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ORIGINAL ARTICLE

Correlation between Glasgow Coma Scale and brain computed tomography-scan findings in head trauma patients

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ABSTRACT

Background: The study aimed to assess the relationship between computed tomography (CT) scan findings and Glasgow Coma Scale (GCS) score with the purpose of introducing GCS scoring system as an acceptable alternative for CT scan to clinically management of brain injuries in head trauma patients.

Materials and Methods: This study was conducted on hospitalized patients with the complaints of head trauma. The severity of the head injury was assessed on admission by the GCS score and categorized as mild, moderate, or severe head injury.

Results: Of all study subjects, 80.5% had GCS 13–15 that among those, 45% had GCS 15. Furthermore, 10.5% had GCS ranged 9–12 and 9% had GCS <8. Of all subjects, 54.5% had abnormal CT findings that of them, 77.1% categorized as mild head injury, 11.0% had a moderate head injury, and 11.9% had a severe head injury. Furthermore, of those with GCS 15, 41.0% had abnormal CT scan. Of all patients with abnormal CT findings, 33.0% underwent surgery that 61.1% categorized in mild head injury group, 13.9% categorized in moderate head injury group, and 22.2% categorized in severe head injury group. Of those with GCS equal to 15, only 27.0% underwent surgery.

Conclusion: The use of GCS score for assessing the level of injury may not be sufficient and thus considering CT findings as the gold standard, the combination of this scoring system and other applicable scoring systems may be more applicable to stratify brain injury level.

Key words: Brain computed tomography -scan findings, Glasgow Coma Scale, head trauma

Introduction

Head trauma accounts for a high proportion of emergency centers and includes high workloads of primary cares and clinical services. According to the published reports, head trauma is a major cause of death in young adults, as well as physical and psychological disabilities in more than half of the affected individuals with a head injury.[1-4] The management of patients with head trauma is clinically based on the Glasgow Coma Scale (GCS) that can present a comprehensive framework for assessing the three clinical aspects of verbal, visual, and motor responsiveness leading proper stratifying neural impairment and head injury severity.[5,6] In this regard, the degree of head injury can be scored as mild (GCS score 13–15), moderate (GCS score 9–12), and severe (GCS score equal to or <8). According to the great observational studies, of all attendance to clinical settings because of head trauma, 93% of adults and 96% of children suffer mild head injury, 6% of adults and 5% of children suffer moderate head injury and only 1% of adults and 0.5% of children suffer severe head injury according to the GCS stratification rule.[7-10]

Beside the clinically management of head trauma patients, intracranial lesions in these patients can be detected

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aided by imaging methods even before appearing clinical manifestations. In this context, studies could demonstrated that early detection of neurological lesions by these modalities have resulted in achieving the appropriate clinical outcome and also preventing unnecessary interventional treatments.[11,12] In this regard, the optimal time point for performing computed tomography (CT) scanning was produced to be 8 h of head trauma especially in the elderly, the evidences of skull fracture, seizure appearance, retrograde amnesia, or any dangerous mechanical injuries.[13-15]

Despite high advantages of CT scanning in patients with head trauma especially in detecting brain lesions particularly in early stages, the use of this procedure may be unavailable in some settings and also may be contraindicated in most conditions. Furthermore, although following the lesion development by CT scan is necessary before and also after treatment interventions in these patients, but applying an appropriate clinical alternatives can result in dissuading clinicians from obtaining unnecessary follow-up CT scans. The present study aimed to assess the relationship between CT scan findings and GCS score with the purpose of introducing GCS scoring system as an acceptable alternative for CT scan to clinically management of brain injuries in head trauma patients.

Materials and Methods

This retrospective study was conducted on 200 hospitalized patients with the complaints of head trauma and admitted to neurosurgery ward of Imam Hossein Hospital in Tehran, Iran between 2006 and 2008. The head injury was defined as a history of a blow to the head or the presence of a scalp wound or those with evidence of altered consciousness after a relevant injury.[16] All patients' information was retrospectively collected by reviewing the hospital recorded files. In all subjects, the level of consciousness was assessed on admission by the GCS and its severity was categorized as mild head injury if GCS score set as 13–15, moderate head injury if GCS score set as 9–12 and severe head injury if GCS score set as <9. Also, the documents of CT scans and the recorded reports were assessed by a radiologist who blinded to results of the patients' GCS score, and the types of lesions were also determined. For statistical analysis, mean ± standard deviation was determined to describe continuous variables and frequency (percentage) was used to describe categorical variables. Data were analyzed using IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. (Armonk, NY: IBM Corp).

Results

In total, the recorded information of 200 patients with head injury (107 men and 17 women) was retrospectively assessed. Among those, 76 were children younger than 12 years while 22 aged 13–18 years, 39 aged 19–30 years, and 63 aged more than 30 years. Regarding type of trauma, the highest frequency of head trauma occurred in younger than the 12 years group (38.0%), followed by the age groups older than 30 years (31.5%) and 19–30 years (19.5%). The most common causes of head injury in men was an accident (69/107), followed by falling (21/107), hitting objects to the head (11/107). Also, the most common causes of head injury in women were an accident (8/17), falling (5/17) and hitting objects to the head (3/17). Also, falling (52/76) was the most common causes for injury in children following by accident (20/76) and hitting objects to the head (3/17). Thus, there was the difference in the distribution of causes, according to age and gender. Regarding clinical condition, of 200 study subjects, 161 (80.5%) had GCS 13–15 that among those, 45% had GCS 15. Also, 21 (10.5%) had GCS ranged 9–12 and 18 (9%) had GCS <8. Of all subjects, 109 (54.5%) had abnormal CT findings that of them, 77.1% categorized as mild head injury (GCS 13–15), 11.0% had moderate head injury (GCS 9–12), and 11.9% had severe head injury (GCS <9). Also, of those with GCS 15, 41.0% had abnormal CT scan. Of 109 patients with abnormal CT findings, 36 (33.0%) underwent surgery that 22 (61.1%) categorized in mild head injury group, 5 (13.9%) categorized in moderate head injury group, and 8 (22.2%) categorized in severe head injury group. Also, of those with GCS equal to 15, 10 (27.0%) underwent surgery. Regarding type of lesions in CT scans, the most common type of lesion was epidural hematoma (38.5%), followed by cerebral contusion (29.4%), and pneumocephaly (17.4%) [Table 1]. As shown in Table 2, brain lesion type A was detected in 47.9% of patients with mild brain injury, 42.9% of patients with moderate brain injury, and 27.7% of patients with severe brain injury. In this regard, lesion type B was detected in 5.5% of patients with mild brain injury, 4.8% of patients with moderate brain injury, and none of the patients with severe brain injury. The overall prevalence of skull fracture was 30.0% as linear fracture in 76.7%, a depressed fracture in 23.3%, and combined fracture in 3.3%. Among affected children, 32.9% suffered a skull fracture that among those, 76.0% had a linear fracture, and others had depressed fracture. In this regard, among adult patients, 28.2% had skull fracture as linear in 71.5%, depressed in 22.8% and combined in 5.7%. Using the test for agreement between CT findings and GCS severity scoring, a weak correlation was revealed between the two modalities to determine brain lesions (Somers'd value $= -0.097 \pm 0.065$, $P = 0.142$).

Discussion

Association between the severity of brain lesion assessed by the level of consciousness on GCS scoring system and presence or absence of brain lesions in CT scan is now considered as a new subject to minimize unnecessary CT following in patients with head trauma. This subject can be very important in children, as well as in those with complete

Table 1: Different types of brain lesions in patients with head injury

Brain lesions	Epidoral hematoma	Cerebral contusion	Pneumocephaly	Acute subdural hematoma	Intracranial hemorrhage	Chronic subdural hematoma	Subarachnoid hemorrhage	Subdural hygroma	Subdural hydroma	Intraventricular hemorrhage
Series 1	42	32	19	18	15	4	3	3	2	1

Table 2: Types of brain lesions according to severity of injury on GCS scoring

	A	B	C	D	E	B, E	B, C	B, D
Mild	47.9	5.5	23.6	13.7	3.7	0.6	3.1	1.9
Moderate	42.9	4.8	9.5	19	9.5	0	9.5	4.8
Sever	27.7	0	44.4	5.5	11.1	0	5.5	0

or partial contraindications of CT scanning. Our study attempted to determine the association between CT findings and GCS categorization to test the possibility of predicting brain lesions by determining GCS score on admission. In our observation and among those with positive CT findings on brain abnormality, 77.1 patients had a mild brain injury, 11.0% had a moderate brain injury, and 11.9% had a severe brain injury. On the other hand, a notable number of patients with abnormal CT findings may have only mild injuries leading mild consciousness impairment while about one-fourth of patients with CT findings may have moderate to severe consciousness impairment. In fact, the presence of CT finding may not be an indicator for the level of consciousness impairment assessed by GCS score.

A few recent studies assessed correlation between GCS score and CT scan to assess brain lesions. In a study by Lee *et al.*,[16] the change in CT scans was compared with the GCS the day of the scan showed a positive correlation between the two modalities. In this regard, in patients with unchanged or improved GCS, 73.1% had improved or the same CT appearance, while in those with a worse GCS, the CT was worse in 77.9%. Finally, the authors concluded that due to good correlation between the CT scan appearance and the clinical status, the use of follow-up CT scans was recommended only in patients with clinical deterioration unexplained by intracranial pressure changes alone. Farshchian *et al.*[17] showed that only three lesions of extra-axial hematoma, subarachnoid hemorrhage, and hemorrhagic contusion might be associated with low GCS scores. In a study by Joseph *et al.*,[18] a mild GCS score (GCS 13–15) in patients with an intracranial injury does not preclude progression on repeat head CT and the need for neurosurgical intervention. Melo *et al.*[19] also indicated that of patients with mild brain injury, neurosurgery was performed in 6.7% and 9.2% had neurological disabilities. In fact, mild brain injury based on GCS score may be associated with significant abnormalities in CT scan, require of neurosurgical procedure and Intensive Care Unit admission. Moreover, Chieregato *et al.*[20] showed that the GCS scoring system was not enough for assessing brain injury, and, therefore, it should be combined with other systems such as traumatic brain injury classification.

Conclusion

In summary, because of disagreement between brain injury severity assessed by GCS score and findings brain abnormalities in CT scan, the use of GCS score for assessing the level of injury may not be sufficient and thus considering CT findings as the gold standard, the combination of this scoring system and other applicable scoring systems such as traumatic brain injury classification and also considering clinical signs like depressed fracture may be more applicable to stratify brain injury level.

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Conflicts of interest

There are no conflicts of interest.

References

1. American College of Surgeons Committee on Trauma. Advanced Trauma Life Support for Doctors. Student Course Manual (ATLS). 7th ed. Chicago: The College; 2004.
2. Roy CW, Pentland B, Miller JD. The causes and consequences of minor head injury in the elderly. Injury 1986;17:220-3.
3. Thornhill S, Teasdale GM, Murray GD, McEwen J, Roy CW, Penny KI. Disability in young people and adults one year after head injury: Prospective cohort study. BMJ 2000;320:1631-5.
4. Whitnall L, McMillan TM, Murray GD, Teasdale GM. Disability in young people and adults after head injury: 5-7 year follow up of a prospective cohort study. J Neurol Neurosurg Psychiatry 2006;77:640-5.
5. Teasdale G, Knill-Jones R, van der Sande J. Observer variability in assessing impaired consciousness and coma. J Neurol Neurosurg Psychiatry 1978;41:603-10.
6. Braakman R, Gelpke GJ, Habbema JD, Maas AI, Minderhoud JM. Systematic selection of prognostic features in patients with severe head injury. Neurosurgery 1980;6:362-70.
7. Strang I, MacMillan R, Jennett B. Head injuries in accident and emergency departments at Scottish hospitals. Injury 1978;10:154-9.
8. Swann IJ, MacMillan R, Strong I. Head injuries at an inner city accident and emergency department. Injury 1981;12:274-8.
9. Thillainayagam K, MacMillan R, Mendelow AD, Brookes MT, Mowat W, Jennett B. How accurately are fractures of the skull diagnosed in an accident and emergency department. Injury 1987;18:319-21.
10. Teasdale GM, Murray G, Anderson E, Mendelow AD, MacMillan R, Jennett B, *et al.* Risks of acute traumatic intracranial haematoma in children and adults: Implications for managing head injuries. BMJ 1990;300:363-7.
11. Bricolo AP, Pasut LM. Extradural hematoma: Toward zero mortality. A prospective study. Neurosurgery 1984;14:8-12.
12. Teasdale G, Galbraith S, Murray L, Ward P, Gentleman D, McKean M. Management of traumatic intracranial haematoma. Br Med J (Clin Res Ed) 1982;285:1695-7.

13. Link TM, Schuierer G, Hufendiek A, Horch C, Peters PE. Substantial head trauma: Value of routine CT examination of the cervicocranium. Radiology 1995;196:741-5.
14. Thomas M, Teece S. Towards evidence based emergency medicine: Best BETs from Manchester Royal Infirmary. Computed tomography and the exclusion of upper cervical spine injury in trauma patients with altered mental state. Emerg Med J 2002;19:551-2.
15. Holmes JF, Akkinepalli R. Computed tomography versus plain radiography to screen for cervical spine injury: A meta-analysis. J Trauma 2005;58:902-5.
16. Lee TT, Aldana PR, Kirton OC, Green BA. Follow-up computerized tomography (CT) scans in moderate and severe head injuries: Correlation with Glasgow Coma Scores (GCS), and complication rate. Acta Neurochir (Wien) 1997;139:1042-7.
17. Farshchian N, Farshchian F, Rezaei M. Correlation between Glasgow Coma Scale and brain CT-scan findings in traumatic patients. J Inj Violence Res 2012;4(3 Suppl 1): Paper No. 44.
18. Joseph B, Pandit V, Aziz H, Kulvatunyou N, Zangbar B, Green DJ, *et al.* Mild traumatic brain injury defined by Glasgow Coma Scale: Is it really mild? Brain Inj 2015;29:11-6.
19. Melo JR, Lemos-Júnior LP, Reis RC, Araújo AO, Menezes CW, Santos GP, *et al.* Do children with Glasgow 13/14 could be identified as mild traumatic brain injury? Arq Neuropsiquiatr 2010;68:381-4.
20. Chieregato A, Martino C, Pransani V, Nori G, Russo E, Noto A, *et al.* Classification of a traumatic brain injury: The Glasgow Coma Scale is not enough. Acta Anaesthesiol Scand 2010;54:696-702.