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Predicting the need for hospital admission in patients with intentional drug overdose

C.F.M. Meulendijks[1], E.J. van den Berg[2], H. Droogleever Fortuyn[3], R.J. Verkes[3], G.J. van der Wilt[1], C. Kramers[2*]

Departments of [1]Medical Technology Assessment, [2]Pharmacology/Toxicology and Internal Medicine, [3]Psychiatry, University Medical Centre St Radboud, PO Box 9101, 6500 HB Nijmegen, tel.: +31 (0)24-361 36 90, e-mail: c.kramers@pharmtox.umcn.nl, * corresponding author

ABSTRACT

Background: Self-poisoned patients are often admitted to a medical unit. However, often no treatment is given. We have developed a model to predict those patients who will not be treated and how long patients should be observed before this prediction can be safely made.

Methods: In this retrospective study a model to predict treatment was developed based on cases of self-poisoning in 1996 and validated on cases between 1997 and 1999. In a teaching hospital in the Netherlands 299 adults performing 353 episodes of self-poisoning were studied. The main outcome measures were predicted versus initiated medical treatment, time to prediction and time to initiation of treatment.

Results: The model predicted that in 51% (156/307) of all autointoxications no treatment would be given. In 2% (6/307) of all cases, treatment was incorrectly not predicted. All but one of these were preventive treatments based on the ingested compound. 4.5 hours after admission no additional patients fulfilled the criteria for prediction of treatment and all treatments were started within 4.5 hours.

Conclusions: In 51% of patients that present with an autointoxication the model accurately predicts that no treatment will be initiated. This decision can be made in the first 4.5 hours after presentation. This model can be used for a first screening of patients. It can also be used as a basis for a further prospective study to establish rational guidelines in the management of these patients.

INTRODUCTION

In the developed world, self-poisoning accounts for thousands of admissions each year and its incidence is increasing. In the UK, around 10 to 15% of the workload in emergency departments[1] and medical units involves self-poisoning.[2]

Clinicians dealing with autointoxication are faced with two questions: 1) does or will the patient need medical treatment requiring hospitalisation, and 2) how long does the patient need to be observed before a decision not to admit the patient can be safely made?

The history of these patients may be unreliable.[3] Thus, it is often unclear at what time, what amount and what type of drug(s) have been ingested. Consequently, it is uncertain whether the clinical situation may be aggravated in the coming hours. For these reasons, many of these patients are admitted to a medical unit. However, in many cases no treatment is given and the patient is discharged the next morning. Admissions are not based on clear clinical criteria.[4] For patients admitted to the ICU it has been found that applying a simple list of clinical criteria could reduce the admission rate by 40%. [5] Until now, such an analysis has not been performed for patients admitted to a medical unit (department of internal medicine and intensive care).

We aimed to develop a list of clinical criteria to predict if a patient will need to receive treatment or not. Secondly, we aimed to determine the observation period that is necessary and sufficient to be able to make this prediction. If it is predicted that no treatment will be given, the patient can be referred to the psychiatrist for further care. Unnecessary admission to a medical unit should be avoided. The staff is not specifically trained to take care of

these patients, which may lead to inappropriate behaviour and neglect.[6,7] In view of current resource constraints the issue has become even more pressing.

MATERIALS AND METHODS

The records of all patients presenting to the teaching hospital between 1 January 1996 and 12 December 1999 because of self-poisoning were studied retrospectively. Therefore, this study was excluded from ethical review by the institutional review board. Adult patients (>17 years) were identified using the hospital information system. This system registers all patients seen in the hospital, including those who were not admitted after visiting the emergency department. Excluded were patients who were transferred to another hospital, and patients who had taken more than 3 g acetaminophen because there are clear guidelines for this intoxication.[8] Follow-up of patients not admitted in the hospital was obtained by telephone from their general practitioners. If follow-up was not available, the patient was excluded from analysis.

Based on existing literature[5] and expert opinion a list of clinical and laboratory parameters was developed to serve as a model to predict treatment. The list comprises basic clinical and laboratory parameters, and questions on medical history and ingestion of slow-release medication. These parameters were collected from the clinical charts in the period between presentation and the start of treatment or, if no treatment was started, between presentation and discharge. Only parameters that were available in the chart were used in the model. If any criterion on the list was met (so, if one or more of the criteria were present), the model predicted treatment.

Cut-off points were based on the records of patients who were admitted to the internal medical ward in 1996 (reference group), in such a way that >95% of treatments were predicted by the list. The model was validated on patients seen between 1997 and 1999. It was determined whether any of the criteria that predicted treatment were met and if so, at what time after admission. Prediction of treatment was compared with actual initiation of treatment in these patients. Treatments were any medical actions that required hospitalisation (fluid administration, oxygen delivery, etc.) except for fluid administration of less than one litre per 24 hours. Moreover, the number of hours after presentation before treatment was started was recorded.

RESULTS

Using the hospital information system episodes of self-poisoning were identified during the reference period 1996 (admitted to the internal medical ward) and the validation period (1997 to 1999). The reference group consisted of 40 episodes of self-poisoning in 37 patients. The validation group consisted of 436 episodes of self-poisoning. From 32 episodes, clinical records could not be found and 97 episodes were excluded (38 because of transfer to another hospital, 53 because of ingestion of acetaminophen and 6 were lost for follow-up). This yielded 307 cases of self-poisoning in 254 patients in the validation group. Of these, 185 were admitted to a medical unit (62 to the ICU and 123 to the internal medical ward) and 122 to the psychiatric ward or sent home. None of the patients died or had sequelae of the autointoxication.

Table 1 shows the group of drugs and compounds that patients reported to have ingested. One has to realise that this list is based on the history of the patient, which may be unreliable, and not on toxicological analysis. The kinds of drugs reported are similar to what has been published in the literature.[9] No differences were found between amount and prevalence of drugs taken in patients admitted to a medical unit and other patients (i.e. patients admitted to the psychiatric ward and patients who were sent home; data not shown). As expected, benzodiazepines were most frequently used and in the group admitted to the ICU there was a higher prevalence of ingestion of tricyclic antidepressants (data not shown).[10]

Table 1
Drugs ingested in 307 episodes of self-poisoning in 256 patients (1997-1999)

DRUG CATEGORY	N (%)[A]
Benzodiazepines	197 (64%)
SSRIs[B]	51 (17%)
NSAIDs[C]	35 (11%)
TCAs[D]	34 (11%)
Phenothiazines	33 (11%)
Opioids	21 (7%)
Antipsychotics	19 (6%)
Antiepileptics	15 (5%)

[A] Number (%) of autointoxications in which patients reported to have taken a drug of this category. [B] SSRIs = Selective serotonine reuptake inhibitors. [C] NSAIDs = Non-steroidal anti-inflammatory drugs. [D] TCAs = Tricyclic antidepressants.

In *table 2* the list of criteria used to predict treatment is presented. Predicted versus actual treatment in patients seen in the period 1997 to 1999 is presented in *table 3*. The sensitivity of the model to predict treatment is 92%, whereas the specificity is 65%. In the upper panel of this table it can be seen that in 156 out of 307 episodes of self-poisoning (51%) the model predicts that no treatment will be given. In six cases this prediction was incorrect, so the

Table 2
List of criteria: if any of these criteria is met, the model predicts treatment

Medical history	History of diabetes mellitus/epileptic fits/cardiovascular disease/lung disease
Rectal temperature	<36 or >38.4°C
Mean blood pressure	<70 mmHg
Heart rate	<60 or >109 beats/min
Respiratory rate	<12 or >24/min
Oxygenation	PO_2 ≤9.3 kPa
Arterial pH	<7.33 or >7.49
Serum sodium	<130 or >149 mmol/l
Serum potassium	<3.5 or >5.4 mmol/l
Serum creatinine	>110 μmol/l
QRS duration	>0.10 s
QTc time	>0.44 s
Responds to talking	No
Epileptic fits	Yes
Ingestion of a slow-release drug or caustic agents?	Yes

Table 3
Prediction versus actual commencement of treatment in patients presenting because of self-poisoning in 1997-1999: treatment is predicted if any of the criteria listed in table 2 are met

All self-poisonings occurring in 1997-1999		*Treatment given?* *Yes*	*No*	Total
Treatment predicted?	*Yes*	70	81	151
	No	6	150	156
	Total	76	231	307
Self-poisonings admitted to the medical unit in 1997-1999		*Treatment given?* *Yes*	*No*	Total
Treatment predicted?	*Yes*	70	58	128
	No	6	51	57
	Total	76	109	185

negative predictive power of the model is 96%. Four of these patients were treated preventively with forced diuresis (three because of reported ingestion of NSAIDs and one of lithium). One was treated with naloxone because of mild heroin intoxication and one was treated with saline without obvious reasons.
In 151 episodes the model predicts treatment, whereas treatment was actually given in 70 of these, yielding a positive predictive power of 46%. In 23 episodes the patient was not admitted to the medical unit, despite the fact that treatment was predicted (data not shown). No sequelae occurred in any of these patients.

As stated, the model predicts treatment in 151 auto-intoxications, whereas there were 185 instances of admission to a medical unit. So use of this model could lead to a small reduction of admissions. If the model were to be applied to patients admitted to a medical unit only, in 57 out of 185 episodes it predicted that treatment would not be given (table 3, lower panel).
In 148 out of 151 predicted treatments, the criteria were met within the first hour after presentation. In three of them, criteria were met at a later time point, 4.5 hours after presentation at the latest. The time until a criterion is met can roughly be considered to be (negatively) exponentially distributed. Taking the probability that the criterion is met after 4.5 hours (or later) to be one in 151, it can be calculated that the probability that a criterion is met more than six hours after presentation is 0.12%.
In 76 cases the patient was treated: in 71 of these, treatment was started within the first hour of presentation and the maximum time before treatment was commenced was 4.5 hours. Following the reasoning described above, the probability a treatment will be initiated more than six hours after presentation is 0.32%.

DISCUSSION

The decision whether or not to admit a patient after self-poisoning is based on a combination of the history (how much of what drug was ingested and when) and the clinical parameters. However, every clinician realises that the history may be unreliable[3] and the clinical picture may alter in time. For that reason many of these patients are admitted to a medical unit, even if they are in no physical distress. In the majority of these patients the clinical course is benign and no treatment is given. Because of the unreliability of the history we developed a list of criteria that is mainly based on the clinical condition of the patient. This list of criteria has to be applied on the clinical and laboratory parameters that the clinician finds relevant to collect in a specific patient. Since the patient's condition may alter in time, we studied all data collected after presentation until treatment was started or until discharge. We reasoned that admission to a medical unit was not justified if no treatment was given. Because of the retrospective nature of our study, we were not able to judge whether a treatment that had been given was necessary or not. So, we set up a model to predict non-treatment: if treatment is not given, it is clear that admission for medical reasons is not necessary and the psychiatrist may decide whether to admit a patient for psychiatric or social reasons. Administration of less than 1 litre of fluid intravenously per 24 hours was not considered a treatment justifying admission. This has no substantial effect on the circulation and is only given to ensure quick access to the circulation.

Using the list of criteria in patients admitted to the medical unit, a considerable number of patients could be identified who, during six hours of observation, did not meet any of the predictive criteria. The negative predictive power of our model is high (96%), so using this model one can decide not to admit these patients. The positive predictive power of the model is low, so if the model predicts treatment this does not necessarily mean that this treatment will be given. Thus, this model could be used as a first screening to decide who should not be admitted to a medical unit. If the model predicts treatment, the clinician should decide, depending on the particular case, if admission is necessary. For instance, although a patient with non-insulin dependent diabetes mellitus (NIDDM) meets a criterion that predicts treatment, that does not mean that every patient with NIDDM should be admitted after an autointoxication. There were some patients who were treated although this was not predicted. All but one of these were treated preventively, based on the history of the ingested compound. These cases show that it is impossible to completely ignore the history.

In some patients who were not admitted, criteria were found that predicted treatment. In these patients treatment was not started. Some of them were even sent home. No clinical problems were reported in these patients. This again shows that if a treatment is predicted, it does not mean that this treatment is necessary. We do not think that all of these patients should be admitted. Our criteria list could be used to identify patients who will not be treated and therefore should not be admitted to a medical unit. An observation period of six hours is enough to make this decision. The psychiatrist should make further decisions in these patients. Admission to a medical unit should be considered, but is not obligatory, in all other patients.

Since this is a retrospective analysis, our study has a few drawbacks. We only used data that were available in the charts. These were the parameters the attending physician felt necessary to be able to judge the severity of the auto-intoxication. For instance, if a patient is not in respiratory distress, no blood gas analysis will be performed. So we felt it is justified to use only parameters that were available in the charts. We feel, however, that this model should be further validated and for this reason we are currently planning a prospective study. We expect that this will lead to guidelines regarding which patients should be admitted to the medical unit and who should be referred to the psychiatrist to decide whether the patient can be sent home.

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