THE USE OF AN IN HOUSE SCORING SYSTEM SCALE VERSUS GLASGOW COMA SCALE IN NON-TRAUMATIC ALTERED STATES OF CONSCIOUSNESS PATIENTS : CAN IT BE USED FOR TRIAGING PATIENTS IN SOUTHEAST ASIAN DEVELOPING COUNTRIES?

M Maheswaran[1], WAW Adnan[1], R Ahmad[1], NHN Ab Rahman[1], NN Naing[2] and J Abdullah[3]

[1]Department of Accident and Emergency Medicine, [2]Unit of Biostatistics and Research Methodology, [3]Department of Neurosciences, Universiti Sains Malaysia, Kubang Kerian, Kelantan, Malaysia

Abstract. Non-traumatic Altered States of Consciousness (ASC) are a non-specific consequence of various etiologies, and are normally monitored by Glasgow Coma Scale (GCS). The GCS gives varriable results among untrained emergency medicine personel in developing countries where English is not the first language. An In House Scoring System (IHSS) scale was made by the first author for the purpose of triaging so as to quickly asses patients when seen by medical personel. This IHSS scale was compared to the GCS to determine it's specificity and sensitivity in the accident and emergency department (ED) of Hospital University Sains Malaysia (HUSM). All patients with non-traumatic ASC were selected by purposive sampling according to pre-determined criteria. Patients were evaluated by the two systems, IHSS and GCS, by emergency physicians who were on call. Patient demographics, clinical features, investigations, treatment given and outcomes were collected and followed for a period of 14 days. A total of 221 patients with non-traumatic ASC were studied, 54.3% were males. The mean age of the patients was 56 years old. The mean overall GCS score on presentation to the ED was 10.3. The mean duration of ASC was 11.6 hours. One hundred thirty patients (58.8%) experienced ASC secondary to general or focal cerebral disorders. The mortality rate was 40.3% 2 weeks after the ED visit. Fifty-four point three percent of the patients were awake and considered to have good outcomes while 45.7% of the patients had poor outcomes (comatose or dead) 2 weeks after the ED visit. The mean overall GCS score, verbal and motor subscores as well as the IHSS had significantly decreased (worsened) after treatment in the ED. A poor IHSS scale, hypertension, current smoking, abnormal pupillary reflexes and acidosis were associated with a worse 2-week outcome. The mean age and WBC count was lower and the mean overall GCS score and eye, verbal and motor subscores were higher as well as those having a lower IHSS scale for the good outcome category. Multivariate analysis revealed that smokers and hypertensives were at higher risk for a poor outcome. Higher eye scores on the GCS were associated fewer poor outcomes. There was significant agreement between the IHSS scale and GCS scores in the assessment of non-traumatic ASC. The sensitivity and specificity of the IHSS score versus GCS were 71.9% and 100.0%, respectively.

Correspondence: Prof Dr Jafri Malin Abdullah, Department of Neurosciences, School of Medical Sciences, Universiti Sains Malaysia, 16150 Kubang Kerian, Kelantan, Malaysia.
Tel: 609-7664240; Fax: 609-7648613
E-mail: deptneurosciencesppspusm@yahoo.com

INTRODUCTION

Consciousness is a state of awareness of one's self and environment. Normal consciousness requires both awareness and arousal. Awareness is a combination of cog-

nition and affect. It can be inferred based on a patient's interaction with his or her environment. Cognition is the mental faculty and process by which knowledge is gained through perception, reasoning or intuition, *ie* cortical function. Affect is the emotional feeling and mood attached to a thought including its external manifestations. Arousal is a state of being able to perceive one's environment. Awareness is determined by the cerebral hemispheres, whereas arousal is determined by the Ascending Reticular Activating System (ARAS) commonly called the sleep center (Edwards and Simon, 1988; King and Avner, 2003).

Altered states of consciousness (ASC) imply a disturbance of the normal state of awareness, arousal or both in an individual (King and Avner, 2003). ASC is defined as a clinical state manifested by conditions ranging from confusion and disorientation in time, place and person to stupor and coma (Plum and Posner, 1972; Teasdale and Jennet, 1974; Bates *et al,* 1977; Levy *et al,* 1981; Melka *et al,* 1997). It can be caused for traumatic and non-traumatic etiologies.

ASC can result from traumatic and non-traumatic etiologies. The use of the Glasgow Coma Scale (GCS) for assessment of severity and prediction of prognosis and outcomes in head-injured patients is well established (Sternbach, 2000). The GCS score has even been adopted for the description of patients with ASC from other causes (non-trauma) (American College of Surgeons Committee on Trauma, 1997). However, the use of the GCS for assessment of severity and prediction of prognosis and outcomes is not well established in patients with ASC secondary to non-traumatic etiologies and mostly misused to assess patients with non-traumatic ASC. The GCS was found to be sensitive for the above-mentioned purposes, however, one author found the GCS to have limitations which prevent it from being used as a tool to assess the severity and prognosis of patients with traumatic and non-traumatic etiologies (Gabbe *et al,* 2003).

The GCS was used to assess the severity of ASC secondary to non-traumatic etiologies in patients presenting to the Emergency Department (ED), Hospital Universiti Sains Malaysia (HUSM). This study aimed to determine if there was an association between GCS scores and acute (2-week) outcomes in patients with ASC secondary to non-traumatic etiologies. It also sought to determine if the IHSS scale was specific and sensitive indetermining acute outcomes. It was attempted to determine if there was an agreement between the GCS score and the IHSS scale when assessing the level of consciousness in patients with ASC secondary to non-traumatic etiologies.

METERIALS AND METHODS

This study was conducted in the ED, HUSM from August 1, 2003 over a period of 12 months. Ethical approval was obtained from the Research and Ethics Committee, School of Medical Sciences, Universiti Sains Malaysia. The target population were patients with altered states of consciousness (ASC) secondary to non-traumatic etiologies. The study was prospective, and various demographic and clinical data were recorded using a data collection sheet (DCS). The patients were then followed up with review of two weeks later to determine the two-week outcome (awake, comatose or dead), etiology and collect other data as shown in the DCS.

Using purposive sampling, all patients with ASC secondary to non-traumatic etiologies, seen in the ED during the 12-month study period who fullfilled the inclusion and exclusion criteria were included. A patient was deemed to have ASC if any of the following criteria were identified by the attending Emergency Physician (EDP) caring for the patient at the time of presentation (Kanich *et al,* 2002).

Inclusion criteria for the study were patients with features of ASC, older than twelve (12) years old, with ASC for up to 72 hours who had no history of trauma. Exclusion criteria were loss of consciousness secondary to cough, vasovagal or micturation syncope, migraine headaches, ASC due to pregnancy related disorders, such as pre-eclampsia or eclampsia, ASC secondary to terminal or end-stage diseases, patients with chronic ASC or abnormal cognition due to traumatic or non-traumatic brain insults or congenital disorders, patients with known psychiatric illnesses or bizarre or inappropriate behavior and recurrent episodes of non-traumatic ASC during the study period caused by the same etiology.

The duration of ASC was defined as the length of time between the onset of ASC and the time the level of consciousness was assessed in ED. The time of examination and duration of ASC was also recorded in the DCSs. Other demographic and clinical data were recorded, including patient age, sex, race, date and time of admission, presenting symptoms, physical examination, investigations performed, treatment, specialized monitoring, outcome and complications of treatment.

The level of consciousness of the selected patients was evaluated in the ED first using the GCS. The patient's GCS score in the ED was assessed by the ED physician on duty. The IHSS scale was also determined by the same physician. The definitions of the various components of the IHSS were made according to defined guidelines (Sacco *et al* 1990). The IHSS was developed using definitions from various authors (Plum and Posner, 1972; Haerer, 1979; Nolan, 1996; Adam *et al*, 1997) for alert, lethargy/drowsiness, obtunded, stupor, coma, agitation/restlessness and confusion (Table 1). Other criteria were the presence or absence of neck stiffness, papillary reflex, papilledema, oculocephalic reflex/doll's eye sign and the Babinski sign. The maximum number of points for IHSS was 6 for the level of consciousness, and for the other signs the maximum was 6, giving a maximum total score of 12. Those who had a score of 0 were deemed normal; 1 to 6 had suspected moderate neurological insult and 6 to 12 had suspected severe neurological insult.

Physical examination and investigations carried out in the ED included an electrocardiogram (ECGs), blood for full blood count (FBC), random blood sugar (RBS), renal function test and arterial blood gases and pH; and urinalysis for sugar, ketones and microscopic examination. The imaging tests most commonly performed were chest radiographs and computerised tomography (CT) of the brain, cerebral angiography (CA) and magnetic resonance imaging (MRI). The level of consciousness of the patient, after all investigations and treatments were carried out, was again assessed objectively and subjectively and then recorded according to published recommendations (Plum and Posner, 1972; Teasdale and Jennet, 1974; Bates *et al,* 1977; Levy *et al,* 1981; Haerer, 1992; Nolan, 1996; Adams *et al,* 1997; Melka *et al,* 1997). The state of consciousness was defined according to standard criteria (Plum and Posner, 1972; Haerer, 1992; Nolan, 1996; Adams *et al,* 1997). Good and bad outcomes were performed at the two week follow-up as recommend by Sacco *et al* (1990).

Complications found in patients within two weeks of being seen in the ED were recorded in the patient's medical records, and were defined according to existing critical care data (Civetta *et al,* 1992; Yew *et al,* 1999).

Statistical analysis

Data entry and analysis were done using the Statistical Package for Social Sciences (SPSS) 11.0 software for Windows. For the purpose of analysis at the two-week outcome: awake, comatose and dead were coded as 1, 2 and 3, respectively. A good outcome was coded as 1 while a poor outcome was coded as 0. The level of consciousness was coded

using the GCS as an indicator of severity of altered consciousness. Patients with GCS scores of 3 to 8, 9 to 13 and 14 to 15 were categorized as having severe, moderate and mild states of altered consciousness, respectively (Teasdale and Jennet, 1974). GCS scores of 3 to 8, 9 to 13 and 14 to 15 were coded as 1, 2 and 3, respectively.

Socio-demographic data was analyzed using descriptive analysis. Univariate analysis was done using chi-square tests for categorical variables, such as sex, race, underlying medical illnesses, smoking, alcohol consumption, illicit drug use, pupillary reflexes, acidosis, etiology of ASC and the IHSS scale. This was to determine the association of these variables with two-week outcomes.

Independent *t*-tests were used for continuous variables, such as age, GCS scores, duration of ASC, RBS values, white blood cell counts (WBC) and duration of stay in the ED. This was done to compare the mean values for these variables between the good and poor outcome groups. Paired *t*-tests were used to determine if there was any improvement or deterioration in the overall GCS scores and eye, verbal and motor subscores after treatment in the ED. The Kappa agreement test was used to determine the association between objective and subjective assessment of the ASC.

Multiple logistic regression was applied to determine factors associated with the outcome. Backward stepwise multiple logistic regression analysis was done by applying the likelihood ratio test to identify the significant variables. Fit of the model was checked by using the Hosmer and Lemeshow test and overall correctly classified percentage. Results were presented as adjusted odds ratio with a 95% confidence interval, Wald statistic and corresponding p-values.

RESULTS

During the study period beginning 1 August 2003 for 12 months, there were 221 patients with non-traumatic ASC seen in the ED.

There were 120 (54.3%) males and 101 (45.7%) females in the study. This gives a male to female sex ratio of 1.18 : 1.

The patients were predominantly Malay (90.1%). Of the remaining 22 (9.9%) non-Malay patients, 16 (7.2%) were Chinese and 6 (2.7%) were of other races, such as Indian and Thai.

The mean age of the patients in the study was 56.03 ± SD 17.04 years old (range: 13-85 years old). Forty-four of 221 patients (70.2%) were age 50 years old and above.

The mean duration of ASC was 11.6 ± SD 16.8 hours (range: 0.25-72 hours). Nearly 60% of patients had ASC for less than 6 hours.

A total of 149 patients (67.4%) were non-smokers or ex-smokers. Two hundred nineteen patients (99.1%) had never used illicit drugs or had used them greater than 1 year previously. Only 2 patients admitted to using illicit drugs, which were “pill kuda” and heroin (1 patient each).

More than 20% of patients had hypertension (57.9%), DM (31.7%) or cardiovascular diseases (21.7%). One hundred eightly-three patients (82.8%) had a known history of underlying medical illness. Seventy-seven point four percent of the patients in the study had no previous episodes of non-traumatic ASC prior to the study period; 22.6% had at least 1 episode of non-traumatic ASC.

Twenty-four patients (56.1%) were referred from health clinics, district hospitals or other major hospitals, such as Hospital Kota Bahru (HKB) and Hospital Kuala Terengganu (HKT).

Twenty-two patients (17.7%) were referred to HUSM already intubated. Nineteen patients (86.4%) were intubated in HKB or HKT, and 3 patients (13.6%) were intubated in health clinics.

Apart from ASC, other symptoms that

were obtained from the patients' history were closely related to the cardio-respiratory and central nervous systems. More than 20% of the patients presented with shortness of breath (26.7%), seizures (21.3%) or fever (20.4%).

Patients with non-traumatic ASC arrived at the ED by private vehicle (32.7%), ambulance from the ED (11.2%) or ambulance transporting patients from health clinics or hospitals (56%).

The mean heart rate for the patients was 93.6 ± SD 27.8 beats per minute (range: 0-180 beats per minute). The mean systolic blood pressure (SBP) for the patients was 148 ± SD 46.7 mmHg (range: 0-260 mmHg). The mean diastolic blood pressure (DBP) was 82.4 ± SD 26.3 mmHg (range: 0-180 mmHg). The mean oral temperature for the patients was 37.3ºC ± SD 0.6ºC (range: 37ºC - 41ºC). On arrival at the ED, the mean overall GCS score was 10.3 ± SD 1.1 (range: 3-14). The mean GCS eye subscore was 2.8 ± SD 1.2 (range: 1-4). The mean verbal subscore was 2.7 ± SD 1.4 (range: 1-5). The mean motor subscore was 4.8 ± SD 3.3 (range: 1-6). When the overall GCS scores were divided into categories, 80.1% of the patients had GCS scores of 13 or below.

Using the IHSS scale, more than 40% of the patients were assessed as lethargic or drowsy (43.4%) whereas only 18.6% were assessed as comatose. Two hundred eighteen patients (98.6%) in the study had a positive oculocephalic reflex or normal doll's eye. Two hundred three patients (91.9%) did not have neck stiffness; 208 patients (94.1%) did not have papilledema; 206 patients (93.2%) had bilaterally reactive pupils; 15 patients (6.8%) had unilaterally or bilaterally nonreactive pupils.

One hundred five patients (47.5%) had normal reflexes; 33 patients (14.9%) had unilateral hyperreflexia; 15 patients (6.8%) had bilateral hyperreflexia; 21 patients (9.5%) had unilateral hyporeflexia and 47 patients (21.3%) had bilateral hyporeflexia.

One hundred seven patients (48.4%) had bilaterally downgoing plantar reflexes; 57 patients (25.8%) had unilateral upgoing plantar reflexes; 23 patients (10.4%) had bilateral upgoing plantar reflexes; 17 patients (7.7%) each had equivocal unilateral or equivocal bilateral plantar reflexes.

Apart from ASC, other physical findings were closely related to the cardio-respiratory system and central nervous system. Many patients had pulmonary crepitations (50.7%), asymmetrical weakness (33.5%), asymmetrical tone (29.9%) or an absent gag reflex (21.7%).

The mean RBS value for patients in the study was 9.4 ± SD 6.6 mmol/l (range: 1.0-41.7 mmol/l). The mean WBC count was 12.2 ± SD 5.6 X 10^3 cells/mm^3 (range: 2.3 X 10^3-35.3 X 10^3 cells/mm^3). Ninety patients (40.7%) had metabolic acidosis; 31 patients (14%) had respiratory acidosis; 13 patients (5.9%) had mixed acidosis; 9 patients (4.1%) had respiratory alkalosis; 77 patients (34.8%) had a normal blood pH and 1 patient (0.5%) had metabolic alkalosis. A total of 134 patients (60.6%) had some form of acidosis, whereas 87 patients (39.4%) had a normal or alkaline blood pH.

Most patients had electrocardiograms (ECGs) (100%), blood tests (100%), chest radiographs (98.2%) or urine analysis (85.5%) performed. Brain computer tomographic scans were performed on 54.8% of patients. Patients usually received treatment in the ED.

Some patients received intravenous vasodilator drugs (9.5%), ranitidine or omeprazole (9.5%), anti-hypertensive drugs (8.6%), mannitol (8.1%) or insulin (8.1%).

After treatment in the ED, the mean overall GCS score decreased to 9.4 ± SD 1.1 (range: 3-15). The mean GCS eye subscore decreased to 2.7 ± SD 1.3 (range: 1-4). The

mean verbal subscore decreased to 2.5 ± SD 1.5 (range: 1-5). The mean motor subscore decreased to 4.1 ± SD 2.1 (range: 1-6).

The percentage of patients with an overall GCS scores of 13 or below decreased from 80.1% to 71.1% after treatment in the ED. The percentage of patients with an overall GCS score of 8 or below increased from 25.8% to 37.6% after treatment in the ED.

Using the IHSS scale, 3.6% of the patients remained alert while 65.2% of the patients developed a moderate neurological insult score. The percentage of patients who developed a severe neurological insult score increased from 18.6% to 31.2% after treatment in the ED. About half the patients (55.2%) were admitted to the Intensive Care Unit (ICU) the while rest were admitted to Critical Care Units (CCU) and High Dependency Units (HDU).

Central venous lines for intravascular volume monitoring and arterial lines for invasive blood pressure monitoring were inserted in 16 (7.2%) and 3 (1.4%) patients, respectively.

Four patients (1.8%) died in the ED despite aggressive treatment and resuscitation. The causes of deaths included massive acute myocardial infarction (AMI), acute pulmonary edema (APO), acute renal failure(ARF) and cardiogenic shock. The mean duration of stay in the ED was 2.82 ± SD 1.3 hours (range: 0.5-11.5 hours). 63.3% of the patients were in the ED for more than 2 hours.

Two weeks after being seen in the ED, 120 patients (54.3%) were awake, 12 patients (5.4%) were comatose and 89 (40.3%) were dead. Thus, 101 patients (45.7%) were considered to have a poor outcome.

The mean duration of hospitalization was 8.46 ± SD 8.5 days (range: 57 minutes-35 days). Fifty-nine point seven percent of patients were hospitalized for 7 days or less. One hundred nine patients (49.3%) had already been discharged 2 weeks after being seen in the ED and were no longer in the HUSM.

Of the 109 patients discharged, 18 patients (16.5%) took discharge against medical advice. Out the 89 patients who had died, 68 (76.4%) died in the HUSM whereas 21 (23.6%) died at other locations, such as in their own homes, a relative's residence or in other hospitals.

Thirty-four point eight percent of the patients died secondary to septic shock, 23.6% died secondary to intracranial bleed (ICBs), 14.7% died secondary to ischemic stroke (IS) and 12.4% died secondary to cardiovascular system (CVS) disease. During their stay at the HUSM, 48.4% of patients had pneumonia and 21.3% had septicemia.

Thirty-nine point eight percent of patients underwent mechanical ventilation, 43.9% had central venous pressure monitoring, 34.4% had intra-arterial blood pressure monitoring and 5.9% had intracranial pressure monitoring.

Fifty-eight point eight percent of patients experienced ASC secondary to general or focal cerebral disorders (58.8%). The most common causes of non-traumatic ASC were ischemic stroke (IS) (22.6%), intracranial bleeds (ICBs) (17.2%) and cardiovascular system (CVs) diseases (9.5%). Uncommon causes of non-traumatic ASC included etiologies such as drug-induced encephalopathy, hypertensive encephalopathy, hyponatremia, hepatic encephalopathy, heat exhaustion, hypovolemic shock secondary to dissecting aortic aneurysm and acute typhoid gastroenteritis (each less than 1%).

Univariate analysis

In this study, there was a decrease in the mean eye, verbal and motor GCS subscores and the overall GCS scores after treatment and therapeutic interventions in the ED.

There was a significant decrease ($p < 0.05$) in the mean overall GCS score in those who died ($p<0.001$) and decrease in the GCS verbal ($p=0.040$) and motor subscores in those

who were comatose (p<0.001) (Table 2).

The good outcome group consists of patients awake 2 weeks after being seen in the ED whereas patients dead or still comatose at that time are defined as the poor outcome group.

The mean age, WBC count and RBS values are lower for the good outcome group. The mean duration of ASC is longer for the good outcome group. The mean duration of ED stay is shorter for the good outcome group. The mean eye, verbal, motor and overall GCS scores are higher for the good outcome group.

Table 1
IHSS scoring system.

0	Alert	
1	Confused	
2	Agitation	
3	Lethargy	
4	Obtunded	
5	Stupor	
6	Coma	
	Absent/ Normal	Present/ abnormal
Neck rigidity	0	1
Pupillary reflex	0	1
Papilledema	0	1
Oculocephalic reflex	0	1
Deep tendon reflexes	0	1
Babinski sign	0	1

There was a significant difference between good and poor outcome groups for age (p=0.011), WBC count (p=0.014), GCS overall score (p<0.001) and GCS eye (p<0.001), verbal (p<0.001) and motor subscores (p < 0.001). There was no difference between good and poor outcome groups for duration of ASC, RBS values and duration of ED stay (Table 3).

To test association of IHSS scale, smoking, hypertension, epilepsy, acidosis, pupillary reflexes, sex, race, etiology of ASC, drug abuse, alcohol consumption, other medical illnesses and overall presence of underlying medical illnesses with outcome were analysed.

IHSS scale (p<0.001), smoking (p<0.001), hypertension (p=0.040), epilepsy (p=0.005), acidosis (p<0.001) and pupillary reflexes (p=0.026) were associated with outcome.

Sex, race, etiology of ASC, illicit drug use, alcohol consumption, DM, CVS diseases, obstructive airway disease, hypercholesterolemia, CVAs, renal diseases and overall underlying medical illnesses were not associated with outcome (Table 3).

Categories for the IHSS scale were collapsed for statistical analysis. The agitated/ confused/restless was combined with the lethargic category. The stuporous category was combined with the obtunded category. The comatose category stood alone. The subjective categories in each combination had less

Table 2
Comparison of mean differences (95% CI) for overall GCS, eye, verbal and motor sub-scores before and after treatment in the emergency department.

Score	Mean difference (95% confidence interval)	t-statistic	p-value[a]
Eye	0.13 (0.02, 0.28)	1.76	0.790
Verbal	0.17 (0.01, 0.33)	2.06	0.040
Motor	0.69 (0.44, 0.94)	5.43	<0.001
Overall	0.99 (0.50, 1.84)	4.00	<0.001

[a] Paired *t*-test applied level of significance was set at 0.05 (two-tailed).

Table 3
Univariate analysis showing association between variables and outcomes.

Variable	Outcome		Test statistic	p-value
	Good	Poor		
Age	53.4 (18.5)[a]	59.2 (14.6)[a]	2.57	0.011[c]
WBC	11.3 (5.0)[a]	13.2 (6.0)[a]	2.48	0.014[c]
Eye	3.1 (1.0)[a]	2.5 (1.2)[a]	4.55	<0.001[c]
Verbal	3.0 (1.2)[a]	2.4 (1.2)[a]	3.91	<0.001[c]
Motor	5.2 (1.2)[a]	4.4 (1.6)[a]	4.13	<0.001[c]
Overall GCS	11.3 (2.9)[a]	9.2 (3.6)[a]	4.83	<0.001[c]
Duration of ASC	12.5 (7.7)[a]	10.5 (15.9)[a]	0.90	0.372[c]
RBS	8.9 (6.4)[a]	9.9 (6.9)[a]	1.13	0.260[d]
Duration in ED stay	2.7 (1.2)[a]	2.9 (1.5)[a]	1.38	0.170[d]
Severe IHSS score	61 (63.5)[b]	35 (36.5)[b]	21.04	<0.001[d]
Smoking (Yes)	25 (34.7)[b]	47 (65.3)[b]	16.49	<0.001[d]
Hypertension (Present)	62 (48.4)[b]	66 (51.6)[b]	4.21	0.040[d]
Epilepsy (Present)	12 (92.3)[b]	1 (7.7)[b]	8.04	0.005[d]
Pupillary reflex alone (present)	119 (56.9)[b]	90 (43.1)[b]	4.95	0.026[d]
Acidosis (present)	58 (42.9)[b]	75 (57.1)[b]	14.46	<0.001[d]
Sex (Males)	59 (49.2)[b]	61 (50.8)[b]	2.79	0.095[d]
Race (Malays)	108 (54.3)[b]	91 (45.7)[b]	0.001	0.980[d]
Etiology	22 (59.5)[b]	15 (4.1)[b]	5.86	0.210[d]
Illicit drug use (present)	1 (50.0)[b]	1 (50.0)[b]	0.02	0.902[d]
Alcohol use (present)	3 (75.0)[b]	1 (25.0)[b]	0.70	0.402[d]
Diabetes mellitus (present)	37 (52.8)[b]	33 (47.2)[b]	0.09	0.770[d]
Cardiovascular disease (present)	30 (62.5)[b]	18 (37.5)[b]	1.66	0.197[d]
Obstructive airway disease (present)	14 (58.3)[b]	10 (41.7)[b]	0.18	0.674[d]
Hypercholesterolemia (present)	9 (64.2)[b]	5 (35.8)[b]	0.60	0.438[d]
Cardiovascular accident (present)	14 (58.3)[b]	10 (41.7)[b]	0.18	0.674[d]
Renal disease (present)	16 (61.5)[b]	10 (38.5)[b]	0.62	0.430[d]
Underlying medical illness (present)	101 (55.2)[b]	82 (44.8)[b]	0.34	0.56[d]

[a]mean (sd); [b]n (%); [c]Independent *t*-test applied; [d]Pearson chi-square test applied

difference between each other in the broad spectrum of ASC. The categories were then matched with GCS categories of similar states of altered consciousness.

Using kappa agreement test, there was an agreement (Kappa=0.79, p<0.001) between GCS scores and IHSS scale when assessing level of consciousness of patients with non-traumatic ASC (Table 4).

Multivariate analysis

Multiple logistic regression revealed that

Table 4
Sensitivity and specificity of ASC compared to GCS.

IHSS	GCS	
	Severe	Not severe
Severe	41	0
Not Severe	16	164

Sensitivity = 71.9%
Specificity = 100%
Kappa = 0.79 (p < 0.001)

Table 5
Multiple logistic regression analysis showing significant variables associated with outcomes.

Variable	Adjusted odds ratio	95% CI of odds ratio	Wald statistic	p-value
Eye score	0.56	0.43,0.73	17.84	<0.001
Smoking	3.40	1.79, 6.47	13.89	<0.001
Hypertension	2.14	1.13, 4.04	0.32	0.019

Backward stepwise multiple logistic regression applied.
Fit of the model was checked by Hosmer and Lemeshow test (p=0.315) and correctly classified overall percentage (68.8%).

increase in eye score would likely to reduce the risk of having poor outcome (adjusted OR=0.56, 95% CI 0.43, 0.73, p<0.001). smokers were 3.40 times more likely to be at risk of having poor outcome (adjusted OR=3.40, 95% CI 1.79, 6.47, p<0.001). Hypertensive patients were 2.14 times more likely to have poor outcome (adjusted OR=2.14, 95% CI 1.13, 4.04, p=0.019) (Table 5).

DISCUSSION

Objective assessment using the GCS and IHSS scale were subject to inter-observer variability.We attempted to reduce this measurement bias by briefing and training the ED MOs on proper assessment of non-traumatic ASC using the GCS and subjective methods. A pilot study was done after the briefing in the ED, to identify mistakes and weaknesses and thus steps were taken to correct them.

In a study of prognosis in non-traumatic coma, 23% of the patients had absent pupillary reflexes and 33.3% had absent oculocephalic reflexes (Levy *et al,* 1981). In this study, 6.8% of the patients had unilaterally or bilaterally unreactive pupils. This may indicate localized intracranial structural lesions or diffuse cerebral and brainstem insult (Edwards and Simon, 1982). One point four percent of the patients had absent oculocephalic reflex or abnormal doll's eye sign. Both reflexes are indicators of brainstem function (Edwards and Simon, 1982). The low rates for absent oculocephalic reflex (1.4%) and unilaterally or bilaterally unreactive pupils (6.8%) indicate that the majority of the patients in this study did not experience severe brainstem dysfunction at the time of assessment by the ED physician.

In a study of prognosis in non-traumatic coma, 19% of the patients had normal or decreased deep tendon reflexes (Levy DE *et al,* 1981). Fifty percent of the patients in our study had normal deep tendon or plantar reflexes.

We could not find any other study in the medical literature that examined physical signs apart from level of consciousness, neurological functions and brainstem reflexes among patients with non-traumatic ASC. The majority of the physical findings were related to the CNS and cardio-respiratory system. This was consistent with the results of the study that showed that 58.8% and 20.8% of the patients had ASC secondary to general or focal cerebral disorders and hypoxic-ischemic disorders, respectively. Fifty point seven percent of the patients had pulmonary crepitations. This was not solely due to cardiac or respiratory causes of ASC but could also be due to intracerebral disorders such as SAH, ischemic stroke and ICBs. Patients with these latter conditions may have diminished level of consciousness, reduced protective airway reflexes and thus could aspirate their stomach contents (Civetta *et al,* 1992). They can then develop pneumonia or pneumonitis and hence have pulmonary crepitations on chest examination.

It has not been reported yet in the medical literature that examined blood pH in all patients with non-traumatic ASC as a whole. Sixty point six percent of the patients in this study had either metabolic acidosis, respiratory acidosis or mixed acidosis. Metabolic acidosis could indicate a condition of decreased tissue perfusion as a result of CNS dysfunction, hypoxic-ischemic events or septic causes resulting in increased lactic acid production (Tintinalli *et al,* 2000; Braunwald *et al,* 2001). It can also be due to metabolic derangements such as renal failure, uncontrolled DM, DKA and poisoning with toxic alcohols or drugs such as salicylates (Tintinalli *et al,* 2000; Braunwald *et al,* 2001). Respiratory acidosis could indicate a primary cardiorespiratory dysfunction resulting in impaired gaseous exchange or ventilation-perfusion mismatch resulting in accumulation of carbon dioxide in the bloodstream (Tintinalli *et al*, 2000; Braunwald *et al*, 2001).

We could not find any other study in the medical literature that examined GCS scores before and after treatment in the ED or in the wards. The mean GCS score after treatment in the ED was 9.4 as compared to 10.3 on arrival at the ED. The mean GCS eye, verbal and motor subscores were 2.7, 2.5 and 4.1, respectively. After treatment in the ED, the proportion of patients in the severe category (GCS scores 8 and below) had increased by 45% *ie,* from 57 (25.8%) to 83 (37.6%). The proportion of patients in the mild category (GCS scores 14 and above) had increased by 45.4% *ie,* from 44 (19.9%) to 64 (29%). This indicates that some patients in the moderate category (GCS scores 9 to 13) had benefited from treatment in the ED.

After treatment in the ED, the proportion of patients described as comatose had increased from 18.6% to 31.2%. Eleven point eight percent of the patients were described as obtunded or stuporous as compared to 18.1% on arrival in the ED. This is due to patients deteriorating despite treatment and also due to some patients being intubated as mentioned earlier and hence assessed to have lower levels of consciousness.

After treatment in the ED, 7.7% of the patients were described as restless, agitated or confused as compared to 19.9% on arrival in the ED. This decrease again could be due to deterioration of these patients' condition to a comatose state despite ED treatment or reduced responsiveness secondary to sedative, analgesic or muscle relaxant drugs used to control their condition.

In a study of predictors of 2-week outcome in non-traumatic coma, 44.4% and 21.5%, respectively of the patients had died or were comatose by two weeks (Sacco *et al,* 1990). In our study, two weeks after being seen in the ED, 40.3% and 5.4% of the patients had died or were comatose, respectively. The death rates were similar in both studies, although the above study focused on coma only, therefore poor outcomes were inevitable.

In a study of patients with non-traumatic ASC in North Western Ethiopia, the mean duration of hospital stay was 6 days (Melka *et al,* 1997). In a study of patients with altered mental status seen in the ED, the mean hospital stay was 7.6 days (Kanich *et al,* 2002). However, this study included trauma patients. The mean duration of hospitalization in our study was 8.5 days. The longest stay was 35 days. Fifty-nine point seven percent of the patients were hospitalized for no more than 7 days. The duration of hospitalization reflected the degree of in-patient evaluation and treatment based on the etiology of the ASC. Longer duration of stay may indicate a more serious etiology, more complications or more intensive treatment and monitoring required for these patients.

Two weeks after admission, 109 patients (49.3%) were no longer in the HUSM. They

were either at home or in other locations (relative's home, another hospital or had died). These patients had already been discharged home either by HUSM authorities (83.5%) or had taken discharge against midical advice (16.5%). The remaining patients were still at HUSM undergoing treatment. The annual rate for patients discharged against medical advice at the HUSM in 1990 was 1.4%; it had decreased to 0.3% in 1995 (HUSM, 1990-1995).

The rate for discharge against medical advice by 2 weeks among the patients in the study was more than 15%. This is quite high compared to the overall annual rate at the HUSM. This may reflect the traditional mindset and rural background of people in North-Eastern Peninsular Malaysia.

A total of 23.6% of patients who had died within two weeks of the ED visit, died at home. Most of these patients were brought home by their families against medical advice. The remaining patients had been discharged by hospital authorities but still died due to complications of their illnesses. Sixty-eight patients (76.4%) died at the HUSM despite aggressive treatment.

Two weeks after admission, 59% of patients had undergone at least one form of invasive monitoring, usually in the ICU, CCU or HDU. These patients were usually bedridden and had multiple tubes, lines and catheters. This predisposed them to nosocomial infections and other complications. More than 50% of patients experienced nosocomial infection, such as septicemia, pneumonia, urinary tract infection and dessiminated intravascular coagulopathy.

Two weeks after the ED visit, the most common causes of death were related to focal or general cerebral etiologies such as ICBs and ischemic strokes. This made up 46.2% of the deaths. These etiologies of non-traumatic ASC were related to underlying medical illnesses, such as diabetes mellitus and hypertension, reflecting the serious nature and complications of these illnesses if left untreated or poorly controlled (Stamler *et al,* 1993; Whelton, 1994; Grundy *et al,* 1999; Braunwald *et al,* 2001; Ong and Raymond, 2002). Hence, more aggressive control of these underlying illnesses may help to reduce the incidence and deaths secondary to these cerebral pathologies. There was a high rate of deaths secondary to septic shock (34.8%). Many patients underwent further treatment in the ICU, CCU or HDU. They often developed infection-related complications secondary to invasive monitoring and then succumbed to them.

Nearly 15% of patients in a study of non-traumatic ASC in North Western Ethiopia had ASC secondary to structural cerebral disorders; however diagnosis was made by clinical evaluation only (Melka *et al,* 1997). This is much lower than that found in our study of 42.2%. The above-mentioned study also found 55% and 22.3% of their patients had ASC secondary to infection and metabolic causes, respectively, whereas our study had only 19.5% of patients experiencing ASC secondary to metabolic or septic etiologies.

In our study, 22% and 17.2% of patients had ischemic strokes and ICBs, respectively. Hypoxic and ischemic disorders consisted mainly of CVS diseases (9.5%), such as AMI, APO, cardiogenic shock and cardio-respiratory arrest. Six point eight percent of patients experienced renal etiologies such as ARF with fluid overload, hyperkalemia or uremic encephalopathy. Five point four percent of patients had a subarachnoid hemorrhage (SAH). Underlying risk factors for the above-mentioned disorders are hypertension, DM, coronary artery disease (CAD) and peripheral vascular disease (Stamler *et al,* 1993; Whelton, 1994; WHO, 1994; Grundy *et al,* 1999; Braunwald *et al,* 2001; Ong and Raymond, 2002).

This study showned a high proportion of non-traumatic ASC were due to cerebral disorders (58.8%). This could be due to poorly controlled hypertension or DM. If these illnesses are identified and well controlled with medication and lifestyle modification, it is hoped that the incidence of ASC secondary to these cerebral disorders can be reduced. Further long term studies are needed to determine if this is true.

The mean overall GCS and verbal and motor subscore decreased significantly after treatment in the ED. The mean overall GCS score decreased from 10.4 to 9.4; the mean verbal subscore decreased from 2.7 to 2.5; the mean motor subscore decreased from 4.8 to 4.1.

There was a significant difference between the good and poor outcome groups in regard to age, WBC count, GCS overall score and GCS eye, verbal and motor subscores. However, only the eye score was significant on multivariate analysis.

There were no differences ($p > 0.05$) between good and poor outcome groups in regard to duration of ASC, RBS values and duration of ED stay.

In a study of predictors of outcome in non-traumatic coma, age was not associated with 2-week outcome (Sacco *et al,* 1990). In a study of prognosis in non-traumatic coma, functional recovery did not depend on age (Levy *et al,* 1981). These two studies concentrated only on patients with coma, a GCS score 8 or below.

The mean value for age in the current study was significantly lower in the patients with a good 2-week outcome. This means younger patients may have a better chance of achieving a good 2-week outcome following non-traumatic ASC. Younger patients would be expected to have lower risks for having diseases such as hypertension, DM and CAD (Harris, 1993; Stamler *et al,* 1993; Whelton, 1994; National Institute of Health, 1997; Braunwald *et al,* 2001); thus their lower risk of acquiring complications such as ICBs, ischemic strokes, acute myocardial infarction (AMI) and diabetic ketoacidosis (DKA). However, this lower risk does not necessarily translate to a better outcome because other factors, such as the initial level of consciousness, duration of symptoms, severity of illness and availability of medical treatment, can influence the outcome. There was no significant association between age and outcome on multivariate analysis in this study.

In a study of non-traumatic ASC in North Western Ethiopia, mortality was strongly associated with the level of consciousness on presentation, such that 72% of patients with a GCS score below 7 died compared to 13.3% mortality for those with GCS scores above 7 (Melka *et al,* 1997). In a study of predictors for 2-week outcome in non-traumatic coma, patients with an initial GCS score of 6 to 8 were 7 times more likely to awaken than those with a score of 3 to 5; this study concentrated only on patients with coma, *ie* GCS scores 8 and below (Sacco *et al,* 1990).

In this study, the mean values for overall GCS scores and GCS eye, verbal and motor subscores on admission were significantly higher in the patients with good 2-week outcomes. This means that patients with higher initial GCS scores may have a better chance of achieving a good 2-week outcome following non-traumatic ASC. This result is similar to the above studies. In this study, the mean value for WBC count was significantly lower for patients with a good 2-week outcome. This means that patients with a lower WBC count on arrival at the ED may have a better chance of achieving a good 2-week outcome following non-traumatic ASC. However, no parameters mentioned here, except eye score, were significant on multivariate analysis.

In this study, there was no significant dif-

ference in the mean values for duration of ASC between patients with good and poor outcomes. This means the duration of ASC, measured from onset to arrival at the ED did not influence the 2-week outcome. There was no significant difference in the mean values for RBS between patients with good and poor outcomes. This means that the RBS values on arrival at the ED did not influence 2-week outcomes.

There was no significant difference in the mean values for duration of stay in the ED between patients with good and poor outcomes. The duration of patient stay in the ED did not influence the 2-week outcome. We could not find any other studies in the medical literature to support or dispute this finding.

In this study, etiology was not associated with 2-week outcome. This difference, when compared to the above-mentioned studies, may be due to the different etiological categories used to incorporate the various etiologies for non-traumatic ASC. Each of the above-mentioned studies used different categories to goup the various etiologies, although this study used the categorization of non-traumatic etiologies of ASC used by Sacco *et al* (1990). It may also be due to the differences in inclusion criteria used with respect to the GCS. Sacco *et al* (1990) and Levy *et al* (1981) included patients with a GCS score of 8 or lower only, whereas Melka *et al* (1997) and our study included patients with a GCS score of 14 and below.

In this study, pupillary reflexes were associated with the 2-week outcome. Absence of a pupillary light reflex was defined as no pupillary constriction to conventional bright penlight in at least 1 eye (Tokuda *et al,* 2003). However, it was not significant on multivariate analysis.

In this study, hypertension was found to be associated with the 2-week outcome following non-traumatic ASC, and was confirmed by multivariate analysis. Individuals with any form of underlying medical illness accounted for 82.8% of the patients. Underlying medical illness was not associated with 2-week outcome.

In this study, acidosis, whether metabolic, respiratory or mixed, was found to be associated with 2-week outcome following non-traumatic ASC. We looked at the association between acidosis and outcomes for all non-traumatic etiologies of ASC combined.

Smoking was associated with 2-week outcome following non-traumatic ASC. We examined the association between smoking and outcome for all non-traumatic etiologies of ASC combined. We could not find other studies in the medical literature that assessed the association between smoking and outcome for all etiologies of non-traumatic ASC combined. Multivariate analysis confirmed smokers were at risk for having a poor outcome. Subjective categorization of level of consciousness on admission to the ED was associated with 2-week outcome.

In a study of predictors of outcome in non-traumatic coma, sex and ethnicity were not related to 2-week outcome (Sacco *et al,* 1990). In our study, gender, ethnicity and alcohol consumption were not associated with outcome.

DM was also not associated with 2-week outcome. We assessed the effect of DM on the outcome for all patients with non-traumatic ASC as a whole irrespective of etiology. We could find no other studies that assessed the association between DM and outcome for all etiologies of non-traumatic ASC combined.

IHSS was found to be no better than GCS in sensitivity, which is more important than specificity when a scoring system is needed for triaging patients who do not suffer from critical conditions such as altered consciousness. More studies are needed to assay the validity of IHSS in other groups of patients who

suffer from traumatic ASC or ASC from chronic diseases such as diabetes mellitus or cancer.

In conclusion, we found a simpler scoring system, like IHSS, may be used for the assessment of ASC patients of the non-traumatic type with a specificity of 100.0% and a sensitivity of more than 70.0% compared to the GCS with a specificity of 84.0% and a sensitivity of 79.0% (Prasad, 1996). The GCS score requires a more sophisticated neurological knowledge which may be lacking amongst rural medical personel in developing countries in Asia (Beuchler *et al*,1998). Eye opening on the GCS was a similar significant variable in outcomes seen in a recent Canadian study (Moore *et al*, 2006). IHSS may be used as a simpler tool in rural medical centers in Southeast Asian countries which manage patients with non-traumatic ASC. A moderate or severe score means the patient should be referred immediately to a tertiary center with facilities to perform a computer tomographic scan of the brain.

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