Emergency Medicine Medication Use, Errors & Interactions

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## Institute of Medicine (IOM)

- The Institute of Medicine (IOM) defines an adverse drug event (ADE) as an injury resulting from medical intervention related to a drug, which can be attributable to preventable and nonpreventable causes.
- Unpredictable
  - i.e. Idiosyncratic or unexpected allergic responses
- Predictable
  - i.e., adverse effects or toxic reactions related to the inherent pharmacologic properties of the drug

### **Medication Errors**

- Medication errors occur as a result of human mistakes or system flaws.
- A medication error is any preventable event that occurs in the process of ordering or delivering a medication, regardless of whether an injury occurred or the potential for injury was present.
  - Example: an allergic reaction to a medication can be an adverse reaction if there is no history of patient allergy, yet can be a medication error in that same case of allergic reaction if the patient did have a documented history of allergies but that medical information was not available, not consulted, or overlooked.
  - Medication errors can occur in the absence of injury to the patient.

## **Series of Actions**

- Series of actions must be performed correctly by several members of the health care team.
  - physician, hospital pharmacist, nurse
- Errors are possible at any step of the process.
  - medication selection and ordering
  - order transcription
  - drug formulation
  - drug dispensing
  - drug administration

## Epidemiology

- For adults, the reported incidence of errors in treatment with medications ranges from 1% to 30% of all hospital admissions, or 5% of orders written.
- In pediatrics, this number has been reported to be as high as 1 in 6.4 orders.
- A 1995–1999 study by the US Pharmacopeia (USP) Medication Errors Reporting Program demonstrated a significantly increased rate of medication error resulting in harm or death in pediatric patients (31%), compared with adults (13%).
- In a more recent study, ADEs occurred at a similar rate between pediatric (5.7%) and adult patients (5.3%). However, potential ADEs—those errors not causing harm—occurred in pediatric patients 3 times more often than in adults.
- In adult studies, antimicrobial agents, analgesic agents, and cardiovascular drugs are most often associated with reported errors.
- For pediatrics, intravenous fluids are the most commonly cited product involved in medication errors reported to the USP.

## Examples

- In pediatric and adult populations, the most commonly reported errors include the following:
  - inappropriate medication for the condition being treated
  - incorrect dosage or frequency of administration of medication
  - wrong route of administration
  - failure to recognize drug-drug interactions
  - lack of monitoring for drug adverse effects
  - "missed/late dose errors" with delayed drug administration
  - inadequate communication between the physician, other members of the health care team, the parent or caregiver, and the patient.

### **Pediatrics**

- Incorrect dosing is the most commonly reported error.
- In teaching hospitals, prescribing errors decrease with each year of training
  - Lesar TS, et al. Medication prescribing errors in a teaching hospital. JAMA. 1990; 263:2329–2334
- Computerized physician or prescriber order entry (CPOE), standardized order forms, and alert systems have all demonstrated success in decreasing errors.
  - Teich JM, et al. Effects of computerized physician order entry on prescribing practices. Arch Intern Med. 2000;160:2741–2747
  - Bates DW, et al. The impact of computerized physician order entry on medication error prevention. J Am Med Inform Assoc. 1999;6:313–321

## Cost

- The 1999 IOM report implicates medication errors, at least in part, as a direct cause of up to 98,000 patient deaths annually. Drug errors associated with morbidity and mortality increase inpatient health care costs by an estimated \$4,700 per hospital admission, or approximately \$2.8 million annually for a 700-bed teaching hospital.
  - Institute of Medicine, Committee on Quality Health Care in America. To Err Is Human: Building a Safer Health System. Report of the Institute of Medicine. Kohn LT, Corrigan JM, Donaldson MS, eds. Washington, DC: National Academy Press; 2000
- In a study of medical liability suits filed from January 1985 through December 2001, the Physician Insurers Association of America found medication error was the fifth most common misadventure for pediatricians. More than 30% of these cases resulted in a paid claim, with total indemnity at \$14.7 million.
  - Physician Insurers Association of America. *Medication Errors Symposium White Papers. Washington, DC: Physician Insurers Association of America*; 2000
- The economic burden for all areas of health care from drug misadventures exceeds \$100 billion annually in the United States alone.
  - Schumock GT. Methods to assess the economic outcomes of clinical pharmacy services. *Pharmacotherapy. 2000;20(suppl 2):243S–252S*



### Joint Commission on Accreditation of Healthcare Organizations (JCAHO)



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### The Effect of Detection Approaches on the Reported Incidence of Tenfold Errors

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#### Abstract

Background: Tenfold errors in calculation of paediatric drug doses are often life threatening. The magnitude and characteristics of this phenomenon have not been fully described.

**Objectives:** The objective of this study was to describe the incidence and nature of paediatric tenfold errors and to describe the effect of different detection approaches on the detection of such errors.

Methods: To evaluate the incidence of tenfold errors, data were collected from three different studies on medication errors all conducted at a large tertiary care paediatric hospital: (i) a study investigating medication event reports to the hospital's Medication Incident Committee; (ii) a study auditing the charts of 1532 patients in the emergency department (ED) and; (iii) a prospective study of medication errors occurring during mock code resuscitations in the ED.

**Results:** In the first study, 20 tenfold errors were reported during the surveyed period. Almost all errors were prescribing errors. The calculated incidence was 1 per 22 500 doses prescribed. In chart auditing study in the ED, two tenfold errors where found in 1678 orders. In the prospective study, four tenfold errors were identified in eight mock resuscitations (125 orders for drugs).

**Conclusion:** The incidence of tenfold errors in paediatrics varies dramatically when different detection approaches are used. The rate of tenfold errors may be especially high in resuscitation situations and is underestimated by spontaneous reporting.

### Variables Associated With Medication Errors in Pediatric Emergency Medicine

Eran Kozer, MD\*‡; Dennis Scolnik, MB ChB\*‡; Alison Macpherson, MSc§; Tara Keays, BScH\*; Kevin Shi, BSc\*; Tracy Luk, BSc\*; and Gideon Koren, MD‡

ABSTRACT. *Objective.* Medication errors are a common cause of iatrogenic morbidity and mortality. The incidence of medication errors in pediatric emergency departments (EDs) has not been described. The objective of this study was to describe the incidence and type of drug errors in a pediatric ED and determine factors associated with risk of errors.

*Methods.* A retrospective cohort study was conducted of the charts of 1532 children who were treated in the ED of a pediatric tertiary care hospital during 12 randomly selected days from the summer of 2000. Two pediatricians, blinded to other study variables, independently decided whether a medication error occurred and ranked it according to a severity score. Disagreement was resolved by consensus.

*Results.* Prescribing errors were identified in 10.1% of the charts. The following variables were associated in univariate analysis with an increased proportion of errors: patients seen between 4 AM and 8 AM (odds ratio [OR]: 2.45; 95% confidence interval [CI]: 1.10–5.50), patients with severe disease (OR: 2.53; 95% CI: 1.18–5.41), medication ordered by a trainee (OR: 1.48; 95% CI: 1.03–2.11), and patients seen during weekends (OR: 1.48; 95% CI: 1.04–2.11). Among trainees, there was a higher rate of errors at the beginning of the academic year (OR: 1.67; 95% CI: 1.06–2.64). Logistic regression revealed increased

I thas been estimated that between 44 000 and 98 000 people die each year in the United States as a result of medical errors.<sup>1</sup> Medication errors are a common cause for iatrogenic adverse events<sup>2-4</sup> and can lead to severe consequences, including prolonged hospitalization, unnecessary diagnostic tests, unnecessary treatments, and death.<sup>3,5-8</sup>

Preventable errors are significantly more common in emergency departments (EDs) than in other hospital departments,<sup>3,4</sup> and prescribing errors are most common in pediatric and EDs.<sup>9,10</sup> Prescribing and administering medications in the ED is particularly complex for several reasons. Medications frequently need to be given urgently; thus, many are kept in ward stock. Auditing of these drug orders by a pharmacist is not current practice at our institution. In addition, patients in the ED are seen only for a short encounter, and in many cases the physician does not have complete information regarding the patients' medical and drug history.

The incidence of medication errors in the pediatric ED has not been fully described, and factors associated with such errors have not been elucidated. In 1 retrospective review of medication errors in a pediatric ED, incorrect recording of patients' weights,

TABLE 2. Type of Physician Prescription Errors*						
Type of Error	п	% of All Errors	No. of Errors That Were Significant or Severe			
Wrong doset	133	49.1%	68/133			
Wrong frequency <sup>±</sup>	117	43.2%	52/117			
Wrong route§	7	2.6%	2/7			
Wrong drug	5	1.8%	4/5			
Information¶	7	2.6%	3/7			
Other	2	0.7%	1/2			
Total	271	(100%)	130/271			



TABLE 4.	Variables Associated With Prescribing Errors in the	e
Pediatric ED	(Univariate Analysis)	

Variable	OR	95% CI
Ordering physician		
Staff	1.00	Reference
Trainee	1.48	(1.03 - 2.11)
Medication ordered at the beginning of the academic year		
Medication ordered before July 1	1.00	Reference
Trainees	1.67	(1.06 - 2.64)
Staff	1.30	(0.81 - 2.08)
All physicians	1.33	(0.95-1.86)
Severity of disease (based on triage category)		· · · · ·
Mild	1.00	Reference
Moderate	1.48	(1.00 - 2.17)
Severe	2.53	(1.18-5.41)
Age group		
12–18 y	1.00	Reference
<3 mo	0.38	(0.08 - 1.82)
3 mo-5 y	1.91	(0.98 - 3.72)
6–11 y	1.46	(0.75 - 2.84)
Waiting time before seen by doctor		
<2 h	1.00	Reference
≥2 h	0.88	(0.54 - 1.43)
Weekends vs weekdays		
Weekdays	1.00	Reference
Weekends	1.48	(1.04 - 2.11)
Time when drug ordered		
08:00-11:59	1.00	Reference
12:00-15:59	1.02	(0.56 - 1.85)
16:00-19:59	1.23	(0.66 - 2.31)
20:00-23:59	1.64	(0.96 - 2.80)
00:00-03:59	1.39	(0.71 - 2.72)
04:00-07:59	2.45	(1.10 - 5.50)

Variable	OR	95% CI
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Staff	1.00	Referenc
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Modication ordered before July	1 1.00	Reference
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Chaff	1.0/	(1.00-2.09)
	1.50	(0.01-2.00)
All physicians	1.50	6 (0.95-1.86
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- A 94-year-old 40 kg woman presents to the ED following a ground level fall after tripping.
- On presentation she complained only of left wrist pain. Her past medical history was significant for osteoporosis and peripheral vascular disease. She was taking no medications and had no known drug allergies. The patient lived alone and was self-sufficient. The physical examination was normal except for swelling and deformity of the left wrist.
- Radiographic evaluation revealed an ulnar styloid fracture and a dorsally angulated distal radius fracture.
- You want to perform a hematoma block. The nurse hands you a 2% vial of lidocaine containing 20 cc. You draw up 10 cc to infuse.



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- Radiographic evaluation revealed an ulnar styloid fracture and a dorsally angulated distal radius fracture.
- You want to perform a hematoma block. The nurse hands you a 2% vial of lidocaine containing 20 cc. You draw up 10 cc to infuse.
- Can you cause injury from this?



- Upon aspiration, there was a blood return, thought to be from the hematoma.
- A total of 10 mL of 2% plain lidocaine (total dose 200 mg or 5 mg/kg) was infused into the hematoma over 1 min.
- Approximately 15 s after conclusion of the infiltration, the patient experienced a rapid decline in her mental status, and sustained a generalized tonicclonic seizure. This continued for approximately 2 min and resolved spontaneously without pharmacologic intervention.



- On reexamination following this seizure, her gag reflex remained intact, she moaned incomprehensible words, she withdrew from painful stimulation, and she opened her eyes to voice. She had symmetric movement of the extremities, with no tremor, hyperreflexia, or clonus noted. The vital signs following the seizure were: temperature 36.2°C, pulse 99 beats/min, blood pressure 170/87 mm Hg, respiratory rate 18 breaths/min, and pulse oximetry reading of 92%. Auscultation of the chest revealed clear breath sounds and tachycardia without murmurs, rubs or gallops. The abdomen was soft and non-tender with audible bowel sounds. All of the pulses were palpable. The skin was warm, with a moist axilla noted.
- The patient was placed on oxygen at 4 L/min with pulse oximetry showing 100%. No further ventilatory support was necessary.
- An electrocardiogram (EKG) revealed a normal sinus rhythm with no prolongation of the QRS or QT intervals.
- A blood glucose, metabolic panels, troponin, complete blood count, and head computed tomography (CT) scan were normal.
- One hour after the seizure, the patient was noted to arouse to verbal stimuli, but was orientated to person only. She rapidly drifted back to sleep without stimulation. She was admitted for overnight observation, and she gradually returned to her baseline function over the ensuing 8 h. At 6month follow-up, her mental status remains normal and she has suffered no sequelae.



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#### LIDOCAINE-INDUCED ALTERED MENTAL STATUS AND SEIZURE AFTER HEMATOMA BLOCK

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□ Abstract—Hematoma blocks with lidocaine are routinely utilized in the Emergency Department to allow reduction of Colles' fractures. Lidocaine toxicity is a potential complication of this procedure. We present a case report of a patient who developed acute mental status changes and generalized seizure immediately following administration of lidocaine during a hematoma block. The rapid onset of seizure development following injection was most likely due to inadvertent intravascular administration. © 2006 Elsevier Inc.

□ Keywords—lidocaine; hematoma block; seizure; toxicity

#### INTRODUCTION

Fracture reduction in the Emergency Department (ED)

#### CASE REPORT

A 94-year-old 40-kg woman presented to the ED following a ground level fall after tripping. On presentation she complained only of left wrist pain. Her past medical history was significant for osteoporosis and peripheral vascular disease. She was taking no medications and had no known drug allergies. The patient lived alone and was self-sufficient. The physical examination was normal except for swelling and deformity of the left wrist. Radiographic evaluation revealed an ulnar styloid fracture and a dorsally angulated distal radius fracture.

A hematoma block was attempted. A needle was placed through the skin in the direction of the hematoma. Upon aspiration, there was a blood return, thought to be from the hematoma. A total of 10 mL of 2% plain

## Lidocaine

- It has been recommended by the manufactures that the total amount of plain lidocaine infiltrated should not exceed 5 mg/kg without epinephrine and 7 mg/kg with epinephrine.
- Lidocaine anesthesia is achieved when nociceptive afferent sodium channels are blocked, thereby inhibiting neuronal conduction. At appropriate doses, lidocaine can be administered locally without central nervous system (CNS) or cardiac toxicity because local tissue concentrations reach a thousand-fold higher levels than blood concentrations
- If lidocaine does enter the systemic circulation following local injection, peak arterial lidocaine concentrations are blunted due to the considerable uptake in the lungs. This is followed by back diffusion of lidocaine into the circulation, occurring within 30 seconds.
- Lidocaine crosses the blood-brain barrier rapidly and has long been recognized as a proconvulsant drug.



## Lidocaine

- In a report on the toxic effects of lidocaine, the Boston Collaborative Drug Surveillance Program found CNS disturbances to be most common. Adverse reactions to the local anesthetic were noted in 6.3 percent of patients (47 in 750), with two out of three reactions involving CNS symptoms (31 in 47). The overall incidence of seizures related to lidocaine is 5.7 per 1000 patients.
- There is an increased likelihood of toxicity in the elderly.
- Even when proper precautionary measures are taken, the ability to recognize the signs and symptoms of lidocaine toxicity is critical. Circumoral or tongue numbness, tinnitus, visual disturbances, and mental status decline are early warning signs of lidocaine toxicity.
- Seizure activity induced by lidocaine is typically brief. If necessary, lidocaine-induced seizures can be interrupted with the intravenous administration of benzodiazepines, barbituates, or propofol.



#### Palliative Care Rounds

### Lidocaine Toxicity During Frequent Viscous Lidocaine Use for Painful Tongue Ulcer

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Department of Anesthesia and Critical Care Medicine (S.Y., H.Y.), Iwaki Kyoritsu General Hospital, Iwaki, Fukushima, Japan; Department of Anesthesiology (S.S.), Hamamatsu Medical University, Shizuoka, Japan; and Departments of Anesthesiology (M.M.) and Clinical Pharmacy (Y.K.), Institute of Clinical Medicine, University of Tsukuba, Ibaraki, Japan

#### Abstract

Oral viscous lidocaine is useful for the treatment of symptoms induced by oral inflamed mucosa, such as radiation- or chemotherapy-induced mucositis. The toxic reactions associated with an accidental overdose have been reported in pediatric cases. We report a case of lidocaine toxicity in a 22-year-old man during frequent viscous lidocaine use for severe painful tongue ulcer. The toxic symptoms developed when the amount of oral viscous lidocaine exceeded 240 ml per day. The serum lidocaine concentration associated with this use was  $6.7 \mu g/ml$ . The toxic symptoms continued in spite of the serum lidocaine concentration below the toxic level after the start of a diluted preparation, which contained a half-dose lidocaine. It is speculated that lidocaine metabolites might have contributed to the toxic symptoms. Clinicians should consider the risk of lidocaine toxicity in cases of frequent viscous lidocaine use, and determine the serum concentrations of lidocaine and its metabolites. J Pain Symptom Manage 2002; 24:543–545 © U.S. Cancer Pain Relief Committee, 2002.

### Transitory Ataxia Related to Topically Administered Lidocaine

Pascal Perney, François Blanc, Georges Mourad, Jean-Pierre Blayac, and Dominique Hillaire-Buys

OBJECTIVE: To report 2 cases of transitory cerebellar ataxia related to lidocaine administered topically for endoscopy.

**CASE SUMMARIES:** Two patients developed transitory cerebellar ataxia a few minutes after local anesthesia using lidocaine 10% spray and lidocaine 2% orally for a bronchoscopy and transesophageal echocardiography. This effect completely disappeared in 3–5 hours. In neither case was an alternate etiology of cerebellar ataxia identified. The second patient had previously experienced a similar reaction to lidocaine.

DISCUSSION: Several central neurologic effects of lidocaine have been reported, but until now, only few cases of cerebellar ataxia. In these 2 cases, the Naranjo probability scale indicated that a probable and a highly probable relationship existed between lidocaine administration and the transitory cerebellar ataxia.

CONCLUSIONS: Cerebellar ataxia may occur after local anesthesia with lidocaine; therefore, care must be taken to avoid overdose, even when administered topically.

KEY WORDS: ataxia, cerebellar syndrome, lidocaine, topical administration.

Ann Pharmacother 2004;38:828-30.



- A 45 y/o female presents to triage and is brought immediately back to room 33 in the ED following envenomation from a bee sting.
- She complains of inability to breath with broken words, is tripoding, and has audible wheezing & stridor. Her vitals: BP 70 palpable, P 140, RR 40. Husband at bedside. Nurses just got an IV established.





- A 45 y/o female presents to triage and is brought immediately back to room 33 in the ED following envenomation from a bee sting.
- She complains of inability to breath with broken words, is tripoding, and has audible wheezing & stridor. Her vitals: BP 70 palpable, P 140, RR 40. Husband at bedside. Nurses just got an IV established.
- What are you going to do?



# Anaphylaxis



## Epinephrine

- Epinephrine should be injected IM in the mid-anterolateral thigh (vastus lateralis) which leads to a better absorption than IM or subcutaneous injection into the deltoid.
- The length of the needle in crucial in ensuring the dose reaches the muscle. Auto-injectors' needles may be too short in obese patients.
- Intravenous (1:10,000) epinephrine infusion should only be used with continuous hemodynamic monitoring.
- There are no absolute contraindications to epinephrine. Dose adjustment is almost never required in the setting of acute anaphylaxis.
- Erroneous intravenous administration or epinephrine overdose may lead to cardiac arrhythmias, pulmonary edema or even death.
- Some drugs interact with epinephrine, for example, bblockers (including eye drops) and may reduce efficacy.



 What does 1:1,000 and 1:10,000 mean in regards to dose per volume?





- What does 1:1,000 and 1:10,000 in regards to dose per volume?
  - 1 mg/ml and 0.1 mg/ml respectively





- What does 1:1,000 and 1:10,000 in regards to dose per volume?
  - 1 mg/ml and 0.1 mg/ml respectively
- How many ml of epi 1:1,000 would you give to an a patient over 12 years of age, a child between 6-12, and a child less than 6?





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  - 0.5 ml, 0.3 ml, and 0.15 ml respectively

![](_page_31_Picture_5.jpeg)

![](_page_32_Picture_0.jpeg)

- What does 1:1,000 and 1:10,000 in regards to dose per volume?
  - 1 mg/ml and 0.1 mg/ml respectively
- How many ml of epi 1:1,000 would you give to an a patient over 12 years of age, a child between 6-12, and a child less than 6?
  - 0.5 ml, 0.3 ml, and 0.15 ml respectively
- What would you do if the patient was on a beta-blocker and had no effect from the epinephrine?

![](_page_33_Picture_0.jpeg)

- What does 1:1,000 and 1:10,000 in regards to dose per volume?
  - 1 mg/ml and 0.1 mg/ml respectively
- How many ml of epi 1:1,000 would you give to an a patient over 12 years of age, a child between 6-12, and a child less than 6?
  - 0.5 ml, 0.3 ml, and 0.15 ml respectively
- What would you do if the patient was on a beta-blocker and had no effect from the epinephrine?
  - IM or IV Glucagon

![](_page_34_Picture_0.jpeg)

- What does 1:1,000 and 1:10,000 in regards to dose per volume?
  - 1 mg/ml and 0.1 mg/ml respectively
- How many ml of epi 1:1,000 would you give to an a patient over 12 years of age, a child between 6-12, and a child less than 6?
  - 0.5 ml, 0.3 ml, and 0.15 ml respectively
- What would you do if the patient was on a beta-blocker and had no effect from the epinephrine?
  - IM or IV Glucagon
- How much epinephrine in an Epipen and Epipen Junior?

![](_page_34_Picture_8.jpeg)

![](_page_35_Picture_0.jpeg)

- What does 1:1,000 and 1:10,000 in regards to dose per volume?
  - 1 mg/ml and 0.1 mg/ml respectively
- How many ml of epi 1:1,000 would you give to an a patient over 12 years of age, a child between 6-12, and a child less than 6?
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- What would you do if the patient was on a beta-blocker and had no effect from the epinephrine?
  - IM or IV Glucagon
- How much epinephrine in an Epipen and Epipen Junior
  - 0.3 mg and 0.15 mg respectively

![](_page_35_Picture_9.jpeg)
## **Other Treatment**





- A 32 y/o M with a history of seizure disorder on phenytoin presents after having a grand mal seizure on the city bus. He is brought into the ED via EMS and is noted to be postictal.
- Laboratory testing demonstrates a non-detectable phenytoin level.
- The resident orders a loading dose of 1 gm of phenytoin intravenous.





- A 32 y/o M with a history of seizure disorder on phenytoin presents after having a grand mal seizure on the city bus. He is brought into the ED via EMS and is noted to be postictal.
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- What two things should be discussed with nursing before the start of the infusion?





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- Laboratory testing demonstrates a non-detectable phenytoin level.
- The resident orders a loading dose of 1 gm of phenytoin intravenous.
- What two things should be discussed with nursing before the start of the infusion?
  - Rate of infusion and location of infusion



# Phenytoin







#### University of Virginia Medical Center Clinical Protocol Extravasation Management of Non-Chemotherapeutic Agents

- 1. When infusing vesicants/irritants, monitor IV line regularly (eg, every 30 minutes).
- 2. With suspected extravasation, stop infusion immediately.
- 3. Withdraw 3 to 5 mL of blood from catheter to remove remaining drug, if possible.
- 4. Notify licensed independent practitioner (LIP) on call.
- 5. Delineate infiltration area on patient's skin with marker.
- 6. Obtain order for and administer antidote immediately (antidotes are most effective when administered within 12 hours of event):
  - a. Sympathomimetics (dobutamine, dopamine, epinephrine, norepinephrine, phenylephrine, vasopressin):
    - i. Apply warm compresses 15-30 minutes every 4-6 hours for 24-48 hours, AND
    - ii. Use phentolamine: Dilute 5 mg phentolamine in 10 mL normal saline. Inject 5 mL through catheter and five 1 mL doses subcutaneously around edge of infiltrate. Change needle after each injection. (Pediatrics: maximum 0.1 mg/kg or 5 mg total).
  - b. Hyperosmolar solutions (aminophylline, calcium, dextrose solutions >5%, gentamicin, magnesium, mannitol, nafcillin, parenteral nutrition, penicillin, phenytoin, potassium, sodium bicarbonate, vancomycin):
    - i. Apply cold compresses 15-30 minutes every 4-6 hours for 24-48 hours, AND
    - Use hyaluronidase: Inject five 0.2 mL doses of 150 units/mL solution subcutaneously around edge of infiltrate. Change needle after each injection. (Pediatrics: use 15 units/mL solution by diluting 1 mL of 150 units/mL solution with 9 mL normal saline).
- 7. Remove infusion needle/catheter.
- 8. Elevate extravasated limb to highest degree possible. Avoid pressure or irritation to skin that may aggravate the injury.
- 9. Document event by noting date, time, needle size/type, method of administration, insertion site, name of drug suspected of extravasation, estimation of volume of extravasation based on rate of infusion and time infusion was started, location of extravasation, appearance of site, patient symptoms, LIP notification, and management procedures in medical record.
- 10. Complete an incident report using QR Track.
- 11. Monitor site for several days after event. Consult Plastic Surgery if necessary.

# **Purple Glove Syndrome**



## **Intraosseous Lines**





- A previously healthy 9-yr-old female presented to the ED for lethargy and AMS.
- The patient's mother reported that, 4 days prior, the patient had presented to an OSH with R ankle pain that was diagnosed as an ankle fracture and was prescribed Tylenol with codeine and Phenergan. The patient had subsequently developed worsening sedation and decreased appetite but no subjective fever.
- On arrival to the ED the patient had CNS depression and was only responsive to pain. Her initial vital signs:
  - T 37.6° C; P 185; BP undetectable; RR 46; O2 saturation of 100%.
- Pupils 4 mm & non-reactive; dry mucus membranes; lungs clear and equal; heart tachycardia with no murmurs; abdomen soft with audible bowel sounds. Peripheral pulses were difficult to palpate. Her skin was noted to be cold, mottled and cyanotic, with delayed capillary refill. Her right ankle was noted to be swollen, ecchymotic, and tender. Neuro only responsive to pain, dysconjugate gaze.



### Phenergan

#### Contraindicated Use in Pediatric Patients less than 2 years of age

- Promethazine should not be used in pediatric patients less than 2 years of age because of the potential for fatal respiratory depression
- Post marketing cases of respiratory depression, including fatalities, have been reported with the use of
  promethazine in pediatric patients less than 2 yrs of age. A wide range of weight-based doses of promethazine
  have resulted in respiratory depression in these patients.
- Caution should be exercised when administering this drug to pediatric patients 2 years of age or older. It is
  recommended that the lowest effective dose of promethazine be used in such patients and concomitant
  administration of other drugs with respiratory depressant effects be avoided.

#### Severe Tissue Injury, Including Gangrene

Language for Black Box Warning Has Not Been Finalized: The Following is A Summary of Information and Not Complete. See FDA Link Below

- Perivascular extravasation, unintentional intra-arterial injection and intraneuronal or perineuronal infiltration of the drug may result in irritation and tissue damage, including gangrene.
- The Boxed Warning will remind practitioners that due to the risks of intravenous injection, the preferred route of
  administration is deep intramuscular injection and that subcutaneous injection is contraindicated.
- Perivascular extravasation, unintentional intra-arterial injection and intraneuronal or perineuronal infiltration of the drug may result in irritation and tissue damage. Healthcare professionals should be alert for signs and symptoms of potential tissue injury including burning or pain at the site of injection, phlebitis, swelling, and blistering



- Initial management included 0.4 mg Naloxone IVP which resulted in the patient awakening and becoming restless, agitated, and talkative but not orientated. A toxicology consult was called for at this time due to concern for OD. IVF replacement was begun and labs, including blood and urine cultures were sent.
- Initial lab work: WBC 15.9, HCT 43.4, platelet 66; Na 135 mmol/L, K 4.6 mmol/L, CI 99 mmol/L, bicarbonate 10 mmol/L, BUN 61 mg/L, Cr 2.7 mg/L, glu 50 mg/L, Ca 7.8 mmol/L, Mg 3.5 mmol/L; ALT 136 U/L, AST 235 U/L.
- Other labs?



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- CK was 140,000 U/L and lactate was 31mmol/L.



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- LP?
  - LP was performed which later came back showing 654 RBCs, 34 WBCs, glucose 49 mg/dL, and CSF protein of 47 mg/dL.



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- 1.5 hours after arrival, patient was again noted to have decreased mental status but this time she was not responsive to naloxone.
- Mother allowed during resuscitation?
- Patient intubated with direct visualization of the cords and good BS after intubation.



- Shortly thereafter, patient developed bradycardia and QRS widening which rapidly progressed to PEA.
- CPR was performed for 18 minutes and patient had eventual response to sodium bicarbonate along with vasopressors and she was transferred to the pediatric ICU.
- Why?



- On hospital day one, cultures from the patient's ankle came back positive for Group A betahemolytic streptococcus (GAS); antibiotics were targeted to this organism and a diagnosis of toxic shock syndrome was made.
- On hospital day three, CSF culture came back positive for GAS; loss of brainstem reflexes was also noted at this time and a CT with perfusion study showed severe cerebral edema and a lack of perfusion. Patient was declared brain dead on hospital day four.
- Autopsy was declined.



- A 32 y/o F developed cyanosis and dyspnea following administration of topical benzocaine spray during nasopharyngeal endoscopy.
- Initial vital: BP 130/48, P 115, RR 24, oxygen saturation 82% on a non-rebreather mask.
- An ECG revealed ST and a CXR was normal.
- Arterial blood gas revealed chocolate brown blood with pH 7.43, pCO2 32, pO2 328













- A 32 y/o mother of 5 presents with cellulitis of the arm following a puncture wound in the garden. She has no significant PMH. She does have a history of rash associated with ampicillin given when she tested positive for Group B streptococcus in her second pregnancy.
- Can you given her cephalexin?



### Campagna JD. The Use of Cephalosporins in Penicillin-allergic Patients: A Literature Review. J Emerg Med 2012; 42:612-620.

- There is limited correlation between allergy to a penicillin antibiotic and allergy to a cephalosporin antibiotic.
- Most cross reactivity between penicillins and cephalosporins stems from whether their R1 side chains are structurally similar.
- Cross reactivity between penicillins and most second- and all third- and fourth-generation cephalosporins is negligible.
- The overall cross reactivity between penicillins and cephalosporins in individuals who report a penicillin allergy is approximately 1% and, in those with a confirmed penicillin allergy, 2.55%.
- If a patient has had an allergic response to penicillin, it is safe to administer a cephalosporin with a side chain that is structurally dissimilar to that of the penicillin or to administer a third- or fourth- generation cephalosporin.

Penicillin	Cephalosporins That Cross React	Common R1 Side Chain
Amoxicillin Ampicillin	Cefaclor† Cefadroxil* Cefatrizine* Cefprozil† Cephalexin* Cephradine*	

Figure 2. Penicillin and cephalosporins known to have a risk of allergic cross reaction 17, 19, 34, 37, 47 and 49. These cephalosporins should be avoided in patients who are allergic to penicillin.\*First generation.†Second generation.Patients who are selectively allergic to amoxicillin or ampicillin should avoid the cephalosporins listed, because they have similar R1-group side chains.



















- A 37 y/o M presents after MVC with facial trauma, marked agitation, a smell of alcohol on his breath. Initial vitals: BP 156/93, P 124, RR 24.
- Rapid sequence intubation is performed with 100 mg of succinylcholine and 30 mg of etomidate with good color change and breath sounds.
- Five minutes after intubation, the patient's HR increases to 156, BP drops to 93/34 and the respiratory therapist notes increased difficulty with bagging despite clear BS.
- ABG reveals: P<sub>A</sub>CO<sub>2</sub>: 67 mm Hg; P<sub>A</sub>O<sub>2</sub>: 284 mm Hg; HCO<sub>3</sub>: 19.9 mEq/L; S<sub>P</sub>O<sub>2</sub>: 96.4%; Base excess: -8.3 mmol/L; pH 7.21).
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- What happened and what do you need to emergently administer or this patient will die?

### Succinylcholine malignant hyperthermia

- MH is a rare life-threatening condition that is usually triggered by exposure to certain drugs used for general anesthesia, specifically the volatile anesthetic agents and succinylcholine.
- Susceptibility to MH is often inherited as an autosomal dominant disorder, for which there are at least 6 genetic loci of interest, most prominently the ryanodine receptor gene (*RYR1*). MH is usually revealed by anesthesia, or when a family member develops the symptoms.
- The typical symptoms of malignant hyperthermia are due to a hypercatabolic state, which presents as a very high temperature, an increased heart rate, increased carbon dioxide production, increased oxygen consumption, acidosis, rigid muscles, and rhabdomyolysis.
- The symptoms usually develop within one hour after exposure to trigger substances, but may even occur several hours later in rare instances.
- The current treatment of choice is the intravenous administration of dantrolene.
  - 1 mg/kg administered by continuous rapid intravenous push and continued until symptoms subside or the maximum cumulative dose of 10 mg/kg has been reached.

### **SCENARIO**

- 22 y/o 48 kg female admitted for surgical extraction of impacted wisdom teeth was administered 50 mcg of fentanyl with no effect
  - 4 minutes later she received and additional 25 mcg of fentanyl with no effect
  - 2 minutes later she received an additional 25 mcg of fentanyl and suddenly became rigid, stopped breathing, and jaws were clenched

### CHEST WALL RIGIDITY SYNDROME

- Usually associated with large or rapid doses of fentanyl
- May be reversed with Naloxone
- May need neuromuscular blocking agent like succinylcholine to facilitate artificial respiration.

• Vaughn RL, Bennett CR, Fentanyl Chest Wall Rigidity Syndrome- A Case Report; Anesthesia Progress, 1981 Mar-April;28(2):50-1



### Chest Wall Rigidity in Two Infants After Low-Dose Fentanyl Administration

Elisabeth Dewhirst, MD, \* Aymen Naguib, MD, \* and Joseph D. Tobias, MD\*†

- Known to cause skeletal muscle rigidity
- When it effects the respiratory musculature and chest wall, can have symptoms ranging from
  - Cough to severe chest wall and laryngeal rigidity.
- Frequently reported with adults after rapid administration of large doses
- Treat with naloxone and neuromuscular blocking agents
- Chest Wall Rigidity reported in neonates and infants at doses as low as 1µg/kg




## Godambe SA. latrogenic Pleuropulmonary Charcoal Instillation in a Teenager. Ped Pulm 2003;35: 490-3

- A 13 y/o F ingested an unknown quantity of hydromorphone, butalbital, amitriptyline, and sustained release morphine. She presents somnolent and difficult to arouse.
- A 50-g dose of charcoal was administered via an 18 French NGT.
- Following administration of 2 mg of naloxone intravenously, she became more alert and responsive to voice. A gag reflex was present.
- Physical and laboratory evaluation, including an electrocardiogram, were otherwise unremarkable.
- She was noted to have diminished breath sounds in the left lung field as compared to the right.
- A chest X-ray showed:

## Placement of Substances via Nasogastric Tubes











