



ORIGINAL ARTICLE

## Clinical and tomographic evaluation of patients with severe traumatic brain injury in Intensive Care

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### ABSTRACT

**Introduction:** traumatic brain injury is a health problem due to the costs generated by its care and its impact on the patient's life.

**Objective:** to clinically and tomographically evaluate patients with traumatic brain injury.

**Methods:** an observational, descriptive, prospective longitudinal study was conducted in patients with traumatic brain injury admitted to the intensive care unit of "Abel Santamaría Cuadrado" Hospital in Pinar del Río during the years 2022–2024. A purposive sample of 51 individuals who met the selection criteria was included. Documentary review of medical records and physical examination allowed the collection of information that yielded the analyzed variables, respecting medical ethics.

**Results:** the mean age was 44 years, with a predominance of males (80,40 %). Pedestrian accidents were the main injury mechanism (96,07 %). At admission, the mean Glasgow Coma Scale score was 8 points. Endotracheal intubation was required in 84,31 % of the sample, and 82,35 % underwent surgery. The mean hospital stay was 20 days, with a mortality rate of 37,30 %. A total of 45,10 % had Glasgow scores between 3–8 points, with a mortality of 27,45 %, showing improvement in this scale when reassessed at 72 hours. Diffuse brain injuries predominated (76,47 %), resulting in death in 25,49 % of patients with Glasgow scores <8 points.

**Conclusions:** clinical and tomographic evaluation of patients with traumatic brain injury are vital tools for diagnosis and treatment, thereby improving indicators related to this disease.

**Keywords:** Glasgow Coma Scale; Tomography; Craniocerebral Trauma; Intensive Care Units.

## INTRODUCTION

Traumatic brain injury (TBI) is a major public health problem and represents the leading cause of disability and mortality among young adults in developed countries. Globally, it is estimated that 50 to 60 million people suffer a TBI each year, imposing an economic burden equivalent to 400 billion US dollars on the global economy. According to data from the Centers for Disease Control and Prevention (CDC), the United States records approximately 403 emergency department visits and 85 hospitalizations per 100,000 inhabitants annually, generating significant socioeconomic impact.<sup>(1,2)</sup> TBI is increasingly recognized not only as an acute condition but also as a chronic disease with long-term consequences requiring ongoing follow-up and treatment.<sup>(3)</sup>

In Latin America, TBI incidence is high, primarily due to traffic accidents and violence. The most affected groups include motorcyclists and pedestrians in traffic-related injuries, and populations in countries with high rates of violence—whether due to armed conflict, domestic violence, or child abuse. In Cuba, according to the 2024 Statistical Yearbook, traffic accidents were the fifth leading cause of death in both sexes, with the most affected age group being 5–19 years.<sup>(4,5)</sup>

Appropriate management of these patients requires continuous monitoring of systemic and neurological parameters to prevent irreversible damage resulting from delayed diagnosis of complications, which can lead to severe disability or, in the worst cases, fatal outcomes.<sup>(2)</sup>

It is now known that approximately 30 % of patients with severe traumatic brain injury—defined as a Glasgow Coma Scale (GCS) score  $\leq 8$ —present upon intensive care admission with cerebral oxygen consumption reduced to nearly half of normal levels. Neurological and functional outcomes after severe TBI depend not only on the severity of the initial biomechanical impact (primary injury) but also on the presence and severity of systemic or intracranial insults that occur minutes, hours, or even days after the trauma. These secondary insults amplify and/or cause new brain damage, collectively termed secondary brain injury.<sup>(6)</sup>

Advances in scientific and technical capabilities in specialized neurocritical care units have enabled the development of neuromonitoring techniques that allow early detection of intracranial hypertension. Cranial computed tomography (CT) is fundamental in acute-phase imaging diagnosis of TBI due to its high sensitivity and specificity for identifying and managing acute intracranial lesions.<sup>(7)</sup>

The “Abel Santamaría Cuadrado” Hospital in Pinar del Río is the regional referral center for polytrauma patients, and TBI is one of the most frequent conditions requiring intensive care admission. Therefore, this study aims to clinically and tomographically evaluate patients with traumatic brain injury admitted to Intensive Care Unit (ICU) 3 of the “Abel Santamaría Cuadrado” Hospital from January 1, 2022, to December 31, 2024.

## METHODS

An observational, descriptive, prospective longitudinal study was conducted among patients with traumatic brain injury admitted to ICU 3 of the “Abel Santamaría Cuadrado” Hospital between January 2022 and December 2024.

The study population comprised all patients with TBI admitted to the Intensive Medicine Service of the "Abel Santamaría Cuadrado" General Teaching Hospital during the aforementioned period. A non-probabilistic, purposive sample of 51 patients was selected based on inclusion criteria (patients treated in ICU 3 with TBI during the study period who underwent clinical and tomographic evaluation) and exclusion criteria (patients meeting brain death criteria or who died within the first 48 hours of admission).

Data were obtained through documentary review of patients' medical records, allowing the selection of the following variables: age, sex, mechanism of injury, Glasgow Coma Scale score, Marshall CT classification, tomographic findings, need for endotracheal intubation, surgical treatment, ICU length of stay, and mortality.

Empirical research methods included information collection through direct observation and documentary analysis (review of medical records and hospital admission logs). Theoretical research methods included the hypothetico-deductive and historical-trend approaches, along with scientific procedures of analysis-synthesis and induction-deduction. These methods facilitated the formulation of conclusions and recommendations to align efforts and resources toward improving comprehensive care for TBI patients.

Statistical analysis employed standard qualitative research techniques—proportions, percentages, and ratios. Data were processed by creating a database in Microsoft Office Excel on a personal Pentium 5 computer capable of running specialized statistical software (SPSS for Windows).

The study received approval from the institutional ethics committee. Patient confidentiality was strictly maintained, and data were used exclusively for research purposes, in compliance with the bioethical principles for human research outlined in the Declaration of Helsinki and Cuban ethical regulations.

## RESULTS

The mean age was 44 years (standard deviation: 16; 95 % CI). Male sex predominated (80,40 %). The most frequent injury mechanisms were pedestrian struck by vehicle and motor vehicle accidents (96,07 %). On admission, the mean Glasgow Coma Scale (GCS) score was 8 (SD: 3,2; 95 % CI). Endotracheal intubation was required in 84,31 % of patients. Surgical intervention was performed in 82,35 %, with decompressive craniectomy being the most common procedure. The mean ICU length of stay was 20 days (SD: 18; 95 % CI), and TBI-related mortality was 37,30 % (Table 1).

**Table 1.** Clinical and tomographic evaluation of patients with traumatic brain injury.

Variable		No.	%
Age*		44	16
Sex	Male	41	80,40
	Female	10	19,60
Mechanism of injury	Run over	49	96,07
	Falls	2	3,92
GCS on admission*		8	3,2
Intubation		43	84,31
Surgical		42	82,35
ICU length of stay (days)*		20	18
Mortality		19	37,30

\*Notes: Mean (Standard deviation)

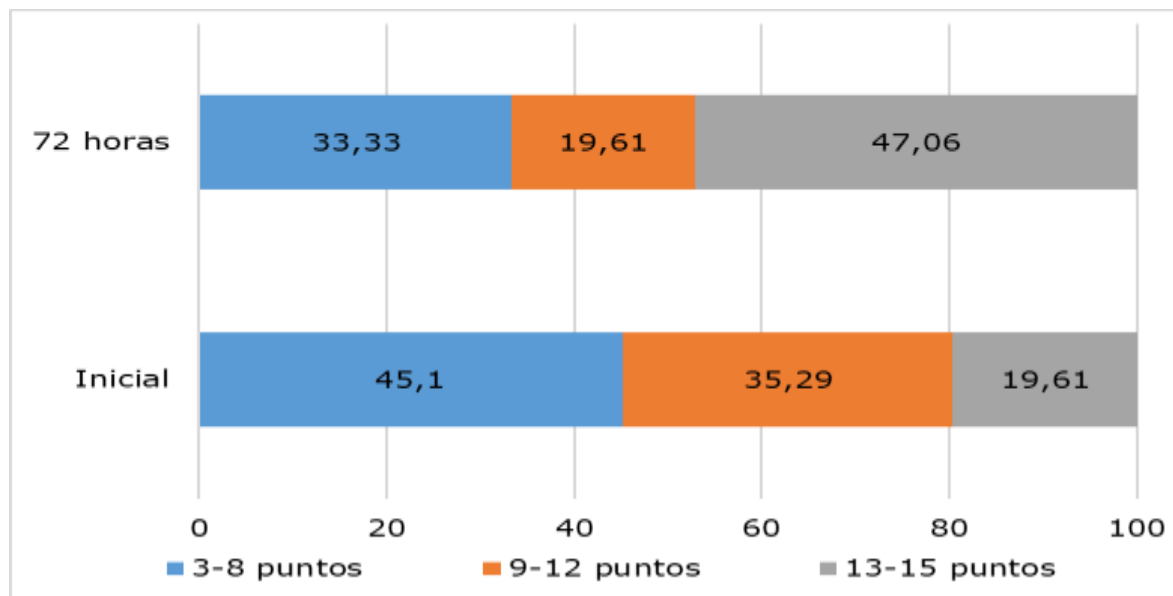
The association between GCS and mortality was significant: 45,10 % of patients had a GCS of 3–8, reflecting severity, with a mortality of 27,45 %. Patients with higher GCS scores showed greater survival. These results were highly significant ( $\chi^2 = 12,25$ ;  $p = 0,002$ ) (Table 2).

**Table 2.** Glasgow Coma Scale and mortality in TBI patients.

GCS	Alive		Deceased		Total	
	No.	%	No.	%	No.	%
3–8	9	17,65	14	27,45	23	45,10
9–12	16	31,37	2	3,92	18	35,29
13–15	7	13,73	3	5,88	10	19,61
<b>Total</b>	32	62,75	19	37,25	51	100

Pearson's  $\chi^2$  test: 12.25 ( $p = 0.002$ )

As shown, there was overall improvement in GCS upon reassessment at 72 hours, reflecting the healthcare team's preparedness in comprehensive management and adherence to trauma protocols. A GCS <8 at admission was a mortality risk factor; this risk extended to patients with GCS <12. A significantly higher proportion of patients achieved GCS 13–15 by 72 hours, correlating with reduced TBI mortality during this period (Fig. 1).



**Fig. 1.** Evolution of the Glasgow Coma Scale in TBI.

Regarding the Marshall CT classification and its relationship with mortality, diffuse brain injuries (DBI) types I-IV predominated (76,47 %), with 25,49 % mortality, making this tomographic pattern a risk factor. Mass lesions (ML) types V-VI were not significantly associated with death (Table 3).

**Table 3.** Marshall CT classification and mortality in TBI.

Type	Alive		Deceased		Total	
	No.	%	No.	%	No.	%
DBI (I-IV)	26	50,98	13	25,49	39	76,47
ML (V-VI)	6	11,76	6	11,76	12	23,53
<b>Total</b>	32	62,75	19	37,25	51	100

The relationship between GCS and Marshall classification showed that DBI was associated with GCS 3-8 in 33,33 % of cases (Table 4).

**Table 4.** Relationship between GCS and Marshall classification in TBI.

Type	GCS 3-8		GCS 9-12		GCS 13-15		Total	
	No.	%	No.	%	No.	%	No.	%
DBI (I-IV)	17	33,33	15	29,41	7	13,73	39	76,47
ML (V-VI)	6	11,76	3	5,88	3	5,88	12	23,53
<b>Total</b>	23	45,10	18	35,29	10	19,61	51	100

Subarachnoid hemorrhage was the most common tomographic finding (22 cases, 43,14 %), followed by cerebral contusion and fractures. Intraparenchymal hematoma was highly associated with death (75 % mortality). Subdural hematoma, fractures, and DBI type I were identified as survival risk factors in this TBI cohort (Table 5).

**Table 5.** Tomographic findings in TBI and their relationship with mortality.

Tomographic finding	Alive		Deceased		Total	
	No.	%	No.	%	No.	%
Cerebral contusion	12	57,14	9	42,86	21	41,18
Subdural hematoma	9	81,82	2	18,18	11	21,57
Epidural hematoma	4	57,14	3	42,86	7	13,73
Subarachnoid hemorrhage	12	54,55	10	45,45	22	43,14
Intraparenchymal hematoma	4	25,00	12	75,00	16	31,37
DBI type I	1	100,00	0	0,00	1	1,96
Fractures	11	64,71	6	35,29	17	33,33
Intracranial hypertension	1	50,00	1	50,00	2	3,92

## DISCUSSION

The mechanism of traumatic injury explains the high incidence of TBI among younger, productive-age patients. The brain's pathophysiological response to trauma varies with age; the elderly brain appears more vulnerable due to reduced neuronal reserve and diminished recovery capacity compared to younger individuals. Male predominance was evident. The mean GCS of 8 classifies these cases as severe TBI, justifying the need for mechanical ventilation and surgical intervention. The average ICU stay of 20 days underscores the necessity of a well-prepared healthcare team to manage these critical cases. Despite improvements compared to other studies, TBI-related mortality in this unit remains high.

Iris Pantelatos et al.,<sup>(8)</sup> in their study *Prediction of outcome in moderate and severe traumatic brain injury*, found a mean age of 44 years, with 75 % of cases being male and a mean Glasgow Coma Scale (GCS) score of  $5 \pm 2$ , requiring mechanical ventilation. Similar results regarding age, sex, mortality, and etiology were reported by Riverol González et al.,<sup>(9)</sup> at the "Arnaldo Milián Castro" University Clinical and Surgical Hospital in Villa Clara, Cuba, where males predominated (70 %), the most affected age group was 40–49 years, mortality was 40,6 %, and traffic accidents were the most frequent cause (79,2 %). Ayele et al.,<sup>(10)</sup> in a study of 429 TBI patients in Ethiopia, reported a mortality rate of 33,8 %—results consistent with the present investigation.

The GCS was originally designed to monitor the evolution of patients with TBI. The earlier the GCS assessment is performed, the better, as the patient's responsiveness may change during the first hours post-injury. Thus, its prognostic value lies in the initial evaluation. It is an extremely useful tool for detecting neurological changes and predicting clinical outcomes.<sup>(11)</sup>

Barea Mendoza et al.,<sup>(12)</sup> found that GCS alone showed an area under the curve (AUC) of 0,69 (95 % CI: 0,67–0,72), while GCS combined with pupillary reactivity yielded an AUC of 0,75 (95 % CI: 0,72–0,77). Although pupillary GCS showed superior mortality prediction, a general GCS score below 8 was clearly associated with increased mortality and the need for neurosurgical intervention. Iyanna et al.,<sup>(13)</sup> reported similar findings, noting that a prehospital GCS decline was strongly associated with higher mortality, independent of TBI type.

The Glasgow Coma Scale is an essential clinical tool. Following initial resuscitation, it enables classification of TBI as mild, moderate, or severe. A decline in GCS due to clinical deterioration mandates prompt diagnostic or therapeutic decisions to optimize prognosis. Clinical worsening can also stem from extraneurological causes—particularly pulmonary infection leading to respiratory failure, observed in more than half of patients. Coagulation disorders are the medical comorbidity most influencing patient outcomes, indicating that patients with coagulopathies or on anticoagulant therapy require closer monitoring. Patients with chronic alcoholism also exhibit a higher incidence of intracranial pathologies.<sup>(14)</sup>

Gilete Tejero et al.,<sup>(15)</sup> in their study on the effect of age on prognosis in TBI patients undergoing craniotomy, found that patients with GCS <8—especially geriatric patients—had significantly worse outcomes compared to younger individuals.

According to the Marshall classification, there is a direct relationship between the initial injury type and patient outcome: as lesion severity increases, so does the proportion of poor neurological outcomes, necessitating neurosurgical intervention and correlating with higher mortality.<sup>(16)</sup>

Fiallos Duque et al.,<sup>(17)</sup> in a study of moderate and severe TBI patients at Vicente Corral Moscoso Hospital, found that diffuse axonal injury type II predominated (42,5 %), followed by types IV (21,3 %) and I (16,1 %) among 174 patients—results consistent with our findings. Ricardez Cazares et al.,<sup>(18)</sup> in Mexico (2021), compared the Rotterdam and Marshall scales in TBI patients and demonstrated that scores from both scales were directly proportional to GCS.

The Glasgow Coma Scale is a universal tool that numerically quantifies TBI severity through clinical assessment. Achieving hemodynamic stability is a priority in these patients; additionally, cranial CT (CCT) is indispensable, surgical treatment must be evaluated, and close monitoring in an intensive care unit is essential. Diagnostic imaging is crucial for early detection of treatable lesions, thereby reducing sequelae. CCT is the gold standard in TBI due to its high diagnostic accuracy and precise visualization of cerebral structures.<sup>(2,6,16)</sup>

In 2024, Wei Liu et al.<sup>19</sup> conducted a meta-analysis of 33 cohort studies involving 71,718 patients with severe TBI. They found subarachnoid hemorrhage (SAH) in 87 % ( $p < 0.01$ ; OR 1,64, 95 % CI), subdural hematoma in 75 % ( $p < 0,01$ ; OR 1,99, 95 % CI), with 94 % requiring surgical intervention (craniotomy) and 83 % requiring endotracheal intubation—consistent with our study, where SAH was the most frequent primary lesion. Another study in Santiago de Cuba reported cerebral contusion as the predominant lesion (39 %), followed by subdural hematoma (11,8 %) and subarachnoid hemorrhage (9,6 %).<sup>(20)</sup>

## CONCLUSIONS

Clinical and tomographic evaluation of patients with traumatic brain injury are vital tools for timely diagnosis and treatment, enabling better characterization of injury severity and appropriate therapeutic decision-making. Integrating these methods supports the implementation of more efficient care protocols, reducing mortality, optimizing intervention timing, and improving functional recovery. Consequently, the systematic use of these strategies enhances the quality of medical care and positively impacts TBI-related health indicators.

**Conflict of interest**

The authors declare no conflict of interest.

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**Author contributions**

**LMQ:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

**YMP:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

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**DBC:** Data curation, Investigation, Software, Writing – original draft, Writing – review & editing.

**BIBLIOGRAPHIC REFERENCES**

1. Karaboue MA, Ministeri F, Sessa F, Nannola C, Chisari MG, Cocimano G, et al. Traumatic Brain Injury as a Public Health Issue: Epidemiology, Prognostic Factors and Useful Data from Forensic Practice. *Healthcare* [Internet]. 2024 [citado 15/10/2025]; 12(22):2266. Disponible en: <https://doi.org/10.3390/healthcare12222266>
2. American College of Surgeons. Best Practices Guidelines. The Management of Traumatic Brain Injury [Internet]. Copyright; 2024 [citado 15/10/2025]. Disponible en: <https://www.facs.org/media/vgfgjpfk/best-practices-guidelines-traumatic-brain-injury.pdf>
3. Maas AI, Menon DK, Manley GT, Abrams M, Akerlund C, Andelic N, et al. Traumatic Brain Injury: Progress and challenges in prevention, clinical care, and research. *Lancet Neurol* [Internet]. 2022 [citado 15/10/2025]; 21(11): 1004-1060. Disponible en: [https://doi.org/10.1016/S1474-4422\(22\)00309-X](https://doi.org/10.1016/S1474-4422(22)00309-X)
4. Ordinola LJ. Características Clínicas y epidemiológicas de pacientes con traumatismo por accidentes de tránsito en emergencia del Hospital de Apoyo II-2 Sullana. 2018-2020 [Tesis]. Piura: Universidad Nacional de Piura; 2021. [citado 15/10/2025]. Disponible en: <https://repositorio.unp.edu.pe/bitstream/handle/20.500.12676/2702/MHUM-OLA-ORD-2021.pdf>
5. Ministerio de Salud Pública. Dirección de registros médicos y estadísticas de salud. Anuario Estadístico de Salud 2024 [Internet]. La Habana; 2025 [citado 18/10/2025]. Disponible en: <https://files.sld.cu/dne/files/2025/09/AES-2024-para-sitio-3.pdf>

6. Robba C, McCredie V, Chesnut RM, Citerio G, Gauss T, Hawryluk GW, et al. Traumatic brain injury management in the intensive care unit: standard of care and knowledge gaps. *Intensive Care Med* [Internet]. 2025 [citado 18/10/2025]; 51:1112-1127. Disponible en: <https://doi.org/10.1007/s00134-025-07967-1>
7. Lell MM, Kachelrie BM. Recent and Upcoming Technological Developments in Computed Tomography High Speed, Low Dose, Deep Learning, Multienergy. *Investigative Radiology* [Internet]. 2020 [citado 18/10/2025]; 55(1): 8-19. Disponible en: <https://doi.org/10.1097/RLI.0000000000000601>
8. Iris Pantelatos R, Skandsen T, Follestad T, Sandrod O, Saeterstad C, Einarsen CE, et al. Prediction of Outcome in Moderate and Severe Traumatic Brain Injury: The Value of Pragmatic Estimation of the Duration of Posttraumatic Confusional State. *Archives of Rehabilitation Research and Clinical Translation* [Internet]. 2025 [citado 18/10/2025]; 7(3):100446. Disponible en: <https://doi.org/10.1016/j.arrct.2025.100446>
9. Riverol González Y, Rodríguez García C, González Cabrera Y, Llanes Pulido D. Mortalidad por traumatismo craneoencefálico, aspectos médico-legales. *Acta Médica del Centro* [Internet]. 2024 [citado 18/10/2025]; 18(2): e1899. Disponible en: <https://revactamedicacentro.sld.cu/index.php/amc/article/view/1899/1752>
10. Ayele A, Anteneh S, Seid Degu F, Dessie G, Lonsako AA, Anley A, et al. Time to death and its predictors among traumatic brain injury patients admitted to East Amhara comprehensive specialized hospitals, Ethiopia: retrospective cohort study. *BMC Neurology* [Internet]. 2024 [citado 26/10/2025]; 24: 370. Disponible en: <https://doi.org/10.1186/s12883-024-03886-8>
11. Newcombe V, Brennan PM, Citerio G. Whats new: the Glasgow Coma Scale at 50 – evolution and future directions. *Intensive Care Med* [Internet]. 2025 [citado 26/10/2025]; 51: 607-609. Disponible en: <https://doi.org/10.1007/s00134-024-07757-1>
12. Barea Mendoza JA, Llompert Pou JA, Pérez Bárcena J, Quintana Díaz M, Servia Goixart LL, Guerrero López F, et al. Validación externa de la Escala de Coma de Glasgow con valoración pupilar en pacientes con traumatismo craneoencefálico grave. *Emergencias* [Internet]. 2023 [citado 26/10/2025]; 35: 39-43. Disponible en: <https://doi.org/10.55633/s3me/E097.2023>
13. Iyanna N, Donohue JK, Lorence JM, Guyette FX, Gimbel E, Brown JB, et al. Early Glasgow Coma Scale Score and Prediction of Traumatic Brain Injury: A Secondary Analysis of Three Harmonized Prehospital Randomized Clinical Trials. *PREHOSPITAL EMERGENCY CARE* [Internet]. 2025 [citado 26/10/2025]; 29(5): 615-623. Disponible en: <https://doi.org/10.1080/10903127.2024.2381048>
14. Zufiría JM, Lomillos Prieto N, Choque Cuba B, Sierra Rodríguez M, Poveda Núñez P, Tamarit Degenhardt M, et al. Perfil clínico y principales factores pronósticos del traumatismo craneoencefálico. *Rev Cub de Neurol y Neurocir.* [Internet]. 2017 [citado 27/10/25]; 7(1):15-24. Disponible en: <file:///C:/Users/User/Downloads/Dialnet-ClinicalProfileAndMainPrognosticFactorsOfMildTraum-6093569-1.pdf>
15. Tejero IJ, Ippolito Bastidas HZ, Bernal García LM, Mata Gómez J, García Moreno R, Ortega Martínez M, et al. Efecto de la edad en el pronóstico de pacientes con traumatismo craneoencefálico sometidos a craneotomía: análisis de una serie quirúrgica. *Rev Neurol.* [Internet]. 2024 [citado 27/10/25]; 79(11): 113-120. Disponible en: <https://doi.org/10.33588/rn.6604.2017411>

16. Medellín MA, Fernández Mancilla RK. Evaluación por tomografía en el traumatismo craneoencefálico grave. *Med Int Méx [Internet]*. 2022 [citado 29/10/25]; 38(2): 420-424. Disponible en: <https://doi.org/10.24245/mim.v38i2.5301>
17. Fiallos Duque JA, Tapia Cárdenas JP, Ávila Narváes JE, Sandoya Masa KN, Abad Terán ME. Hallazgos tomográficos según Escala de Marshall en pacientes con traumatismos cráneo encefálicos moderados y severos atendidos en el Hospital Vicente Corral Moscoso. *Revista Estudiantil CEUS [Internet]*. 2023 [citado 29/10/25]; 5(1): 11-18. Disponible en: <https://ceus.ucacue.edu.ec/index.php/ceus/article/view/168>
18. Ricardez Cazares LG, Gonzáles Fernández MA, Dehesa López E, Peraza Garay F. Rotterdam vs. Marshall; Comparación de Predictores de Desenlace en Traumatismo Craneoencefálico Mediante Tomografía Computarizada. *Rev Med UAS [Internet]*. 2021 [citado 29/10/25]; 11(2):87-94. Disponible en: <http://dx.doi.org/10.28960/revmeduas.2007-8013.v11.n2.002>
19. Wei Liu M, Qiang Ma Z, Li Liao R, Mei Chen W, Ran Zhang B, Juan Zhang Q, et al. Incidence and mortality related risk factors in patients with severe traumatic brain injury: A meta-analysis. *EXPERIMENTAL AND THERAPEUTIC MEDICINE [Internet]*. 2025 [citado 29/10/25]; 29(4):84. Disponible en: <https://doi.org/10.3892/etm.2025.12834>
20. Ferrer Ramírez M, Rodríguez Domínguez L, Aguilar Cabrera LF, Rodríguez Cascaret A, Hernández Cortés KS. Caracterización anatómica y tomográfica relacionada con factores de riesgo clínicos en pacientes con traumatismo craneoencefálico. *MEDISAN [Internet]*. 2024 [citado 29/10/25]; 28(6): e5048. Disponible en: <https://medisan.sld.cu/index.php/san/article/download/5048/pdf/26915>