Tricyclic Antidepressant Overdose
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Target Audience: Emergency Medicine Residents, Medical Students

Primary Learning Objectives:

1. Recognize signs and symptoms of tricyclic antidepressant/amitriptyline toxicity
2. Recognize importance of ECG in TCA overdose and ECG findings of sodium channel blockade
3. Describe technique for alkalinizing serum
4. Discuss potential complications of serum alkalinization
5. Order appropriate laboratory and radiology studies in tricyclic antidepressant overdose

Secondary Learning Objectives: detailed technical/behavioral goals, didactic points

1. Perform a mental status evaluation of the altered patient
2. Formulate independent differential diagnosis in setting of leading information from RN
3. Describe how to make a bicarbonate infusion.
4. Describe importance of potassium replacement during serum alkalinization
5. Describe how to manage sodium channel blockade when refractory to alkalinization

Critical actions checklist:

1. Perform endotracheal intubation
2. Obtain peripheral IV access for resuscitation with crystalloid fluid
3. Obtain ECG
4. Obtain appropriate labs
5. Initiate serum alkalinization
6. Sedate with GABA agonist
7. Consult Poison Center/Toxicologist
8. Admit to the MICU

Environment:

1. Room Set Up – ED acute care area
   a. Manikin Set Up – Mid or high fidelity simulator, simulated sweat if available
   b. Airway equipment, Sodium Bicarbonate, Nasogastric tube, Activated charcoal, IV fluid, norepinephrine, Simulated naloxone, Simulate RSI medications (etomidate, succinylcholine)
2. Distractors – ED noise

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CASE SUMMARY

SYNOPSIS OF HISTORY/ Scenario Background

The setting is an urban emergency department.

This is a case of a16-year-old girl who is brought to the ED from home by her mother for altered mental status. Mother reports daughter came home from school and was upset and tearful, but would not talk about it and asked "to be left alone." Thirty minutes later, the mother went to check on the daughter, found her with an altered mental status, and bought her to the ED. By the time of ED presentation, the patient was last seen normal approximately one hour ago.

The patient was upset after breaking up with her boyfriend that day and overdosed on amitriptyline as part of a suicide attempt. There were no other co-ingestions.

Patient will require intubation, may receive decontamination with activated charcoal after intubation, IVF, sodium bicarbonate, vasopressor (norepinephrine, phenylephrine), and ICU admission. Toxicology consultation should be requested but will have no additional suggestions.

After initial evaluation (vital signs, physical exam), patient will become even more unresponsive, and demonstrate decreased respirations and hypotension. **At that time, the mother will check the daughter's pocketbook and find that her amitriptyline pill bottle is empty.**

SYNOPSIS OF PHYSICAL

The patient is initially stuporous and delirious, with an intact gag reflex, and mumbling incoherently, saying random words.
The patient's airway is protected at the time of her arrival to the ED.
The patient is tachycardic.
The patient's exam demonstrates other findings consistent with "anticholinergic" manifestations of tricyclic antidepressant toxicity: the skin is dry, the abdominal exam shows absent bowel sound, and there is suprapubic fullness.

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CRITICAL ACTIONS

1. **Perform endotracheal intubation**

   Patient requires endotracheal intubation.
   Cueing Guideline: Nurse can note that the patient starts to vomit while being unresponsive and that the airway is not protected.

2. **Obtain peripheral IV access for resuscitation with crystalloid fluid**

   Bilateral large bore peripheral IV access should be established as the patient is hypotensive and tachycardic. 1-2 L of crystalloid should be given.
   Cueing Guideline: The nurse may say, “We have a line in place. Would you like any fluids?” Alternatively, the nurse can mention the tachycardia. If not done the patient will become more tachycardic (140) and BP may drop to 75/43.

3. **Obtain ECG**

   Order and obtain ECG. The participant should note the wide QRS (and prolonged QTc) and sinus tachycardia.
   Cueing Guideline: The nurse can mention that the QRS looks wide on the monitor. If not done, the patient will develop runs of ventricular tachycardia.

4. **Obtain appropriate labs**

   To meet this critical action, the participant must obtain at least a metabolic panel, salicylate level (undetectable), acetaminophen level (undetectable), ethanol level (undetectable), and TCA screen (positive).
   Cueing Guideline: The nurse can ask if any labs or drug levels should be obtained. If resident/student asks for an amitriptyline level, nurse or lab tech can state only a qualitative screen is available. The use of serum or urine for this is immaterial.

5. **Initiate serum alkalinization**

   Recognition of sodium channel blockade. Two-to-four ampules of sodium bicarbonate should be given as a bolus, and a bicarbonate infusion (**150 mEq of sodium bicarbonate - three ampules - in 1 L of D5W**) should be started.
   Cueing Guideline: Nursing can note continued apparent widening of QRS on monitor. Repeat ECG will show QRS widening to 160 msec. If still not done, the patient will start to become bradycardic and develop ventricular tachycardia. Return of spontaneous circulation (ROSC) will not be achieved using standard ACLS interventions (e.g., epinephrine, defibrillation, compressions) until sodium bicarbonate is given.

6. **Administer vasopressor for hypotension**

   As the case progresses, the patient will require vasopressor support. Participants meet this critical action with the administration of norepinephrine or equivalent vasopressor.
   Cueing Guideline: If not done, patient will remain hypotensive.

7. Consult Poison Center/Toxicologist

The local poison center or Toxicology Service should be consulted for further management recommendations (pH goals, pressor choices, etc.)
Cueing Guideline: Nurse can ask if the doctor has called the Poison Center/Toxicologist yet.

8. Admit to the MICU

Admit to the MICU for definitive care. Patient will not be stable for any other destination (e.g. telemetry or floor unit). Any attempt to admit elsewhere will be blocked by accepting physician.
Cueing Guideline: The nurse can ask the doctor if anyone has called the intensivist to arrange for a definitive disposition decision.

Critical Actions Checklist[1]

Resident Name	
Case Description	

Skills measured **Core competencies: PC** Patient care, **MK** Medical knowledge, **IC** Interpersonal and communication skills **P** Professionalism, **PB** Practice-based learning and improvement **SB** Systems-based practice	Very Unacceptable		Unacceptable		Acceptable		Very Acceptable	
Data Acquisition (D) PC MK I	1	2	3	4	5	6	7	8
Problem Solving (S) PC MK PB	1	2	3	4	5	6	7	8
Patient Management (M) PC MK IC P PB SB	1	2	3	4	5	6	7	8
Resource Utilization (R) PC PB SB	1	2	3	4	5	6	7	8
Health Care Provided (H) PC SB	1	2	3	4	5	6	7	8
Interpersonal Relations (I) IC P	1	2	3	4	5	6	7	8
Comprehension of Pathophysiology (P) MK PB	1	2	3	4	5	6	7	8
Clinical Competence (C) PC MK IC P PB SB	1	2	3	4	5	6	7	8

Critical Actions

Yes	No		Comments:
		Perform endotracheal intubation	
		Obtain peripheral IV access for resuscitation with crystalloid fluid	
		Obtain ECG	
		Obtain appropriate labs	
		Initiate serum alkalinization	
		Administer vasopressor for hypotension	
		Consult Poison Center/Toxicologist	
		Admit to the MICU	

Yes	No	
		Dangerous actions

[1] Modified ABEM Oral Certification Examination checklist and scoresheet

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HISTORY

Onset of Symptoms: Today

Background Info: This is a 16-year-old girl brought in by EMS after her mother found her with altered mental status approximately one hour ago after coming home from school.

Additional History

From EMS: If asked about the scene in the apartment they will describe a cluttered, small apartment. Near the patient were bottles of trazodone and butalbital-acetaminophen-caffeine, with pills still in them. There was vomitus at the scene.

From Mother: Mom states daughter was in usual state of health until today; tearful after coming home from school; found agitated and delirious 30 minutes after coming home from school; altered mental status has been present for approximately one hour by the time the patient presents to the ED

Chief Complaint: Altered mental status

Past Medical Hx: None

Past Surgical Hx: None

Last menstrual period: Two weeks ago

Medications: None

Allergies: None

Habits: Tobacco, alcohol, or recreational drugs: None known or

Family Med Hx: Mother has depression, recently prescribed amitriptyline (**will reveal this fact during the interview if asked**)

Social Hx: Single, lives with mother (divorced)
Currently in High School

ROS: Patient is unable to answer.

CASE CONTINUATION

The patient is swiftly brought to the treatment area. Initial vital signs are obtained.

Vital Signs: BP: 100/50 mmHg P: 112/minute R: 16/minute T: 38.3C (101F)
POx: 100% (FiO_2=0.21)

Primary Survey

Airway – Initially appears to protect airway (impending deterioration as case progresses)
Breathing – Initially appears adequate
Circulation – Tachycardia (110's), SBP 100's, radial pulses slightly diminished
Disability – Patient is stuporous and mumbling incoherently
Exposure – No evidence of trauma, rashes, or track marks

Required Actions within the First Two Minutes

- Establish safety net (IV, oxygen, cardiac monitor, two large bore IVs, draw blood for labs)
- A/B – Provide supplemental oxygen and prepare to intubate patient.
- C – Cardiac monitor; NS IV bolus; ECG – recognize wide QRS
- D – Point-of-care glucose = 95 mg/dL; diagnostic labs should be sent by this time

Branch Points

- **IF NO INTERVENTION OCCURS,** then the patient's blood pressure drops to 80/45 mmHg, and the tachycardia worsens to 130-140/minute.

PHYSICAL EXAM

General Appearance: Young female. Unresponsive.

Updated Vital Signs: **BP: 90/54 mmHg P: 130/minute R: 36/minute T: 37C (98.6F) POx: 90% (FiO_2=0.21)**

Head: Normocephalic and atraumatic; facial diaphoresis

Eyes: PERRLA, pupils 5 mm bilaterally

Ears: TM's normal.

Mouth: Dry mucous membranes

Neck: Trachea midline, supple

Skin: Dry axillae, no rashes, warm

Chest: Mild tachypnea. No trauma. Good chest rise initially.

Lungs: Clear, equal bilaterally, non-labored,

Heart: Tachycardic, S1 S2, no murmurs

Back: Normal

Abdomen: Soft, non-tender, no signs of trauma, no rebound/guarding, absent bowel sounds, fullness in suprapubic area

Extremities: No signs of trauma, no edema, radial pulses weak, central pulses strong

Genital: Digital vaginal exam negative for retained foreign body

Rectal: Normal tone, guaiac negative

Neurological: Grimaces to pain, 4+ patellar reflexes with sustained ankle clonus (if not sedated and paralyzed for endotracheal intubation by this time), upper extremity reflexes normal

Mental Status: Stuporous, mumbling, delirious, saying random words

Required Actions within the Next Two Minutes

- Further resuscitation with additional NS fluid boluses
- Administer 2-4 50-mL ampules of 8.4% $NaHCO_3$ IV bolus
- Perform endotracheal intubation as patient's mental status continues to decline
- May order non-contrast head CT but cannot obtain until patient is more stable
- May place a Foley catheter (drain 900 mL of urine)
- May need to sedate patient (benzodiazepines preferred)

Branch Points

- **DESPITE INTERVENTIONS,** patient will become progressively hypotensive as the case moves forward (lower blood pressure to 80/50 mmHg)

Required Actions within the Next Two Minutes

- ED diagnostics should be available by this time
- Aspirin, acetaminophen, and ethanol levels should be provided
- A TCA screen, if it had been ordered, should be provided by this time

Branch Points

- **ADDITIONAL IV CRYSTALLOID FLUID BOLUSES WILL BE INSUFFICIENT FOR RESTORING THE PATIENT'S BLOOD PRESSURE TO NORMAL LEVELS**
- **IF A VASOPRESSOR IS ADMINISTERED,** then the blood pressure will improve to 100/50 mmHg over the next few minutes.
- **IF SODIUM BICARBONATE IS NOT ADMINISTERED,** then the QRS on the monitor will widen, and the systolic blood pressure will drop to 55-60 mmHg.

Required Actions within the Next Two Minutes

- Check venous pH: goal for serum alkalinization is 7.50-7.55
- **AT FACULTY DISCRETION,** administer additional sodium bicarbonate as needed to achieve therapeutic goal
- **AT FACULTY DISCRETION,** ask participant for details on how to mix/order a sodium bicarbonate infusion (3 ampules of 8.4% $NaHCO_3$ – **150 mEq $NaHCO_3$ in 1L D_5W**) and run at 250mL/hr

Branch Points

- **IF SODIUM BICARBONATE IS NOT ADMINISTERED,** then the patient's heart rate begins to drop and hypotension worsens. **IF A REPEAT ECG IS ORDERED AT THIS POINT,** the QRS will demonstrate widening (provide ECG stimuli as appropriate).
- **IF SODIUM BICARBONATE CONTINUES TO BE WITHHELD,** then the patient develops refractory ventricular tachycardia (VT) and dies, unless bicarbonate given during resuscitation.
- **IF SODIUM BICARBONATE IS GIVEN,** blood pressure appears to respond, although patient remains hypotensive with systolic blood pressures in the 80s-90s and MAPs in the 55-60 range until vasopressors are administered.

Required Actions within the Next Two Minutes

- Norepinephrine or phenylephrine should be chosen as a vasopressor and started at this time
- Call the Poison Center or Consultation with the Toxicologist should be performed at this time
- Lidocaine may also be used if VT develops

Required Actions at the End of the Case

- Additional central venous access as required
- Call MICU for admission and definitive disposition

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STIMULUS INVENTORY

#1 Complete blood count

#2 Basic metabolic panel

#3 Urinalysis

#4 Liver function tests

#5 Venous blood gas

#6 Cardiac enzymes

#7 Toxicology

#8 Radiology (CXR, CT head)

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LAB DATA & IMAGING RESULTS

Stimulus #1	
Complete Blood Count (CBC)	
WBC	9,400/mm^3
Hemoglobin	13.2 g/dL
Hematocrit	38%
Platelets	250,000/mm^3
Differential	
PMNLs	45%
Lymphocytes	55%
Monocytes	2%
Eosinophils	1%

Stimulus #2	
BMP	
Sodium	139 mEq/L
Potassium	4.1 mEq/L
Chloride	106 mEq/L
Bicarbonate	23 mEq/L
Glucose	95 mg/dL
BUN	12 mg/dL
Creatinine	1 mg/dL

Stimulus #3	
Urinalysis	
Color	Yellow
Specific gravity	1.017
Glucose	Negative
Protein	Negative
Ketones	Negative
Leuk. Esterase	Negative
Nitrites	Negative
WBC	0/hpf
RBC	0/hpf

Stimulus #4	
Liver Function Tests	
AST	37 U/L
ALT	28 U/L
T. Bilirubin	1.1 mg/dL
D. Bilirubin	0.2 mg/dL
Albumin	4.3 mg/dL
Protein	7 mg/dL

Stimulus #5	
Venous Blood Gas	
pH	7.39
pCO_2	38 mm Hg
pO_2	52 mm Hg
HCO_3	23 mEq/L
O_2 saturation	70%

Stimulus #6	
Cardiac Enzymes	
Troponin	< 0.01 ng/mL

Stimulus #7	
Toxicology	
Salicylate	Undetectable
Acetaminophen	15 mcg/mL
Ethanol	Undetectable
Urine drug screen	
Amphetamines	Negative
Benzodiazepines	Negative
Cocaine	Negative
Opiates	Negative
TCAs	Negative
THC	Negative

Stimulus #8	
Radiology	
CXR	Normal
CT head	Normal

Stimulus #9 (also see separate PDF)

ECG #1 with NSR ~110/minute, prolonged QRS interval, PR interval 130 ms, QTC 619 ms, R wave, amplitude in AVR is 3 mm.

ECG #2: Worsening TCA toxicity (no bicarbonate)

ECG #3: Resolution of QRS widening (s/p bicarbonate)

Stimulus #1

Complete Blood Count (CBC)

WBC	9,400/mm^3
Hemoglobin	13.2 g/dL
Hematocrit	38%
Platelets	250,000/mm^3
Differential	
PMNLs	45%
Lymphocytes	55%
Monocytes	2%
Eosinophils	1%

Stimulus #2

Basic Metabolic Panel (BMP)

Sodium	139 mEq/L
Potassium	4.1 mEq/L
Chloride	106 mEq/L
Bicarbonate	23 mEq/L
Glucose	95 mg/dL
BUN	12 mg/dL
Creatinine	1 mg/dL

Stimulus #3

Urinalysis

Color	Yellow
Specific gravity	1.017
Glucose	Negative
Protein	Negative
Ketones	Negative
Leuk. Esterase	Negative
Nitrites	Negative
WBC	0/hpf
RBC	0/hpf

Stimulus #4

Liver Function Tests

AST	37 U/L
ALT	28 U/L
T. Bilirubin	1.1 mg/dL
D. Bilirubin	0.2 mg/dL
Albumin	4.3 mg/dL
Protein	7 mg/dL

Stimulus #5

Venous Blood Gas

pH	7.39
pCO_2	38 mm Hg
pO_2	52 mm Hg
HCO_3	23 mEq/L
O_2 saturation	70%

Stimulus #6

Cardiac Enzymes

Troponin	< 0.01 ng/mL

Stimulus #7

Toxicology

Salicylate	Undetectable
Acetaminophen	15 mcg/mL
Ethanol	Undetectable
Urine drug screen	
Amphetamines	Negative
Benzodiazepines	Negative
Cocaine	Negative
Opiates	Negative
TCAs	Negative
THC	Negative

Stimulus #8

Radiology

CXR	Normal
CT head	Normal

Debriefing Materials – <u>Tricyclic Antidepressant Toxicity</u>

Educational Goals: review the key principles of recognition and management of TCA overdose.

Debriefing Approach:

I. Decompress – "How did you feel it went?" (not asking for details; just a chance for the resident to decompress, decrease anxiety/energy level to be more open to learning/retaining knowledge)

II. Core Medical Knowledge (instructor covers details of scenario and objectives)

III. Advocacy/Inquiry
   a. As an instructor "advocate" for your point of view/observations of resident actions
   b. Inquire with an open mind to see why the resident acted the way they did – use this response as a springboard to determine what exactly to teach (e.g., was the resident's poor performance due to missing core medical knowledge or is it a lack of communication skills with the rest of the team?)

IV. Plus/Delta
   a. Plus – tell the resident what went well
   b. Delta – Tell the resident what she could change for next time

Sources of Exposure:

- Examples of TCAs: protriptyline, amitriptyline, nortriptyline, imipramine, clomipramine, desipramine, doxepin
- No longer first-line for depression, but still used
- Finding new uses in other disease processes: sleep (amitriptyline, doxepin), headache (amitriptyline, nortriptyline), neuropathic pain, irritable bowel syndrome
- In pediatrics, used for ADHD, enuresis

Pathophysiology:

- 7 mechanisms of TCA toxicity:
  - Muscarinic receptor antagonism
  - Biogenic amine reuptake inhibition (therapeutic mechanism)
  - Histamine (H1) receptor antagonism
  - Alpha-adrenergic receptor antagonism
  - GABA receptor antagonism
  - Cardiac sodium channel antagonism
  - Cardiac potassium channel antagonism

Severity of Ingestion:

- In acute overdose, fatal cardiac dysrhythmias are rare with VT/VF developing in 4%
- Children younger than 6 account for 12-13% of exposures, a strongly disproportionate number compared to demographics of population prescribed TCAs
- 1-2 adult-strength tablets are sufficient to produce severe symptoms or death in young children
- Seizures occur in 4% of acute overdoses and in 13% of those that result in death

- Death directly due to TCA toxicity usually occurs within hours of overdose, delayed deaths due to complications of toxicity such as ARDS, septic shock, trauma after seizures, etc.

Organ System Effects:

- Psychiatric:
    - Antimuscarinic effects may cause agitated delirium. Early, this may manifest as hallucinations, disorientation, and combativeness. Antimuscarinic toxicity will generally persist after resolution of cardiotoxicity.
- Pulmonary:
    - Aspiration pneumonitis and ARDS may occur secondary to loss of airway protective reflexes, delirium, and seizures.
- Cardiovascular:
    - Acute lethality after TCA overdoses frequently due to cardiovascular toxicity
    - Hypotension develops from several mechanisms:
        - Alpha-adrenergic blockade resulting in inappropriate vasodilation
        - Cardiac Na channel blockade resulting in bradycardia and poor inotropy
        - Systemic effects including volume depletion, metabolic acidosis, and hypoxemia
    - Sinus tachycardia is the most common dysrhythmia.
        - Reflex tachycardia in setting of alpha-adrenergic blockade
        - Muscarinic receptor antagonism
        - Biogenic amine (norepinephrine/dopamine/serotonin) reuptake inhibition
    - ECG characteristically shows intraventricular conduction delay and rightward shift of the terminal 40 ms of the QRS axis (manifested as a prominent terminal R-wave in aVR)
    - ECG findings can be used as a dosimeter of toxicity (see below)
    - Wide-complex tachycardia is the prototypical life-threatening dysrhythmia
    - Prolongation of the QT interval both secondary to and independent of QRS prolongation may occur
- Neurologic:
    - TCAs uniformly cause central nervous system toxicity in life-threatening overdose
    - CNS toxicity may range from agitated delirium to sedation to seizures
    - Doxepin is profoundly sedating due to potent antihistamine effects and may cause coma with minimal cardiovascular effects
    - Delirium, agitation, and/or psychosis result from muscarinic receptor antagonism
    - Seizures are generally brief and occur early in toxicity; status epilepticus is unusual
    - Serotonergic symptoms are also common and can be differentiated from antimuscarinic/sympathomimetic effects by recognition of lower extremity hyperreflexia and clonus out of proportion to upper extremity reflexes
    - Mild CNS toxicity may manifest as blurred vision, dizziness, or ataxia
- Other:
    - Multisystem organ toxicity and failure secondary to hypotension, shock, hypoxemia
    - Antimuscarinic findings may include any of: mydriasis, dry mucous membranes, urinary retention, decreased GI motility and ileus, dry/flushed skin

Diagnostic Testing:

- Quantitative serum TCA levels are not practical
- Qualitative serum or urine TCA is a widely available test
    - Many false positives: 1st generation antihistamines, atypical antipsychotics, carbamazepine, cyclobenzaprine, etc.
- Chemistry panel
    - Repeat as needed
    - Keep potassium within normal range
- Blood gas
    - Serial venous blood gases every 2 hours to ensure accurate pH titration
- Electrocardiogram
    - QRS duration can be used as dosimeter
        - QRS >100 ms portends increased seizure risk, consideration of prophylactic lorazepam depending on mental status
        - QRS >140 ms portends increased risk of ventricular dysrhythmia and warrants aggressive management
    - QT prolongation may occur
    - If treating with bicarbonate, repeat every 2 hours to ensure QRS is narrowing or stable
    - Repeat ECG if mental status worsening

Treatment:

- Decontamination
    - Oral activated charcoal can be considered only in patients presenting less than 1 hour after ingestion and with normal mental status
    - No role for lavage or whole bowel irrigation
- Administer lactated Ringer or isotonic sodium chloride solution for volume expansion with goals of correcting hypotension and maintaining 1-1.5-mL/kg/h urine output.
- Physostigmine: theoretically contraindicated owing to risk of unmasking cardiac potassium channel blockade effects by slowing heart rate and decreasing seizure threshold in setting of GABA-antagonistic effects of TCAs
- Vasopressors: titrate to improving markers of perfusion: mean arterial pressure, capillary refill, lactate, urine output
    - Norepinephrine 1st line: start at 0.1 mcg/kg/min
    - Epinephrine 2nd line: start at 0.1 mcg/kg/min
    - Phenylephrine 3rd line (unless tachycardia profound, may use as 1st line): start at 0.5-1 mcg/min
    - Vasopressin 4th line: 0.4 units/min
    - AVOID dopamine – TCA inhibits reuptake of dopamine, thus, conversion to norepinephrine is blocked
- If QRS >100 ms consider 1-2 mg of lorazepam for seizure prevention if mental status can tolerate
- If QRS >100-120 ms, initiate serum alkalinization (see below)
- Alkalinization of serum disrupts TCA binding to cardiac sodium channels due to slight conformational change
    - 1-2 mEq/kg sodium bicarbonate boluses repeated until QRS narrowing or pH at goal
    - Start infusion of D5W + 150 mEq NaHCO3 + 40 mEq KCl at 1.5-2.5 cc/kg/hr
    - Titrate bicarbonate infusion to pH 7.5-7.55
    - Maintain serum potassium in normal range

- Hypernatremia: if QRS continues to widen or ventricular dysrhythmia develops despite goal pH, induce hypernatremia with goal sodium 150-155 mEq/L
    - Bolus 100 cc 3% sodium chloride until goal sodium met
- Lidocaine: if ventricular tachycardia/fibrillation refractory to pH and sodium optimization, use lidocaine for rhythm control. Amiodarone, may prolong QT interval further.
    - Bolus lidocaine 1-1.5 mg/kg (or 100 mg to keep simple)
    - Initiate lidocaine infusion at 2-4 mg/min
- Elimination: there is no benefit for HD nor MDAC
- Heroic measures: consider intravenous lipid emulsion or extracorporeal membrane oxygenation (ECMO) for refractory shock

Consultations:

- Consult the regional poison center or a local medical toxicologist for additional information and patient care recommendations.

Disposition:

- All potential ingestions require 6 hours of observation to ensure delayed toxicity does not develop
- Admit patients with major signs and symptoms to an ICU.
- Consult psychiatric service personnel for stabilized patients with intentional overdose.

Take-Home Points:

- Obtain ECG early in toxicity
- ECG can be used as a dosimeter.
- 7 mechanisms of toxicity:
    - Sodium channel blockade: wide QRS, cardiogenic shock, dysrhythmias
    - Potassium channel blockade: prolonged QT, dysrhythmias
    - Antihistamine: sedation
    - Antimuscarinic: anticholinergic syndrome
    - Alpha-adrenergic blocker: vasoplegic shock, reflex tachycardia
    - GABA antagonist: seizures
    - Biogenic amine reuptake inhibition: sympathomimetic, seizures, hallucinations, serotonin syndrome, dopamine unresponsiveness
- 6-hours observation for suspected ingestions due to risk of delayed toxicity
- Treatment principles include stabilizing the ABCs, fluid resuscitation, sodium bicarbonate in the setting of sodium channel blockade, GABA agonists for seizures or agitation
- Physostigmine theoretically contraindicated
- If QRS >120 ms, alkalinize serum to pH 7.5-7.55. If ventricular dysrhythmia develops despite alkalinization, push sodium to 150-155 with hypertonic saline.
- Lidocaine is antidysrhythmic of choice if dysrhythmia refractory to alkalinization and hypernatremia
- Replace potassium to maintain the potassium-hydrogen exchange in the renal tubules and to maintain alkalinization.
- Assess serial ECGs every 1-2 hours, along with venous pH and electrolytes in severe, acute toxicity

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