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Analysis of Patients with Altered Mental Status in an Emergency Department of Eastern Taiwan

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Abstract

Objective: The purpose of this study was to determine the etiologies of altered mental status (AMS) in an emergency department (ED) and the associated contributing factors.

Materials and Methods: A retrospective chart review of the medical records was performed from January 2006 through December 2006 in a medical center in eastern Taiwan among the ED patients with AMS. Data collected included sex, age, date of ED visit, chief complaint, disposition, admission diagnosis, date of admission, location admitted to (ordinary ward or intensive care unit), diagnosis at discharge, and date of discharge from hospital.

Results: Of the 595 patients analyzed during the study period, which accounted for 1.3% of total ED census, the mean age was 51.55 years. The three leading etiologies of AMS were trauma, hypoglycemia, and stroke. Among them, trauma had higher incidences in the summer and winter; hypoglycemia had increased tendencies in the spring; the population of stroke patients increased in the summer and fall. Of the cases studied, 51.3% were admitted with a mean length of stay of 13.54 days; incidence of death was 12.4%. Other conditions with admission rate >50% were hypoxia and stroke. The diagnoses with the lowest admission rate were psychosis, trauma and alcohol abuse. One third of AMS patients was younger than 40 years and the other one third was older than 70 years.

Conclusion: It is important for ED physicians to be knowledgeable about the etiologies of patients with AMS in general, special subgroups, and the etiologic tendencies during the different seasons. Ranking results for the different etiologies of AMS in our study differed from the results of previous studies due to differences of local culture and residents in eastern Taiwan.
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1. Introduction

Altered mental status (AMS) is a fairly common reason for patients to visit the emergency department (ED). The real causes behind AMS are varied and broad. Many emergency physicians (EPs) like to use mnemonics to help them with differential diagnosis. One commonly used mnemonic for AMS is AEIOU-TIPSM: A for alcohol, other toxins, drugs; E for endocrine, electrolytes; I for insulin, diabetes-related, hypoglycemia; O for oxygen, opiates; U for uremia; T for trauma, temperature; I for infection; P for psychiatric, poisoning, porphyria; S for stroke, seizure, shock, subarachnoid hemorrhage; and M for metabolic: hyperammonia [1]. However, the differential diagnoses for AMS include conditions with significant morbidity and mortality rates. Caring for these patients must be rapid and thorough [2]. Acute mental change must be evaluated in rapid sequence or simultaneously while using the tools of basic resuscitation, history, clinical assessment, laboratory evaluation and radiological assessment [3,4]. Even experienced physicians may not find the exact diagnosis during the whole course of the patient's stay in the ED, despite using all possible means including laboratory and imaging studies. That is why there are still many tentative diagnoses written as AMS on the admission permit sheets in daily practice. When the correct diagnosis is made in the ED, definitive treatment can be given before admittance to hospital. Accordingly, a favorable prognosis is usually obtained. Unfortunately, there are only a limited number of articles with regard to the diagnosis of AMS in the ED. The purpose of this study was to explore the etiologies and risk factors responsible for AMS in an ED. Furthermore, we wanted to determine the correlation between season and disease manifestation clinically. Thus, determining the occurrence rate of different etiologies causing AMS in the different seasons may be a great benefit to diagnosis. It has also never previously been considered, so the factor of season was added to our study.

2. Materials and methods

A retrospective chart review study was conducted from January 2006 through December 2006 in the ED of a university-affiliated medical center in eastern Taiwan, with 700 acute care beds and 52,000 ED visits annually. Patients visiting this ED during the study period with the diagnosis of AMS were analyzed. AMS was defined as meeting any one of the following criteria: Glasgow coma scale score <15; not alert or oriented to people, things, place or time; diminished reaction to verbal or physical stimulation; difficult to arouse; unable to remain awake; hallucination; confusion; bizarre or inappropriate behavior and any other finding suggesting AMS to the treating physicians in the ED. Eligible cases were extracted from our "new medical information system", by which monthly reports were collected and information such as sex, age, date of ED visit, chief complaint, disposition, admission diagnosis, date of admission, location admitted to (ordinary ward or intensive care unit (ICU)), diagnosis at discharge, and date of discharge from hospital were listed. The medical records of those who met our criteria were also collected and reviewed by two EPs.

We divided the patients in this study into subgroups according to season, sex and age. Cases from February through April, May through July, August through October, and November through January represented spring, summer, fall and winter, respectively. The classification of age was performed using eight scales with one scale for every 10 years from <20 years to >80 years.

The diagnoses were divided into 10 subgroups, which included A (alcohol, other toxins, drug use); E (endocrine, electrolytes); I (insulin, diabetes-related); O (oxygen, opiates); U (uremia); T (trauma, temperature); I (infection); P (psychiatric, porphyria); S (stroke, seizure, shock); and M (metabolic: hyperammonia).

All data were analyzed using Microsoft Excel 2003 and SPSS version 13.0 (SPSS Inc., Chicago, IL, USA), with a p value <0.05 taken as statistically significant.

3. Results

Of the 650 AMS patients seen during the study period, 595 were enrolled into this study after excluding those whose data were incomplete. This number represented 1.3% of the total ED census. The mean age was 51.55 years, and the male to female ratio was 1.07:1 (Table 1).

Table 1 — Characteristics of 595 AMS patients in the ED*

Sex	
Male	308 (51.76)
Female	287 (48.24)
Mean age (yr)	51.55
Male	48.22
Female	55.11
Disposition	
Admission to ordinary ward	167 (28.07)
Admission to ICU	138 (23.19)
Discharge from ED	285 (47.9)
Died in ED	5 (0.84)
Death	77 (12.94)
Mean length of stay (d)	
Ordinary ward	13.54
ICU	4.99

*Data presented as n (%). AMS = altered mental status; ED = emergency department; ICU = intensive care unit.

Of the study patients, 47.90% were discharged from the ED, 23.19% were admitted to the ICU, and 28.07% were admitted to ordinary wards. Among them, 12.94% died and most (93.5%) of them died after admission to hospital. For those admitted, the mean length of stay (LOS) was 13.54 days (range, 1–95 days) in the ordinary wards and 4.99 days (range, 1–35 days) in the ICU (Table 1).

The ranking of the final diagnoses at discharge for the AMS patients were T (trauma; 36.81%), I (mainly hypoglycemia; 17.65%), S (mainly stroke; 15.46%), A (mainly alcohol; 11.93%), I (infection; 8.57%), M (hepatic encephalopathy; 3.36%), P (psychosis; 2.01%), U (uremia; 1.68%), O (aspiration asphyxia; 1.34%) and E (electrolyte imbalance; 1.18%) (Table 2). We found that all cases of hypothermia occurred together with hypoglycemia.

The percentage of patients younger than 40 years was 33.3%, and that of those older than 70 years was 32.1%. The etiologies of AMS in patients younger than 40 years included alcohol use and trauma. The etiologies in those older than 65 years were infection, oxygen (aspiration) deprivation, uremia, stroke and hypoglycemia (Table 2).

The number of patients visiting the ED varied minimally among the seasons. The ranking of incidences of etiologies of AMS in the spring were U (uremia; 60%), M (hepatic encephalopathy; 55%) and I (hypoglycemia; 35.2%). The ranking of etiologies in the summer were A (alcohol, drug and toxin use; 52.11%), I (infection; 29.41%) and S (mainly stroke; 27.17%). In the fall, stroke increased in tendency, accounting for 32.61%. Trauma and infection were the two diagnoses with higher incidence in the winter (Table 2).

Characteristics regarding the disposition and prognosis of the AMS patients are shown in Table 2. The three leading diagnoses causing admission to the hospital were infection (90.2%), E (endocrine, electrolytes; 85.71%) and M (metabolic: hyperammonia; 65.0%). Other conditions with admission rate >50% were O (oxygen, opiates) and S (stroke, seizure, shock). The diagnoses with lowest admission rates were P (psychiatric, porphyria; 8.33%), T (trauma, temperature; 23.74%) and A (alcohol, other toxins, drugs; 23.90%). Among the patients admitted to the hospital, the most common diagnoses were T (trauma, temperature; 25.53%), S (stroke, seizure, shock; 21.27%) and infection (20.81%). The diagnosis with the longest LOS was S (stroke, seizure, shock; 19.61 days), followed by T (trauma, temperature; 13.42 days) and infection (12.89 days) after excluding P (psychiatric, porphyria), O (oxygen, opiates) and E (endocrine, electrolytes) due to the low number of patients studied. Patients with O (oxygen, opiates), infection and T (trauma, temperature) received critical care, and had the longest LOS of 12.75 days, 5.45 days and 5.39 days, respectively. The three leading diagnoses causing death were infection, M (metabolic: hyperammonia) and S (stroke, seizure, shock).

The diagnoses with female predominance were E (endocrine, electrolytes; 100%), P (psychiatric, porphyria; 83.33%), O (oxygen, opiates; 75%), U (uremia;

Table 2 — Etiologies in different age, season and their admission rate

	Etiologies (*n*)											
	A	E	I	O	U	T	I	P	S	M	Total	%
Total *n*	71	7	105	8	10	219	51	12	92	20		
%	11.93	1.18	17.65	1.34	1.68	36.81	8.57	2.01	15.46	3.36		
Age (yr) distribution												
<20	4	0	0	0	0	77	2	1	0	0	84	14.11
20–29	19	1	2	0	0	23	0	2	0	0	47	7.90
30–39	20	1	6	0	0	29	0	3	4	1	64	10.76
40–49	12	0	5	1	1	28	2	2	11	6	68	11.43
50–59	9	3	10	1	1	21	5	1	6	2	59	9.91
60–69	4	0	29	1	2	11	9	0	22	4	82	13.78
70–79	1	1	40	4	4	16	20	0	33	5	124	20.84
≥80	2	1	13	1	2	14	13	3	16	2	67	11.26
Season												
Spring	14	1	37	2	6	55	11	4	24	11	165	27.73
Summer	37	3	19	1	0	35	15	3	25	5	143	24.03
Fall	13	1	22	2	2	56	9	2	30	2	139	23.36
Winter	7	2	27	3	2	73	16	3	13	2	148	24.87
Admission rate (%)	23.90	85.71	29.52	50.00	40.00	23.74	90.20	8.33	51.09	65.00		

A = alcohol, other toxins, drugs; E = endocrine, electrolytes; I = insulin, diabetes-related, hypoglycemia; O = oxygen, opiates; U = uremia; T = trauma, temperature; I = infection; P = psychiatric, poisoning, porphyria; S = stroke, seizure, shock, subarachnoid hemorrhage; M = metabolic: hyperammonia.

70%) and I (hypoglycemia; 62.86%). Male predominance was observed for M (metabolic: hyperammonia; 80%), A (alcohol, other toxins, drugs; 57.74%) and T (trauma, temperature; 58.9%).

In this study, polynomial regression analysis revealed positive correlation between admission rate and emergency triage level, as well as admission rate and diagnosis of infection. Statistically, people arriving at the ED in the spring and with the diagnosis of A (alcohol, other toxins, drug use), I (hypoglycemia) and T (trauma, temperature) were not related to admission ($p<0.05$).

4. Discussion

AMS is a common complaint of patients visiting the ED, and there may be many reasons for the AMS. However, the real diagnosis is sometimes difficult to determine. In a retrospective review of the medical records at a university hospital (5), the most common diagnosis at discharge accounting for AMS were neurological (28%), followed by toxicological (21%), trauma (14%), psychiatric (14%), infectious (12%), endocrine/metabolic (5%) and others (pulmonary, oncology, cardiovascular, gastrointestinal and renal, all together accounting for (9%). Boston City Hospital listed numerous etiologies in 1934 (6), including substance intoxication, stroke and trauma. Ethanol intoxication was the leading cause of coma, which affected nearly 60% of intoxication cases. Head trauma accounted for approximately 15% of AMS cases, of which cerebral vascular events caused 10% of the alterations. A significant range of etiologies accounted for the remainder of the cases of coma, including non-ethanol intoxication, epilepsy-related convulsion or sequelae of seizure, complications of diabetes, meningitis, pneumonia and cardiogenic shock. EPs usually encounter a tremendous number of patients with AMS during a daily shift with a wide range of etiologies. In our study, those etiologies could be approximately categorized into AEIOU-TIPSM. The most common diagnostic group accounting for AMS was trauma (38%). There is no wonder that the incidence of major trauma occurring in eastern Taiwan was higher than any other place in Taiwan (7,8). Hypoglycemia and cerebral vascular events were responsible for the next most frequently encountered diagnostic category causing AMS, which could be explained by the high epidemiologic prevalence of diabetes mellitus and hypertension with poor control in eastern Taiwan. In addition, ethanol was the most frequent toxin in this diagnostic group due to the local aborigines, who account for one third of the population of eastern Taiwan.

Previous investigations have focused on segments of the ED population, particularly the elderly (9–11). However, the mean age of our presenting patients with AMS was 51.55 years, which is significantly younger than the patients reported in previous studies. This may be because traumatic, ethanol, psychotic and toxicological causes are found much more often in the younger population. However, it was noted that in the elderly population, the most frequent causes of AMS were stroke, hypoglycemia, sepsis and hyperammonemia.

There was a tendency toward male and youth predominance in some etiologies such as trauma and alcohol consumption. Driving under the influence (DUI) and drunken fighting are big problems in our society, especially in eastern Taiwan. Compared with the younger population, most of the diagnoses accounting for AMS in the elderly population had underlying causes such as diabetes, hypertension, renal dysfunction and infection.

There were some obvious differences between our results and those of previous investigations. The mean age of our patients was younger. The rankings of the leading causes of AMS were different, and no other studies mentioned the relationship between season and etiologies of AMS. In addition, our findings were in accordance with the lifestyle, ancestral heritage and local culture in eastern Taiwan.

There were several drawbacks in this study. First, retrospective review of old charts may be influenced by incomplete and/or inconsistent gathering of clinical information. Second, the prehospital management by emergency medical technicians was not included in this study, which has impact on the time spent on diagnosis as well as on prognosis. Third, we did not investigate the risk factors for the unknown etiologies of patients with AMS until admission to the hospital, which is most important for the EPs. By knowing that, EPs would make the correct diagnosis and be able to provide definitive treatment earlier. The results of previous studies showed that specific features of clinical evaluations providing the greatest diagnostic value were history of present events, medical history, physical examination and response to various treatments (12). These four diagnostic tools were helpful in 40–50% of cases (12). The portion of the clinical evaluation that was of little benefit included various radiographs, 12-lead electrocardiogram, and laboratory study results (12).

We conclude that it is important for EPs to be knowledgeable about the etiologies of patients with AMS in general and special subgroups, including seasonal and epidemiological tendencies in the area. According to our study results, the most common causes of AMS were trauma, hypoglycemia and cerebral vascular accidents in eastern Taiwan. In addition, we would like to reiterate the importance of the mnemonic of AEIOU-TIPSM as a useful tool for determining the causes of AMS.

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