



## COMPARATIVE STUDY OF VARIOUS HEAD INJURY PROGNOSTIC SCALES

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**ABSTRACT** **BACKGROUND** Traumatic Brain injury (TBI) is an important public health care problem<sup>1-3</sup> and is one of the most common causes of death. The symptoms of TBI can be various depending on the extent of damage to the brain. Any ideal prediction score or model should be easy to apply, with high sensitivity and specificity rates irrespective of the management protocol, its time and place of application.

**Aim of the study** Comparing the various head injury prognostic scales.

**MATERIALS AND METHODS** It is a prospective analytical study; study period was from september 2014 to February 2015 in the department of neurosurgery, Thanjavur medical college. 300 consecutive patients admitted in our hospital trauma ward with moderate to severe head injury. All Patients presenting to the trauma ward of our hospital with moderate to severe head injury are included .patients with mild head injury were excluded.Comparison of MHIPS, NIMHANS, EDINBURGH Scores as a better prognostic score for outcome .

**RESULTS**

**MHIPS;** This scoring method has a good sensitivity of 87% and specificity of 79% for predicting the outcome in moderate and severe TBI.

**NIMHANS;** The sensitivity of the scoring system was only 20% while specificity was 81%; **EDINBURGH;** This scoring method has high sensitivity 97%, And low specificity was only 13%.

**Conclusion**

In our study MHIPS scoring method has good sensitivity of 87% and specificity of 79% for predicting the outcome in moderate and severe TBI.

**KEYWORDS :** Traumatic brain injury(TBI), MHIPS, NIMHANS, EDINBURGH scoring system.

**Introduction**

Traumatic Brain injury (TBI) is an important public health care problem<sup>1-3</sup> and is one of the most common causes of death. Its incidence is rising at large proportions in regions with rapidly increasing motorization and industrialization. The incidence varies from 67 to 317 per 100000 individuals and mortality rates range from around 4-8% for moderate injury to approximately 50% with severe head injury.<sup>4</sup>

The symptoms of TBI can be various depending on the extent of damage to the brain. Many patients with TBI have milder injuries, but residual deficits are common.<sup>5</sup>

The outlook for patients with mild TBI is generally a good recovery, while patients with a severe TBI have a substantial risk to die. Predicting outcome for very good or very severe patients is therefore rather easy. Any ideal prediction score or model should be easy to apply, with high sensitivity and specificity rates irrespective of the management protocol, its time and place of application This study is aimed at comparing the various head injury prognostic scales.

**AIM OF THE STUDY**

- The application of various prognostic scales on the outcome of moderate to severe head injury patients in our hospital setup.
- Assessment of the efficacy of the scores.
- To recognize the sensitivity and specificity of the various prognostic scales

**MATERIALS AND METHODS**

- Place of study : Department of neurosurgery, Thanjavur Medical College
- Period Of study : september 2014– February 2015
- Type of Study :Prospective study
- Total no. of patients : 300

**Methodology**

1. This Study was conducted on 300 moderate to severe head injury patients who came to department of neurosurgery, Thanjavur Medical College
2. A thorough Clinical and detailed neurological examination will be

done and the patient details will be recorded in a proforma.

3. The following Prognostic Scores will be plotted for every patient :

- Madras Head Injury Prognostic Scale (MHIPS).
- NIMHANS Model (NM).
- Edinburgh Prognostic Scale

4. The efficacy, sensitivity and specificity will be noted for every score and compared for the outcome of these patients.

**Inclusion Criteria**

- All Patients presenting to the trauma ward of our hospital with moderate to severe head injury.
- All Patients presenting to the trauma ward of our hospital with head injury and other systemic injuries.

**Exclusion Criteria**

- All patients presenting with mild head injury

The primary reason for choosing to compare these three scores in our study is:

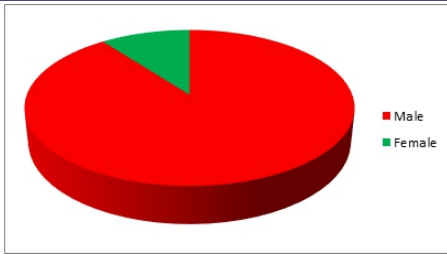
1. All the three scores have taken into account almost similar variables.
2. All these scores are objective and measurable on a numerical scale.
3. All the three scores are simple enough to be used during a routine bedside clinical assessment.
4. Also these scores are easy to apply even for a junior member of the team.

**RESULTS**

**Table 1: Gender Distribution**

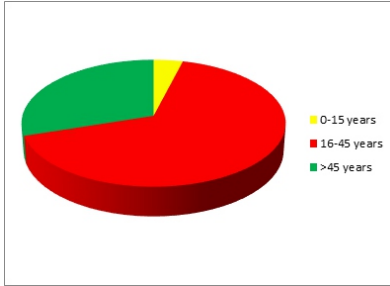
Out of 300 patients studied, 269(89.7%) patients were male while 31(10.3%) patients were female.

Total number of patients	300	100%
Male	269	89.7%
Female	31	10.3%



**Table 2: Age Distribution**

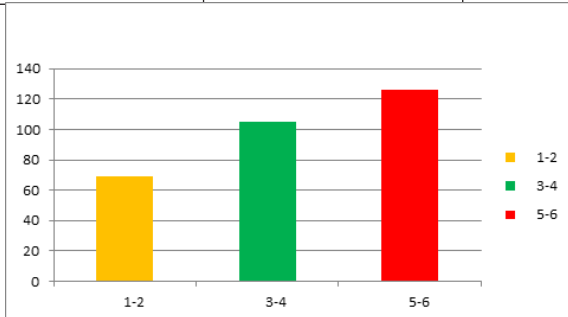
Age Group	No. Of Patients	Percentage
0-15 years	12	4%
16-45 years	198	66%
>45 years	90	30%



Out of the 300 patients studied, the maximum numbers of patients were in the age group of 16-45 years i.e. 198(66%) patients.

**Table 3: Best Motor Response**

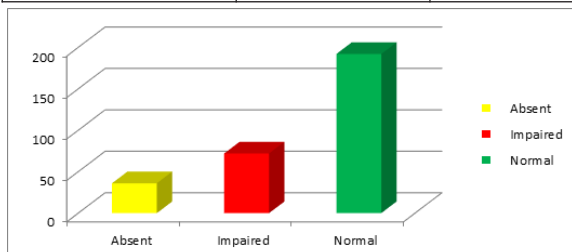
Best motor response	Number of patients	Percentage
1-2	69	23%
3-4	105	35%
5-6	126	42%



Out of the 300 patients studied, the maximum numbers of patients had best motor response of 5-6 i.e. 127(42.3%) patients, followed by 104(34.7%) with best response between 3-4 and 69 (23%) patients with best motor response between 1-2.

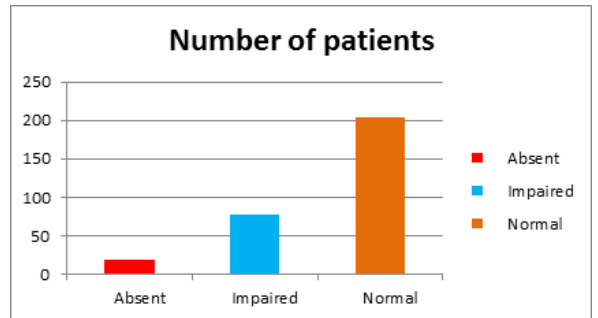
**Table 4: Pupillary Light Reflex:**

Pupillary Light Reflex	Number of patients	Percentage
Absent	36	12%
Impaired	72	24%
Normal	192	64%



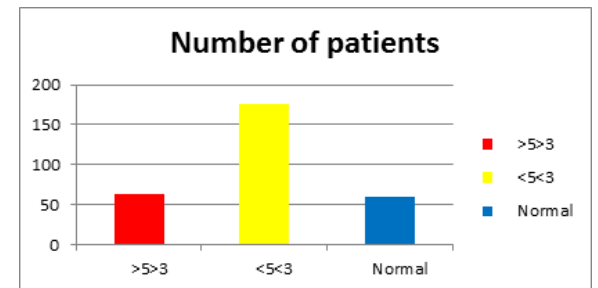
**Table 5: Oculocephalic Reflex**

Oculocephalic Reflex	Number of patients	Percentage
Absent	18	6%
Impaired	79	26.3%
Normal	203	67.6%



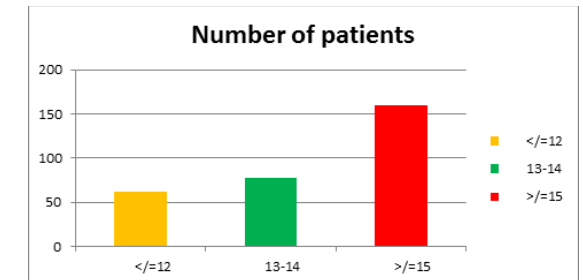
**Table 6: CT Findings**

CT Findings	Number of patients	Percentage
>5>3	65	21.7%
<5<3	182	60.7%
Normal	53	17.6%



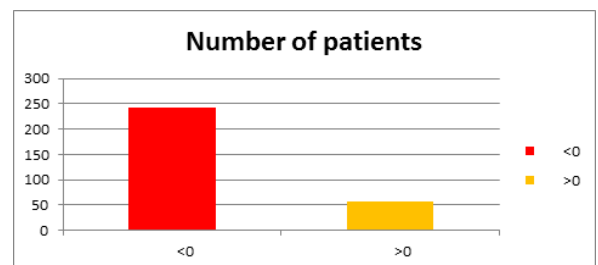
**Table 7: MHIPS SCORE**

Score	Number of patients	Percentage
<=12	62	20.7 %
13-14	78	26%
>=15	160	53.3%



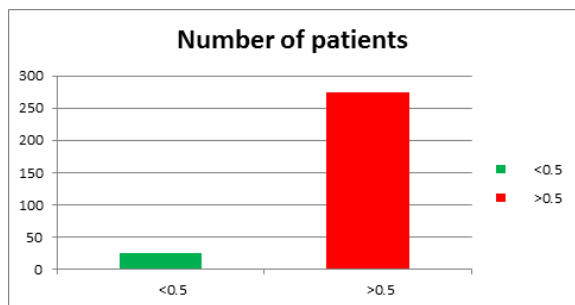
**Table 8: NIMHANS Score:**

Score	Number of patients	Percentage
<0	242	81.4%
>0	58	18.6 %



**Table 9: Edinburgh Model:**

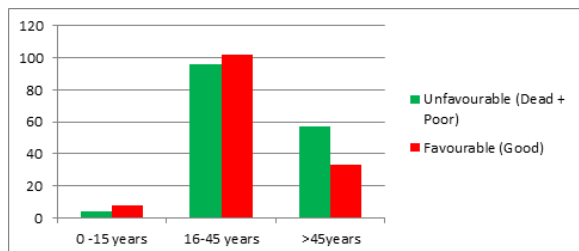
Score	Number of patients	Percentage
<0.5	25	8.3%
>0.5	275	91.7%



**Table 10: Age versus Outcome**

Age	Unfavourable (Dead + Poor)	Favourable (Good)	Total
0 -15 years	4 (33.3%)	8 (66.7%)	12
16-45 years	96 (48.5%)	102 (51.5%)	198
>45years	57 (63.3%)	33 (36.7%)	90

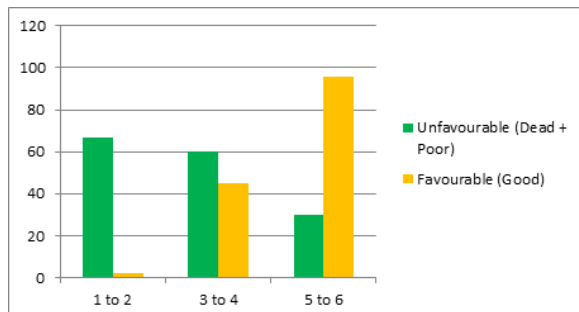
P value =.031



**Table 11: Best Motor Response versus Outcome**

Best Motor Response	Unfavourable (Dead + Poor)	Favourable (Good)	Total
1-2	67 (97.1%)	2 (2.9%)	69
3-4	60 (57.1%)	45 (42.9%)	105
5-6	30 (23.8%)	96 (76.2%)	126
Total	157	143	300

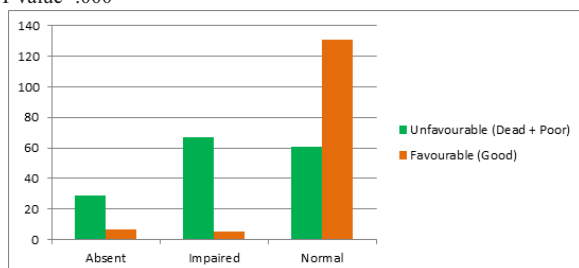
P value =.000



**Table 12: Pupillary Light Reflex versus Outcome**

Pupillary Light Reflex	Unfavourable (Dead + Poor)	Favourable (Good)	Total
Absent	29 (80.6%)	7 (19.4%)	36
Impaired	67 (93.1%)	5 (6.9%)	72
Normal	61 (31.8%)	131 (68.2%)	192
Total	157	143	300

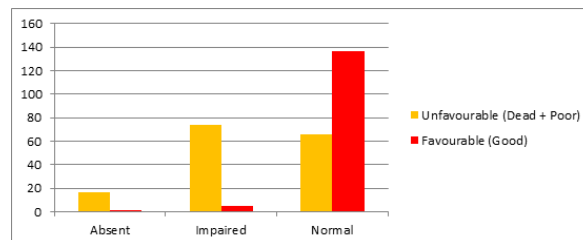
P value =.000



**Table 13: Oculocephalic reflex versus outcome:**

Oculocephalic Reflex	Unfavourable (Dead + Poor)	Favourable (Good)	Total
Absent	17 (94.4%)	1 (5.6%)	18
Impaired	74 (93.7%)	5 (6.3%)	79
Normal	66 (32.5%)	137(67.5%)	203
Total	157	143	300

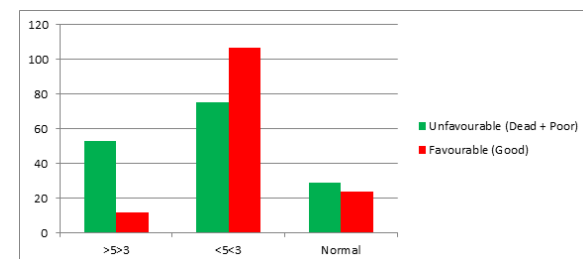
P value =.000



**Table 14: CT findings versus Outcome**

CT findings	Unfavourable (Dead + Poor)	Favourable (Good)	Total
>5>3	53 (81.5%)	12 (18.5%)	65
<5<3	75 (41.2%)	107 (58.8%)	182
Normal	29 (54.7%)	24 (45.3%)	53
Total	157	143	300

P value =.000



**Table 15: MHIPS Score versus Outcome**

Outcome	MHIPS Score			Total
	<=12	13-14	>=15	
Dead	57 (92%)	33 (41.3%)	25 (15.8%)	115
Poor	3 (4.8%)	31 (38.7%)	08 (5.1%)	42
Good	2 (3.2%)	16 (20%)	125 (79.1%)	143
Total	62	80	158	300

Sensitivity=0.87 95% confidence Interval: 0.81 to 0.92  
 Specificity=0.79 95% confidence Interval: 0.72 to 0.85  
 Positive Predictive value=0.79 95% confidence Interval: 0.72 to 0.85  
 Negative Predictive Value=0.87 95% confidence Interval: 0.81 to 0.92  
 P value=.000

**Table 16: NIMHANS Score versus Outcome**

Outcome	NIMHANS Score		Total
	<0	>0	
Unfavourable (Poor+ Dead)	127 (52.5%)	30(51.7%)	157
Favourable (Good)	115(47.5%)	28(48.3%)	143
Total	242	58	300

Sensitivity = 0.20 95% confidence Interval: 0.14 to 0.27  
 Specificity = 0.81 95% confidence Interval: 0.74 to 0.86  
 Positive Predictive value=0.48 95% confidence Interval: 0.36 to 0.61  
 Negative predictive value=0.52 95% confidence Interval: 0.46 to 0.59  
 pValue=0.517

**Table 17: Edinburgh Model versus Outcome:**

Outcome	Edinburgh Model	Total
	<0.5	>0.5

Unfavourable (Poor+ Dead)	20(80%)	137(49.8%)	157
Favourable (Good)	5(20%)	138(50.2%)	143
Total	25	275	300

Sensitivity=0.97 95% confidence Interval:0.92 to 0.98  
 Specificity=0.13 95% confidence Interval:0.08 to 0.19  
 Positive Predictive Value=0.50 95% confidence Interval:0.44 to 0.56  
 Negative predictive Value=0.80 95% confidence Interval:0.61 to 0.91  
 P value =.003

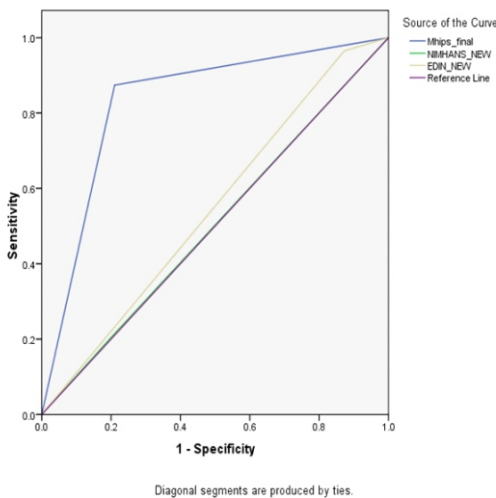
**Area Under the Curve**

Area	Std. Errora	Asymptotic Sig.b	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound
.832	.025	.000	.783	.881
.502	.033	.944	.437	.568
.546	.033	.167	.481	.611

**Area Under the Curve**

Test Result Variable(s)	Area	Asymptotic 95% Confidence Interval			
		Std. Errora	Asymptotic Sig.b	Lower Bound	Upper Bound
Mhips_final	.832	.025	.000	.783	.881
NIMHANS_NEW	.502	.033	.944	.437	.568
EDIN_NEW	.546	.033	.167	.481	.611

ROC Curve



**DISCUSSION**

The results from our study show that the variables taken into account for prognosticating the outcome of moderate and severe traumatic brain injury in various scoring models have significant correlation with the outcome of patients admitted in our institution.

**Gender:**

In our study, out of the total number of patients studied i.e. 300, there was a predominance of the male population i.e. 269 (89.7%) with traumatic brain injury than female population (10.3%) in our institution.

A much larger sample size is essential to assess the interaction between gender and prognosis of TBI thoroughly.

**Age:**

The patients admitted with TBI were mainly in the age group between 16 -45 years i.e.198 patients constituting 66% of the study population. The main cause of TBI was road traffic injury.

The outcome of TBI was seen to be worse with advancing age. Out of the 12 patients admitted in the age group of 0-15years, majority i.e.8 (66.7%) patients were seen to have good a good outcome at discharge.

While patients aged >45years were 90, out of which majority i.e. 57(66.3%) had an unfavourable outcome i.e. were either dead or had a poor outcome which included severe disability and persistent vegetative state based on Glasgow Outcome Scale.

Chantal W.P.M Hukkelhoven et al on a prospective study on 5600 patients did an analysis about patient age and outcome following severe traumatic brain injury. The analysis revealed a mortality of 21% and unfavourable outcome of 39% in patients less than 35years of age. The mortality was 52% and unfavourable outcome was 74% in patients older than 55 years. The study concluded that older age is constantly associated with a worsening outcome after TBI.

S.V Pillai et al in their retrospective study on 289 patients with severe traumatic brain injury found that 91% of patients with age >45years had unfavourable outcome while 71% of patients with age <45years had unfavourable outcome.

**Best Motor response:**

Our study included 126 patients with best motor response between 5-6. 96 (76.2%) patients had a favourable outcome at discharge (p value=.000). The number of patients with best motor response between 3-4 were 105 out of which 57.1% patients had unfavourable outcome and score between 1-2 were 69 with 97.1% patients showed unfavourable outcome This showed that motor component of GCS is a reliable factor in predicting the prognostic outcome in patients with moderate and severe TBI.

The better the motor component of GCS on admission, the better the outcome.

(p value =.000)

Raj K Narayan et al conducted a prospective study on 133 patients on improved confidence of outcome prediction in severe head injury and found that patients with best motor response 1-2, 68% had unfavourable outcome and 32% had favourable outcome. Best motor response 3-4 59% patients had unfavourable outcome. Patients with best motor response 5-6,96% of them had favourable outcome.

S.V.Pillai et al on their retrospective analysis of 289 patients on outcome model for severe traumatic brain injury had found that patients with best motor response on 1-2 had 96% unfavourable outcome and patients with best motor response 2-4 had 73% unfavourable outcome. Patients with best motor response 5-6 had 47% unfavourable outcome.

**Pupillary Light Reflex:**

The reflex was categorized as normal, impaired and absent. The majority of the patients with absent pupillary reflex i.e. 36 had an unfavourable outcome at discharge 29 ( 80.6%).The patients with normal pupillary reflex on admission in our study fared to have a good prognosis on discharge. 131 (68.2%) out of 192 patients with normal pupillary reflex had favourable outcome.

If one excludes direct injury to the eye, then pupillary signs provide prognostic information in moderate to severe TBI patients.

S.V.Pillai et al on their retrospective analysis of 289 patients found that among patients with absent pupillary light reflex, 96% had unfavourable outcome whereas patients in whom pupillary light reflex was present had only 60% unfavourable outcome.

Raj K Narayan et al on his prospective study on 133 patients showed that in patients with normal pupillary light reflex had 76% favourable outcome and 24% unfavorable outcome. In patients whom pupillary light reflex was absent 70% had unfavourable outcome.

**Oculocephalic Reflex:**

Out of the 203 patients admitted with normal pupillary response 137

patients i.e. 67.5% patients had favourable outcome on discharge. While out of the 18 patients admitted with absent pupillary response on admission 17 (94.4%) patients had unfavourable outcome on discharge.

This showed a significant correlation between Occulocephalic reflex and outcome at discharge. (p value=.000)

S.V Pillai et al on their retrospective analysis of 289 patients found that in patients with absent Occulocephalic reflex had 98.4% unfavourable outcome while patients with normal occucephalic reflexes had 55% unfavourable outcome.

#### CT Scan :

The CT findings noted were

Group 1: Absent basal cisterns/midline shift >5mm/lesion density >3cm.

Group 2: Partly effaced basal cisterns/midline shift <5mm/lesion density <3cm.

Group 3: Normal basal cisterns/no midline shift/no lesions.

The number of patients admitted in group 1 on admission were 65. Out of them 53 (81.5%) patients were either dead or were having a poor outcome on discharge or at the end of 1 month.

The number of patients admitted in group 2 on admission were 182. Out of them 107 (58.8%) patients had a good outcome on discharge or at the end of 1 month.

The study showed that effacement of the basal cisterns and the presence of SAH on CT are good predictors of outcome in TBI patients.

Steven M. Toutant et al on a prospective study about absent or compressed basal cisterns on first CT scan: ominous predictors of outcome in severe head injury. The mortality rates were 77% in patients with absent basal cistern, 39% with compressed basal cistern, and 22% among normal basal cisterns.

Comparison of MHIPS, NIMHANS, EDINBURGH Scores as a better prognostic score for outcome prediction in TBI

#### MHIPS SCORE:

Our study of this model revealed the following results:

Out of the 62 patients with MHIPS score  $\leq 12$ , 57 patients i.e. 92% patients were dead and 3 patients i.e. 4.8% patients had poor outcome on discharge or at 1 month after TBI.

Out of 80 patients with score of 13-14, 64 patients i.e. 80% of the patients had unfavourable outcome and only 20% patients had favourable outcome.

Out of the 158 patients admitted with MHIPS score of  $\geq 15$ , 125 patients i.e. 79.1% had good outcome and 11.9% had unfavourable outcome.

Therefore, a low MHIPS score was associated with unfavourable outcome and high MHIPS score was associated with favourable outcome in our study. This was consistent with the study conducted by V.G.Ramesh et al in 2007.

This scoring method has a good sensitivity of 87% and specificity of 79% for predicting the outcome in moderate and severe TBI.

The p value is .000 which makes this scoring system statistically significant.

#### Edinburgh Prognostic Model:

In our study, the number of patients admitted with a score of < 0.5 (probability of survival) were 25. Out of them 80% had unfavourable outcome and 20% had favourable outcome.

Out of the 275 patients admitted with score of >0.5, 137 (49.8%)

patients had unfavourable outcome and 138 (50.2%) patients had favourable outcome.

This scoring method was able to predict the poor outcome in patients with low scores; hence the sensitivity was high i.e. 97%.

But in patients with score >0.5, the prediction was not as accurate hence the specificity was only 13%.

Our study was conducted to see the outcome on discharge or at a period of 1 month. In the original study the outcome was seen at the end of 1 year. Hence we need to evaluate this scoring method for a longer period of time and on a larger population study.

The p value is .003 which makes this scoring system statistically significant.

#### NIMHANS Score:

Out of the 242 patients with score <0, 127 i.e. 52.5% patients had unfavourable outcome while 115 patients i.e. 47.5% patients had favourable outcome.

Out of 58 patients admitted with score >0, 30 patients i.e. 51.7% had unfavourable outcome while 28 patients i.e. 48.3% had poor outcome.

This scoring system in our study did not predict satisfactorily the prognostic outcome in comparison to the actual outcome. The sensitivity of the scoring system was only 20% while specificity was 81%. The p value is 0.517 which was not statistically significant.

#### CONCLUSION

In our study MHIPS scoring method has good sensitivity of 87% and specificity of 79% for predicting the outcome in moderate and severe TBI. Pupillary light reflex, oculo cephalic reflex and motor response of the GCS scoring system has better prognostic value in severe head injury.

#### ACKNOWLEDGEMENT

I thank the Dean of Thanjavur Medical College, thanjavur for permitting me to conduct this study in the Department of neurosurgery. I thank Prof. Dr. Ramasamy, MS, MCh, Head of Department of neurosurgery and my Associate Prof. Dr. Mathiyasarthar MCh for helping and guiding me during this study. I am greatly thankful to my Assistant Professors, Dr. Muthuraman, who have given their valuable time in guiding me in many aspects of this study and in honing my surgical skills. My gratitude to the Professor and Assistant Professors of all other Units. I thank my fellow postgraduates who helped me in conducting this study. I am thankful to all my patients for successful completion of this study.

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