Bangladesh Crit Care J March 2014; 2 (1): 1-3

From the Desk of the Editor

Looking for an ideal coma scale: It is time to replace GCS.

Mohammad Omar Faruq

The evaluation of comatose patients in intensive care unit (ICU) is very much challenging. Within the complex spectrum of consciousness, scoring systems have been developed to obtain a fast comprehensive assessment of coma to facilitate communication among examiners as well as to monitor changes for therapeutic decision and to provide prognostic information. Assessment of coma is a core clinical skill for physicians. Scales have been constructed to improve communication among health care personnel and also to standardize examination of the unconscious patients. It also allows the grading of an unconscious patient over time which would indicate changes in clinical condition so that outcome may be predicted. Coma scales can also be used to facilitate data entry for clinical studies.

The assessment of comatose patients requires a comprehensive examination, interpretation of difficult laboratory tests which includes neuroimaging and electro encephalogram (EEG) on different occasions. An ideal coma scale[1] should be reliable, valid, easy to use, easy to remember and of course an indicator of patient outcome. Raters who examine patients should be able to test accuracy of an ideal coma scale. Such scales should not involve additional cards or tools and should be useful in variety of patients with acute neurological disease not exclusively traumatic brain injury. Medical intervention like endotracheal intubation should not make assessment of certain components unreliable. There should not be any scope for educated guess or pseudo scoring in an ideal coma scale and it should be easy to memorize all components of the scale. The scale should have internal consistency which means when component changes parallel changes should be seen in other components. Lower scores in an ideal scale should indicate higher chances in mortality or future disability in a patient. Above all an ideal coma scale should not be too simple or too complicated.

Clinicians should not forget that a coma scale may be less effective if confounders are present. A patient with aphasia, dementia or with a tracheostomy may have impaired verbal response. A patient with ocular trauma or periorbital edema will have impaired eye opening. An ICU patient who is on sedation or on neuromuscular junction blocker will not show appropriate brainstem reflexes. A patient who is on ventilator in ICU or a patient with pulmonary edema will not allow assessment of respiratory pattern in a comatose condition.

Historically coma scales originated in neurosurgical intensive care units. Charting neurologic status and physiologic functions at the bedside was a common practice but the need for a clinical tool prompted development of a grading system.

The earliest literature describing coma score or scale goes back in 1966, when a comprehensive scoring system called "Vital Sign Card" was developed by Ommaya[2], a neurosurgeon at the National Institute of Neurological diseases and Blindness at Bethesda, Mary land, USA. It was later known as Ommaya Coma Scale and it had total 41 scoring points distributed under 8 headings. The headings included level of consciousness, motor activity, pupillary status, corneal reflex, blood pressure, rate & type of respiration and rectal temperature. This scoring system was reported to be used only in author's institution.

In 1974, Teasdale and Jennett from Institute of Neurological Science, Glasgow, UK published the land mark article in Lancet[3] "Assessment of coma and impaired consciousness: a practical scale." The first version of the scale was known as the coma index but soon became known as Glasgow Coma Score (GCS) for the home of author's institution. The GCS was constructed mainly to improve communication between physicians and nurses when describing difficult state of impaired consciousness and to avoid ambiguous definition such as somnolence.

Teasdale and Jennett excluded certain tests from the scale (e.g. Brainstem reflexes) that they believed would be difficult for inexperienced junior doctors and nurses to perform or interpret. The GCS therefore assessed only motor, verbal and eye response. The GCS was initially was unnumbered system. The practice of assigning numbers to the response using "1" for the lowest score rather than "0" was introduced in a later publication[4]. Users of the GCS began creating sum scores for the 3 components (giving a total range of 3 to 15 points).

Since its introduction GCS has been used extensively. It has become the gold standard against which newer scales began to be compared. The GCS scale was rapidly adopted by physicians other than neurologists and neurosurgeons. It has been incorporated in Intensive care and trauma scoring systems to assess risk of in hospital mortality. GCS sum score also became a marker for prognosis.

Despite its broad acceptance, however GCS did not escape criticism[1]. First the score was skewed toward the motor part of the scale (6 items versus 4 for eyes and 5 for verbal). Second, the verbal component of the GCS is unusable in intubated and dysphasic patients. Third, abnormal brainstem reflexes, changing breathing patterns and need for mechanical ventilation could reflect severity of coma. Fourth, the GCS may not detect subtle changes in neurological examination.

In 1973 Sugiura from department of surgical neurology of University of Edinburg, UK devised a scale and it was named as Edinburg coma scale. As it was published in a Japanese Journal[5] it did not get international attention. In 1993 Sugiura et al modified the Edinburg Coma scale and developed Edinburg - 2 Coma scale (E2 CS)[6]. This scale rapidly became obsolete but claimed more sensitivity than GCS regarding patient's ability to follow commands.

In 1988, Born from Belgium modified GCS into Glasgow – Liege scale[7]. It added a set of tests of brainstem responses that

may disappear when the brainstem loses its function in a retro caudal direction.

In 1991 Brain Resuscitation Clinical Trial II Study Group introduced Pittsburg Brain Stem Score (PBSS) [1] incorporating brainstem reflexes.

In1984, Comprehensive level of Consciousness Scale (CLOCS) [8] was developed by dept of neurosurgery of University of Tennessee Health Science Center, USA. This scale was very comprehensive and included 197 options which was too comprehensive to be useful for clinical practice.

In 1988, Reaction level Scale (RLS 85)[9] was adopted in Sweden. It categorized patients as alert, drowsy or confused or unconscious with all categories followed by specific motor responses. The RLS 85 demonstrated greater accuracy than the GCS. However a strong correlation was found between RLS 85 and GCS.

In 1991, Innsbruck Coma Scale[10] was published in Lancet. This scale included brainstem reflexes and eliminated the verbal response. Retrospective study showed that the scale had greater predictive power for mortality than did the GCS.

All these alternative scales other than GCS rarely emerged in publications outside the institution or country where they originated and they never had widespread acceptance like that of GCS among neuromedicine specialists or neurosurgeons.

In 2005, Wijdicks et al from Mayo Clinic USA published a land mark scoring system in Annals of Neurology[11], the Full Outline of Unresponsiveness (FOUR) score, a new scale developed to provide a better and comprehensive assessment. The FOUR score included additional information, not assessed by GCS like brainstem reflexes, visual tracking, breathing pattern and respiratory drive. FOUR score scale has range of 0-16 scoring points as opposed to 3-15 scoring points of GCS.

As opposed to GCS (which has 3 components e.g. Eye opening, Best verbal response and Best motor response) FOUR score has 4 components namely Eye response, Motor response, Brainstem reflexes and Respiration.

According to its proponents, FOUR score gives greater neurologic information. It quantifies consciousness by examining eye and motor responses, brainstem reflexes and breathing pattern. It has been observed that FOUR score remains testable in neurologically critically ill intubated patients while intubation invalidates one of 3 components of GCS. FOUR score tests essential brain stem reflexes and provides information about brainstem injury that is unavailable with GCS. FOUR score recognizes locked in syndrome and points to signs suggesting brain death, uncal herniation. In these situations GCS has not been useful or reliable. Attention to respiratory pattern in FOUR score not only may indicate need for respiratory support in comatose patients but also provide information about respiratory drive. FOUR score further characterizes the severity of comatose patients with lowest GCS score. As a result probability of in hospital mortality is higher for the lowest total FOUR score when compared with that of GCS. FOUR score has been subjected to validation studies[11-16] in different scenarios like neuro ICU, emergency departments, medical ICU, comatose stroke patients in acute stroke unit , traumatic brain injuries etc. It has been compared with GCS in these validation studies and excellent inter rater agreements have been observed.

Looking into the history and evolution of coma scale, it appears that GCS so far stood the test of time for 30 years since its introduction until 2005 when it was challenged by the proponents of FOUR Score Scale. In spite of its draw backs GCS is still being used by clinicians of many institutions because of its simplicity of use. But it has lost its usefulness in severe neuro impaired patients more so in the settings of ICUs. At best we can conclude that GCS is probably more suitable for simpler non intubated patients without brainstem dysfunction. In conclusion FOUR Score has the potential to achieve wide spread acceptance among our physician community to become a universally acceptable gold standard Coma Scale.

Mohammad Omar Faruq
MD, FACP, FACEP, FCCM, FCPS .
Professor of Critical Care Medicine,
BIRDEM General Hospital and Ibrahim Medical College,
Dhaka, Bangladesh.
Email: faruqmo@yahoo.com

References:

1. Wijdicks EFM. Clinical scales for comatose patients: The Glasgow coma scale in historical context and the new FOUR score. Reviews in neurological diseases.2006 ; 3(3) : 109 – 117.
2. Ommya AK. Trauma to the nervous system. Ann R Coll. Surg. Engl. 1966 ; 39 : 317- 347.
3. Teasedale G, Jennett B. Assessment of coma and impaired consciousness: A practical scale. Lancet . 1974 ; 2(7872) : 81-4.
4. Teasedale G, Jennett B. Assessment and prognosis of coma after head injury. Acta Neurochir (wien). 1976 ; 34 : 45 – 55.
5. Sugiura K, Whatmore WJ, Gillingham FJ. The state of consciousness as a prognostic guide after severe head injury. No Shinkei Geka. 1973. 1 : 475- 479 (in Japanese).
6. Sugiura K, Muraoka K, Chishiki T, Baba M. The Edinburg - 2 Coma scale: A new scale for assessing impaired consciousness. Neuro Surgery. 1983; 12 (4): 411- 415.
7. Born JD. The Glasgow – Liege scale: Prognostic value and evolution of motor response and brainstem reflexes after severe head injury. Acta Neurochir (Wien). 1988; 91: 1 - 11.
8. Stanczak DE, Whise JG 3rd, Gouview WD. Assessment of level of consciousness following severe neurological insults. A comparison of the psychomotor qualities of Glasgow coma scale and comprehensive level of consciousness scale. J. Neurosurg. 1984; 60: 955 – 960.
9. Starmark JE, Stalhammer D, Holmgren E. The reaction level scale (RLS 85), manual and guidelines. Acta Neurochir (Wien). 1987; 91: 12 – 20.

10. Benzer A, Mitterschiffthaler G, Murosi M, Luef A, Puhringer F, De La Renotiere K, Lehner H, Schmutzhard E. Prediction of non survival after trauma : Innsbruck coma scale. Lancet. 1991 ; (338) : 977- 978.

11. Wijdicks EFM, Bamler WR, Maramattom BV, Manno EM, Mc Celland RL. Validation of new coma scale: The Four score. Ann. Neurol. 2005; 58 : 585 – 593.

12. Iyer VN, Mandrekar JN, Danielson RD, Zuvkof AY., Elmer JL, Wijdicks EFM. Validity Four score coma scale in the medical intensive care unit. Mayo Clin Proc. 2009; 84(8): 694 – 701.

13. Kervic J, Jelinek GA, Knott J, Weiland TJ. Validation of full outline of unresponsiveness (FOUR) scale for conscious state in the emergency department : comparison against the Glasgow coma scale. Emerg. Med. J. 2011; 28 : 486 – 490.

14. Stead LG, Wijdicks EFM, Bhagra A, Kashyap R, Bellolio MF, Nash D, Enduri S, Schears R, William B. Validation of a new coma scale , the FOUR score in the emergency department. Neurocrit. Care. DOI 10.1007/s 12028 – 008 - 9145 – 0.

15. Sadaka F, Patel D, Lakshman R. The FOUR score predicts outcome in patients after traumatic brain injury. Neurocrit. Care. DoI 10.1007/s 12028 – 011 – 9617 – 5.

16. Idrovo L, Fuentes B, Medina J, Gabaldon L, Ruiz – Ares G, Abenja MJ, Aguilar – Amat MJ, Martinez – Sanchez P, Rodriguez L, Cajorla R, Martinez M, Tafur A, Wijdicks EFM, Diez – Tezedor E. Validation of FOUR score (Spanish version) in acute stroke : An inter observer variability study. Eur. Neurol. 2010; 63 : 364 – 369.