OBSERVATIONAL COMPARATIVE STUDY BETWEEN MARSHALL AND ROTTERDAM CT SCORES IN PREDICTING EARLY DEATHSIN PATIENTS WITH TRAUMATIC BRAIN INJURY (TBI)

DR. RAHUL ATUL GOSWAMI[1], *DR. M. B. BAGWAN[2], Dr. Vijay Kanase[3]

[2] *ASSOCIATE PROFESSOR (medicaldirector.kh@gmail.com)*
[3] *Professor and Head*
Department Of General Surgery, Krishna Institute Of Medical Sciences,Krishna Vishwa Vidyapeeth (Deemed To Be University), Karad – 415 539, Maharashtra, India

KEYWORDS

MARSHALL, ROTTERDAM, TRAUMATIC BRAIN INJURY

ABSTRACT

Introduction: Traumatic brain injury (TBI) is a severe condition causing impairment of physical, cognitive, and psychological functions. CT is preferred for primary investigation due to availability, affordability, and shorter scan time. MRI is superior for detecting brain fractures and hemorrhage, while computed tomography assesses post-traumatic lesions. **Aims:** The study compares Marshall and Rotterdam CT scoring systems for predicting early deaths in traumatic brain injury patients, examining their clinical profile, predictive value, and mortality rates. **Methodology**: A retrospective comparative study comparing Marshall CT scoring classification and Rotterdam CT score systems on 100 traumatic brain injury patients from May 2019 to April 2021, analyzing results and comparing them with mortality data. **Results:** A study of 100 severe head injuries revealed various pathologies, with mortality rates calculated using NCCT brain study and Marshall CT scoring classification, with an AUC of 0.67. **Discussion:** The study compared Marshall and Rotterdam CT scoring systems for predicting early mortality in traumatic brain injuries, finding the Marshall system had a higher mortality rate. **Conclusion:** NCCT brain studies aid in diagnosing traumatic brain injuries and predicting early mortality, with common pathologies being intraventricular hemorrhage and subarachnoid hemorrhage, with Rotterdam CT scoring system superior.

INTRODUCTION

Traumatic brain injury (TBI) is a severe condition resulting from external mechanical force, leading to impairment of physical, cognitive, and psychological functions. Common causes include falls, motor vehicle accidents, assaults, and sports-related injuries. The severity of TBI is classified by the Glasgow coma scale (GCS). CT is preferred over MRI for primary investigation due to availability, affordability, and shorter scan time. Computed Tomography scanning is routine in severe cases, providing information for further management. [1,2]

CT imaging plays a crucial role in diagnosing neuroparenchymal brain injury, providing prognostic information such as basal cistern effacement, trauma subarachnoid hemorrhage, midline shift, and intracranial injuries. Early diagnosis and management can prevent complications and improve patient condition.[3] CT aids in surgical planning and anatomical information for skin incisions. Despite MRI's accuracy, CT imaging is preferred due to its shorter duration, lower cost, and ease of use.[4]

CT imaging is crucial for detecting skull fractures and hemorrhage, but has limitations like beam-hardening, signal displacement, and missed blood. It may underestimate injury within three hours. MRI is superior after 48-72 hours, but detection of hematoma changes with blood composition. MRI shows no abnormality in most mild traumatic brain injury patients.[5]

MRI is better for detecting cerebral hemorrhagic contusions, altered white matter signal intensity, permanent hemosiderin deposition, petechial hemorrhage, diffuse axonal injury, small hemorrhagic contusion, and subtle neuronal damage.[6]

Computed tomography is crucial for assessing post-traumatic hemorrhagic lesions in brain injury patients, determining emergency neuropsychiatric surgery needs. Two scoring systems, the Marshall System and Rotterdam CT score of TBI, improve patient outcomes prediction. However, the Marshall classification has limitations, such as hematoma division and mass lesion volume separation.[7]

AIM & OBJECTIVES

The study aims to compare the effectiveness of Marshall and Rotterdam CT scoring systems in predicting early deaths in patients with traumatic brain injury, examining their clinical profile, predictive value, and mortality rates among patients.

MATERIALS & METHODS:

STUDY TYPE: Observational retrospective comparative study

STUDY PERIOD: May 2019 to April 2021.

STUDY POPULATION:100 traumatic brain injury patients with positive neuro parenchymal findings in CT scan.

CT SCANNER:

Siemens somatom definition edge. C2 level to vertex

Mode –spiral non contrast

Scan orientation- Caudo-cranial Scan time: 5 to 6 sec Kvp/mA- 100 to120 kvp, 300 to 320 mAs

A retrospective study of 100 traumatic brain injury cases from May 2019 to April 2021 used Marshall CT scoring classification and Rotterdam CT score systems. Results were analyzed using word and excel software, and CT scores were compared with mortality data. The study also compared the two systems in receiver operating characteristic graphs.

Inclusion criteria

Patients over 18 years old admitted with traumatic brain injury between May 2019-April 2021, with moderate to severe injury and GCS less than or equal to 12/15.

Exclusion criteria

Patients under 18, those with TBI with brain death, those with GCS over 12/15, those taking anticoagulant treatment, and pregnant females are excluded.

OBSERVATION & RESULTS

The table shows patient age distribution, with 10 cases under 20, 60 cases between 21-40, 24 between 41-60, and 6 over 60, with a mean age of 36 years.

TABLE NO 1: AGE WISE DISTRIBUTION OF CASES

Age	No of patients
Less than / equal to 20 years	10
21-40 years	60
41-60 years	24
>60 years	6
Total	100

The study involved 100 patients, with 79 males and 21 females, out of a total of 100.

TABLE NO 2: GENDER WISE DISTRIBUTION OF CASES

Male	**79**
Female	**21**
Total	**100**

The study found that 57 patients had severe head injuries, with a GCS of 8 or less, and 39 patients had moderate head injuries.

TABLE NO 3: SEVERITY OF INJURY

Moderate head injury	**43**
Severe head injury	**57**
Total Patients	**100**

The study revealed 17 patients had extradural hemorrhage, 13 had subdural hemorrhage, 18 had subarachnoid hemorrhage, 20 had intraventricular hemorrhage, 2 had intraparenchymal hemorrhage, 12 had cerebral contusions, and 18 had multiple pathologies.

TABLE NO 4: MAJOR CT FINDINGS

CT FINDINGS	NO OF PATIENTS
Extradural hemorrhage	**17**
Subdural hemorrhage	**13**
Subarachnoid hemorrhage	**18**
Intraventricular hemorrhage	**20**
Intraparenchymal hemorrhage	**2**
Contusion	**12**
Mixed pathology	**18**
Total	**100**

Out of 100 patients, 23 had extradural hemorrhage, with 17 isolated cases and 6 associated with other traumatic brain pathology. Mortality was 13.04% in EDH group compared to 16.88% in other traumatic brain pathology.

TABLE NO 5: EXTRA DURAL HEMMORRHAGE

EDH	Death	Alive	Total
Present	3 (13.04%)	20 (86.96%)	**23**
Absent	**13(16.88%)**	**64 (83.12%)**	**77**

Out of 100 patients, 20 had subdural hemorrhage, 13 isolated SDH, and 7 associated with other traumatic brain pathology. Mortality was 20% in SDH group compared to 15% other traumatic brain pathology.

TABLE NO 6: SUBDURAL HEMORRHAGE

SDH	Death	Alive	Total
Present	4 (20 %)	16 (80 %)	**20**
Absent	**12 (15 %)**	**68 (85 %)**	**80**

Out of 100 patients, 28 had subarachnoid hemorrhage, 18 isolated and 10 associated with other traumatic brain pathology. Mortality was 17.86% in SAH group compared to 15.28% in other traumatic brain pathology.

TABLE NO 7: SUBARACHNOID HEMORRHAGE

SAH	Death	Alive	Total
Present	5 (17.86 %)	23 (82.14 %)	**28**
Absent	**11 (15.28 %)**	**61 (84.72 %)**	**72**

Out of 100 patients, 20 had contusion, 12 isolated and 8 associated with other traumatic brain pathology. Mortality was lower in contusion patients (10.00%) compared to other traumatic brain pathology (17.50%).

TABLE NO 8: CONTUSION

Contusion	Death	Alive	Total
Present	2 (10 %)	18 (90 %)	**20**
Absent	**14 (17.50 %)**	**66 (82.50 %)**	**80**

Out of 100 patients, 25 experienced intraventricular hemorrhage, with 20 isolated cases and 5 associated with other traumatic brain pathology. Mortality was similar, 16% in IVH group.

TABLE NO 9: INTRAVENTRICULAR HEMORRHAGE

IVH	Death	Alive	Total
Present	4 (16 %)	21 (84 %)	**25**
Absent	**12 (16%)**	**63 (84 %)**	**75**

Out of 100 patients, 48 experienced basal cistern effacement, with mortality increasing progressively from 3.85% to 37.5% in patients with normal, compressed, or complete effacement.

TABLE NO 10: BASAL CISTERN EFFACEMENT

Basal cistern	Death	Alive	Total
Normal	2 (3.85 %)	50(96.15%)	**52**
Compressed	8 (25.00%)	24(75.00%)	**32**
Absent	**6 (37.5%)**	**10 (62.5%)**	**16**

Out of 100 patients, 86 had a midline shift, with mortality increasing progressively. Patients with absent midline shift had 7.14% mortality, while those with 1-5 mm, 6-10 mm, and >10 mm midline shifts had 33.33%.

Table NO 11: MIDLINE SHIFT

Midline shift	Death	Alive	Total
Absent	1(7.14%)	13(92.86%)	**14**
1-5mm	4(8%)	46(92%)	**50**
6-10mm	10(30.30%)	23(69.70%)	**33**
>10mm	**1(33.33%)**	**2(66.67%)**	**3**

The study classified 100 patients using NCCT brain study and Marshall CT scoring classification, calculating their mortality rates according to their respective NCCT brain study results.

Table NO 12: MARSHALL CT SCORING CLASSIFICATION

Marshall CT score Classification	Death	Alive	Total
Diffuse injury II	1(1.92%)	51(98.08%)	**52**
Diffuse injury III (swelling)	2(22.22%)	7(77.78%)	**9**
Diffuse injury IV (shift)	5(27.78%)	13(72.22%)	**18**
Evacuated lesion V	4(25.00%)	12(75.00%)	**16**
Non-evacuated lesion VI	**4(80.00%)**	**1(20.00%)**	**5**

The study classified 100 patients using the Rotterdam CT score system based on their NCCT brain study, calculating their mortality rates.

Table NO 13: ROTTERDAM CT SCORE SYSTEM

Rotterdam CT score	Death	Alive	Total
(1/6)	0(0%)	13(100%)	**13**

(2/6)	3(6.67%)	42(93.33%)	**45**
(3/6)	1(9.09%)	10(90.91%)	**11**
(4/6)	6(27.27%)	16(72.73%)	**22**
(5/6)	4(57.14%)	3(42.86%)	**7**
(6/6)	**2(100%)**	**0(0%)**	**2**

The AUC calculation from the graph indicates that the Marshall CT score classification has an AUC of 0.67, while the Rotterdam CT score system has an AUC of 0.71.

DISCUSSION

India has 1% of the world's vehicles, but 6% of total global RTA death results in greater economic loss. Assessment of prognosis of traumatic brain injuries is a neglected area in research, with few attempts to create scoring systems. A study involving 60 patients aged 21-40 and 41-60 found that 57 patients experienced severe traumatic brain injuries and 43 experienced moderate injuries. Extradural hemorrhage was present in 17 patients with 13.04% mortality, while subdural hemorrhage was present in 13 patients with 20% mortality. The study also found a good correlation between individual CT characteristics like midline shift and basal cistern effacement with mortality. Various classification systems have been applied to assess prognosis, but this study compared Marshall and Rotterdam CT scoring systems to predict early mortality in patients with traumatic brain injuries.

The study found that outcomes with patterns 1, 3, 6, and 8 were significantly better than those with patterns 2, 4, and 7, when assessed using Jennett B and Bond M. categories.[9]

The study found that the Marshall CT score system had a higher mortality rate than the Rotterdam CT score system, with an AUC of 0.67 for the Marshall system and 0.71 for the Rotterdam system, suggesting superiority in predicting early death. This finding was consistent with previous studies. [8]

Mata-Mbemba et al's study found that patients with higher Marshall and Rotterdam scores experienced more deaths, with both scoring systems having similar discriminative power in predicting early death in patients with TBI, with the Marshall score remaining useful in predicting prognosis.[10]

The study by Lukas B et al found that the Rotterdam classification system is more effective in describing intracranial changes than the Marshall classification. The Rotterdam system is practical for clinical use and has good prognostic capability. The Marshall classification does not recognize different types of traumatic intracranial mass lesions and often focuses on the initial CT scan, which can be dangerous. The Rotterdam classification uses a scoring chart with CT characteristics to estimate outcome, making it more sensitive and better for prognostication.[11]

CONCLUSIONS:

The study reveals that NCCT brain studies are useful for diagnosing traumatic brain injuries and predicting early mortality. The most common age group and gender affected were 21-40 years old, with common pathology being intraventricular hemorrhage and subarachnoid hemorrhage. The Rotterdam CT score system was found to be superior to the Marshall system, as it better illustrates changes over time.

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