# GALVESTON ORIENTATION AND AMNESIA TEST: APPLICABILITY AND RELATION WITH THE GLASGOW COMA SCALE

*Silvia Cristina Fürbringer e Silva*[1]
*Regina Marcia Cardoso de Sousa*[2]

Silva SCF, Sousa RMC. Galveston orientation and amnesia test: applicability and relation with the Glasgow Coma Scale. Rev Latino-am Enfermagem 2007 julho-agosto; 15(4):651-7.

*Restrictions in the application of the Galveston Orientation and Amnesia Test and questionings about the relationship between conscience and post-traumatic amnesia motivated this study, which aims to identify, through the Glasgow Coma Scale scores, when to initiate the application of this amnesia test, as well to verify the relationship between the results of these two indicators. The longitudinal prospective study was carried at a referral center for trauma care in São Paulo - Brazil. The sample consisted of 73 victims of blunt traumatic brain injury, admitted at this institution between January 03rd and May 03rd 2001. Regarding the applicability, the test could be applied in patients with a Glasgow Coma Scale score > 12; however, the end of post traumatic amnesia was verified in patients who scored > 14 on the scale. A significant relationship ($r_s$ = 0.65) was verified between these measures, although different kinds of relationship between the end of the amnesia and changes in consciousness were observed.*

*DESCRIPTORS: amnesia; craniocerebral trauma; Glasgow coma scale*

# GALVESTON ORIENTATION AND AMNESIA TEST: APLICABILIDAD Y RELACIÓN CON LA ESCALA DE COMA DE GLASGOW

*Restricciones en la aplicación del Galveston Orientation and Amnesia Test y los cuestionamientos sobre la relación entre conciencia y amnesia post-traumática motivaron este estudio que visa identificar, a través de la puntuación de la Escala de Coma de Glasgow, el periodo más adecuado para la aplicación de la prueba de amnesia, y observar la relación entre los resultados de esos dos indicadores. El estudio prospectivo y longitudinal fue realizado en un centro de referencia para traumas en São Paulo - Brasil. El número fue de 73 victimas de trauma craneoencefálico contuso, internadas en esta institución en el periodo de 03/01 a 03/05/ 2001. Con relación a la aplicabilidad, la prueba puede ser aplicada en los pacientes con la Escala de Coma de Glasgow > 12, pero el término de la amnesia post-traumática fue observado en los pacientes con puntuación > 14 en la escala. Correlación significativa (rs = 0,65) fue observada entre esas medidas, aunque diferentes formas de relación entre el término de la amnesia y alteración de conciencia fueron observadas.*

*DESCRIPTORES: amnesia; trauma craniocerebral; Escala de Coma de Glasgow*

# GALVESTON ORIENTATION AND AMNESIA TEST: APLICABILIDADE E RELAÇÃO COM A ESCALA DE COMA DE GLASGOW

*Restrições na aplicação do Galveston Orientation and Amnesia Test e questionamentos sobre a relação entre consciência e amnésia pós-traumática motivaram este estudo que visa identificar, pelos escores da Escala de Coma de Glasgow, quando iniciar a aplicação desse teste de amnésia, bem como verificar a relação entre os resultados desses dois indicadores. O estudo prospectivo longitudinal foi realizado em centro de referência para atendimento de trauma em São Paulo - Brasil. A amostra foi de 73 vítimas de trauma craniencefálico contuso, internadas nessa instituição, no período de 3/1 a 3/5/2001. Com relação à aplicabilidade, o teste pôde ser aplicado nas vítimas com Escala de Coma de Glasgow ³ 12, porém, o término da amnésia pós-traumática foi verificado nos pacientes com pontuação ³ 14 nessa escala. Correlação significativa ($r_s$= 0,65) foi verificada entre os indicadores, no entanto, diferentes formas de relação entre término de amnésia e alteração da consciência foram observadas.*

*DESCRITORES: amnésia; trauma craniocerebral; escala de coma de glasgow*

[1] Faculty, São Camilo University Center, Doctoral Student; [2] Associate Professor, e-mail: vian@usp.br. University of São Paulo School of Nursing, Brazil

## INTRODUCTION

In recent years, consciousness changes and post-traumatic amnesia have been important indicators of the gravity of blunt traumatic brain injury (TBI)[1], and also the safest parameters to forecast functional capacity after this kind of trauma, in the medium and long terms[2-9].

Post-traumatic amnesia is a very frequent disorder in patients with TBI and has been studied for more than 50 years. In 1932, for the first time, Ritchie Russel presented the duration of post-traumatic amnesia as a severity indicator of the cranial injury and of the duration of the subsequent disability[10].

Until the 1980's, the duration and end of post-traumatic amnesia were established retrospectively, questioning the patient after his/her continuous memory had been restored[11]. Criticism related to the accuracy of the retrospective measure appointed the subjectivity of the method and considered that the duration and end of post-traumatic amnesia could thus only be estimated after the patient's recovery from the mental confusion[5,11-12].

In 1979, the Galveston Orientation and Amnesia Test (GOAT)[12] was published. This was one of the first in a series of instruments aimed at prospectively establishing the duration of amnesia after TBI.

Since its publication, the GOAT has been widely used. Studies applying the test demonstrated that it is an important instrument to detect post-traumatic amnesia and determine its duration[5].

However, in view of the observed restrictive conditions, a clear guideline is missing for its application. To determine the GOAT score, a ten-item questionnaire is applied. In clinical practice, there are various situations impeding its use, mainly related to the victims' inability to maintain verbal communication.

In the literature review, the criterion to apply the scale has been described as "individuals consistently out of coma"[3], a description that remains indefinite on how to apply the instrument.

Thus, indicators are needed on when to apply the GOAT. The Glasgow Coma Scale (GCS) is a globally renowned scale and widely used to assess victims after TBI[13]. Therefore, it can be an important indicator of the appropriate time to apply this instrument.

The GCS is the most widely used scale to graduate changes in consciousness[13-15]. It was first published in 1974 and was elaborated to propose a consistent clinical assessment of the consciousness level of patients with brain damage[16].

In post-traumatic amnesia research, studies attempting to reveal the relation between the change in the consciousness level and amnesia after TBI are important to clarify the physiopathology of these phenomena[5, 17].

Initially, post-traumatic amnesia was considered the initial phase of recovery, after the lower consciousness level interval that occurs in sever blunt TBI[3]. However, in practice, some patients experience a longer post-traumatic amnesia period than the changed consciousness level period, as measured by the GCS. In other words, patients with a normal or close to normal GCS score who, when asked about earlier attitudes or behaviors, cannot remember.

The lack of definitions about when to apply the GOAT and about the association between consciousness change and post-traumatic amnesia, led to the realization of this study, with the following objectives: identify, through total and partial GCS scores, the most appropriate time to apply the GOAT and to verify the relations between the results obtained on the GOAT and the GCS, with a view to contributing to knowledge about the relations between the victims' post-traumatic amnesia and consciousness alteration.

## CASES AND METHOD

We carried out a prospective longitudinal field study with a quantitative and correlation approach, at a public hospital that is a referral center for care to trauma victims in the West of greater São Paulo. Victims of TBI hospitalized at this institution are admitted at the emergency care unit.

Study participants were victims of blunt TBI, between 12 and 60 years old, without a previous diagnosis of TBI or memory change, who received care at the place of study after the trauma and were hospitalized for treatment between January 3rd and May 3rd 2001.

To collect information for this study, an individual data recording form was created. This

permitted the victims' identification and characterization, besides daily notes on partial and total GCS and GOAT scores.

Every day during the data collection period, victims of blunt TBI were tracked who received care at the emergency care unit and had been hospitalized at the study institution during the last 24 hours. To identify and locate these victims, we consulted the files of patients hospitalized in this hospital area and also asked nurses from the sector for information.

Once the victims who attended to the inclusion criteria had been located, assessments with the GCS and the GOAT started and were carried out every day, preferably at the same time, until the end of the amnesia was detected (minimum score of 75 on the GOAT for two consecutive days). Death, discharge, hospital transfer and other circumstances described in the results, which made it impossible to continue daily assessments, terminated the victim's follow-up before the end of the amnesia period. Situations of surgery, tests outside the unit, or any other situation that impeded the application of the two scales, were briefly described in the data collection instrument, but did not determine the end of the patient's follow-up.

The total GOAT score was obtained in accordance with guidelines by the scale authors, subtracting the total error points from 100 (Total score = 100 - total error points). In the application of this instrument, scores under 75 indicate that the victim is still in the amnesia period. As indicated by earlier research, the end of the post-traumatic amnesia period was considered to be the first time when the victim reached, for two consecutive days, a score of 75 or higher on the GOAT[3,11].

After the information had been inserted in a database, analyses were performed to characterize the cases under study and reach the proposed objectives. To verify the relation between sequential GCS and GOAT scores, Spearman's Rank Correlation Coefficient was applied. In this analysis, a p-value under 0.05 was considered statistically significant.

The study received was approved by the Institutional Review Board of the study hospital and the victims were included in the research after their or their relatives' consent.

## RESULTS

During the data collection period, 73 victims of TBI attended to the study inclusion criteria, with 72.6% male patients and a large majority (79.5%) between 12 and 36 years old; as to external cause, the most frequent events that provoked blunt TBI in the study group were traffic accidents (75.3%), followed by falls (21.9%); with respect to the severity of the TBI, the extreme categories included the largest number of victims (35.6% severe and 48.0% light). The mean follow-up time of victims was 8.7 days (± 8.9 days). This time ranged from 1 to 39 days and most of the victims (69.9%) were followed and assessed for up to 10 days.

During the follow-up, the 73 victims were submitted to 419 assessments. The GOAT could not be applied in 188 of these (44.9%), due to situations that impeded the patient's collaboration in the application of the test, such as orotracheal intubation, agitation and other accentuated behavioral or consciousness changes. In these cases, only the GCS was applied.

Table 1 shows that, in all assessments in which the GCS was lower than 12, the GOAT could not be applied. The test could only be applied once in a patient with a GCS score of 12, although it resulted in a score under 75.

Table 1 - GCS and GOAT scores in the assessments (n=419). São Paulo, 2001

| GCS | < 12 | | 12 | | 13 | | 14 | | 15 | |
|---|---|---|---|---|---|---|---|---|---|---|
| **GOAT** | **nº** | **%** | **nº** | **%** | **nº** | **%** | **nº** | **%** | **nº** | **%** |
| < 75 | - | - | 1 | 11.11 | 18 | 81.8 | 89 | 78.1 | 29 | 28.4 |
| > 75 | - | - | - | - | - | - | 22 | 19.3 | 72 | 70.6 |
| NA* | 172 | 100 | 8 | 88.9 | 4 | 18.2 | 3 | 2.6 | 1 | 1.0 |
| **Total** | **172** | **100** | **9** | **100** | **22** | **100** | **114** | **100** | **102** | **100** |

(*) Not applicable

The GOAT could be applied relatively easily in patients with a GCS score of 13, although scores in all applications did not reach 75. In the 114 GCS applications that resulted in score 14, the victims reached scores ³ 75 in only 22 of GOAT assessments (19.3%). On the other hand, most (70.6%) of the test applications reached this score when patients scored 15 on the GCS.

In Table 2, it is observed that the test could be applied in victims who scored 2 or more on the Eye Opening parameter of the GCS, although the GOAT indicated the end of post-traumatic amnesia only when this score reached at least 3.

Table 2 - GOAT and GCS Eye Opening (EO) parameter scores on the assessments (n=419). São Paulo, 2001

| EO | 1 | | 2 | | 3 | | 4 | |
|---|---|---|---|---|---|---|---|---|
| GOAT | nº | % | nº | % | nº | % | nº | % |
| < 75 | - | - | 1 | 6,7 | 23 | 28,7 | 113 | 46,9 |
| > 75 | - | - | - | - | 12 | 15,0 | 82 | 34,0 |
| NA* | 83 | 100 | 14 | 93,3 | 45 | 56,3 | 46 | 19,1 |
| **Total** | **83** | **100** | **15** | **100** | **80** | **100** | **241** | **100** |

(*) Not applicable

Table 3 shows that the test was applied when the score on the Best Verbal Response parameter of the GCS was 4 or 5, when results ≥ 75 were also observed on the GOAT. Out of three GCS items, this was the one that most frequently reached score 1. Situations that impeded the assessment of the Best Verbal Response were frequent in this parameter, almost always due to the patients' orotracheal intubation.

Table 3 - GOAT and GCS Best Verbal Response (BVR) scores on the assessments (n=419). São Paulo, 2001

| BVR | <4 | | 4 | | 5 | |
|---|---|---|---|---|---|---|
| GOAT | nº | % | nº | % | nº | % |
| < 75 | - | - | 102 | 87,2 | 35 | 28,7 |
| > 75 | - | - | 9 | 7,7 | 85 | 69,7 |
| NA* | 180 | 100 | 6 | 5,1 | 2 | 1,6 |
| **Total** | **180** | **100** | **117** | **100** | **122** | **100** |

(*) Not applicable

Table 4 relates the score on the Best Motor Response parameter with the total GOAT score. The victim's collaboration in the application of the test was only achieved in individuals who scored 6 on the Best Motor Response item of the GCS, that is, who were capable of obeying simple commands. Similarly, with this GCS score, the victims reached ³ 75 on the GOAT.

Table 4 - GOAT and GCS Best Motor Response (BMR) scores on the assessments (n=419). São Paulo, 2001

| BMR | < 6 | | 6 | |
|---|---|---|---|---|
| GOAT | nº | % | nº | % |
| < 75 | - | - | 137 | 45,4 |
| > 75 | - | - | 94 | 31,1 |
| NA* | 117 | 100 | 71 | 23,5 |
| **Total** | **117** | **100** | **302** | **100** |

(*) Not applicable

To analyze the relations between GOAT and GCS results, the daily scores on both instruments were paired and submitted to Spearman's Rank Correlation Coefficient. The analysis showed a statistically significant positive ordinal correlation ($r_s$ = 0.65; p<0.001).

For the sake of a better characterization of the relation between consciousness alteration and post-traumatic amnesia, results for the victims for whom the end of post-traumatic amnesia was determined during the follow-up period are presented in Table 5.

Of the 73 victims included in this study, the duration of post-traumatic amnesia was determined in only 40 (54.8%). In various situations, the daily assessment of the study participants could not be continued until the end of the amnesia period: 14 (19.2%) were discharged and went home; 9 (12.3%) died; 5 (6.8%) were transferred to other hospitals; 2 (2.8%) escaped from the hospital and 3 (4.1%) evolved with disabilities that made it impossible to assess their memory (aphasia, behavioral disorder).

These 40 victims were distributed according to the relation observed between the end of their memory and consciousness changes. In this analysis, we considered that score 15 on the GCS is an important indicator of a normal physiological condition on the consciousness parameter.

Table 5 - Victims whose post-traumatic amnesia time was determined (n=40), according to the relation observed between the end of post-traumatic amnesia and the end of the consciousness change period. São Paulo, 2001

| End of post-traumatic amnesia | No | % |
|---|---|---|
| Concomitantly with GCS = 15 | 21 | 52.5 |
| Before GCS = 15 | 10 | 25.0 |
| After GCS = 15 | 09 | 22.5 |
| **Total** | **40** | **100** |

It is observed in Table 5 that, in most of the victims, 21 patients (52.5%), signs of normal memory and consciousness appeared at the same time, that is, they presented the end of the post-traumatic amnesia period at the same time as score 15 on the GCS. However, 10 patients presented the end of the post-traumatic amnesia period before reaching score 15 on the GCS and, in 9 patients, the end of the post-traumatic amnesia period was only determined some days after they had reached the maximum score on the GCS.

## DISCUSSION

In this research, in order to identify the most adequate moment to apply the GOAT, partial and total

GCS scores, obtained during the follow-up of blunt TBI victims were analyzed in view of the GOAT, considering the obtained results and the possibility of its application.

In these analyses, it was observed that the minimum GCS score to obtain the victim's collaboration to apply the GOAT was 12, with partial scores of 2 on the Eye Opening parameter, 4 on Best Verbal Response and 6 Best Motor Response.

In presenting an expanded proposal of the GCS, which includes the assessment of post-traumatic amnesia, that authors affirm that, with respect to this parameter, patients with a score of £ 12 on the GCS can rarely be assessed[15].

Score 6 for Best Motor Response has already been appointed by other authors[3] as the most important indicator in the GCS that the victim is out of coma and has, therefore, the minimum perceptivity needed to collaborate with the application of the GOAT.

The victim's collaboration is essential to apply the GOAT or any other memory test. This requires the presence of answers that cover perceptivity and verbal expression capacity.

When the end of post-traumatic amnesia was considered in the analyses on the applicability of the GOAT, the results indicated a total GCS score of 14, with a minimum score of 3 on the Eye Opening parameter, 4 on Best Verbal Response and 6 on Best Motor Response.

This observation must be considered an important indicator of when to apply the GOAT. To the extent that new studies confirm that scores 12 and 13 on the GCS precede the end of post-traumatic amnesia, the start of GOAT assessments can be systemized after reaching score 14 on the GCS. This avoids the victim's and the evaluator's exhaustion during a period in which the GOAT score probably will not reach 75 points.

In this study, we observed a statistically significant correlation between GOAT and GCS results. We did not locate any studies in scientific literature which analyzed the correlation between the scores on these two indicators, although several authors looked at the relation between the duration of amnesia and coma. Like in our study, these analyses aimed to study the relation between post-traumatic consciousness and memory changes. Results certified a significant correlation between the indicators of these two parameters[3,6,18].

The amnesic deficit after TBI is frequently accompanied by disorientation in terms of time, place and person, besides agitation, disinhibited behavior, deficient attention and other memory changes, such as confabulation and retrograde amnesia. Physical or verbal agitation and aggression are common, and hallucinations can also occur[12].

In studying cognitive changes during the acute recovery period of TBI, researchers from Toronto, Canada, concluded that post-traumatic amnesia is essentially a post-traumatic confusional state, defined as a transitory organic mental syndrome that starts acutely, characterized by a global impairment of cognitive functions, with concurrent consciousness disorder, attention abnormality, reduced or increased psychomotor activity and dysfunction in the sleep/wake cycle[16].

For these researchers, the clinical situation that has been denominated amnesia seems to be secondary to the inability to pay attention while coding or recovering information, suggesting that attention problems are prominent or even the most important in the recovery phase after TBI.

According to these assertions, post-traumatic amnesia should be concurrent with the confusional state[12,16] and, therefore, the end of amnesia should occur at the same time as a GCS score of 15. In this study, in 25% of cases, the end of post-traumatic amnesia preceded score 15 on the GCS. This end occurred when score 14 was reached. Most of these patients obtained the following partial GCS scores: Eye Opening = 4, Best Verbal Response = 4 and Best Motor Response = 6. This showed confused patients whose GOAT scores indicated the end of the post-traumatic amnesia. In 22.5% of cases, on the other hand, patients had obtained score 15 on the GCS for at least one day when the end of the post-traumatic amnesia occurred.

This last group of victims, who scored 15 on the GCS before they recovered from the memory change, does not support the hypothesis that post-traumatic amnesia is essentially a confusional state. On the other hand, patients who were confused but presented signs of the end of amnesia, are not directly opposed to this hypothesis as, in these cases, it can be considered that the amnesia ends before the confusional state.

Post-traumatic amnesia was longer in relation to coma in a subgroup of TBI victims analyzed by researchers from the United Kingdom. These authors observed that 17 out of 38 patients, who were hospitalized after TBI of different severities, had post-

traumatic amnesia for two days or more, although they presented coma periods for less than six hours. Among these 17 victims, eight stood out because their amnesia lasted for more than seven days. For patients who remained in a coma for six hours or more, results were more coherent and, in most cases, the amnesia continued for more than seven days[6].

In this study, the eight patients with an extended amnesia time and short coma period, when comparing magnetic resonance results with those of the other patients, presented more extensive brain hemisphere damage. In the group as a whole, both coma and amnesia were related to the number of lesions detected in central brain structures, but only the duration of the post-traumatic amnesia was significantly related with the number of hemispheric lesions. These results permitted the conclusion that both coma and amnesia are related with the brain damage, although they reflect different injury patterns[6].

In view of these observations, it can be suggested that different injury patterns caused the different relations between the memory and consciousness parameters, observed in Table 5. However, the importance of attention in the memorization process and the difficulty to clearly distinguish between confusion and the post-traumatic amnesia syndrome cannot be ignored. Hence, in the group in which the end of amnesia occurred at the same time as or before score 15 on the GCS, the possibility that the change in the consciousness level influenced memory results cannot be put aside[6].

Moreover, the use of the GOAT score to determine the end of the post-traumatic amnesia identifies a recovery stage that seems to be more concurrent with the return of orientation capacity than with the recovery of spontaneous memory. According to some authors, in more severely traumatized patients, the amnesia actually contributes to the GOAT score but, in lighter traumas, attention and confusion are the primary factors contributing to the score.

The use of the GOAT as an instrument to establish the end of amnesia limits the researcher's capacity to distinguish between confusion and post-traumatic memory changes. In the GOAT structure, the predominance of orientation measures is evident and in accordance with the premise that the amnesia period is the initial phase of recovery, after an interval with a lower consciousness level.

The study of post-traumatic amnesia is still permeated by many gaps, as well as the relations between the cognitive functions. New studies, with a clearer distinction between the assessed cognitive processes and with a concomitant analysis of the image diagnosis of the injury, can result in clearer information of the physiopathology involved in the post-traumatic cognitive recovery process, especially of memory. In this study, the potential adverse effects of the drugs used in the acute trauma phase should also be considered, which can affect memory performance[3].

## CONCLUSIONS

As to the best moment to apply the GOAT, it can be affirmed that:

- This instrument can be applied when score 12 is reached on the GCS, with partial scores higher than 2 for Eye Opening, higher than 4 for Best Verbal Response and 6 for Best Motor Response.
- Victims with scores 14 and 15 on the GCS, with partial scores of 3 or 4 on the item Eye Opening, 4 or 5 on Verbal Response and 6 on Motor Response reach scores ³ 75 on the GOAT. These results indicate the application of this instrument after the victims reach these scores on the GCS.

As to the relations between GOAT and GCS results, it can be concluded that:

- Spearman's Rank Correlation Coefficient between sequential GCS and GOAT scores corresponded to 0.65, $p < 0.001$, indicating a relatively strong relation between these measures; however, the analysis of the end of post-traumatic amnesia and of the consciousness changes appointed by these instruments showed that, in 47.2% of the cases, the end of post-traumatic amnesia occurred before or after score 15 was reached on the GCS.

## REFERÊNCIAS BIBLIOGRÁFICAS

1. Alves D, Mussi FC, Jeukens MMF, Silva SCF, Silva EB, Koizumi MS. O que lembra o paciente com TCE sobre o período de hospitalização?. Rev Latino-am Enfermagem 2000 abril; 8(2):91-8.

2. Cifu DX, Keyser-Marcus L, Lopez E, Wehman P, Kreutzer JS, Englander J, et al Acute predictors of successful return to work 1 year after traumatic brain injury: a multicenter analysis. Arch Phys Med Rehabil 1977; 78:125-31.

3. Ellemberg JH, Levin HS, Saydjari C. Posttraumatic amnesia as a predictor of outcome after severe closed head injury. Arch Neurol 1996; 53: 782-91.

4. Jennett B, Teasdale G. Predicting outcome in individual patients after severe head injury. Lancet 1976; 1(7968): 1031-4.

5. McMillan TM, Jongen ELMM, Greenwood RJ. Assessment of post-traumatic amnesia after severe closed head injury: retrospective or prospective? J Neurol Neurosurg Psychiatry 1996; 60:422-7.

6. Wilson JTL, Teasdale GM, Hadley DM, Wiedmann KD, Lang, DL. Post-traumatic amnesia: still a valuable yardstick. J Neurol Neurosurg Psychiatry 1993; 57:198-201.

7. Pastorek NJ, Hannay HJ, Contant CS. Prediction of global outcome with acute neuropsychological testing following closed head injury. J Int Neuropsychol Soc 2004; 10(6):807-17.

8. Orient-López F, Sevilla-Hernández E, Guevara-Espinosa D, Terré- Boliart R, Ramón-Rona S, Bernabeu-Guitart M. Resultado funcional al alta de los traumatismos craneoencefálicos graves ingresados en una unidad de daño cerebral. Rev Neurol 2004; 39(10):901-6.

9. De Guise E, Leblanc J, Feys M, Thomas H, Gosselin N. Effect of an integrated reality orientation programme in acute careon post-traumatic amnesia in patients with traumatic brain injury. Brain Inj 2005; 19(4):263-9.

10. Shores EA, Maeosszeky JE, Sandanam J, Batchelor J. Preliminary validation of a clinical scale for measuring the duration of post-traumatic amnesia. Med J Aust 1986; 144(26):569-72.

11. Levin HS, O'Donnell VM, Grossman RG. The Galveston Orientation and Amnesia Test : a practical scale to assess cognition after head injury. J Nerv Ment Dis 1979; 167(11):675-84.

12. Ladera-Fernandez V. Síndrome amnésico postraumático. Rev Neurol 2001; 32(5):467-72.

13. Alves D, Koizumi MS. Escala de Coma de Glasgow: tempo de reavaliar seu uso em serviço de emergência. Acta Paul Enfermagem 1999;12(3):92-100.

14. Brooks DN, Hosie J, Bond MR, Jennett B, Aughton M. Cognitive sequelae of severe head injury in relation to the Glasgow Outcome Scale. J Neurol Neurosurg Psychiatry 1986; 49:549-53.

15. Nell V, Yates DW, Kruger J. An extended Glasgow Coma Scale (GCS-E) with enhanced sensitivity to mild brain injury. Arch Phys Med Rehabil 2000; 81(5):614-7.

16. Marion DW, Carlier PM. Problems with initial Glasgow Coma Scale assessment caused by prehospital treatment of patients with head injury: results of a national survey. J Trauma 1994; 36(1):89-95.

17. Stuss DT, Binns MA, Carruth FG, Levine B, Brandys CE, Moulton RJ, et al. The acute period of recovery from traumatic brain injury: posttraumatic amnesia or post-traumatic confusional state? J Neurosurg 1999; 90:635-43.

18. Katz DI, Alexander MP. Traumatic brain injury: predicting course of recovery and outcome for patients admitted to rehabilitation. Arch Neurol 1994; 51:661-70.

Recebido em: 24.7.2006
Aprovado em: 10.5.2007