Comparison of Glasgow Coma Scale with Revised Trauma Score in Assessing the Mortality of Head Injured

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ARTICLE INFO

A B S T R A C T

Background: Head injury causes temporary or permanent damage to the brain. The incidence and mortality of head injuries is very high worldwide, so fast and appropriate treatment is needed. Glasgow Coma Scale and Revised Trauma Score are easy to use and can assess the mortality of head-injured patients. Objective: To analyze the comparison of the Glasgow Coma Scale and Revised Trauma Score in assessing the mortality of head-injured patients. Methods: This research is a systematic review study using the PRISMA approach. Inclusion criteria, namely studies focusing on head injury patients, articles published in 2016-2022, and articles in English. Exclusion criteria were studies other than head injury patients, articles published before 2016, and articles other than English. A systematic review using PICO. Search database using Pubmed, Science Direct, SAGE, and DOAJ. Results: The JBI analysis of 9 selected articles found that the Revised Trauma Score was more accurate in assessing head injury mortality. RTS has a mortality accuracy of 86%-90% and GCS 83%-88% at 24 hours of treatment of head-injured patients. Conclusion: The Glasgow Coma Scale is the most frequently used standard instrument for the assessment and prognosis of patients with head injuries. The Revised Trauma Score is a combined assessment of the nervous system (GCS), circulatory system (SBR), and respiratory system (RR) which are important components in assessing the mortality of head injured patients.

A B S T R A K

Latar Belakang: Cedera kepala menyebabkan kerusakan sementara atau permanen pada otak. Kejadian dan mortalitas cedera kepala sangat tinggi di dunia sehingga diperlukan penanganan yang cepat dan tepat. Glasgow Coma Scale dan Revised Trauma Score mudah digunakan dan dapat menilai mortalitas pasien cedera kepala. Tujuan: Menganalisis perbandingan Glasgow Coma Scale dan Revised Trauma Score dalam menilai mortalitas pasien cedera kepala. Metode : Penelitian ini merupakan studi sistematik review dengan pendekatan PRISMA. Kriteria inklusi yaitu studi berfokus pada pasien cedera kepala, artikel dipublikasikan tahun 2016-2022, artikel berbahasa Inggris. Kriteria eksklusi yaitu studi berfokus selain pasien cedera kepala, artikel dipublikasikan sebelum tahun 2016, artikel selain berbahasa Inggris. Tinjauan sistematis menggunakan PICO. Database penelusuran menggunakan Pubmed, Science Direct, SAGE, dan DOAJ. Hasil: Dari analisis JBI 9 artikel terpilih diperoleh hasil bahwa Revised Trauma Score lebih akurat dalam penilaian mortalitas cedera kepala. RTS memiliki akurasi mortalitas 86%-90% dan GCS 83%-88% pada 24 jam perawatan pasien cedera kepala. Kesimpulan: Glasgow Coma Scale sebagai instrumen standar yang paling sering digunakan untuk penilaian, dan prognosis pasien dengan cedera

kepala. Revised Trauma Score merupakan gabungan penilaian sistem persarafan (GCS), sistem sirkulasi (SBR), dan sistem pernafasan (RR) adalah komponen penting pada penilaian mortalitas pasien cedera kepala.

INTRODUCTION

Head injury is defined as sustained brain damage resulting from a physical impact that causes temporary or permanent functional or structural damage to the brain (Rosenfeld et al. 2012; Ginting et al., 2020; Crupi et al., 2020; Maas et al., 2022). Head injuries can also be called head injuries or traumatic brain injuries (TBI). The most common causes of head injuries are falls, road traffic accidents, assault, and self-injury, and these mechanisms vary according to age, sex, and geographic location. (Lystad et al., 2019). Head injuries are a leading cause of disability and death, especially in young adults, and account for approximately 30% of all injuries-related deaths (Pervez et al., 2018). The incidence of head injuries in Indonesia has increased from 0.4% to 11.9% (Kemenkes RI, 2019). The consequences of a head injury can increase a large socio-economic burden as well as high medical costs (Putri et al., 2021; Meilando, 2020).

The trauma scoring system is the most important factor for determining the severity of a trauma patient. Several trauma assessment systems have been developed and used in Indonesia and worldwide. The trauma scoring systems commonly used to predict trauma patient outcomes are the Glasgow Coma Scale (GCS) and the Revised Trauma Score (RTS). This parameter facilitates assessment in the early stages of trauma. GCS and RTS almost always provide reliable scores that make informed decisions in the triage setting and can be used to predict mortality in trauma patients (Kim et al., 2017 ; Galvagno et al., 2019)

The Glasgow Coma Scale (GCS) is the most frequently used scale to determine severity by assessing the level of consciousness in head injured patients. GCS is a method to quantitatively measure the neurological status of head injured patients in which central nervous system function is assessed by observing eye opening (score 1-4), verbal (score 1-5) and motor (score 1-6) responses to stimuli. The level of awareness is obtained by adding up the three GCS components, where the higher the score, the better the level of awareness. The lowest total score is 3 and the highest score is 15. GCS score for classifying head injuries is divided into mild (GCS 13-15), moderate (GCS 9-12), and severe (GCS 3-8) categories (Marbun et al., 2020; Dixon et al., 2020 ; Salottolo et al., 2021; Ginting, et al., 2020).

Revised Trauma Score (RTS) is a physiological scoring system that combines GCS values with respiration rate and systolic blood pressure. RTS has a high degree of accuracy in assessing the mortality of injured patients (Javali et al., 2019). The Revised Trauma Score (RTS) is used worldwide in prehospital practice and in the emergency department (ED). This system is the most widely used because it is easier and simpler so it only takes a short time to do an assessment. RTS assessment is done immediately after the patient is traumatized (Khoiriyati, 2019).

Based on the description in the paragraph above, an intervention is needed in the form of an appropriate head injury assessment so that people with head injuries get prompt and appropriate treatment. This is what motivated the researchers to conduct a systematic review study entitled "Comparison of the Glasgow Coma Scale (GCS) and the Revised Trauma Score (RTS) in Assessing the Mortality of Head Injured Patients".

METHOD

The design used in this study uses the Preferred Reporting Items for Systematic Review and Meta-analyses (PRISMA) method. This method is carried out by reviewing, studying, structured evaluation, classifying, and categorizing based on previously generated evidence. This literature review aims to analyze how the Glasgow Coma Scale (GCS) and the Revised Trauma Score (RTS) compare in assessing the mortality of head injured patients. The literature search used the Pubmed, Science Direct, SAGE, and DOAJ databases with publications ranging from 2016-2022. Articles that meet the criteria for assessment and quality according to inclusion and exclusion. There are nine articles that discuss the mortality assessment of head injured patients. Results of analysis of nine articles on comparison of trauma assessment using GCS and RTS on MGAP, GAP, KTS, Injury Severity Score (ISS), National Early Warning Score (NEWS), Shock Index (SI), Modified Shock Index (MSI) and Trauma and Injury Severity Score (TRISS).

RESULTS AND DISCUSSION

Head injury is a cause of death, especially in adults. Therefore, fast and appropriate treatment is needed to prevent worsening of the patient's condition. Measuring the severity of trauma to determine prognosis is a very important step to prevent head injury patient mortality. The Glasgow Coma Scale (GCS) and Revised Trauma Score (RTS) are used as prognostic models for mortality in head injured patients because each component of the GCS and RTS has a role in the control function, oxygenation and perfusion of brain tissue under normal conditions or not. (Ristanto et al., 2016).

The total GCS score is used to group patients into several categories so that treatment protocols can be developed, and the expected results will be better. A total score of 13–15 indicates mild head injury, 9–12 moderate head injury and 3–8 severe head injury. There are three parameters used, namely eye opening, verbal response and motor response. The maximum (normal) value of each parameter is eye opening (E) = 4, the best motor response (M) = 6, and verbal response (V) = 5 (Nair et al. 2017). According to Godoy et al. (2016) a new scheme categorizes head injury cases into two groups. The first group was a potentially severe head injury, with a GCS score of 9-10, while the other group had an abnormal GCS of 11-13. The GCS score has a strong influence on the chances of survival and recovery in head injured patients. A low initial GCS score at the start of an injury will have a poor outcome (Reith et al., 2016; Reihani et al., 2017; Ginting et al., 2020).

GCS is a parameter to determine the prognosis of head injured patients, the lower the GCS score, the worse the

prognosis of head injured patients. The motor response component in head-injured patients has the best predictive value, because eye and verbal responses cannot be assessed under certain conditions, such as endotracheal tube insertion, aphasia, and palpebral edema. There is a strong relationship between abnormal motor responses with worsening conditions and high mortality. The worse the motor response, the higher the worsening condition and patient mortality. In contrast, a good motor response score (score>4) indicates better recovery and lower mortality (Osler et al., 2016; Ristanto, 2018; Javali et al., 2019; Riduansyah et al.,2021).
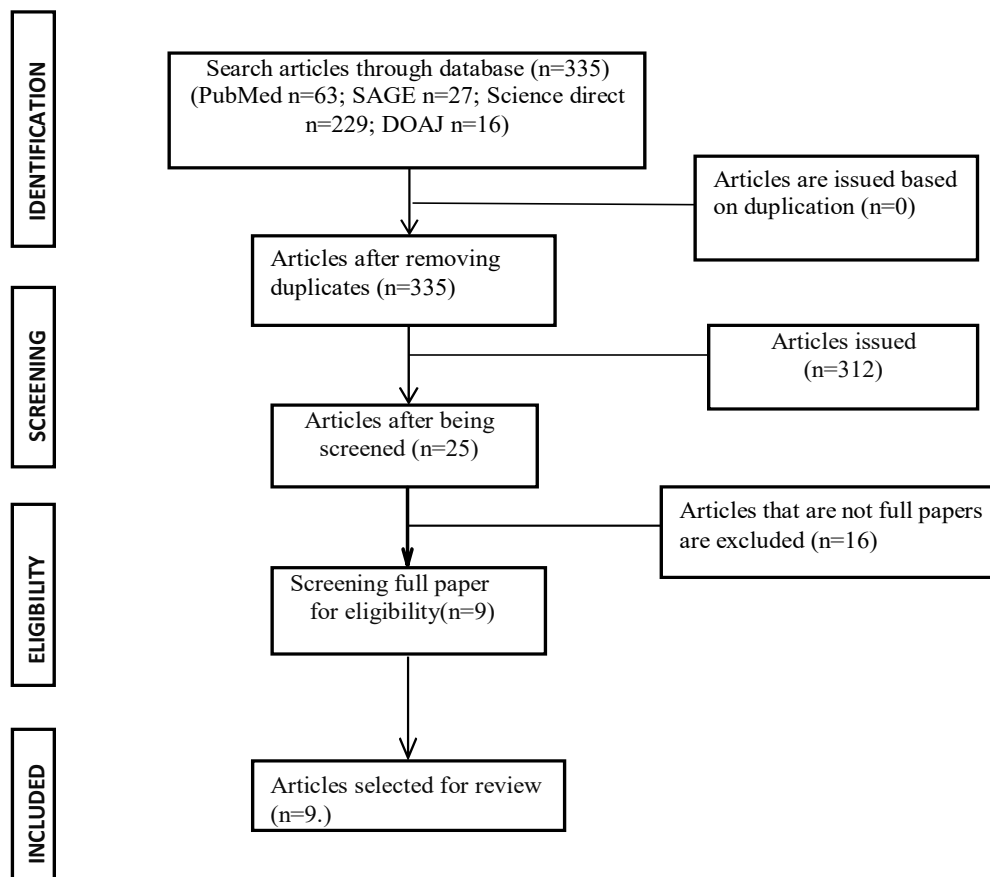

Figure 1. PRISMA flow diagram

Table 1. List of Search Results

No	Title	Author	Year	Objective	Methods, research design	Sample	Comparison	Research Result
1	Glasgow coma scale compared to other trauma scores in discriminating in-hospital mortality of traumatic brain injury patients admitted to urban Indian hospitals: A multicentre prospective cohort study.	Basak et al.	2022	compared discrimination of GCS with MGAP, GAP, RTS and KTS for 24-hour and 30-day in-hospital mortality in adult TBI (Trauma Brain Injury) patients,	multicenter prospective cohort study	3306 patients	GCS, MGAP, GAP, RTS and KTS	GCS is comparable to more complex trauma scores in predicting 24-hour and 30-day in-hospital mortality in adult TBI patients. RTS is better at predicting TBI patient mortality than GCS.
2	New prehospital scoring system for traumatic brain injury to predict mortality and severe disability using motor Glasgow Coma Scale, hypotension, and hypoxia: a nationwide observational study	Gang et al.	2019	developed a new prehospital trauma score for TBI (Trauma Brain Injury) (NTS-TBI) to predict death and disability.	Retrospective cross-sectional study	3.642	NTS-TBI	The NTS-TBI model 2 AUC values for mortality and disability were higher than RTS (0.819 and 0.761 respectively) (P<0.01).
3	Modified Revised Trauma–Marshall score as a proposed tool in predicting the outcome of moderate and severe traumatic brain injury	Mahadewa et al.	2018	determine whether combining both physiologic (RTS) and anatomical (MCTC) factors better predicts outcome	prospective observational study	181	Marshall CT scan (MCTC) classification score	Score combination physiology and anatomy improve the prognostic outcome in moderate and severe TBI patients, that is formulated in an accurate, simple, applicable, and m-RTS prognostic score model reliable
4	The accuracy of acuity scoring tools to predict 24-h mortality in traumatic brain injury patients: A guide to triage criteria	Najafi, Zakeri, and Mirhaghi	2018	determine the accuracy of the 24-hour acuity assessment tool and mortality among TBI (Trauma Brain Injury) patients both in pre-hospital and hospital setting	observational, prospective cohort	185 patients	Revision Trauma Score (RTS), Injury Severity Score (ISS), National Early Warning Score (NEWS), Shock Index (SI), Modified Shock Index (MSI) and Trauma and Injury Severity Score (TRISS)	Hospital RTS, and prehospital NEWS significantly improved predictions Dead. The model explains the 51.2% variance in survival of patients with TBI.
5	Incorporating age improves the Glasgow Coma Scale score for predicting mortality from traumatic brain injury.	Salottolo et al.	2021	account for any observed variation by age by revising the GCS score categories (mild, moderate, severe) and determining whether the revised category discrimination is improved compared to the standard GCS categories.	Logistic regression	134758		Statistically revised GCS categories significantly outperformed the standard GCS category in predicting mortality (AUC: 0.800 vs 0.755, p<0.001). The GCS categorization revised also outperformed the standard GCS category for mortality in a previously defined

No	Title	Author	Year	Aim	Method	Sample	Variable	Result
								subpopulation: leverage mechanism
6	Impact of Glasgow Coma Scale score and pupil parameters on mortality rate and outcome in pediatric and adult severe traumatic brain injury: a retrospective, multicenter cohort study	Emami et al.	2017	Evaluate and analyze the effect of pupillary status and Glasgow Coma Scale (GCS) score on mortality and functional outcome in pediatric and adult patients	retrospective cohort	9959	pupil parameters	The overall mortality rate and death rate for patients with a GCS of 3 and bilateral pupils are fixed and dilated (19.9% and 16.3%, respectively) higher for adults than pediatric patients (85% vs 80.9%, respectively)
7	The Revised Trauma Score plus serum albumin level improves the prediction of mortality in trauma patients	Kim et al.	2017	evaluated the value of RTS plus serum albumin (RTS-A) and compared it to other existing trauma scores and compared performance predictive of Trauma and Injury Severity Score with RTS-A (TRISS-A) with native TRISS	observational cohort study	2447	RTS plus serum albumin (RTS-A) and TRISS	RTS value plus serum albumin (RTS-A) predicts patient mortality trauma in the hospital is better than RTS, and use TRISS RTS-A (TRISS-A) is a better predictor of mortality compared with native TRISS in patients with blunt trauma
8	The differential mortality of Glasgow Coma Score in patients with and without head injury	Osler et al.	2016	determine whether the relationship between GCS and mortality is influenced by the presence of TBI (Trauma Brain Injury)	The combination of linear coefficients	639549		The GCS will likely prove to be a more reliable component of mortality prediction models in general, and in non-TBI patients in particular
9	Analysis of the Revised Trauma Score (RTS) in 200 victims of different trauma mechanisms	Alvarez et al.	2016	analyzed the epidemiological profile and mortality associated with Revision Trauma Score (RTS) in trauma victims treated at a trauma referral university hospital	cross-sectional study	200		RTS is effective in predicting death in traumatic brain injury

Patients with a low GCS score have a high mortality risk, patients with a high GCS score have a low mortality risk. A low GCS score at the time the patient enters the ED indicates that there is a severe brain disorder. The severity of the disturbance that occurs will cause disruption of the work of the brain which increases the threat of death of the patient. According to research Grace and Borley (2007) Head injured patients with GCS 15 have a 1% mortality rate, GCS 8-12 have a 5% mortality rate, and GCS < 8 have a 40% mortality rate. Therefore, the GCS is an important scale for assessing the level of consciousness, clinical status and prognosis of head injured patients.

The Revised Trauma Score assesses the human physiological system as a whole, the RTS instrument is the result of improving the GCS instrument to assess the initial condition of head trauma patients. Revised Trauma Score (RTS) is a trauma assessment score system that is widely used because it is easier and simpler so it only takes a short time to make an assessment (Irawan et al., 2010; Khoiriyati, 2019). Parameters assessed were GCS (Glasgow Coma Scale), respiration frequency (RR) and systolic blood pressure (SBR). The use of RTS for trauma assessment has several advantages, including not distinguishing age groups, not distinguishing trauma mechanisms, is a combined assessment of the nervous system, circulatory system, and respiratory system (Tirtayasa, 2013; Salim, 2015). The use of RTS components can also be used as an aid in the triage of traumatic brain injury patients. RTS as a standard assessment in the ATLS protocol in trauma patients, and can be used in assessing the mortality of head injured patients. As an assessment of head injury mortality, its use has been recognized in Washington (USA), Manchester (England), Helskinki (Finland), and has been studied by several hospital centers in Indonesia (Wikantama et al., 2020).

Revised Trauma Score (RTS) assesses the severity of trauma from pre-hospital and determines whether the patient will be taken to a puskesmas or hospital service facility. Health care workers can use the RTS assessment instrument to differentiate patients with a good or poor prognosis. As an emergency triage system, RTS is used to predict trauma patient mortality (Galvagno et al., 2019; Fatimah et al., 2022). On research (Ristanto et al., 2016) who used a sample of 96 patients from medical record data, concluded that the RTS had good discrimination and calibration because the ability to predict head injuries who lived was 95.8% and the ability to predict head injuries who died was 79.2%. Research by Wikantama et al. (2020) also stated that Revised Trauma Score (RTS) system has a very high discrimination ability and good calibration so that Revised Trauma Score (RTS) has a high prognostic ability in predicting mortality in traumatic brain injury patients at RSUP Dr. Sardjito, with an RTS score of 6.43 with a sensitivity value of 94.6% and a specificity of 87%.

GCS and RTS have different parameters, in RTS the components assessed are GCS (Glasgow Coma Scale), respiration frequency (RR) and systolic blood pressure (SBR). Respiratory rate/respiratory frequency has a relationship with the worsening of head injury patients. Patients with a respiratory rate <12 x/minute or >24 times per minute increase the risk of worsening or death of head injured patients (Yu et al. 2012). Changes in respiratory frequency from the normal range result in decreased oxygen saturation in the blood and decreased tissue perfusion. Low oxygen perfusion to the brain can lead to worsening of head injury patients (Ristanto, 2018). Hyperventilation occurs in the initial phase after a head injury. The body will try to maintain oxygen saturation by increasing the frequency of breathing (hyperventilation). Hyperventilation decreases the arterial partial pressure of carbon dioxide ($PaCO2$) which causes vasoconstriction, decreases cerebral blood flow, and intracranial pressure which can increase intracranial pressure. Increased pressure can be fatal in head injured patients (Ristanto, 2016).

Systolic blood pressure is a variable that can be used as a predictor in the management of head injured patients. An increase in blood pressure occurs early in the head injury phase with the aim of maintaining Cerebral Perfusion Pressure (CPP). The condition of damage to the cerebral area is increasingly widespread plus more and more bleeding will have an impact on the failure of the control mechanism of blood pressure. Hypotension or hypertension in patients with severe head injury is a clear source of secondary brain damage, hypotension can cause brain ischemia while hypertension can exacerbate cerebri. Blood pressure that is too high or too low indicates a poor prognosis which is usually followed by death. Hypotension < 80 mmHg lasting more than 15 minutes is considered a contributing factor to head injury mortality (Ristanto, 2016; Wahyudianto, at al., 2014 ; Fuller et al., 2014; Hartoyo, et.al., 2012).

CONCLUSIONS AND SUGGESTIONS

Glasgow Coma Scale (GCS) and Revised Trauma Score (RTS) are reliable trauma scoring systems, often used in assessing the mortality of head injured patients. The Glasgow Coma Scale (GCS) has been considered the standard instrument for the classification, assessment, and prognosis of patients with head injuries. RTS is used for the assessment of pre-hospital, health center, and hospital head injury patients. RTS is considered easy and simple for trauma assessment and can assess the prognosis of head injuries effectively. Revised Trauma Score (RTS) is more reliable than the Glasgow Coma Scale (GCS) in assessing the mortality of head injured patients. Glasgow Coma Scale (GCS), respiration frequency (RR) and systolic blood pressure (SBR) are important components in assessing the mortality of head injured patients.

Suggestions for further research are to explain the comparison of GCS and RTS in assessing mortality in cases of moderate or severe head injury, head injury with bleeding or not, in cases of surgery or not surgery. It is recommended to nurses especially in trauma assessment of head injuries using Revised Trauma Score (RTS) can be used in pre-hospital and hospital especially in the emergency room so that immediate treatment can be carried out and reduce the mortality rate of head injured patients.

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