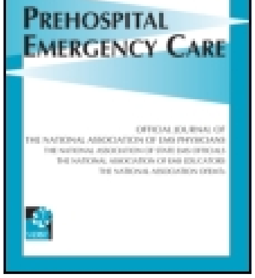

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Naloxone Use in a Tiered-Response Emergency Medical Services System

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Abstract

Objective. To examine the delivery and effect of naloxone for opioid overdose in a tiered-response emergency medical services (EMS) system and to ascertain how much time could be saved if the first arriving emergency medical technicians (EMTs) could have administered intranasal naloxone. **Methods.** This was case series of all EMS-treated overdose patients who received naloxone by paramedics in a two-tiered EMS system during 2004. The system dispatches basic life support–trained fire fighter–EMTs and/or advanced life support–trained paramedics depending on the severity of cases. Main outcomes were geographic distribution of naloxone-treated overdose, severity of cases, response to naloxone, and time interval between arrival of EMTs and arrival of paramedics at the scene. **Results.** There were 164 patients who received naloxone for suspected overdose. There were 75 patients (46%) initially unresponsive to painful stimulus. Respiratory rate was <10 breaths/min in 79 (48%). Death occurred in 36 (22%) at the scene or during transport. A full or partial response to naloxone occurred in 119 (73%). Recognized adverse reactions were limited to agitation/combativeness in 25 (15%) and emesis in six (4%). Average EMT arrival time was 5.9 minutes. Average paramedic arrival time was 11.6 minutes in most cases and 16.1 minutes in 46 cases (28%) in which paramedics were requested by EMTs at the scene. **Conclusions.** There is potential for significantly earlier delivery of naloxone to patients in opioid overdose if EMTs could deliver intranasal naloxone. A pilot study training and authorizing EMTs to administer intranasal naloxone in suspected opioid overdose is warranted. **Key words:** emergency medical technician; heroin; naloxone; Narcan; overdose; opioid; opiate.

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Introduction

Basic emergency medical technicians (EMTs) are usually the first care providers to arrive on the scene in cases of opioid overdose in most communities. States set their own individual standards governing the specific treatments EMTs are allowed to provide. In general, states restrict EMTs from obtaining intravenous access or administering parenteral pharmacotherapies (an exception is subcutaneous epinephrine for anaphylaxis, which is authorized in many states). Intravenous and intramuscular naloxone have been shown to be safe and effective for the treatment of acute heroin overdose by advanced life support paramedics in the prehospital setting and are the treatment of choice for suspected narcotic overdose.[1] More recently, it has been shown that the intranasal route can be a safe, simple, and effective mode of administering naloxone in opioid overdose patients.[2,3] This opens the possibility for EMTs to administer naloxone without penetrating the skin if authorized to do so. Our study sought to examine how much time could be saved if basic EMTs could provide naloxone to patients with suspected opioid overdose in the prehospital setting.

Methods

Study Design, Setting, and Participants

The investigation was a case series of all emergency medical services (EMS)-treated cases of opioid overdose in King County, Washington, in which naloxone was administered by paramedics during 2004. Twenty-five fire departments and four paramedic agencies provide EMS response and transport for the county, which includes urban, suburban, and rural areas and has a population greater than 1,200,000 (excluding Seattle). King County had an annual call volume of 27,627 advanced life support calls and 98,070 basic life support calls in 2004. The study was approved by the University of Washington Human Subjects Committee.

EMS System

King County is served by a two-tiered EMS system that is activated by calling 9-1-1 and speaking with an emergency medical dispatcher. The first tier consists of fire fighter-EMTs who are trained in basic life support and defibrillation. The second tier consists of paramedics who are trained in advance life support. Dispatchers use protocols, established by the county medical director, called "criteria-based dispatch" and depending on the severity of the case may 1) dispatch EMT responders only, 2) dispatch EMTs and paramedics simultaneously,

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3) upgrade the call to paramedic level when more information becomes available, or 4) dispatch paramedics in response to an EMT request from the scene.[4]

Data Collection, Measurement, and Analysis

The first- and second-tier personnel separately complete medical report forms for all cases. Information is then entered into a computerized database. Using the database, we identified 719 cases coded as an intentional or accidental drug overdose that occurred during 2004. These were reviewed for use of naloxone by paramedics, which took place in 164 cases. The 164 paramedic records were manually reviewed for additional data that could be abstracted and combined with information available in the computer database. Of primary interest were the type of paramedic response (simultaneous with EMTs, upgraded by dispatcher, or requested by EMTs at the scene), EMT call-to-arrival time, paramedic call-to-arrival time, and the time interval between EMT and paramedic arrival. Secondarily we collected data on the age and gender of patients, alert/verbal/pain/unresponsive score, respiratory effort, initial respiratory rate, patient mortality, pupil size and reactivity, historical evidence of opioid use, number of naloxone doses and route, endotracheal intubation, response to naloxone, respiratory rate before and after administration of naloxone, pulse oximetry before and after administration of naloxone, systolic blood pressures before and after administration of naloxone, and violent response to naloxone (vomiting, agitation, or combativeness). These secondary data were used to assess accurateness of assessment, effectiveness of resuscitation, and adverse responses to treatment.

Results

There were 164 patients who received naloxone by paramedics. Age ranged from 14 to 86 years, with a median age of 43 years. The age distribution was bimodal, with a large peak centered on the median age and a much smaller peak for patients in their 80s. Males patients accounted for 52% of cases. There was variability in the number of cases across fire departments, as shown in Figure 1. Wide variability among departments remained even when adjusting for population.

Tiered Response

Paramedics were dispatched simultaneously with EMTs in 69 cases (42%). Paramedics were dispatched later due to more information in 39 cases (24%), and paramedics were dispatched in response to EMT request from the scene in 46 cases (28%). For the 69 cases with simultaneous dispatch, the average EMT time to arrival from call received was 5.9 minutes and the average paramedic time to arrival from call received was 11.6 minutes. However, the average paramedic time to arrival (from the time of the call to the dispatch center) was 16.1 minutes when paramedics were requested by EMTs. This longer time is due to the extra time required for the EMTs to arrive at the scene and then request paramedics. The average difference between EMT and paramedic arrival when they were requested by EMTs was 10.2 minutes, and the longest interval between EMT and paramedic arrival for a case was 22.4 minutes. In the King County EMS system, EMTs generally wait at the scene for paramedic arrival if advanced life support assistance is required. When it is known that the paramedics will be delayed beyond 15 minutes, they may choose to rendezvous with the paramedics.

Initial Assessment of Patients

On the AVPU scale (Alert, response to Verbal stimuli, response to Pain, Unresponsive), 13 patients (8%) were alert (able to answer at least one orientation question correctly), 33 (20%) responded to verbal stimulus alone, 43 (26%) responded only to painful stimulus, and 75 (46%) had no response to verbal or painful stimulus. Initial respiratory effort was categorized by paramedics as normal in 37 (23%), labored or shallow in 40 (24%), and <10 breaths/min or absent in 79 (48%). Miotic pupils (defined as pupils $\leq$2 mm, or 3 mm with poor light reactivity) were present in 134 patients (82%). Historical or situational evidence suggesting an opioid as the agent of overdose was found in 128 (78%). This evidence included a history of opioid abuse, admission of opioid use by the patient or acquaintances at the scene, needle track marks, or presence of opioid paraphernalia.

Administration of Pharmacotherapy

A single dose of naloxone was given in 111 cases (68%), two doses were given in 51 (31%), and three doses were given in only two (1%). The route of administration was solely intravenous in 108 (66%), a combination of intravenous and intramuscular in 29 (17%), solely intramuscular in 18 (11%), solely intranasal in two (1%), and a combination of intramuscular and intranasal in one. Intravenous access that was impossible or extremely difficult to attain was noted in nine cases (5%). The most frequent initial dose was 1 mg but ranged from 0.2 to 2 mg. The total dosage ranged from 0.2 to 4 mg.

Response to Therapy

The response to naloxone was subjectively graded as falling into one of four categories: full response (alert

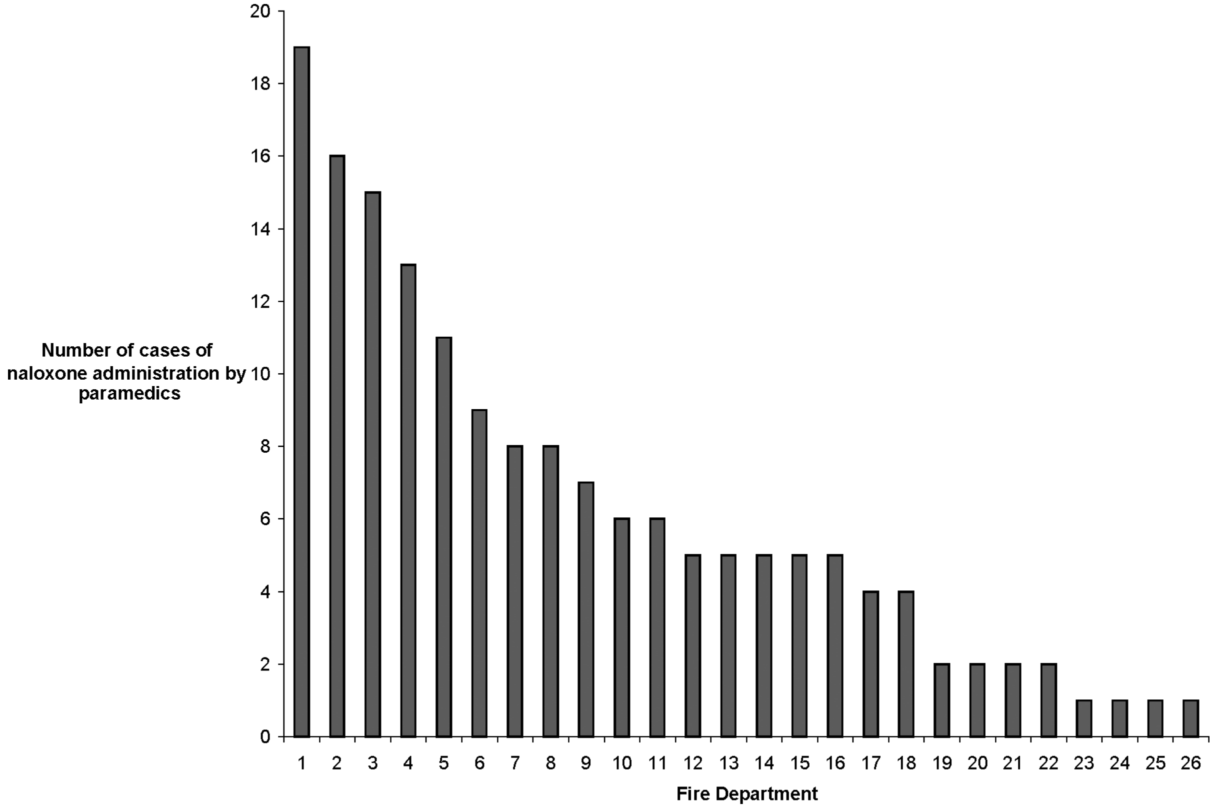

FIGURE 1. Frequency of naloxone administration by paramedics in suspected overdose during 2004, by fire department.

mental status, normal respiratory rate), partial response (improvement in mental status or respiratory rate), no response, or unknown. A full response to naloxone occurred in 78 patients (48%), a partial response occurred in 41 (25%), no response occurred in 24 (15%), and response to naloxone was unrecorded in 21 (13%).

Systolic blood pressure increased from an average of 123 mm Hg before administration of naloxone to an average of 127 mm Hg after administration of naloxone. The range of systolic pressure pretreatment was unmeasurable through 230 mm Hg, and the range posttreatment was 68–192 mm Hg. Respiratory rate increased from an average of 11 breaths/min before administration of naloxone to 18 breaths/min after administration of naloxone. The latter respiratory rate does not include intubated patients. Intubation was performed in 36 cases (22%). The range of respiratory rate changed from 0 to 40 breaths/min before administration of naloxone to 8–40 breaths/min after administraion of naloxone. Arterial hemoglobin saturation (SpO_2) increased from an average of 90% with a range of 35%–100% before administration of naloxone to an average of 97% with a range of 70%–100% after administration of naloxone. (This included all patients for which SpO_2 data were available, including those receiving oxygen therapy and intubated patients.) Thirty-six patients (22%) were known to have died at the scene or during transport.

Adverse Reactions

Naloxone-associated violence, such as agitation, combativeness, or vomiting, occurred in 25 cases (15%). No violence occurred in 127 cases (77%), and it could not be determined whether violence occurred in 12 cases (7%). The 25 cases associated with posttreatment violence were made up of agitation/combativeness in 21 cases (13%) and vomiting in six cases (4%). In all cases of vomiting, the patient was either alert posttreatment or had an intact gagreflex documented.

DISCUSSION

The cause of death in opioid overdose is most commonly secondary to an inability to maintain airway patency, diminished ventilatory drive, and/or anaphylaxis.[5] After ensuring an adequate airway and initiating respiratory and cardiovascular support, naloxone is the drug of choice for management of opioid overdose and can frequently obviate the need for endotracheal intubation.[5]

Recognition of the benefits of early naloxone administration in opioid overdose has led to programs that supply naloxone to opioid abusers for use in the event of an overdose.[6] These programs have been criticized for possibly postponing access to care.[7] Authorizing EMTs to administer naloxone may be an option for making naloxone more readily available where and when it is needed without the possible downsides of a community-based approach.

Serious overdose cases are sometimes hard for the dispatcher to identify, thus leading to a request from the scene for paramedics rather than them being dispatched initially. This is often the case because the call may come from a third party or be misidentified as some other condition (e.g., fainting or sick unknown). In 46 cases (28%) in our series, the emergency dispatcher was unable to recognize the case as one involving opioid overdose and as a result initially dispatched only EMTs to the scene. Once EMTs arrived they requested paramedics, resulting in additional time for paramedics to arrive. This interval of continued respiratory depression may be clinically deleterious due to the risk of acidosis, hypoxemia, and aspiration.

EMTs are not trained to intubate or provide parenteral medications. They are trained to provide bag-valve-mask respiratory support. However, bag-valve masking by EMTs and other relatively inexperienced operators has been associated with inadequate minute ventilation and significant amounts of air entering the stomach.[8] Intranasal naloxone could thus provide EMTs with a needed tool to improve respiratory function in opioid overdose.

No serious side effects of naloxone were recognized in our series. Training to manage the agitation and combativeness seen in 15% of our cases would need to be part of any program training EMTs to administer naloxone. However, nasal administration compared with parenteral administration has been shown to have a lower incidence of agitation in one series, possibly due to slower absorption.[2]

A fair number of life-threatening overdoses were demonstrated in the study area (approximately one every other day), with more frequent occurrence in some communities. More than half (83 of 164) of the opiate overdoses requiring naloxone administration occurred in six fire districts (Figure 1). Any pilot program to train EMTs to administer intranasal naloxone should clearly occur in communities with a high incidence of opioid overdose. Authorization of administration in a few high-incidence communities may thus be more appropriate than throughout an entire region or state.

Our study is limited by its retrospective nature and the use of records completed in an emergent setting. It is possible that EMS providers did not accurately assess some of the findings. Errors may have been made when recording data, and records occasionally had missing data. Coding errors could also be present. The author who conducted data abstraction and subjective grading was not blinded to the route of naloxone administration. Responses seen after administration of naloxone were probably influenced positively by other components of the resuscitative effort.

Conclusions

The issue of whether EMTs should be authorized to administer naloxone in a tiered-response system involves many considerations. Our study cannot speak to all of these. However, we believe the simplicity, efficacy, and safety of intranasal naloxone administration[2,3], the frequency and distribution of opioid overdose in our community, and the time factors associated with the arrival of EMTs and paramedics argue for a pilot project to train EMTs to administer intranasal naloxone in suspected opioid overdose.

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