Paediatric coma scales

Review

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Traumatic and non-traumatic coma is a common problem in paediatric practice with high mortality and morbidity. Early recognition of the potential for catastrophic deterioration in a variety of settings is essential and several coma scales have been developed for recording depth of consciousness that are widely used in clinical practice in adults and children. Prediction of outcome is probably less important, as this may be able to be modified by appropriate emergency treatment, and other clinical and neurophysiological criteria allow a greater degree of precision. The scales should be reliable, i.e. with little variation between observers and in test–retest by one observer, since this promotes confidence in the assessments at different time points and by different examiners. This is particularly important when the patient is being assessed by personnel dealing with adults as well as children, discussed on the telephone, handed over at shift change, or transferred between units or hospitals. The British Paediatric Neurology Association has recommended one of the modified child's Glasgow coma scales (CGCS) for use in the UK. This review looks at the recent history of the development of coma scales and the rationale for recommending the CGCS.

See end of paper for list of abbreviations.

Traumatic and non-traumatic coma is a common problem in paediatric practice with high mortality and morbidity.[1] Early recognition in a variety of settings is essential and several coma scales have been developed for recording depth of consciousness that are widely used in clinical practice in adults and children. The British Paediatric Neurology Association has recommended one of the modified paediatric Glasgow coma scales (GCS) originally developed by James and Trauner[2] (child's Glasgow coma scale [CGCS]; Tables I, II, and III) for use in the UK. This review looks at the recent history of the development of coma scales and the rationale for recommending the CGCS.

Requirements for an ideal coma scale and problems in achieving this

The criteria for an ideal coma scale are that it should be easily administered, useful in a wide range of ages and clinical conditions, consistent between observers (Table III), and sufficiently discriminating to identify levels of coma requiring specific interventions. Many scales have also been used in attempts to predict outcome,[3–5] although this may be a less realistic goal since the advent of intensive care in the developed world, as sedation and paralysis interfere with the accurate assessment of depth of coma at the time points that are discriminatory, and interventions may alter outcome. None of the clinical scales are sufficiently sensitive or specific enough for it to be justifiable to wake up a patient, sedated and/or paralysed for optimal intensive care, to perform them, especially as additional clinical information[6] and alternative neurophysiological techniques have better predictive power[7] for death and poor neurological outcome respectively. However, GCS at injury or on admission is associated with outcome and was the most important predictor of high risk of death, surgery, longer intensive care unit stay, and injury severity score in a recent large series.[5]

A coma scale should be easy to remember and administer since it will be used by medical and nursing staff in many different places (emergency departments, wards, intensive care) on patients of all ages and with a wide range of conditions causing impaired levels of consciousness. The scales should be reliable, i.e. with little variation between observers (Table III) and in test–retest by one observer, since this promotes confidence in the assessments at different time points and by different examiners. This is particularly important when the patient is being assessed by personnel dealing with adults as well as children, discussed on the telephone, handed over at shift change, or transferred between units or hospitals. The assessment of coma scale reliability is difficult since the examinations need to be performed without the other observers present, which means they are often conducted over a period of time during which the condition of the patient may change so that simple studies of interobserver agreement between observers may not be appropriate.[8] Video recordings may help, although it is difficult to assess some components of the scale, e.g. the strength of a painful stimulus.[9] Tests of utility in detecting clinically significant changes which require interventions are more problematical. They are rarely reported, since it is difficult to define a reproducible event associated with a change in level of consciousness. The responses to seizures and episodes of hypoglycaemia have been used in unventilated children with cerebral malaria,[10] although the change in level of consciousness caused by these events may not be applicable to other encephalopathies.

Table I: Child's Glasgow coma scale

	>5y[a]	*<5y*
Eye opening		
4	Spontaneous	
3	To voice	
2	To pain	
1	None	
Verbal		
5	Orientated	Alert, babbles, coos, words or sentences – normal for age
4	Confused	Less than usual ability, irritable cry
3	Inappropriate words	Cries to pain
2	Incomprehensible sounds	Moans to pain
1	No response to pain	
Motor		
6	Obeys commands movements	Normal spontaneous
5	Localizes to supraorbital pain (>9mo)	Withdraws to touch
4	Withdraws from nailbed pain	
3	Flexion to supraorbital pain	
2	Extension to supraorbital pain	
1	No response to supraorbital pain	

[a]For children >5y the responses are similar to the adult Glasgow coma scale.

Pain should be made by pressing hard on the supraorbital notch (beneath medial end of eyebrow) with your thumb, except for Motor score 4, which is tested by pressing hard on the flat finger nail surface with the barrel of a pencil. Toe-nail pressure is likely to elicit spinal withdrawal, especially after 1 or more days coma. If there is doubt about the response to the supraorbital stimulus, then a very localized stimulus can be applied to the sternum.

Score the best response if unclear or asymmetrical. If in doubt repeat after 5 minutes and ask for a second opinion.

Score as usual in the presence of possibly sedating drugs. Plot scores over time on a suitable chart.

The Glasgow coma scale: advantages and disadvantages

In adults, the GCS[11,12] has been widely accepted as fulfilling the above requirements.[13] It is the most widely quoted in published series of head injury[14] and has been used in non-traumatic coma.[15,16] Historically there has been, however, some inconsistency in reporting,[14] particularly with respect to verbal response and with the addition of withdrawal in the motor scale.[12] Alternative scales have been advocated for different aetiological groups, for attempting to predict outcome or for improved reliability in collaborative research. The GCS does not necessarily compare favourably with the alternatives in terms of the assessment of depth of coma, interobserver reliability, or test–retest variation.[14,17–19] Many authors have summed the three parts of the GCS for research purposes, but the summated values in the middle of the range of scores may represent rather different clinical pictures.[14,17,18] Therefore the eye-opening, verbal, and motor scores should be reported separately in adult and paediatric versions of the GCS, particularly in clinical use.[15,20]

Problems with coma scales in intubated patients

Most of the problems in recording depth of coma on the GCS occur in intubated patients, those with severe eyelid swelling, or eye open coma. Pseudo-scoring systems have evolved[21–23] to account for lack of verbal response in ventilated patients but they may underestimate the level of consciousness. In some encephalopathies, e.g. cerebral malaria, the eyes of the patients are often open,[24] although an assessment of this component can be determined by observing the visual tracking of human faces or objects (fixing and following), as in the Blantyre scale,[25] or to a painful stimulus. Alternative scales such as the reaction level scale may actually cover the full range of possibilities more comprehensively,[26] but are rela-

Table II: Verbal responses of paediatric scales

Score	*James*	*Jacobi*[a]	*Adelaide*	*Grimace*
5	Alert, babbles, coos, words or sentences – normal for age	Fixes on, follows, and recognizes objects and persons; laughs	Talks normally	Spontaneous normal facio/oro-motor activity
4	Less than usual ability, irritable cry	Fixes on and follows objects inconsistently. Recognition of persons uncertain	Words	Less than usual spontaneous ability
3	Cries to pain	Arousable at times, does not drink	Cries to pain	Vigorous grimace to pain
2	Moans	Motor restlessness – unarousable	Moans	Mild grimace to pain
1	None	Complete unresponsiveness	None	No response to pain

[a]For infants 1–24mo.

tively complex and require considerable training. A very simple alert/verbal/painful/unresponsive (AVPU) rapid measure of the level of consciousness has been recommended for immediate emergency assessment, e.g. by nursing, medical, or paramedical staff at the scene of an accident or collapse or in the resuscitation room of an emergency department as the 'D' part of the 'primary assessment': A airway; B breathing; C circulation; D disability (level of consciousness/mental sta-

Table III: Comparison of coma scales

Coma Scale	*Ref.*	*Interobserver findings*	*Proportion agreement*	*Disagreement rate*	*Kappa*	*Prediction of outcome*	*Comments*
Adelaide Coma Scale (ACS)[44]							
Eye-opening	38	*1. Video pre and*		0.143		Worst score	Disagreement
Verbal		*post-training*		0.026		associated with	rate all <0.1
Motor	45	*2. Neurosurgeons*		0.111		outcome[44]	after training
		vs nursing staff	0.76				
Eye-opening	42	*3. Paediatric*		0.06	0.29	Predicts outcome	
Verbal		*Neurology Fellow vs*		0.08	0.10	in non-traumatic	
Motor		*Consultant Paediatric*		0.04	0.71	coma[4,10]	
		Neurologist			Kn		
Eye-opening			0.58	0.13	0.44		
Verbal	9		0.63	0.08	0.51		
Motor		*4. Paediatric Neurology*	0.68	0.08	0.58		
Combined		*Fellow vs Consultant*	0.47	0.05	0.42		
		Paediatric Neurologist				Better than	
Combined	10	5. Three observers	0.36	0.31	0.31	Blantyre[10]	
European Federation of Child Neurology Societies[39]							
Eye-opening	42	*1. Paediatric*		0.03	0.45		
Verbal		*Neurology Fellow vs*		0.10	0.22		
Motor		*Consultant Paediatric*		0.06	0.49		
Combined		*Neurologist*					
					Kn		
Eye-opening	9		0.58	0.13	0.44		
Verbal		*2. Paediatric Neurology*	0.58	0.08	0.44		
Motor		*Fellow vs Consultant*	0.68	0.15	0.58		
Combined		*Paediatric Neurologist*	0.26	0.09	0.21		
Modified Coma Scale for Infants and Children[2]							
Eye-opening	23	One of three investigators			Kw		
Verbal		(PICU nurse, paediatric			0.64		
Motor		neurology trainee, PICU trainee)			0.49		
Combined		assessed child within 15min of			0.49		
		child's regular PICU nurse			0.57		
Grimace Scale[23]	23	Same methodology as study above			Kw 0.63		
Seshia scale[35]	42	*1. Paediatric Neurology Fellow vs Consultant Paediatric Neurologist*		0.06	0.63	Entered classification	Other predicators on admission and/(or)
	9	*2. Paediatric Neurology Fellow vs Consultant Paediatric Neurologist*	0.68	0.05	0.61	function for prediction outcome on admission and at 24h after	at 24h*:* extra-ocular movements, pupils, motor patterns, *BP,* temperature, seizure type, (age)
ABCD (AVPU)	29	Emergency physicians (adult study)	0.57		0.41 (0.3–0.51)		
Simplified motor scale	29	Emergency physicians (adult study)	0.83 (0.79–0.9)		0.7 (0.67–0.83)	As good as GCS in 8000 adults	
Blantyre Coma Scale (BCS)[25]	10	3 observers	0.55	0.09	0.27 Verbal 0.02	Worse predictor of neurological sequelae than ACS	BCS more specific but less sensitive than ACS in detecting events (seizures & hypoglycaemia)

Kn, Fixed sample size kappa; Kw, weighted kappa; PICU, Paediatric Intensive Care Unit; BP, blood pressure; GCS, Glasgow coma scale.

tus, pupils, posture). Responsiveness is recorded as A, alert; V, responds to voice; P, responds to pain; U, unresponsive.[27] In many countries it is taught as an easily remembered scale, e.g. in the advanced paediatric life support course.[28] However, the few interobserver data available suggest that this scale performs worse than the GCS[29] (Table III) and it is not as sensitive as the motor component of the GCS at predicting death in children with blunt trauma.[30] The alert, confused, drowsy, unresponsive (ACDU) scale appears no better[29] but a simplification of the motor scale (2: obeys com-

Table IV: Examination of the child at risk from acute neurological deterioration

Settings
The paediatric coma scale should be used routinely in accident and emergency departments and on wards and intensive care units for the assessment of any child with:
trauma (including possible **non-accidental injury**)
infection, e.g. **meningitis, encephalitis, cerebral malaria**
epileptic seizures
diabetes or other known underlying **metabolic** abnormality
hepatic failure
renal failure (including **haemolytic–uraemic syndrome**)
hypertension
In addition, children at risk of the following complications should be assessed frequently:
hypoxic–ischaemic injury, e.g. postoperatively (particularly after **cardiac surgery**)
hypotension, e.g. with **shock** (e.g. **meningococcal**)
hypertension
intracranial hypertension, e.g. with an **acute encephalopathy, diabetic coma, tumour**
after a neuroimaging procedure requiring sedation or anaesthesia
or **after a neurosurgical procedure, e.g. shunt for hydrocephalus**

Preliminaries
Check **Airway**
Breathing
Circulation
Check pupil size, symmetry, and reaction to light

Procedure
It is usually helpful to have the assistance of the child's carer, e.g. in speaking to the child or trying to wake him or her up, but the assessment must be performed objectively and it is essential to use a very painful stimulus.
Step 1 If the child's eyes are open (E4), ask the carer to talk to the patient. Ask the carer to elicit a verbal response appropriate to the child's age e.g. babbling for a child <9mo
waving bye for a child aged 9–12mo
putting a hairbrush to the head for a child aged 12–15mo
pointing to body parts for a child aged 15–24mo
any words from 12mo
any sentences from 2y
orientation in place and time from 5y
Decide with the carer whether any verbal response obtained is appropriate for the child's usual ability (V5) or less than the child's usual ability (V4).
If a child appears to understand what is said to them, even if they are not speaking, ask the child to obey a simple command, e.g. squeeze the carer's finger or squeeze his eyes shut (M6).
If the child does not have any spontaneous speech or eye opening, proceed to step 2.
Step 2 If the eyes are closed, ask the carer to talk to the child and observe whether the child's eyes open in response (E3). If they do, observe whether the child appears to recognize the carer and understand what is said. If this is the case, ask the carer to elicit a verbal response appropriate to the child's age as for step 1.
If a child appears to understand what is said to them, ask the child to obey a simple command, e.g. squeeze the carer's finger or squeeze his eyes shut (M6).
If the child's eyes remain closed or he does not obey commands, proceed to step 3
Step 3.1 Explain to the carer that you are going to press on the child's forehead to see if the patient will respond to pain as part of your assessment of their level of consciousness. If you are not confident about supraorbital pressure, or nailbed pressure, try the technique on yourself first: press hard enough to elicit a very focal sharp pain. This feels different to the pressing feeling and stops as soon as you stop pressing.
Press firmly on the supraorbital notch (beneath the medial end of the eyebrow) with your thumb.
Observe: whether the eyes open
whether the child cries or moans
whether the child moves his arms:
– Above the clavicle (localization to pain, M5)
– Below the clavicle but flexing at the elbow (flexion to pain, M3)
– Below the clavicle without flexion but with rotation at the shoulder (extension, M2)
If the child does not move, press more firmly (as hard as you can) on the supraorbital notch and observe whether there is movement of any body part, including the face (grimace).
If the child flexes but does not localize press very firmly on the nailbed (flat surface of the nail) of one finger with a pencil and observe whether or not the child moves the finger away (withdrawal to pain, M4).
Observe carefully whether there is any asymmetry of movement, which may mean that the child is at risk of uncal herniation, particularly if the pupils are asymmetrical.
3.2 When assessing an infant touch and stroke the child on the hand and forearm and note any withdrawal to touch (M5).
3.3 If you cannot feel one or other supraorbital notch, e.g. because of traumatic facial swelling, apply sternal pressure with the proximal interphalangeal knuckle of your index finger. Alternatively use finger nailbed pressure, as for M4 above. Score localizes to pain (M5) if the child brings the *contralateral* arm partly across the body to dislodge the pain or makes a complex purposeful manoeuvre to remove the pain, not just a simple withdrawal (M4).
Observe the eye opening and verbal responses to pain also.
When assessing infants the eye opening score is often E1 (none), even when verbal and motor scores are high, e.g. V4, V5, M5, or M6.
Step 4 Write down the response observed for eye opening, verbal response, and motor response. If there is asymmetry, e.g. of the motor response, write down the better side.

Footnote: Intubated children
For intubated patients, score eye opening and motor responses as above and write down VT (for 'tube') for the verbal score. Many paediatric intensive care units have adopted the grimace scale in place of the verbal scale.[23] Although there is good inter-observer agreement it has not yet been assessed as a tool for the prediction of outcome.

mands, 1: localizes pain, 0: withdrawal to pain or less) showed the least interobserver variability compared with both four-point scales and the GCS, as well as being a good predictor of outcome after trauma in adults.[29] However, although useful in the emergency setting, such a simplification is unlikely to cover all eventualities in the longer-term management of patients with complex problems. No other scale has taken the place of the GCS either in clinical practice or for research and this methodology is still recommended for more precise assessment and monitoring of children with an impaired level of consciousness,[28] although there has been no consensus on the most appropriate modifications for the paediatric age range.

Need for a paediatric coma scale

A universally agreed paediatric coma scale would be useful in several situations. In trauma, for example, although extradural haematomas are less common in children they account for some of the patients who deteriorate secondarily after head injury.[31] Outcome appears to be related to the level of consciousness at the time of craniotomy[32] and it is therefore important that children are referred for a computed tomography (CT) scan of the brain at a stage before eye closure and obvious abnormal motor posturing. Children who have a lucid interval and then lapse into potentially fatal unconsciousness after an apparently minor head injury may also have had an epileptic seizure or have developed diffuse cerebral oedema.[33] They may benefit from urgent treatment with antiepileptic drugs and/or osmotic diuretics, as may children whose level of consciousness is deteriorating for other reasons such as encephalitis, meningitis, or cerebral malaria. In a number of important paediatric conditions e.g. diabetes, hypertension, haemolytic-uraemic syndrome, the patient is not initially managed in intensive care and the neurological condition may not be the primary concern in terms of management. However, deterioration in level of consciousness is well described in association with the development of cerebral oedema and raised intracranial pressure or hypotension and is associated with poor outcome unless appropriate action is taken very rapidly. Awakening in children who have undergone complicated surgery e.g. cardiopulmonary bypass, may be delayed or incomplete, and great skill is required to distinguish children who have sustained a significant insult in time for appropriate measures to be undertaken.[34] Intracranial pressure monitoring is mainly reserved for those in deep coma, but delay in recognition may make this invasive procedure fruitless. It is not sensible to organize controlled trials of management without a valid means of clinical assessment of the study population, as aggressive management regimes should be reserved for an intermediate severity group who are unconscious but not irreversibly damaged. Prognosis worsens with increasing duration of coma[35] and the assessment of the awakening patient may then become important.

Coma scales used in children

The unmodified GCS has been used in several series of paediatric traumatic coma,[31,36,37] but there are considerable difficulties with application in this age group. In particular, the verbal scale is inappropriate in very young children who often do not speak because they have not acquired speech or are too frightened, rather than because they are unconscious. Several alternative paediatric scales have been designed[2,35,38–45] but as yet none has been universally adopted.

Scales for neonates and infants

Two scales designed specifically for infants[40,41] have high interobserver variability[42] and cannot therefore be recommended. For a neonatal Glasgow-based scale, an alternative to the verbal scale might be the assessment of the response to auditory stimuli,[43] although there have been few studies. There are also difficulties with the motor response. Children under the age of 9 months cannot consistently localize a painful stimulus[10] and those under 18 months do not reliably obey commands because their receptive language is not sufficiently developed. The difficulty is compounded by the possibility of non-accidental injury in this age group, so a reliable history may not be obtained, and because infants may still be crying or whimpering with their eyes open and a fluctuating response to pain just before irreversible neurological deterioration secondary to intracranial hypertension or seizures. If there is any doubt about the level of consciousness, it is essential that infants are intubated, transferred to intensive care, and imaged urgently with CT or magnetic resonance imaging (MRI).

Alternatives to the Glasgow coma scale

For older children, interobserver variation is least for the Seshia scale,[9,42] probably because there are only four levels, and there appears to be a consistent improvement if the choice is less.[9,29] If the variables are presented as dichotomous choices, e.g. ability to localize a painful stimulus,[9] then the findings are more likely to be reliable. Similar remarks apply to the Blantyre scale,[25] which has been widely used in the developing world for the assessment of tropical central nervous system (CNS) infections, such as cerebral malaria.[10]

Paediatric modifications of the Glasgow coma scale

The GCS works well for patients aged 5 years and above (Table I), but below that age, modifications, particularly of the verbal scale, are needed. Three of the published scales are paediatric modifications of the GCS; in each a different approach has been taken to the verbal scoring, to take into account the development of language in children under 5 years (Table II). A group of neurosurgeons in Adelaide, Australia, suggested a modification for use in children with head injury.[38,44,45] In the Adelaide coma scale (ACS; Table II), only expressive language is assessed so that the maximum score achievable on the verbal scale increases from 2 for an infant of less than 6 months to 5 by the age of 5 years. In 1983, a scale designed by Jacobi (Table II) was endorsed by the European Federation of Child Neurology Societies (EFCNS).[39] The Jacobi scale includes an assessment of the child's response to their surroundings for the upper levels and a level of motor restlessness (verbal response 2, corresponding to incomprehensible sounds on the adult scale), which it is useful to recognize, as deterioration to flaccid coma may occur rapidly. It may be more difficult to be objective when assessing response to surroundings, but doing so increases the sensitivity of the scale to subtle changes in levels of consciousness that may give an early warning of secondary deterioration before irreversible brain damage occurs. Under these circumstances, oversensitivity may be preferable to overspecificity. Reliability may be improved by defining the stimulus,[17] e.g. for a child a coloured toy, when assessing interaction with the environment. The third option is the modified coma scale for infants (MCSI), suggested by James and Trauner[2] (Table II), which is similar to the ACS in that only expressive language is included, but the number of categories in the verbal scale is the same over the full age range, so that for the upper levels, the child's response is scored in comparison with a child of the same age.

Assessment of motor response

The problem of assessing motor response in infants has also been addressed in different ways in the three scales. In the ACS and EFCNS, there are only five categories for the motor scale,[11] leaving out withdrawal because of the possibility of confusion with spinal withdrawal in brainstem death. In addition, in the ACS, the fact that children under the age of 9 months do not localize pain is taken into account so that the maximum motor score possible in an infant of less than 6 months is 3, which increases to 5 for children aged over 2 years. The advantage of the six-point motor scale[12] is that it has been widely adopted by units caring for adults. Furthermore, there are advantages to including withdrawal, since it can be used in children who are too young to have a consistent localizing response to pain. Infants who are awake usually move all four limbs either spontaneously or in response to voice[41,43] and it is possible to distinguish between withdrawal and abnormal flexion in this age group. If these four grades are used as the top levels of the infant motor response scale, the grading becomes approximately comparable with the paediatric and adult scales and it may be possible to avoid inflicting pain in fully conscious infants. In addition, there is some evidence that withdrawal has a better prognosis than abnormal flexion in children after head injury.[46] However, in the motor scale, the interobserver variability is usually greatest for the distinction between abnormal flexion and withdrawal.[47,48]

Child's Glasgow coma scale

The modified CGCS[2] has been used over several years by medical and nursing staff in the UK, and has been further modified to be applicable to older preschool children. The latest version (Tables I and II) has been used successfully in many UK centres and has undergone a rigorous assessment of interobserver reliability.[23] A similar scale with an additional grimace scale, as an alternative for the verbal scale for intubated children on paediatric intensive care units (PICU), also exhibits good interobserver reliability (Tables II and III).[23] This version has proved popular with paediatric nurses and has been adopted by the National Paediatric Neuroscience Benchmarking Group, a paediatric intensive care nurses forum covering the whole of the UK (A Warren, personal communication). However, the grimace almost certainly measures different parameters to the verbal response.[49]

For the motor response, the CGCS[2] (Table I) includes withdrawal to touch and to pain, as well as normal spontaneous movements. This makes the score easy to interpret and communicate, as any given score will imply the same level of consciousness impairment, whatever the age of the patient. Furthermore, for clinical audit and research, data on preschool children can be included with data from school-age, adolescent, and adult patients without mathematical transformation to accommodate the variable age-dependent ceiling effect.

Increasing sensitivity and improving interobserver reliability

Training in the use of the scale and the contexts in which it should be applied (Table IV) is very important. Even with the use of a widely accepted scale such as the GCS, inexperienced observers make consistent errors (Table III), particularly in the often critical intermediate levels of consciousness, when events such as seizures[10] occur, or when there is a change of nursing shift.[8] It is essential to have clear descriptions of the different observed responses and their scores on the bedside chart, particularly if they vary with age. Presenting the crucial components of the motor scale in a simplified form for those triaging emergencies[29] or as dichotomous responses may also help (Table III). Additional information, particularly from parents, may be very useful as it is the subtle abnormalities of language function that distinguish between a normal child with a Glasgow score of 15 and one with a score of 11: a simple scale such as 4=worse, 3=same, 2=better, 1=usual self might be usefully compared with nursing observations. However, it is important, particularly in research studies, that the impressions of those familiar with the child are confirmed by an experienced, unbiased observer. This is particularly pertinent in child abuse, a common cause of head injury in infants. It is sensible for all children in coma to be managed on a children's ward by appropriately trained paediatricians and paediatric nurses, able to call on other expertise if the child's level of consciousness deteriorates in any way, even subtly. There may be a need for flexibility in terms of the overlap between the age groups. Thus, children of any age who are restless and talking unintelligibly have a verbal score of 2 and are therefore deeply unconscious; they are at high risk of further deterioration. It is preferable to err on the side of recording too low a score, since it is easier to withdraw treatment from a child who is not improving than to resuscitate one who deteriorates.

A paediatric coma scale must be acceptable to nurses, since they are best placed to recognize improvement or deterioration in time for action to be taken (Table III).[50] It is absolutely vital that such a system should not be confusing and should be validated for interobserver variability (Table III).[51] For Tatman et al.'s report on the modified CGCS,[23] one strength of the study design was the use of the scores of the regular bedside nurses (i.e. those who will be making the observations in real clinical settings), and not just specially trained and very experienced medical investigators. Selection of key components, such as the top end of the motor scale,[29] and reinforcement by regular training may improve interobserver reliability in frontline staff although good, rather than excellent, agreement may be the best achievable in a clinical setting (Table III).

Conclusion

There is a need for a consensus to make teaching and collaborative research easier. Further prospective studies should be undertaken in terms of the interobserver reliability, the validity, including the predictive value, and the utility in monitoring children at risk of deterioration in neurological status. Clinical scoring systems should be used in conjunction with neurophysiological techniques such as electroencephalogram (EEG)[52–54] or evoked potentials, neuroradiological techniques including CT and MRI scanning[55,56] and perhaps serum markers of brain damage such as S100.[57,58] Neurophysiology in particular has a part to play in predicting outcome and guiding management of the unconscious child,[59,60] particularly as therapeutic sedation often makes formal neurological examination uninterpretable. Nevertheless, it is essential that those doctors and nurses who are responsible for children who have a cerebral insult are able to recognize and describe a change in the child's level of consciousness and the CGCS (Table I) has been recommended by the British Paediatric Neurology Association for this purpose.

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List of abbreviations

ACS	Adelaide coma scale
CGCS	Child's Glasgow coma scale
GCS	Glasgow coma scale