Clinical Study

A new scale for prognostication in head injury

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Abstract

The ability to predict the outcome of head injury helps in the efficient use of resources and communicating with the families of the victims. There is need for a simple, easily applicable, objective scale for accurately predicting outcome after severe head injury. A simple, objective bedside scoring system, known as the Madras Head Injury Prognostic Scale (MHIPS), has been devised. It is based upon six well-established prognostic factors: age, best motor response, pupillary light reaction, oculocephalic response, CT scan findings and other systemic injuries. Each factor has been divided into three subgroups and a score assigned based on prognosis. The maximum total score is 18 and the minimum total score is 6. The validity of this scale has been assessed both retrospectively and prospectively. The initial retrospective study involved 355 patients with severe head injury. After correlating the initial MHIPS score with outcome on discharge from the hospital, it was found that most patients with a score of 12 or under died; most patients with a score of 15 and above had a good outcome; and patients with a score of 13 and 14 were either severely disabled or vegetative. The results of the prospective study, which involved 104 patients with severe head injury, showed that the outcome of 87.5% of the patients could be predicted accurately. The MHIPS is a simple, objective, easily applicable, bedside scoring system that can be used without complex mathematical calculations and investigations.

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Keywords: Head injury prognostic scales; Prognostication in head injury

1. Introduction

Outcome prediction after head injury helps in communicating with the families of patients with poor prognoses, and with triaging in cases of mass casualty. It also assists medical staff in targeting patients with a borderline prognosis for more intensive care and management. Many studies have identified various prognostic factors that affect outcome after head injury with varying degrees of correlation.[1–10] A few prognostic models and scales have been devised, which vary in complexity and accuracy of prediction.[11–16] The authors have devised a new prognostic scale, the Madras Head Injury Prognostic Scale (MHIPS), for prediction of outcome after head injury.

2. Materials and methods

2.1. The Madras Head Injury Prognostic Scale

There are six major prognostic factors incorporated in the MHIPS: age, best motor response (as measured using the Glasgow Coma Scale, GCS[17]), pupillary response to light, oculocephalic response, CT scan findings and other associated systemic injuries. Each prognostic factor has been divided into three subgroups, according to prognosis. The subgroup factor with the best prognosis has been assigned a score of 3, the subgroup with the worst prognosis, 1, and the intermediate subgroup, 2. The maximum total score is 18 and the minimum total score is 6 (Table 1).

2.2. Evaluation of the Madras Head Injury Prognostic Scale

Two studies were undertaken to test the validity of the MHIPS, a retrospective and a prospective study. The retrospective study involved 355 patients admitted to the Head Injury ward of our hospital. The patients were exam-

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Table 1
The Madras Head Injury Prognostic Scale

Prognostic factor	Subgroup	Score
Age	>45 years	1
	15–45 years	2
	<15 years	3
Best motor response (Glasgow Coma Scale)	1–2	1
	3–4	2
	5–6	3
Pupillary light response	Absent	1
	Impaired	2
	Normal	3
Oculocephalic response	Absent	1
	Impaired	2
	Normal	3
CT scan findings	Absent basal cisterns/ Midline shift >5 mm/ Lesion density >3 cm diameter	1
	Partly effaced basal cisterns/ Midline shift <5 mm/ Lesion density <3 cm diameter	2
	Normal basal cisterns/ No midline shift/ No lesions	3
Systemic injuries	Thoracic/Abdominal visceral injuries/ >2 long bone fractures	1
	One or two long bone fractures	2
	No other systemic or long bone injuries	3

Maximum total score = 18; minimum total score = 6.

ined in the emergency room by one of the authors before any sedatives or muscle relaxant drugs were given. The MHIPS score was noted at the time of admission, after the initial resuscitation. The CT scans were read by a qualified radiologist. The midline shift was measured at the level of the foramen of Monro by measuring the distance between the inner table of the skull at that level and the distance of the septum pellucidum from the midpoint. The outcome in each of the patients at the time of discharge was noted as per the Glasgow Outcome Scale (GOS). The final outcome was classified into one of three groups as follows: Good Outcome, which included good recovery and moderate disability according to the GOS; Poor Out-

come, which included severe disability and persistent vegetative state; and Death (Table 2). After conducting a Kruskal–Wallis one-way ANOVA using the Statistical Package for the Social Sciences (SPSS PC+, V. 4.0.1, SPSS Inc., Chicago, IL, USA), we found that the mean total MHIPS score in the Good Outcome group was 15.74 (SD = 1.0), the mean total MHIPS score in the Poor Outcome group was 12.76 (SD = 0.92) and the mean total MHIPS score in the Death group was 10.63 (SD = 1.68). The mean total score in the Good Outcome group was significantly higher than the mean total score in the Poor Outcome group, 12.76 (SD = 0.92; $p < 0.0001$). The result for the Good Outcome group was also significantly higher than the mean total score in the Death group, 10.63 (SD = 1.68; $p < 0.0001$) (Table 3). The receiver–operator characteristic curve showed that the optimal cut-off point for the total score is 12, at which point the true positive rate was high, coupled with a low false positive rate. The sensitivity (the true positive rate) was 98.9% and the specificity was 97.4%. Also, the false positive rate (100-specificity) was 2.6% and the false negative rate was 1.1%. After the retrospective study, based on the statistical analysis, we concluded that a MHIPS score of 12 or less signified death as the outcome; scores of 13 and 14 correlated with Poor Outcome and a MHIPS score of 15 or more correlated with Good Outcome.

A prospective study was undertaken to further test the validity of the MHIPS. Patients ($n = 104$) admitted with moderate and severe head injury were studied prospectively. The MHIPS score of each patient was assessed at admission, soon after the initial resuscitation. Each patient was assigned a predicted prognosis on the basis of the above retrospective study (MHIPS score $\leqslant 12$, Death; 13–14, Poor Outcome; $\geqslant 15$, Good Outcome). This was correlated with the actual outcome at the time of discharge. We found that 91 patients (87.5%) had the expected outcome. Of the 13 patients who did not have the expected outcome, we found that factors such as post-surgical complications, status epilepticus and infection affected the predicted outcome.

Table 2
Distribution of patients in various outcome groups in a retrospective study ($n = 355$)

Total MHIPS Score	Good Outcome		Poor Outcome		Death	
	No.	Cumulative %	No.	Cumulative %	No.	Cumulative %
7	–	–	–	–	4 (4.4%)	4.4
8	–	–	–	–	0	4.4
9	–	–	–	–	26 (28.6%)	33.0
10	–	–	–	–	15 (16.5%)	49.5
11	–	–	4 (11.8%)	11.8	12 (13.2%)	62.6
12	–	–	6 (17.6%)	29.4	21 (23.1%)	85.7
13	6 (2.6%)	2.6	19 (55.9%)	85.3	12 (13.2%)	98.9
14	16 (7%)	9.6	4 (11.8%)	97.1	0	98.9
15	62 (27%)	36.5	1 (2.9%)	100	1 (1.1%)	100
16	98 (42.6%)	79.1	–	–	–	–
17	43 (18.7%)	97.8	–	–	–	–
18	5 (2.2%)	100	–	–	–	–