Journal of Critical Care 37 (2017) 156–161

Contents lists available at ScienceDirect

Journal of Critical Care

journal homepage: www.jccjournal.org

Clinical parameters that predict the need for medium or intensive care admission in intentional drug overdose patients: A retrospective cohort study

Huub L.A van den Oever, MD [a,*], Mirja van Dam, MD [a], Esther van 't Riet, PhD [b], Frank G.A. Jansman, PharmD, PhD [c,d]

[a] Intensive Care Unit, Deventer Hospital, Nico Bolkesteinlaan 75, 7416 SE Deventer, The Netherlands
[b] Teaching Hospital Deventer, Deventer Hospital, Nico Bolkesteinlaan 75, 7416 SE Deventer, The Netherlands
[c] Department of Clinical Pharmacy, Deventer Hospital, Nico Bolkesteinlaan 75, 7416 SE Deventer, The Netherlands
[d] Department of Pharmacotherapy, -Epidemiology and -Economics, University Groningen, Antonius Deusinglaan 1, 9713AV, Groningen, The Netherlands

ARTICLE INFO

Available online xxxx
Keywords:
Admission avoidance
Clinical management
Medium care
Drug overdose
Deliberate self
Triage

ABSTRACT

Introduction: Many patients with intentional drug overdose (IDO) are admitted to a medium (MC) or intensive care unit (IC) without ever requiring MC/IC related interventions. The objective of this study was to develop a decision tool, using parameters readily available in the emergency room (ER) for patients with an IDO, to identify patients requiring admission to a monitoring unit.
Methods: Retrospective cohort study among cases of IDO with drugs having potentially acute effects on neurological, circulatory or ventilatory function, admitted to the MC/IC unit between 2007 and 2013. A decision tool was developed, using 6 criteria, representing intubation, breathing, oxygenation, cardiac conduction, blood pressure, and consciousness. Cases were labeled as 'high acuity' if one or more criteria were present.
Results: Among 255 cases of IDO that met the inclusion criteria, 197 were identified as "high acuity". Only 70 of 255 cases underwent one or more MC/IC related interventions, of which 67 were identified as 'high acuity by the decision tool (sensitivity 95.7%).
Conclusion: In a population of patients with intentional drug overdose with agents having potentially acute effect on vital functions, 95.7% of MC/IC interventions could be predicted by clinical assessment, supplemented with electrocardiogram and blood gas analysis, in the ER.

1. Introduction

Patients with intentional drug overdose (IDO) are often admitted to a monitoring ward, even if they appear stable in the emergency room (ER) and in no imminent need of interventions that are usually provided in a medium care (MC) or intensive care (IC) environment [1]. This practice is based on the assumption that risk of deterioration cannot reliably be predicted by the clinical course in the first few hours. As a result, many low-acuity patients are admitted to an MC/IC setting without requiring specific interventions.

Although the in-hospital mortality of patients admitted to care facilities with IDO is low (2.1% in a recent Dutch survey) [2], some patients do develop serious complications. Also, absorption of the agents involved may be delayed, resulting in late manifestation of symptoms. A complicating factor in the stratification of patients presenting after an act of self-intoxication is that a proper history of the nature and amount of drugs ingested is often lacking or unreliable [3]. This uncertainty may lead to an overestimation of the likelihood of late events after drug overdose.

As unnecessary MC/IC admissions may harm patients and generate high medical costs, it is important to recognize at an early stage which patients will benefit from monitoring facilities.

We hypothesized that the need for MC/IC admission of patients with drug overdose can reliably be predicted by clinical observations made while the patient is in the ER. This prediction must be highly sensitive to identify all patients that require MC/IC related interventions.

The aim of the present study was to develop a decision tool, using readily available parameters in the ER for patients with an IDO, to identify high-acuity patients for admission to a monitoring unit.

Abbreviations: CVVH, Continuous venovenous haemofiltration; ECG, Electrocardiogram; ER, Emergency room; GCS, Glasgow Coma Score; IC, Intensive care; IDO, Intentional drug overdose; MC, Medium care; NSAID, Non-steroidal anti-inflammatory drug; PO_2, Partial pressure of oxygen in blood; QRS, Complex of Q-, R- and S-waves in the electrocardiogram; QTc, QT-time on electrocardiogram corrected for heart rate; RF, Respiratory frequency; SBP, Systolic blood pressure; SpO_2, Peripheral oxygen saturation; SSRI, Selective serotonin reuptake inhibitor; TCA, Tricyclic antidepressant.

* Corresponding author.
E-mail addresses: h.vandenoever@dz.nl (H.L.A. van den Oever), mirjavandam@gmail.com (M. van Dam), e.vantriet@dz.nl (E. van 't Riet), f.jansman@dz.nl (F.G.A. Jansman).

http://dx.doi.org/10.1016/j.jcrc.2016.09.020
0883-9441/

2. Material and methods

2.1. Population

All admissions with drug overdose to the combined MC/IC unit of the Deventer Hospital, a teaching hospital in the Netherlands, between January 1, 2007, and December 31, 2013, were investigated. Because of multiple admissions, individual patients could be included more than once. Not included were intoxications with pesticides, insecticides or other chemicals. Intoxications with recreational drugs only (eg, ethanol), intoxications with drugs with no potentially acute effects on neurologic, cardiovascular, or ventilator function (eg, paracetamol), and transfers from other hospitals were excluded.

2.2. Data retrieval

An anonymized database containing eligible cases was built using Microsoft Access. The following data were extracted from ER records, laboratory results and MC/IC unit charts: gender, age, serum drug levels, slow release preparation, ER interventions, and intensive care unit (ICU) interventions. Estimated time of intake, drug groups, drug names, estimated drug doses, were based on patient's history, or on circumstantial evidence such as medicine packages found on the scene. Furthermore, vital parameters present at the ER were registered including temperature, first, lowest and highest measured respiratory rate, lowest measured oxygen saturation, highest F_{IO_2} administered, arterial blood sample, first, lowest and highest heart rate recorded, first, lowest and highest measured systolic and diastolic blood pressure, abnormalities on electrocardiogram, QRS duration, corrected QT interval (QTc), Glasgow Coma Scale and the presence or absence of seizures. When electrocardiogram (ECG) and blood gas results were unavailable, they were assumed to be normal. Serum drug levels were not measured routinely, but only if it was thought they would influence the treatment. ER and ICU admission and discharge times, and discharge destination after MC/IC admission were obtained from hospital administrative data.

2.3. Predictors

We designed a decision tool based on a small number of Boolean (true or false) type criteria. The structure of this tool is such that one positive criterion predicts high acuity, resulting in admission to a monitored ward. The algorithm only predicts low acuity, indicating outpatient care or admission to a general medicine bed or psychiatric unit as the appropriate level of care, if all criteria are negative. By design, such a decision algorithm will results in a cumulative sensitivity much higher than the sensitivity of the individual predictors, at the expense of specificity. For the purpose of identifying IDO patients at risk, high test sensitivity was desired and decreased specificity was considered acceptable. In addition, a decision model with a 'yes-or-no' design is easy to use in daily practice. The design of our decision tool resembled triage algorithms for IDO patients published earlier [1,4]. The choice for this particular design precluded the use of logistic regression to build a formal prediction model in which the weighed sum of various parameters is calculated.

To build the decision tool, parameters were first selected on the basis of clinical suitability, which in this case meant that the parameter should be easily measurable in the emergency room. Cut-off values for these parameters were determined with the use of receiver operating curves, but were also chosen so that they matched national and international MC/IC admission guidelines [5,6], published trigger criteria for rapid response teams [7], normal ECG conduction times, as well as our own unit's admission criteria.

Parameters were then eliminated in a stepwise fashion from the decision tool until sensitivity started to decrease. Criteria were also selected to reflect all vital functions. This resulted in the selection of 6 criteria displayed in Table 1, representing intubation, breathing, oxygenation, cardiac conduction, blood pressure, and consciousness. Prolonged QTc was defined as ≥450 ms in males and ≥460 ms in females.

2.4. Outcome measure: MC/IC intervention

All interventions that require frequent or continuous monitoring of consciousness, ECG, SpO_2, or blood pressure were considered MC/IC related. The list consisted of tracheal intubation, invasive or non-invasive mechanical ventilation, fluid resuscitation (a fluid bolus ≥1000 ml, or a fluid bolus ≥500 ml explicitly administered for hypotension), intravenous administration of vasoactive agents, antiarrhythmics, sedatives, magnesium, calcium, atropine, naloxone or flumazenil, treatment of convulsions, defibrillation, hemofiltration or dialysis.

2.5. Statistical analysis

For the prediction of MC/IC interventions, we considered all predictors in Table 1 to be equally important. Cases were labeled as "high-acuity" if they scored positive on one or more of the criteria in Table 1. "Low-acuity" was defined as being negative on all 6 clinical criteria. The MC/IC interventions were dichotomized (intervention applied yes/no).

General patient characteristics, ER interventions, prevalence of ingested substances and MC/IC interventions were compared between high-acuity and low-acuity cases using Chi-square and Fisher's Exact Tests in case of categorical variables and Student *t* test for continuous variables (after normality of the data was confirmed). Using univariate logistic regression analysis, the relationship between each of the individual predictors as well as the dichotomous variable high/low acuity and outcome measure (IC intervention required yes/no) was investigated. Sensitivity and specificity of each individual predictor, as well as for the combination of predictors, were calculated using crosstabs. For all analyses, IBM SPSS statistical software version 22 was used. $P < .05$ was considered statistically significant.

3. Results

During this retrospective 7-year evaluation period, 363 MC/IC unit admissions with drug overdose were registered. After application of the exclusion criteria, 255 cases remained for analysis (Fig. 1). The median time spent in the ER was 2:15 h (interquartile range 1:27 to 3:15 h); 41% of patients received some form of emergency treatment aimed at decreasing the effect of the intoxicants. This treatment was not provided when the estimated time interval between intake and presentation was too long to expect any benefit. The median time spent in the MC/IC unit was 18:02 h (interquartile range, 13:20 to 31:29 h) h. Mortality in our study cohort was 1 (0.4%) of 255 cases. One patient died due to cardiac arrest before arrival to the ER, after an overdose with antipsychotics. This patient was admitted to the IC unit while being resuscitated, and died when chest compressions were stopped.

Of the 255 eligible cases, 197 (77%) were defined as 'high-acuity', meaning one or more of the 6 defined predictors (Table 1) were present. The patient characteristics are presented in Table 2, stratified according to acuity (high vs. low). A comparison between patients defined as high-acuity and patients defined as low-acuity showed that low-acuity patients were significantly younger and were more likely to be treated with activated charcoal or intestinal lavage on the ER as compared to high-acuity patients. In addition, only high acuity patients received antidotes in the ER.

Benzodiazepines were involved in 63.9% of all IDO cases (Table 2). Also common were ethanol, antidepressants, antipsychotics and analgesics (ethanol and paracetamol were common co-ingestants, overdose with ethanol or paracetamol alone was excluded). Tricyclic antidepressants were involved in 13.3% of cases, and 11.4% of cases consisted of slow-release preparations. None of the intoxications with