

Patients Admitted to an Intensive Care Unit for Poisoning

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Abstract

This paper presents our experience with patients admitted for poisoning to the adult medical intensive care unit (MICU), Tan Tock Seng Hospital, from 1 January 1993 to 31 December 1995.

Case records of 50 consecutive patients admitted to the MICU for management of poisoning were retrospectively analysed for epidemiologic data and intensive care interventions.

There were equal proportions of male and female patients. The majority (76%) were in the economically productive age group of 21 to 60 years old. Most patients (24 out of 50) stayed for 1 day only. The most common drugs involved were organophosphates and carbamates (16 occurrences), benzodiazepines (12 occurrences), tricyclic antidepressants (12 occurrences), and phenothiazines (8 occurrences). About a third involved multiple-agent poisoning; this was significantly more common in males. Fifty-eight per cent of patients had suicidal intent. There were 4 deaths (8%) during this period; 3 of these were due to poisoning by organophosphates and carbamates. Seventeen patients were ventilated, 2 underwent peritoneal dialysis, and 1 underwent forced diuresis.

Ann Acad Med Singapore 1998; 27:347-52

Key words: *Epidemiology, Overdose, Psychiatric disease, Toxidrome*

Introduction

The study of poisoning has been relatively neglected in Singapore. A check through the Infogate database of the National University of Singapore Library revealed only seven papers on the epidemiology of poisoning since 1975 (the earliest year covered by the database) and none targeting those severe enough to require intensive care unit (ICU) management. Brett and colleagues¹ in 1987 suggested that ICU utilisation could have been reduced by up to 54% by the use of risk-stratifying clinical and laboratory criteria. Our aims in embarking on this study were to build a profile of the severely poisoned patient who require ICU care, attempt to determine the applicability of Brett's criteria to our local setting, and summarise our experience with such patients from 1993 to 1995.

Materials and Methods

Tan Tock Seng Hospital (TTSH) is a general hospital with about 980 beds and is affiliated as a teaching

hospital to the National University of Singapore. The hospital Medical Intensive Care Unit (MICU) has a capacity of eight beds. Admission of patients to the MICU was at the discretion of the medical registrar in charge of the MICU. There were no predetermined clinical guidelines or criteria for admission to the MICU.

Patient and Poison Profile

Case notes of 50 consecutive patients admitted to the MICU for management of poisoning between 1 January 1993 and 31 December 1995 were analysed for the following: patient's age, sex, race, source of admission, time interval to transfer if admitted from ward, duration of ICU stay, type of drugs involved, intent at poisoning, and eventual patient outcome. Four case notes were not available for analysis. The following were considered ICU interventions: need for mechanical ventilation, dialysis or forced diuresis, use of antiarrhythmics or cardioversion, anti-seizure therapy, and vasopressor therapy.

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Brett's Proposed Criteria

We also studied the following parameters which had been proposed to guide admission criteria to MICU: whether intubated, presence of seizures, coma with no verbal response, arterial carbon dioxide tension greater than 45 mmHg, non-sinus rhythm (or sinus tachycardia greater than 125/min with tricyclic antidepressant poisoning), second or third degree atrio-ventricular block on electrocardiogram (ECG), QRS duration greater than 0.12 s (0.1 with tricyclic antidepressant poisoning) and systolic blood pressure less than 80 mmHg. In most cases, a baseline ECG was available from the emergency department or from the transferring ward; if not, the first ECG performed in the MICU was used as a surrogate. Similarly, although in most cases a baseline arterial blood gas was not available, the first available blood gas in the case notes was used as a surrogate.

Severity of Poisoning

As an estimate of the severity of poisoning, we grouped patients according to the eventual outcome of the patient (no residual deficit, residual deficit and death), the duration of MICU stay and the need for MICU interventions. We did not include complications during patients' stay as we felt that complications were closely related to duration of stay and eventual outcome. We also attempted to look for any association between our patient groups and the following: patient's age, sex, race, intent at poisoning (whether suicidal or not), known previous attempts at poisoning, and single or multiple drug ingestions. All comparisons were made, where applicable, using the chi-square test.

Results

Demographic Characteristics

The mean age of the patients was 42 years (range 19 to 88 years). Seventy-six per cent of these were in the economically productive age between 21 and 60 years old (Fig. 1). The male to female sex ratio was 1:1. Indians accounted for a significantly disproportionate number of cases (16%) when compared to the national population² (7.1%, Fig. 2, $P < 0.01$). More than half the patients were admitted directly from the emergency department (Table I). Three patients were admitted from the neuro-surgical department; these had been misdiagnosed as strokes at admission. Of the 21 patients who were transferred into the MICU from the general wards, 81% were transferred within 5 hours of admission (Table II). The mean duration of stay was 3.8 days (range 1 to 20 days). About half the patients stayed for 1 day (Fig. 3). Nineteen (40%) patients had at least one previous episode of poisoning.

Drugs Involved in Poisoning

In 38 cases (76%), the offending poisons were identified

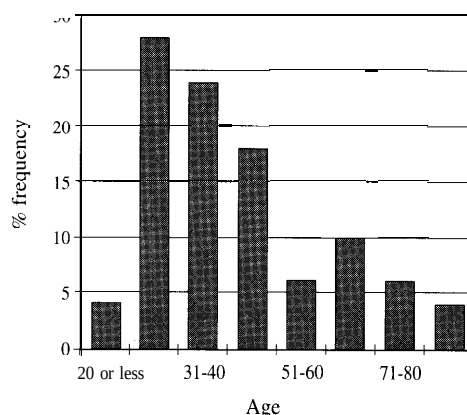


Fig. 1. Age distribution.

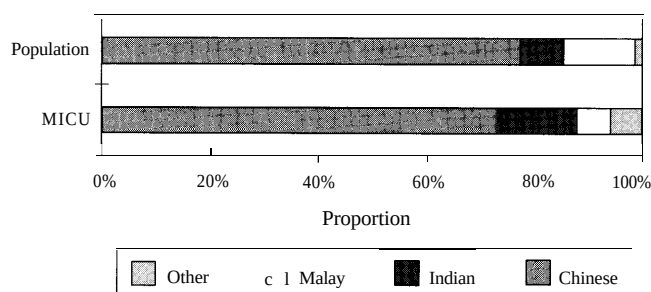


Fig. 2. Race distribution.

TABLE I: ADMISSION SOURCES

Admission source	No.	%
Emergency department	28	56
Medical ward	19	38
Non-medical ward	3	6
Total	50	100

TABLE II: TIME-INTERVAL TO TRANSFER INTO MICU FROM GENERAL WARDS

Interval to transfer (hours)	No.	%
1	6	28.6
2	5	23.8
3	2	9.5
4	2	9.5
5	1	9.5
>5	4	19.1
Total	21	100

able at presentation to the emergency department. Twenty of these were identified from the medication labels, 9 were identified from clinical toxidromes, 7 from both labels and clinical presentations and 2 were identified after diagnostic trials with naloxone and flumazenil, respectively. Toxicological analyses of blood, gastric aspirate and/or urine specimens confirmed the poisons

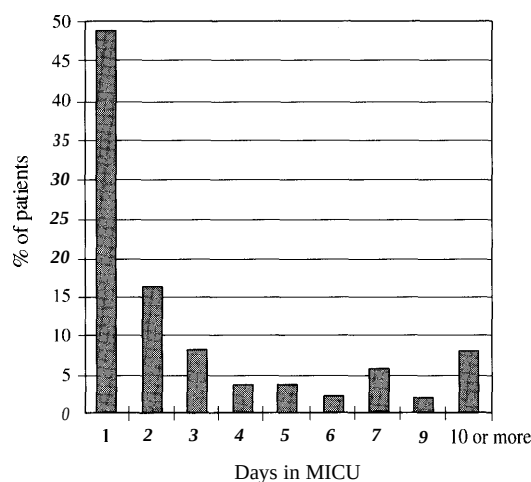


Fig. 3. Duration of MICU stay.

involved in 33 of the patients. In the rest, the toxicological report was not available in the case notes except for 1 patient with paint thinner poisoning, in whom toxicology was not performed.

The number of cases of poisoning requiring MICU admission per year was rather stable (Table III). Organophosphates and carbamates were considered as one group because there was only 1 patient with carbamate poisoning. The 4 most commonly involved

groups of drugs were organophosphates and carbamates, benzodiazepines, tricyclic antidepressants, and phenothiazines. Organophosphates and carbamates showed an increasing trend over the years. This trend was not significant at the 5% confidence level. The most common single-agent poisonings were caused by organophosphates and carbamates, tricyclic antidepressants and solvents. Benzodiazepines, tricyclic antidepressants and phenothiazines were most commonly involved in multiple-agent poisoning. The most commonly used agents in order of frequency for males were benzodiazepines, tricyclic antidepressants, organophosphates and carbamates, and phenothiazines. For females, organophosphates, tricyclic antidepressants and phenothiazines were most often implicated. Males were significantly more likely to take multiple overdoses than females ($P < 0.01$). Fluoxetine overdose, a relatively recent phenomenon, occurred as part of multiple overdose in one of our patients. Other unusual poisonings included a patient with isoniazid overdose and another with duromine (a weight reduction drug) overdose.

Intent of Ingestion

There were 7 cases of accidental poisonings, one was poisoned by inhaling paint thinner at work. The other 6 were: 2 elderly patients who took overdoses of digoxin,

TABLE III: POISONING AGENTS

Poisoning agent	Single agent			Multiple agent			M	F	Year			All
	M	F	Total	M	F	Total			'93	'94	'95	
Organophosphates and carbamates	4	11	15	1	0	1		11	5	8		16
Benzodiazepines	1	1	2	9	1	10	10	2	5	3	4	12
Tricyclic antidepressants	2	2	4	4	4	8	6	6	5	3	4	12
Phenothiazines	1	1	2	4	2	6		3	5	2		8
Paracetamol	0	1	1	2	0	2	2		2		0	3
Opiates	1	0	1	2	0	2	3	0	3	0	0	3
Antihistamines	0	0	0	2	1	3	2		1	2	0	3
Solvents	3	0	3	0	0	0	3	0	0	2		
Anticonvulsants	0	0	0	1	2	3		2	0		2	3
Phenols	0	2	2	1	0	1		2				3
Alcohols	1	0	1	1	0	1	2	0	0			2
Digoxin	1	1	2	0	0	0				0		2
Salicylates	0	1	1	0	0	0	0			0	0	
Duromine	0	1	1	0	0	0	0			0	0	
Isoniazid	1	0	1	0	0	0		0	0		0	
Fluoxetine	0	0	0	0	1	1	0		0	0		
Bleach	0	1	1	0	0	1	0		0	0		
All occurrences	15	22	37	27	11	38	42	33	28	22	25	75
Number of patients												
Single-agent							15	22	13	14	10	37
Multiple-agent							9	4	5	3	5	13
Total							24	26	18	17	15	50

M: Male; F: Female

* The occurrence of poisonings exceed the number of patients because of multiple overdoses.

TABLE IV: INTENT OF POISONING AND PRECIPITATING CAUSES

Precipitating causes	Intent of poisoning											
	Suicide			Parasuicide			Accident			Unknown		
	M	F	Total	M	F	Total	M	F	Total	M	F	Total
Psychiatric disease	6	6	12	0	0	0						
Depression	2	5	7	0	2	2						
Relationship problems	1	2	3	1	2	3						
Financial difficulties	1	0	1	0	1	1	NA			NA		
Chronic illness	0	1	1	1	1	2						
National service	1	0	1	0	0	0						
Unknown	2	2	4	0	0	0						
Total	13	16	29	2	6	8	5	2	7	4	2	6

M: Male; F: Female

a Russian seaman who mistook methanol for alcohol, a patient who swallowed Dettol by mistake, a patient who swallowed insecticide placed in a milk bottle and a psychiatric patient who took extra “make-up” doses. The rest ingested the poisoning agent intentionally (Table IV). Patients with a psychiatric history or depression were most often associated with suicidal overdosage (Table IV). Table V shows the drugs used in suicidal and parasuicidal poisoning.

MICU Interventions

The occurrences of MICU interventions are listed in Table VI. Twenty-one patients required at least one intervention. Thirteen of these had single-agent poisoning and 8 had multiple-agent poisoning. Of the 17 patients who had to be intubated and mechanically ventilated, 8 had organophosphate/carbamate poisoning, 7 had multiple-agent poisoning, 1 had tricyclic antidepressant poisoning, and the last patient had pneumonia from accidental toluene inhalation. Of the 8

TABLE V: DRUGS INVOLVED IN SUICIDAL AND PARASUICIDAL POISONINGS

Drug/Occurrence	Suicide	Parasuicide
Organophosphates and carbamates	11	4
Benzodiazepines	8	
Tricyclic antidepressants	8	0
Phenothiazines	7	0
Paracetamol		2
Opiates	0	
Antihistamines	3	0
Solvents		0
Anticonvulsants	3	0
Phenols		
Salicylates	0	
Isoniazid		0
Fluoxetine		0
Bleach		0
Duromine		

patients with hypotension requiring intravenous pressor support, 4 had multiple-agent poisoning, 3 had organophosphate/carbamate poisoning, and 1 had methanol poisoning. Two patients required peritoneal dialysis. The indications were methanol poisoning and acute renal failure complicating organophosphate poisoning, respectively. Twenty-nine patients (57.1%) did not require any of these interventions, i.e. they were monitored in the MICU. Twenty-four of these patients had single-drug ingestion and 5 had multiple-drug ingestion. Antidote therapy is summarised in Table VII.

Five patients with organophosphate and carbamate poisoning were eventually admitted to the MICU from the general wards after a delay of between 1 to 7 hours. Of these, 2 required at least one MICU intervention.

Patients who stayed 1 day or less in the MICU were less likely to have any MICU intervention ($P=0.02$, chi-square). Of the 24 patients who stayed 1 day or less, 6 had at least one MICU intervention. These were: endotracheal intubation, forced diuresis, pressor support and antiseizure treatment.

Severity of Poisoning

Based on the outcome of the patient, the duration of MICU stay, and whether interventions were required in the MICU, we grouped patients into 11 severity groups.

TABLE VI: MICU INTERVENTIONS

Intervention	Number of cases which required intervention
Intubation/mechanical ventilation	17
Intravenous pressor support	8
Dialysis	2 (peritoneal; methanol poisoning and renal failure)
Forced diuresis	1 (salicylate poisoning)
Alkalinisation of blood	1 (tricyclic antidepressant poisoning)
Antiseizure therapy	3

TABLE VII: ANTIDOTE THERAPY

Antidote	Number of occurrences
Atropine/pralidoxine for organophosphate/carbamates	15
Flumazenil for benzodiazepines	8
Physostigmine for tricyclic antidepressants	3
Naloxone for opiates	1
Ethanol for methanol	1
Pyridoxine for isoniazid	1

TABLE VIII: SEVERITY GROUPS

Group	Outcome	Duration of stay	Interventions	Number
2	Full recovery	1 day	No	18
	Full recovery	1 day	Yes	4
4	Full recovery	2 days	No	4
	Full recovery	2 days	Yes	3
5	Full recovery	3 days	No	2
6	Full recovery	3 days	Yes	2
8	Full recovery	4-7days	No	4
	Full recovery	4-7days	Yes	3
9	Full recovery	>7days	Yes	3
10	Residual deficits	All	Yes	3
11	Deaths	All	Yes	4

ings (Table VIII). We found more males than females clustered in category 3 and above ($P = 0.049$, chi-square). We did not find any significant association between severity and patient's race, sex, intent at poisoning or previous attempts at poisoning. There was also no association with type of drug, single or multiple ingestions.

There were 4 deaths, yielding a case-fatality rate of 8%. One each occurred in 1993 and 1995, and the other 2 in 1994. All had suicidal intent, and 3 of these involved single-agent ingestion of organophosphates and carbamates. The complications leading to death in these patients were pneumonia, sepsis of unknown source and renal failure. The other was a multiple ingestion involving tricyclic antidepressants, phenothiazines and benzodiazepines. This patient had pneumonia before death. All had at least one of the high-risk criteria described by Brett (Table IX).

TABLE X: BRETT'S CRITERIA FOR ADMISSION

	Intervention	No intervention	
Brett's criteria present	21	18	39
Brett's criteria absent	0	11	11
Total	21	29	50

"Avoidable " Admissions

Eleven patients in the study did not have any of Brett's criteria for ICU admission. None of these patients required any ICU intervention. Another 18 patients had at least one of Brett's admission criteria and yet did not require any MICU intervention. Using our figures therefore, Brett's criteria were found to be sensitive (100%) but not specific (38%) in predicting whether MICU interventions were required for our study population (Table X). Using Brett's criteria would have resulted in a potential reduction in MICU admissions of 22.4%. We also tried to determine if Brett's criteria could be simplified for use as admission guidelines. We found that ECG criteria, when occurring in isolation, did not predict need for MICU intervention.

Discussion

Our data demonstrate that organophosphates and carbamates, tricyclic antidepressants, benzodiazepines and phenothiazines were the commonest causes of MICU admission for poisoning. Patients were equally likely to be male or female, and often had a psychiatric history. Males were more likely to take multiple-drug overdoses than females. Fortunately, in 76% of cases, the offending agent was identifiable on presentation. Chee and Teo in 1984^{3,4} reported slightly different figures for patients admitted to both the general wards and MICU for poisoning. In their survey, females outnumbered males 3 to 1. The commonest causes in males were detergent, kerosene, benzodiazepines and barbiturates. For females, the commonest causes were benzodiazepines, paracetamol and bleaches. Experience in the United States, Australia, South Africa, Sweden and Finland broadly concurred that benzodiazepines were common causes of poisoning that required ICU care.^{1,5-8} In Western societies, ethanol ingestion and phenothiazine ingestion

TABLE IX: HIGH-RISK CRITERIA IN PATIENTS WHO DIED

	Case 1	Case 2	Case 3	Case 4
Criterion/Drugs involved	Multi-agent	Organophosphates	Organophosphates	Organophosphates
Need for intubation	Present	Present	Present	Present
No response to verbal stimuli	Present	Present	Present	
ECG rhythm other than sinus rhythm		Present	Present	
QRS duration >120 ms	Present			

were also common reasons for ICU admission, but this was not so in South Africa. Ethanol ingestion as a cause of MICU admission was not common here. Since psychiatric patients accounted for a large number of serious poisonings admitted to the MICU, relatives and caregivers of these patients should closely supervise their drug schedules to reduce the incidence of such poisonings.

In attempting to assess severity, we were limited by the small numbers and the retrospective nature of our study. Also, in many of our patients, we could not determine the amount of drug or poison ingested and the delay from ingestion to intervention (e.g. antidote therapy). Of our 50 patients, only 13 had documented time of ingestion of poison and 7 had documented amount of poison ingested.

Ideally we should have used APACHE II or III for severity stratification. Unfortunately, we were dependent on the available data in the case notes which were not specifically structured for data collection, e.g. not all the patients had their Glasgow Coma Scale recorded or monitored. This limitation may possibly be reduced by using a prospective trial design.

The patient who underwent peritoneal dialysis for methanol poisoning was an interesting problem. His initial blood methanol level was 243 mg%. Peritoneal dialysis was chosen by the renal physician despite the obvious superiority of haemodialysis because the patient was haemodynamically unstable. Sampling of the dialysate yielded methanol levels of about one-third the blood levels, so there may have been some benefit from peritoneal dialysis.

The mortality rate of 8% was high compared with the experience in South Africa (5.8%), Australia (2%), Sweden (2%), Finland (2%), and the United States (1%). This may be due to the larger numbers of organophosphate poisoning seen here, 3 cases of which were fatal. However, in the absence of comparable ICU admission criteria, it is difficult to comment on the difference in mortality rates. The most lethal poison in our survey appears to be organophosphates and carbamates, although the numbers are too small for significance test-

ing. This compares with Tan's report in 1987⁹ of paraquat (35.1%), organophosphates (22.3%) and salicylates (11.7%) being the commonest agents involved in suicidal deaths by poisoning. We suggest that patients with organophosphate poisoning be admitted to at least the medical high-dependency unit for closer initial monitoring for signs of deterioration.

Since Brett's criteria are sensitive in predicting patients who require MICU interventions, they may be useful potentially as admission criteria for poisoned patients. However, we caution that Brett derived his criteria from retrospective analysis of medical records. Prospective validation of Brett's criteria would be useful in further refining MICU admission criteria for poisoning. At the present, we do not think Brett's criteria should be used as guidelines for MICU admission yet.

Acknowledgements

The authors would like to thank staff of the Medical Records Office, Tan Tock Seng Hospital, particularly Harun and Indra; and Dr Azman Johan for his help in some of the data collection.

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