospitalizations (52% and 20.4%, respectively). As regards the penetrating type, gunshot wounds were the most frequent cause (Vakil & Singh, 2017).

Traumatic brain injury can be classified by etiology or severity. Concerning its etiological classifications, closed head injuries, open head injuries, and blast head injuries are the most common types (Pavlovic, Pekic, Stojanovic, & Popovic, 2019; Sheriff & Hinson, 2015). Open head injuries refer to the presence of an open wound to the head from a foreign object. It is typically marked by focal damage occurring along the route of the object which traveled in the brain. While, in closed head injuries, there is a blunt impact to the head that does not violate the bony skull (Ghandour, Kobeissy, Abbass, El-Sayed, & Tamim, 2018). However, blast head injuries are considered a unique subtype of traumatic injury that develops as a result of direct or indirect exposure to an explosion in combat situations (Dixon, 2017). In addition to its etiological classifications, TBI has traditionally been classified according to its severity. The most commonly used injury severity score is the GCS. A score of 13–15 is considered a mild injury while a score of 9–12 is considered a moderate injury, and a score of 8 or less is considered a severe TBI (Teasdale & Jennett, 1974).

Diagnosis of TBI can be difficult because of the wide range of symptoms that can emerge. The most prominent tool is the GCS which is considered the most popular for determining TBI severity (Nayebaghayee & Afsharian, 2016). It determines a patients' level of consciousness (LOC) on a 15 point scale based on the eye-opening response, verbal response, and motor response (Teasdale & Jennett, 1974). Other diagnostic criteria for TBI include the duration of post-traumatic amnesia and the duration of loss of consciousness. If certain symptoms are present, the clinician can use a computed tomography (CT) scan or even magnetic resonance imaging (MRI) for better diagnosis (Schmid & Tortella, 2012).

The most current recommendations of the American College of Radiology for assessment of head trauma in adults and children focus on the use of structural neuroimaging modalities as CT scan and MRI (Ryan et al., 2014; Shetty et al., 2016). The recommendations also illustrated that CT scan is considered the most commonly used initial evaluation tool for TBI. Likely, Prasad et al. (2017) found that a CT scan is considered one of the most comprehensive diagnostic methods for precise localization of the site of injury in acute craniocerebral trauma. In addition, CT scans are cheap, fast, and can be used as a follow-up diagnostic tool (Khadka, Deka, & Karki, 2016; Mutch, Talbott, & Gean, 2016).

During ICU treatment, TBI patients typically exhibit several non-neurological and neurological complications. Non-neurological complications are frequent and have a significant influence in the last stages of ICU hospitalization (Thal, 2019). A study conducted by Goyal et al. (2018) showed that the incidence of respiratory problems was 61% which is considered the most common non-neurological complications and has an independent predictor of worsening neurological condition. Electrolyte imbalances (46.1%), cardiovascular complications (34.4%), and coagulopathy (33.1%) were also presented in those patients which can lengthen their ICU stay.

Additionally, Corral et al. (2012) observed that sepsis occurred in 75% of TBI patients. These findings are supported by the report of De Aguiar Júnior, Saleh, and Whitaker (2016). Furthermore, Omar et al. (2017) declared that the three common non-neurological complications in TBI patients were hospital-acquired pneumonia, delirium, and decubitus ulcers. However, they revealed that the most common neurological complications were convulsions, ischemic stroke, and neurological infections. The authors also reported that neurological complications were associated with a higher risk of mortality than non-neurological complications.

Polytraumatized Patients

Poly-trauma is mostly used to describe trauma patients whose injuries comprise several regions of the body, compromise the physiology of the patient, and potentially cause dysfunction of uninjured organs. Individuals suffering from poly-trauma are at a higher risk of morbidity and mortality than patients with single-injury (Mohamed, Khalifa, & Eltaib, 2020). The impact of poly-trauma on society among severely injured or poly-traumatized patients is more than the isolated trauma patients. Thus, the poly-trauma patients need to be precisely identified to allow appropriate benchmarking and reimbursement of hospitals (Pothmann et al., 2018). Poly-trauma patients who sustain neuro-trauma are among the most severely injured patients (Ecklund & Moores, 2017).

Nursing Role in Caring for Poly-traumatized and Head Trauma Patients

Caring for a traumatized patient in ICUs needs professional skills, prompt response, education, and assessment to be adaptable to a rapidly change clinical decision. Thus, the ability and the power of the observation of each team member are essential to prevent complications and possible deaths resulting from trauma (Marsden & Tuma, 2021). Critical care nurses (CCNs) are considered key persons of a multidisciplinary team that care for those patients (Lovrenčić & Rotim, 2019). A study conducted by De Souza Nogueira et al. (2015) revealed that trauma patients on the first day of ICU stay need an average nursing workload of 71.3%.

One of the most important roles of CCNs is defining and prioritizing care to be given, and establishing preventive and healing measures as the time between life and death is short (Sallum & Sousa, 2012). Immediately after the trauma patients arrive in the ICU, CCNs should repeat the primary and secondary surveys in compliance with advanced trauma life support guidelines to reassess the trauma patient's state (Urden, Stacy, & Lough, 2020). It has been reported that a tertiary survey should also be performed within 24 hours of admission as a part of the routine nursing evaluation of all poly-traumatized patients to detect the missed injuries (Abdelgeleel, Salama, Ali, & Elsagher, 2019). Thus, the application of a poly-trauma assessment sheet is recommended for all poly-traumatized patients. CCNs are also responsible for ensuring the passage of airway (Lovrenčić & Rotim, 2019) as the airway management is still the most important first step in the care of a trauma patient (Galvagno, Nahmias, & Young, 2019). They are also responsible for establishing several intravenous lines for fluid resuscitation and drawing blood samples for analysis according to standard procedures (Lovrenčić & Rotim, 2019).

Trauma patient's monitoring in the ICU is critical for identifying and interpreting problems in the patient's physiological parameters, as well as treating pre-existing illnesses (Lovrenčić & Rotim, 2019). Accordingly, one of the main CCNs responsibilities for those patients is to connect them to invasive and non-invasive monitoring devices. Additionally, Radomski et al. (2016) reported that enteral nutrition is initiated once the patient has been stabilized and is no longer being actively resuscitated.

A recent study conducted by Ohbe, Jo, Matsui, Fushimi, and Yasunaga (2020) depicted that for patients with severe TBI, early enteral nutrition may not reduce mortality but may minimize nosocomial pneumonia. Furthermore, the recently updated guidelines for the management of severe TBI from the brain trauma foundation advised early transgastric jejunal feeding to reduce the incidence of ventilator-associated pneumonia (Carney et al., 2016). CCNs play a major role in acute and non-acute care of TBI patients with the moderate and severe type (Lehman, 2015) in treatment and recovery phases (Oyesanya et al., 2018). The choice of nursing approaches is based primarily on the actual state of patients, their current needs, and their families, which allows nurses to periodically update their care plans (Lehman, 2015).

Recently, the current guidelines for severe TBI medical management focus on the prevention of secondary brain injuries, such as hypoxia and hypotension, optimization of cardiorespiratory physiology, control of intracranial pressure (ICP), and maintenance of cerebral perfusion pressure (Carney et al., 2016). Therefore, CCNs priorities in management of TBI patients should focus on ongoing assessments of their LOC or neurological status, vital signs and hemodynamics, control of increased ICP, and maintain adequate cerebral perfusion pressure (Urden et al., 2020) as presented in figure 1.

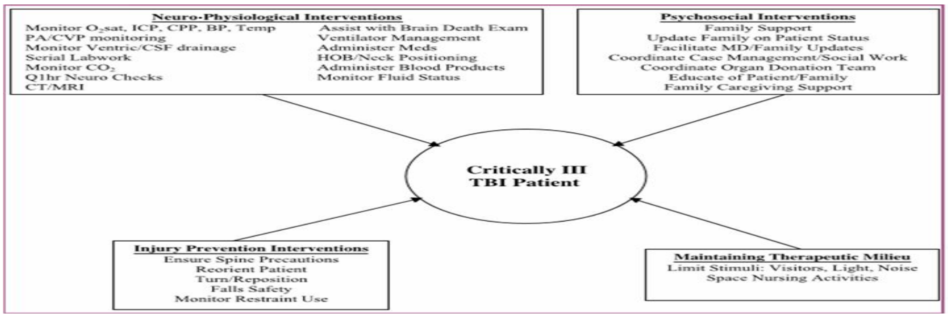

Fig. 1: Nursing Interventions for Critically Ill Traumatic Brain Injury Patient **Adapted from** "Nursing interventions for critically ill traumatic brain injury patients" by McNett, M., & Gianakis, A. (2010). *Journal of Neuroscience Nursing, 42*(2), 71-77

Ongoing nursing assessments are the cornerstone in patient's care as the assessment is the primary mechanism for determining secondary brain injury from cerebral edema, increased ICP, and treatment of complications (Urden et al., 2020). Subsequently, upon admission of TBI patients to the ICU, CCNs should perform a neurologic examination by evaluating the LOC, pupil, pertinent cranial nerve, and sensory function, and assessment of the best motor response. Then, they should compare it with the baseline assessment for detecting the patient's neurologic changes (Zrelak et al., 2020). Moreover, one of the most important measurements that CCNs should continuously monitor is the arterial blood pressure as the hypotension in a TBI patient may indicate additional injuries. Hypotension reduces blood flow to the brain. Thus, the cerebral perfusion pressure should be maintained between 60 and 70 mmHg (Carney et al., 2016).

Intracranial pressure elevation is considered a predictive of poor outcomes in TBI patients (American College of Surgeons [ACS], 2015). Hence, ICP monitoring is important and is generally advised to maintain it below 15 mm Hg (Urden et al., 2020). As a valuable member of the health care team, CCNs must be aware of measures that manage increased ICP which include maintaining body alignment and preventing sharp head turning to one side and sharp hip flexion. Turning the head to one side compresses the jugular vein, prevents drainage of venous blood from the head, and then increases ICP. In the same context, sharp hip flexion raises the intra-abdominal pressure, lowering venous outflow that also causes an increase in ICP (Morton & Fontaine, 2018).

Endotracheal suctioning can also elevate ICP. Therefore, there are some techniques to prevent this problem including pre-oxygenation before and after suctioning, keeping the suction pressure minimal, shorter suctioning duration (<10 seconds), avoidance of carina stimulation, and suctioning only when needed (Urden et al., 2020). Hyperthermia in a patient with severe TBI raises cerebro-metabolic demands and may exacerbate subsequent brain injury (Morton & Fontaine, 2018; Svedung Wettervik et al., 2020).

The consumption of cerebral oxygen is also increased during periods of high body temperature. Thus, euthermia (36° to 37°C) can be achieved by CCNs management including frequent monitoring of body temperature, and the use of antipyretics, and cooling techniques such as evaporative cooling. Additionally, the infection must be ruled out as the cause of fever (Urden et al., 2020). CCNs play a significant role in educating patients and their families about the treatment plan, possible patient outcomes, and reasoning for current therapies. Finally, nurses serving as a source of support for family members by listening to them and providing the necessary reassurance (W. Liu, Zhu, Liu, & Guo, 2015; McNett & Gianakis, 2010)

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Section II: Overview of the GCS, FOUR Score, and GOS

To determine the severity of the trauma, health care professionals need to assess patients' LOC. Accurate measurements of patients' LOC help nurses to plan in the shortest time and the best possible manner to minimize the disability and mortality of trauma patients (Ghelichkhani, Esmaeili, Hosseini, & Seylani, 2018). As well, tools that can provide a quick and reliable assessment of a patient's condition provide a great value in making well-informed crucial decisions and limiting the mortality rate for TBI patients (Zhang, Jiang, & Petzold, 2017). In ICUs, many scoring systems are used to predict patients' morbidity and mortality (Evran, Serin, Gürses, & Sungurtekin, 2016). These scales allow optimizing the use of hospital resources and aid in the development of treatment standards (Rapsang & Shyam, 2015).

Scoring in trauma helps in quantifying injuries which allows the stratification of patients based on the types of injuries and predicts the probability of survival based on its severity (Rapsang & Shyam, 2015). These scales include Acute Physiology and Chronic Health Evaluation II (APACHE II) Score (Knaus, Draper, Wagner, & Zimmerman, 1985), Trauma Score (Champion, Sacco, Carnazzo, Copes, & Fouty, 1981), Sequential Organ Failure Assessment (SOFA) Score (Vincent et al., 1996) and the FOUR Score (Wijdicks, Bamlet, Maramattom, Manno, & McClelland, 2005). However, the most widely utilized coma scale at present is the GCS (Ahamed & Ebraheim, 2017; Lee, Kitchell, Siu, & Chen, 2017).

Glasgow Coma Scale

The GCS was introduced in 1974 by Teasdale and Jennett to objectively describe the neurological status, and predict neurologic patients' outcomes (Teasdale & Jennett, 1974). This scale is used to determine the management issues of patients and the total score is used to group patients under different categories (Bhaskar, 2017). Some studies reported a good correlation between the GCS and patient's outcomes (Gennarelli, Champion, Copes, & Sacco, 1994; Reith et al., 2017).

The GCS scale was originally developed to grade the severity of the head injury and patients' outcome (Teasdale & Jennett, 1974), but now it has been extended for all causes of impaired LOC and coma (Shalaby, Reda, & Emam, 2019). Additionally, it is the primary method of assessing LOC following TBI (Yue et al., 2017). The GCS facilitates communication between nurses, junior inexperienced physicians, and non-neurologic staff working in other medical or surgical units (Wijdicks, 2016). The scale is reliable and easy to use and can be utilized by different observers (Khanal, Bhandari, Shrestha, Acharya, & Marhatta, 2016). Additionally, it has been demonstrated to be an indicator for hospital admission following trauma (Yue et al., 2017).

Elements of GCS

The GCS is based on three clinical findings: eye-opening, verbal expression, and motor response. These elements are summarized in figure 2. Each component is given a score based on the best response with a range of 1 to 4 for eye-opening, 1 to 5 for verbal, and 1 to 6 for motor response to yield the sum overall GCS of 3 to 15. The lowest total score on the GCS is 3, while the highest possible score is 15 (Teasdale & Jennett, 1974). Additionally, a score of 8 or less on the GCS usually indicates coma and requires airway support and in most cases intubation (Woodrow, 2019).

Component tested	Score
Eye response	
Eyes open spontaneously	4
Eye opening to verbal command	3
Eye opening to pain	2
No eye opening	1
Motor response	
Obeys command	6
Localises pain	5
Withdraws from pain	4
Flexion response to pain	3
Extension response to pain	2
No motor response	1
Verbal response	
Oriented	5
Confused	4
Inappropriate words	3
Incomprehensible sounds	2
No verbal response	1

Fig. 2: Elements of the GCS**Adopted from** "Comparison between FOUR score and GCS in assessing patients with traumatic head injury: A Tertiary Centre Study" by Nair, S., Surendran, A., Prabhakar, R., Chisthi, M. (2017). *International Surgery Journal, 4*(2), 656-662

.Limitations of the GCS

Despite its widespread usage, the GCS has several limitations, even if applied correctly. One of its apparent limitations is the requirement of a verbal response, which can be difficult in intubated and aphasic patients (Ramazani & Hosseini, 2019; Wijdicks et al., 2005; Zeiler et al., 2017). The GCS provides data about LOC only and should never be considered as a complete neurologic examination (Urden et al., 2020). It is inappropriate to assess the LOC in patients less than the age of 5 (Ndoumbe, Ekeme, Simeu, & Takongmo, 2018).

In addition, the GCS does not have a clinical index for brainstem reflexes and breathing patterns which makes it more likely to miss some of the early features of brain herniation, brain death, locked-in syndrome, and vegetative state (Abdallah et al., 2020; Bayraktar et al., 2019; Momenyan et al., 2017). To overcome these limitations, especially in the verbal response domain, a new scale was developed by Wijdicks et al. (2005) called the FOUR score.

Full Outline of Unresponsiveness Score

The FOUR score was developed by Wijdicks and colleagues in 2005 to evaluate the LOC in comatose patients and overcome shortcomings in the GCS. It was developed and validated initially in the neurological ICU (Wijdicks et al., 2005). It was also appropriate for both traumatic (Nyam et al., 2017) and non-traumatic brain injuries (Lee et al., 2017).

The FOUR score has been tested in a range of clinical settings such as the medical ICU (Iyer et al., 2009), and the emergency department (Baratloo, Mirbaha, Bahreini, Banaie, & Safaie, 2017; Stead et al., 2009). Additionally, it also has been utilized by trainees, nurses, ICU staff, and neurologists. It is too early to report whether it will become as popular as the GCS. However, early indications are positive because it exists in many languages (Schwab, Hanley, & Mendelow, 2014). Furthermore, it provides a structured objective scoring for aspects of brainstem function that can be assessed in all patients, especially those who are unable to verbally communicate. Hence, it provides more neurological details than the GCS (Almojuela, Hasen, & Zeiler, 2019).

The FOUR scale assesses eye and motor responses, brainstem reflexes, and respiratory patterns, but lacks the verbal component, making it potentially useful in intubated patients (Wijdicks et al., 2005). The FOUR score also detects the locked-in syndrome and the presence of a vegetative state when the eyes open spontaneously but do not track the examiner's finger. The incorporation of hand gestures into the evaluation of motor functions is validated to assess patients' alertness (Wijdicks, 2016).

Components of FOUR score

The FOUR score assesses four domains of the neurological functions: eye responses, motor responses, brainstem reflexes, and breathing pattern as shown in figure 3. Each domain carries five parameters with total points ranging from 0 to 4 with potential scores ranging from 0 to 16. The lowest total score is zero while the highest score is 16 (Wijdicks et al., 2005). Additionally, the lower scores in each domain correlate with an increased risk of mortality (Mallett, Albarran, & Richardson, 2013).

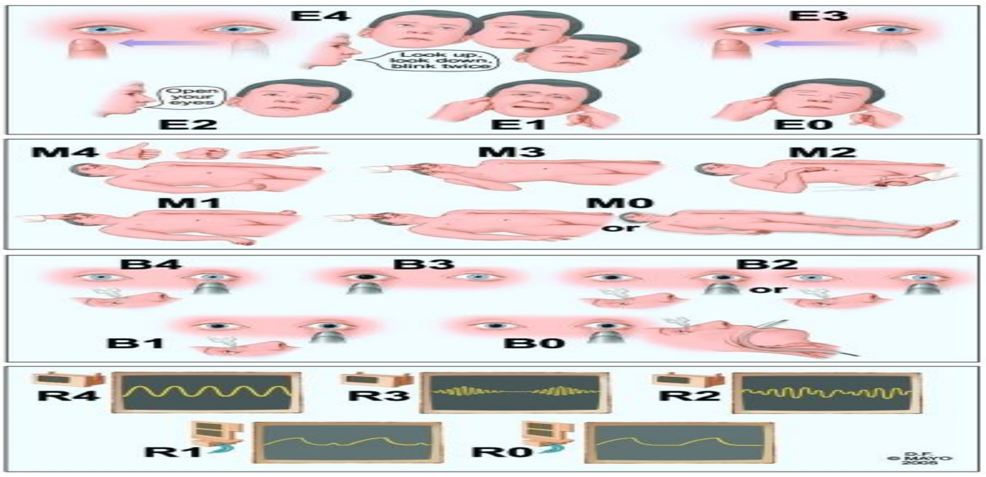

Fig. 3**:** Categories of the FOUR score**Adopted from** "Validation of a new coma scale: The FOUR score" byWijdicks, E., Bamlet, W., Maramattom, B., Manno, E., & McClelland, R. (2005). *Annals of Neurology*, *58*(4), 585–593.

2002). It has been reported that GOS at hospital discharge was a useful long-term prognostic index in severe TBI patients. Therefore, it is the final step to predict a patient's outcomes (Oliveira et al., 2012). This scale involves five elements as presented in figure 4 including; complete recovery or mild disability = 5, moderate disability (disabled but independent, can work in sheltered setting) = 4, severe disability (conscious but disabled, dependent for daily support) = 3, Vegetative = 2 and death = 1 (Jennett & Bond, 1975).

Glasgow Outcome Scale

This scale was developed by Jennett and Bond (1975) to provide an overview of the outcome after brain injury, with an emphasis on social recovery. However, it has also been used by some diagnostic groups, although the emphasis has largely been the head injury (McMillan et al., 2016). Thereby, the GOS in its original or extended form is recommended as an outcome measure for major trauma and head injury (Ardolino, Sleat, & Willett, 2012; Narayan et al.,

Glasgow outcome scale		
Death	Severe injury or death without recovery of consciousness.	1
Persistent vegetative state	Severe damage with prolonged state of unresponsiveness and a lack of higher mental function.	2
Severe disability	Severe injury with permanent need for help with daily living.	3
Moderate disability	No need for assistance in everyday life. Employment is possible but may require special equipment.	4
Low disability	Light damage with minor neurological and physiological deficits	5

Fig. 4**:** Elements of the GOS **Adopted from** "Correlation of Glasgow outcome score to Glasgow coma score assessed at admission" by Kodliwadmath, H. B., Koppad, S. N., Desai, M., & Badiger, S. P. (2016). *International Surgery Journal, 3*(4), 1959-1963

Section III: Prediction of Patients' Outcomes Using the FOUR Score and the GCS

To study the outcomes of trauma, precise and reliable tools are needed for appropriate scoring of severity and outcome prediction (Yousefzadeh-Chabok et al., 2016). One of the primary goals of trauma scoring systems is to objectively describe the trauma population so that outcomes may be compared across centers and countries (Kahloul et al., 2013). Because of the high mortality rates associated with TBI, costs of inpatient and long-term treatments are being increased. Hence, predicting outcomes has always been an important issue (Kafle et al., 2018). Improvements in injury assessment and prioritizing care have been demonstrated to contribute to a 28% reduction in the death rates of injured patients (Ariaka et al., 2020). Thus, access to reliable assessment scales is essential for predicting the mortality risk and patients' outcomes. This in turn helps the caregivers in estimating the severity and outcome of the patient's condition and making the appropriate care decisions (Khoshfetrat, Yaghoubi, Hosseini, & Farahmandrad, 2020).

In this regard, several international research compared the FOUR score and the GCS in predicting patient outcomes. Some studies found that one of these two predictive models was equivalent to the other, while others found that one was superior (Ramazani & Hosseini, 2019). A study conducted by Ghelichkhani et al. (2018) illustrated that both scales had the same predictive values regarding patients' outcomes at discharge time. The same findings were reported by other studies which found no significant difference between the two scales in predicting patients' outcomes (Baratloo, Shokravi, Safari, & Aziz, 2016; Furman, Gorenjak, & Ravnik, 2020). Conversely, other studies reported that the FOUR score is more comprehensive and reliable than the GCS (Bruno et al., 2011; Gorji, Hoseini, Gholipur, & Mohammadpur, 2014; Jalali & Razaei, 2014; Keykha, Askari, Navidian, & Hosseini, 2017).

To the best of our knowledge, the FOUR score is not used as a routine tool for assessing a patient's LOC. This highlights the need for more investigations to assess the ability of each scale to predict traumatized patients' outcomes in Egyptian hospitals.

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