

Target Audience: Emergency Medicine Residents, Medical Students

Primary Learning Objectives:

1. Recognize signs and symptoms of chronic aspirin (ASA) toxicity
2. Describe elimination techniques effective for toxic serum ASA levels
3. Describe technique for alkalinizing urine
4. Discuss potential complications of mechanical ventilation
5. Recognize indications for hemodialysis in ASA overdose
6. Order appropriate laboratory and radiology studies in ASA overdose

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

1. Describe the pathophysiology of chronic aspirin toxicity
2. Compare the differences and similarities in presentation, diagnosis, and management in acute and chronic aspirin toxicity
3. Discuss the management priorities for the emergent stabilization of the patient with aspirin toxicity
4. Describe the methods used to minimize absorption and enhance elimination of toxic aspirin ingestions.

Critical actions checklist:

1. Perform gastric decontamination with AC – (May consider multi-dose activated charcoal. WBI is optional.)
2. Order ASA level and basic metabolic panel; (then serial ASA levels, K, HCO₃, cre)
3. Volume resuscitate with NS
4. Alkalinize urine and replace potassium
5. Consult Poison Center and Nephrology to arrange for dialysis
6. Consider potential problems with mechanical ventilation

Environment:

1. Room Set Up – ED critical care area
 - a. Manikin Set Up – Mid or high fidelity simulator, simulated sweat
 - b. Props – Standard ED equipment

For Examiner Only

CASE SUMMARY

SYNOPSIS OF CASE

A 58-year-old male with a history of gout and coronary artery disease presents to the ED with nausea, vomiting, diarrhea and low-grade fevers. His wife notes that his mental status has changed, and he seems to have flu-like symptoms. On exam he will be hard of hearing, tachypneic, tachycardic, and have a low-grade fever. His symptoms will be suggestive of an infectious process; however, a salicylate level will be significantly elevated and he will need sodium bicarbonate therapy and ICU admission

SYNOPSIS OF HISTORY

Mr. Stevenson is a 58-year-old man who was in his usual state of health until 1 week prior to presentation. His wife states that she first noticed mild nausea with some vomiting at that time, which has since worsened. She reports his "balance is off" and he seems confused. He has had infrequent diarrhea and decreased urination. Additionally, he developed a fever two days ago. Per history obtained from his wife, there have been no medication changes, no known sick contacts, and no known falls or trauma. The rest of his review of systems obtained from his wife is negative for vision changes, chest pain, abdominal pain, rash, dysuria, cough, headache, or neck pain.

SYNOPSIS OF PHYSICAL

Initial Vitals: BP 108/70, HR 118, RR 24, SaO₂ 93% on RA, T 38.3 C (oral). The patient is noted to be mildly confused with difficulty answering questions, and is also noted to be mildly agitated. The patient will be unable to hear the examiner's questions, requiring the examiner to speak loudly. Pupils are normal, and his mouth is dry. Neck is supple. He has mild crackles in the lung bases and is tachycardic and tachypneic. His abdominal exam is unremarkable. His right, great toe is swollen, painful and red, with no other skin abnormalities noted. No focal weakness or neurologic deficits are noted.

SCORING GUIDELINES

Score up for verbalizing differential diagnosis, having his wife go home and check the aspirin bottle, and recognizing he has an acute gouty arthritis flair. Score up for discussion of indications for hemodialysis for chronic salicylate overdose including level greater than 50-60 mg/dL, cerebral or pulmonary edema, worsening acidosis despite resuscitation, or seizures. Activated charcoal may be considered, but is not a critical action given the chronicity of this ingestion. Antibiotics are not needed, but given the differential diagnosis of sepsis, will be acceptable. Do not score down for LP or head CT, but bicarbonate therapy must precede any test performed outside the ED. Score down if potassium replacement has not been started.

CRITICAL ACTIONS

1. Obtain a salicylate level

Simply asking the patient or wife about aspirin use will not suffice. The examiner must verbalize this request to the nurse ordering labs or state that he/she will place the order. The results should be given in a timely manner to expedite the case. It is reasonable that the examiner may not request this test until results of an ABG/VBG demonstrate an acidosis.

Cueing Guideline: The nurse asks if the doctor would like any labs or any levels on the patient.

2. Obtain an ABG/VBG with electrolytes

Either upon recognition of the elevated salicylate level, or in process of the evaluation of this patient's altered mental status, an ABG or VBG should be ordered. The examinee should correctly identify a metabolic acidosis with compensatory respiratory alkalosis. Additionally, once salicylate intoxication has been identified, the potassium level should be verified to be within normal limits.

Cueing Guideline: The nurse asks if the doctor would like any labs or any levels on the patient.

3. Order a point-of-care blood glucose

The provider should order a point-of-care blood glucose due to the patient's altered mental status.

Cueing Guideline: The nurse asks if the doctor would like any labs or any levels on the patient.

4. Alkalinize urine

Once it is determined that the patient has a metabolic acidosis, or when his salicylate level returns elevated, he will need sodium bicarbonate. Starting a continuous infusion will not suffice. He will need a bolus of at least 1-2 amps, then a continuous infusion may be started. The preferred method is 3 ampules of 8.4% sodium bicarbonate in 1L of D5W to run at 200-250 mL/hr. Add KCl 20 mEq/L to the 1L fluids.

Cueing Guideline: Patient will have worsening acidosis and hypokalemia if not treated.

5. Consult nephrology to arrange for dialysis

Nephrology must be consulted. They do not need to see the patient in the emergency department, but must be notified of the chronic salicylate intoxication and need for dialysis. The nephrology team will be responsive and agree to see the patient emergently.

Cueing Guideline: The nurse asks if the PC has been called yet **or** if the doctor wants the PC called. The nurse may also ask if there is anything more that can be done to eliminate ASA since the patient is so symptomatic (e.g. elevated ASA level, acidosis, and altered mental status).

6. Admit to the medical intensive care unit.

This patient must be admitted to the ICU. Any attempt to admit the patient to the ward or step-down unit will be blocked by the admitting physician. The ICU staff will not refuse admission once nephrology has been consulted.

Cueing Guideline: The consulting physician tells the doctor that the patient is too sick to go to a general medical ward or step-down unit. Alternatively, the nurse reports that he/she is uncomfortable with admitting the patient to a non-critical care environment.

Critical Actions Checklist¹

Resident Name								
Case Description								
Skills measured <small>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</small>	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:			
		Obtain a salicylate level						
		Order an ABG/VBG with electrolytes						
		Order a point-of-care blood glucose						
		Alkalinize urine						
		Consult nephrology to arrange for dialysis			Yes	No		
		Admit to the medical intensive care unit					Dangerous actions	

¹ Modified ABEM Oral Certification Examination checklist and scoresheet

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HISTORY

Mr. Stevenson is a 58-year-old man who was in his usual state of health until 1 week prior to presentation. His wife states that she first noticed mild nausea with some vomiting at that time, which has since worsened. She reports his “balance is off” and he seems confused. He has had infrequent diarrhea and decreased urination. Additionally, he developed a fever two days ago. Per history obtained from his wife, there have been no medication changes, no known sick contacts, and no known falls or trauma. The rest of his review of systems obtained from his wife is negative for vision changes, chest pain, abdominal pain, rash, dysuria, cough, headache, or neck pain.

PLAY OF CASE GUIDELINES

This case will be that of a chronic salicylate overdose. The patient has an acute gouty arthritis flair (unrecognized by his wife) and has been taking large quantities of aspirin for his pain. The differential diagnosis includes sepsis, septic arthritis, gouty arthritis, and salicylate overdose. The examinee will need to directly ask for aspirin use or obtain a salicylate level. The patient will have a mixed metabolic acidosis-respiratory alkalosis on arrival.

1. If a salicylate level is not obtained, the patient will have a seizure and develop cardiac arrest. The patient's wife may prompt examiner regarding the patient's recent use of aspirin for pain if needed. If the examiner sends someone to check the home for aspirin tablets, they will find that a 200 count bottle (81 mg tablets) is empty and was purchased 1 week ago.
2. The patient will require sodium bicarbonate administered via bolus infusion of 1-2 ampules (1 ampule = mEq). If a bicarbonate infusion is started before a bolus is considered, the nurse will question the examiner.
3. A call may be made to the poison center, but a toxicologist consult is not available for this case.
4. The MICU staff will refuse admission if the examiner has not spoken with Nephrology.
5. If the patient is intubated without first being given 1-2 ampules of sodium bicarbonate or hyperventilation he will have a seizure and develop cardiac arrest.
6. If activated charcoal is given, the examiner will need to express that the patient's airway appears intact. Placing a NG tube and administering AC via this route is preferred.

Required Actions within the First Two Minutes

- Point-of-care glucose ordered
- Salicylate level ordered
- ABG/VBG and electrolytes (emphasis on potassium) ordered
- History of aspirin ingestion acquired

Branch Points

- **IF NO POINT-OF-CARE GLUCOSE IS ORDERED WITHIN THE FIRST TWO MINUTES**, patient becomes more confused and obtunded.
- **IF NO SALICYLATE LEVEL IS ORDERED WITHIN THE FIRST TWO MINUTES**, patient becomes more confused and obtunded.
- **INTERVENTIONS NOT DIRECTED AT ASA TOXICITY WILL HAVE NO RESPONSE.**
- **NURSE MAY PROMPT FOR THE ABG/VBG AND ELECTROLYTES** if they are not ordered by this time.

Required Actions over the Next Four Minutes

- Salicylate level correctly interpreted
- ABG/VBG correctly interpreted
- Potassium level reviewed and supplemental potassium administered
- Sodium bicarbonate infusion initiated

Branch Points

- **IF INTERVENTIONS DIRECTED AT ASA TOXICITY ARE STARTED**, the patient's mental status slightly improves and the patient stabilizes.
- **IF ABG IS INCORRECTLY INTERPRETED**, patient becomes even more confused and obtunded, and **will eventually suffer cardiopulmonary arrest.**
- **IF NO SALICYLATE LEVEL IS ORDERED**, patient becomes even more confused and obtunded, and **will eventually suffer cardiopulmonary arrest.**
- **IF INTERVENTIONS DIRECTED AT ASA TOXICITY (e.g. SODIUM BICARBONATE THERAPY) ARE NOT STARTED**, patient becomes even more confused and obtunded, and **will eventually suffer cardiopulmonary arrest.**
- **NURSE MAY PROMPT FOR THESE OTHER MEASURES** at faculty discretion.
- **IT WILL BE IMPOSSIBLE TO REVIVE THE PATIENT IF SODIUM BICARBONATE IS NOT ADMINISTERED AND IF NEPHROLOGY IS NOT CONSULTED FOR HEMODIALYSIS.**

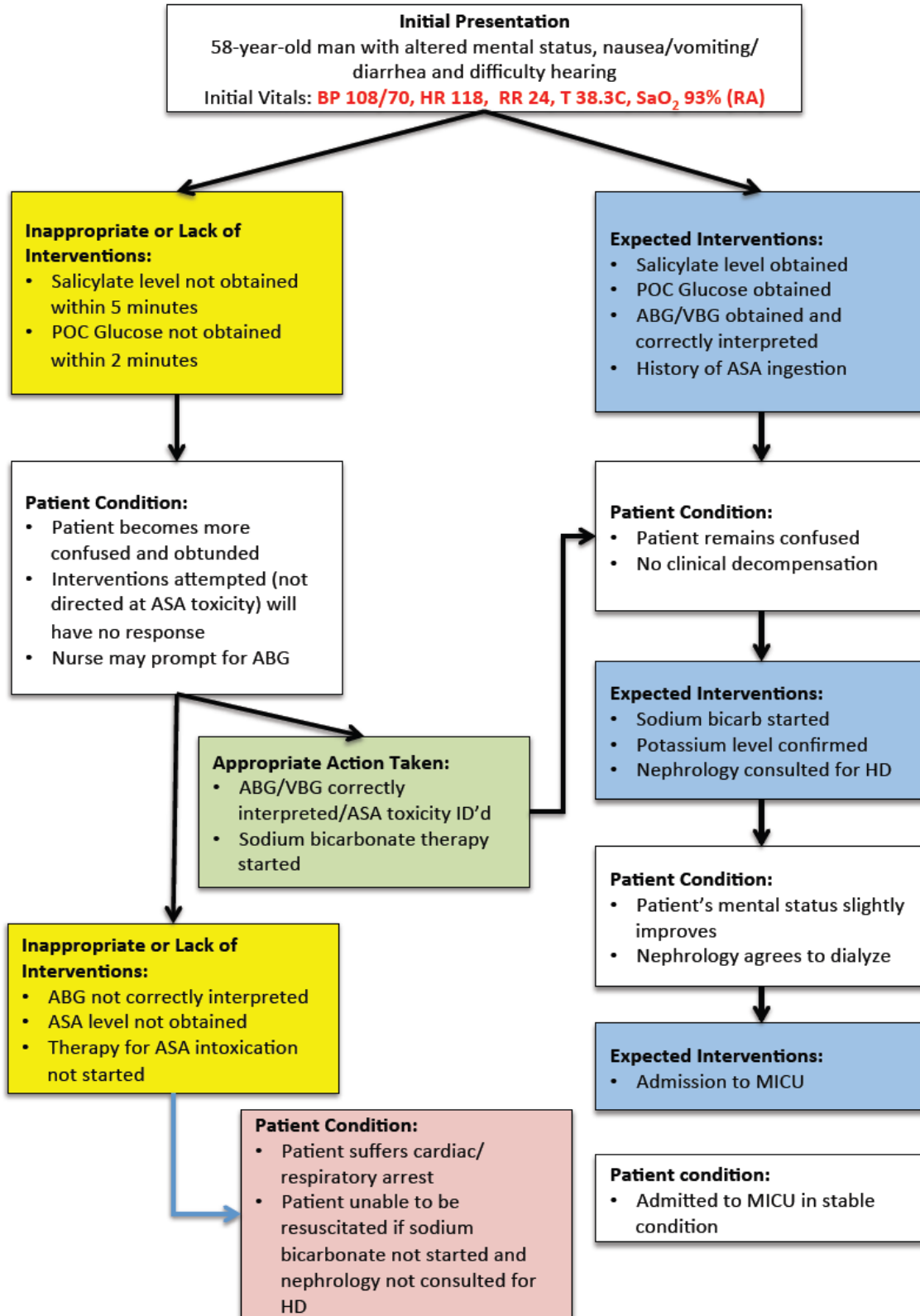
Required Actions over the Remainder of the Case

- Supplemental potassium administration continued and repeat potassium level ordered
- Sodium bicarbonate infusion continued
- Consultation with Nephrology for emergent hemodialysis
- Consultation with the Medical Intensive Care Unit for admission

Branch Points

- **IF INTERVENTIONS DIRECTED AT ASA TOXICITY ARE CONTINUED**, the patient's mental status slightly improves and the patient stabilizes.
- **IF ABG IS INCORRECTLY INTERPRETED**, patient becomes even more confused and obtunded, and **will eventually suffer cardiopulmonary arrest.**
- **IF NO SALICYLATE LEVEL IS ORDERED**, patient becomes even more confused and obtunded, and **will eventually suffer cardiopulmonary arrest.**
- **IF INTERVENTIONS DIRECTED AT ASA TOXICITY (e.g. SODIUM BICARBONATE THERAPY) ARE NOT STARTED**, patient becomes even more confused and obtunded, and **will eventually suffer cardiopulmonary arrest.**
- **NURSE MAY PROMPT FOR THESE OTHER MEASURES** at faculty discretion.
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Timeline and Branch Points for This Case



PHYSICAL EXAM

General Appearance: He is not significantly distressed, but is moderately confused and somewhat agitated.

Vital Signs: BP: 108/70 mmHg P: 118/minute R: 24/minute T: 38.3C (100.4F)
Pox: 93% (room air)

HEENT: PERRLA, 4 mm, non-icteric. Dry oropharynx.

Neck: Supple

Skin: Moist skin/sweaty, no rashes, warm

Cardiovascular: Tachycardic but regular. Normal peripheral pulses. No edema.

Lungs: Crackles in the base. Tachypneic.

Abdomen: Soft, non-distended. Normal BS

Extremities: Warm. Well perfused. He has a tender, swollen, erythematous right great toe at the MTP joint. No other joint swelling, erythema, or tenderness.

Neurological: Aware that he is in the hospital, but confused about the date, time and events. No focal deficits. Speech is slurred at times. Equal strength bilaterally upper and lower extremities, CN II-XII intact bilaterally, sensation grossly intact bilaterally upper and lower extremities. Gait not tested due to subjective complaint of unsteadiness, normal finger-to-nose testing.

Other: All other exam findings will be normal

For Examiner Only

STIMULUS INVENTORY

- #1 Complete blood count
- #2 Basic metabolic panel
- #3 Liver function tests
- #4 Arterial blood gas
- #5 Creatine phosphokinase
- #6 Toxicology
- #7 Coagulation studies
- #8 ECG
- #9 Chest x-ray

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LAB DATA & IMAGING RESULTS

Stimulus #1	
Complete Blood Count (CBC)	
WBC	18,000/mm ³
Hemoglobin	12.5 g/dL
Hematocrit	36%
Platelets	115,000/mm ³
Differential	
PMNLs	80%
Lymphocytes	9%
Monocytes	7%
Eosinophils	4%

Stimulus #2	
Basic Metabolic Profile (BMP)	
Sodium	135mEq/L
Potassium	3.0mEq/L
Chloride	100 mEq/L
Bicarbonate	12 mEq/L
Glucose	62 mg/dL
BUN	48 mg/dL
Creatinine	2.0 mg/dL

Stimulus #3	
Liver Function Tests	
AST	35 U/L
ALT	38 U/L
Alk Phos	60 U/L
T. Bilirubin	0.8 mg/dL
Albumin	4 mg/dL
Protein	7 mg/dL

Stimulus #4	
Arterial Blood Gas	
pH	7.44
pCO ₂	20 mm Hg
pO ₂	101 mm Hg
HCO ₃	14 mEq/L
SaO ₂	94% (FiO ₂ =0.21)

Stimulus #5	
Creatine phosphokinase	
CPK	80 U/L

Stimulus #6	
Toxicology	
Salicylate	85 mg/dL
Acetaminophen	< 10 mcg/mL
Ethanol	Undetectable
Urine drug screen	
Amphetamines	Negative
Benzodiazepines	Negative
Cocaine	Negative
Opiates	Negative
TCA's	Negative
THC	Negative

Stimulus #7	
Coagulation Studies	
INR	1.0
PTT	32 seconds

Stimulus #8	
ECG	

Stimulus #9	
CXR	

Stimulus #1**Complete Blood Count (CBC)**

WBC	18,000/mm ³
Hemoglobin	12.5 g/dL
Hematocrit	36%
Platelets	115,000/mm ³
Differential	
PMNLs	80%
Lymphocytes	9%
Monocytes	7%
Eosinophils	4%

Stimulus #2**Basic Metabolic Profile (BMP)**

Sodium	135mEq/L
Potassium	3.0mEq/L
Chloride	100 mEq/L
Bicarbonate	12 mEq/L
Glucose	62 mg/dL
BUN	48 mg/dL
Creatinine	2.0 mg/dL

Stimulus #3**Liver Function Tests**

AST	35 U/L
ALT	38 U/L
Alk Phos	60 U/L
T. Bilirubin	0.8 mg/dL
Albumin	4 mg/dL
Protein	7 mg/dL

Stimulus #4**Venous Blood Gas**

pH	7.44
pCO ₂	20 mm Hg
pO ₂	101 mm Hg
HCO ₃	14 mEq/L
SaO ₂	94% (FiO ₂ =0.21)

Stimulus #5
Cardiac Enzymes

CPK	80 U/L
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Stimulus #6**Toxicology**

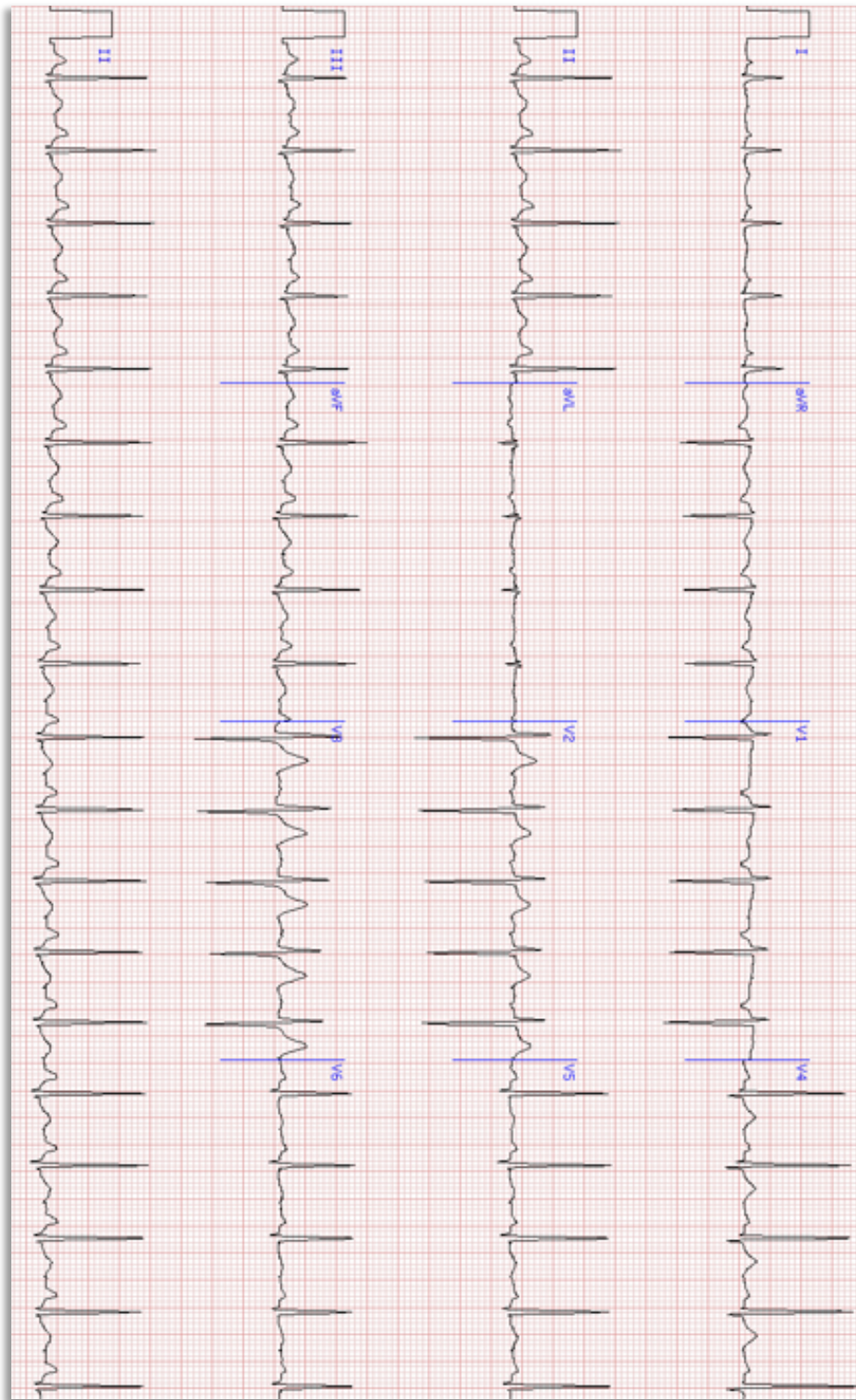
Salicylate	85 mg/dL
Acetaminophen	< 10 mcg/mL
Ethanol	Undetectable
Urine drug screen	
Amphetamines	Negative
Benzodiazepines	Negative
Cocaine	Negative
Opiates	Negative
TCAs	Negative
THC	Negative

Stimulus #7

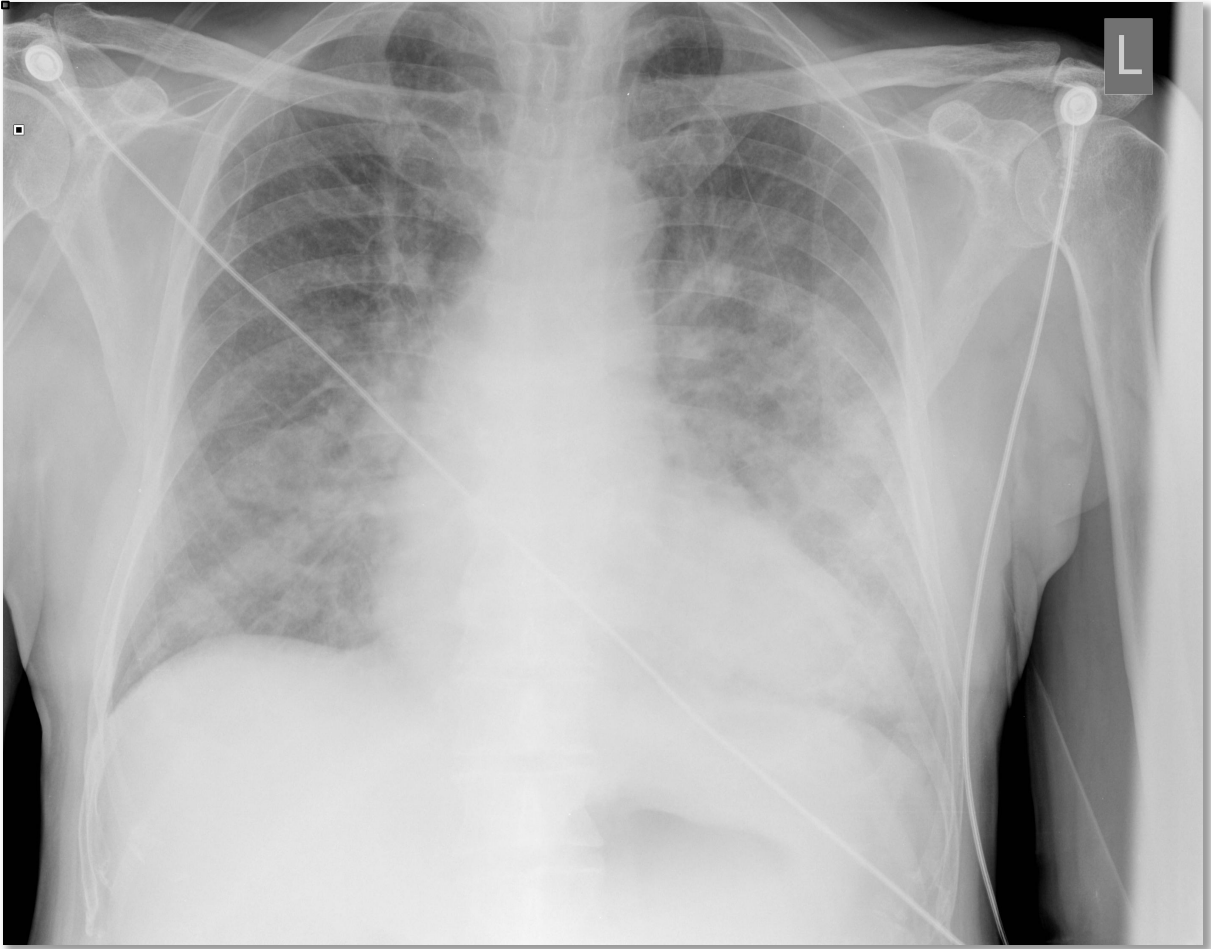
Coagulation Studies

INR	1.0
PTT	32 seconds

Stimulus #8



Stimulus #9



Debriefing Materials - Salicylate Toxicity

Sources of Exposure:

- Salicylates are found in hundreds of over-the-counter medications and in numerous prescription drugs
- Pepto-Bismol, a common antidiarrheal agent, contains 131 mg of salicylate per tablespoon
- Aspirin or aspirin-equivalent preparations include children's aspirin (80-mg tablets), adult aspirin (325-mg tablets)
- Methyl salicylate (e.g., oil of wintergreen) - One teaspoon of 98% methyl salicylate contains 7000 mg of salicylate - more than 4 times the potentially toxic dose for a child who weighs 10 kg

Pathophysiology:

- Salicylates uncouple oxidative phosphorylation, limit production of ATP, and increase lactate production, leading to ketosis and a wide anion-gap metabolic acidosis
- Salicylates stimulate the respiratory center, leading to hyperventilation and respiratory alkalosis

Severity of Ingestion:

- In acute overdose, morbidity rate is 16%, and mortality is 1%
- Prognosis is worse for chronic overdose/exposure because they are often missed
- The following 4 categories are helpful for assessing the potential severity and morbidity of an acute, single event, nonenteric-coated, salicylate ingestion:
 - Less than 150 mg/kg - Spectrum ranges from no toxicity to mild toxicity
 - 150-300 mg/kg - Mild-to-moderate toxicity
 - 301-500 mg/kg - Serious toxicity
 - Greater than 500 mg/kg - Potentially lethal toxicity

Organ System Effects:

- Psychiatric:
 - The chronic ingestion of salicylates may produce the appearance of anxiety with its associated tachypnea, difficulty concentrating, and hallucinations. Patients with underlying psychiatric illness may present with symptoms suggestive of an exacerbation of their underlying psychiatric illness (e.g., mania, psychosis)
- Pulmonary:
 - Salicylates cause both direct and indirect stimulation of respiration. A salicylate level of 35 mg/dL or higher causes increases in both rate (tachypnea) and depth (hyperpnea) of respiration. Salicylate poisoning may rarely cause noncardiogenic pulmonary edema (NCPE) and acute lung injury in pediatric patients
- Cardiovascular:
 - Tachycardia, Hypotension
- Neurologic:
 - Salicylates are neurotoxic; this initially manifests as tinnitus. CNS toxicity is related to the amount of drug bound to CNS tissue. It is more common with chronic than acute toxicity. Acidosis worsens CNS toxicity by increasing the amount of salicylate that crosses the blood brain barrier and increases CNS tissue levels. Other signs and symptoms of CNS toxicity include nausea,

vomiting, hyperpnea, and lethargy. Severe toxicity can progress to disorientation, seizures, cerebral edema, hyperthermia, coma, cardiorespiratory depression, and, eventually, death

- The final common pathway is seizure, coma, death
- Gastrointestinal:
 - Nausea and vomiting are the most common toxic effects. This can be caused by CNS toxicity or by direct damage to the gastric mucosa
- Dermatologic:
 - Diaphoresis is a common sign in patients with salicylate toxicity

Diagnostic Testing:

- Chemistry panel
 - Repeat as needed
- Serum salicylate level
 - Every 2 hours until the salicylate level falls to less than 30 mg/dL
 - Do NOT use the Done nomogram
 - Serum levels determined less than 6 hours postingestion (acute overdose) do not rule out impending toxicity because salicylates are in the absorption-distribution phase
 - In cases of chronic salicylism, measured toxic levels may be only 30-40 mg/dL
 - Acute overdoses are often symptomatic at salicylate concentrations higher than 40-50 mg/dL
 - Patients with salicylate concentrations approaching or exceeding 100 mg/dL usually have serious or life-threatening toxicity
- Urinalysis: Monitor and maintain an alkaline urine pH every 2 hours during alkalinization therapy. Maintain a urine pH of 7.5-8
- Monitor glucose levels closely. Initial hyperglycemia may give way to hypoglycemia
- Obtain hepatic, hematologic, and coagulation profiles for patients with clinical evidence of moderate-to-severe toxicity
- Chest x-ray is indicated if evidence of severe intoxication, pulmonary edema, or hypoxemia is present
- Consider an abdominal x-ray if an aspirin concretion is suspected

Treatment:

- Decontamination
 - Gastric lavage may be beneficial in severe, large volume overdose
 - Oral activated charcoal, especially if the patient presents within one hour of ingestion
 - Repeated doses of charcoal may enhance salicylate elimination and may shorten the serum half-life-Most experts strongly recommend this for patients with a serious ingestion
 - When enteric-coated aspirin has been ingested or when salicylate levels do not decrease despite treatment with charcoal, WBI should be used in addition to charcoal therapy
- Administer lactated Ringer or isotonic sodium chloride solution for volume expansion at 10-20 cc/kg/hr until a 1-1.5-cc/kg/h urine flow is established
- Alkalinization of urine creates a gradient that attracts the unionized salicylate from the brain tissue into the blood stream and then into the urine. The goal is to keep salicylates

away from brain tissue, move them to the urine, “trap” them in the urine in an ionized state, and then excrete them

- When the urine pH increases from 5 to 8, salicylate renal clearance increases 10-20 times.
- Consider this treatment if the salicylate level is higher than 35 mg/dL.
- Give a single IV bolus of NaHCO₃ at 1-2 mEq/kg
- Mix 3 ampules of NaHCO₃ in 1L of D5W. Add 20-40 mEq KCl
- Administer a constant infusion at 1.5-2.5 mL/kg/hr to produce a urine flow of 0.5-1 mL/kg/hr. Closely monitor the serum electrolytes (K⁺, cre, HCO₃⁻, and urine pH. Maintain the urinary pH between 7.5-8
- The urinary excretion of salicylic acid is dependent upon adequate serum potassium due to a H⁺/K⁺ exchange. (An alkaline urine traps the salicylate in an ionized state so it cannot be reabsorbed. In the presence of hypokalemia, however, the body will reabsorb K⁺ and secrete H⁺. An acidic urine provides H⁺ to produce unionized salicylate, which can be absorbed.)

Consultations:

- Consult the regional poison center or a local medical toxicologist for additional information and patient care recommendations.
- Consult Nephrology if hemodialysis is indicated.
 - Dialysis is recommended for patients with severe salicylate poisoning who are altered, have respiratory distress, cannot handle a fluid load, severe acidemia (<7.2), or not responding to current therapy. The Extracorporeal Treatments in Poisoning (EXTRIP) Workgroup recommended extracorporeal treatment for high salicylate concentrations regardless of signs and symptoms (>100 mg/dL) or lower thresholds for renal impairment (>90 mg/dL).

Disposition:

- Admit patients with major signs and symptoms to an ICU.
- Consult psychiatric service personnel for stabilized patients with intentional overdose.
- Patients with accidental ingestions of less than 150 mg/kg and no signs of toxicity can be discharged after 6 hours post ingestion.

Take-Home Points:

- Salicylates may have an enigmatic presentation for the unsuspecting clinician.
- Salicylates uncouple oxidative phosphorylation intracellularly – a key point in understanding the pathophysiology of salicylism.
- Salicylates directly stimulate the medullary respiratory center of the brainstem resulting in tachypnea, classically causing an early pure respiratory alkalosis (centrally mediated), followed by an increased anion gap metabolic acidosis with continued hyperventilation.
- Salicylate-intoxicated patients have rapid respiratory rates and large tidal volumes (increased minute ventilations) that are difficult to maintain with a ventilator. If not maintained, acidemia worsens, and death may ensue.
- Treatment principles include stabilizing the ABCs, limiting absorption, enhancing elimination, correcting electrolyte/metabolic abnormalities, and providing supportive care.

- Salicylate toxicity is one indication for multiple doses of charcoal (1 gm/kg) every 4-6 hours administered until salicylate levels are consistently decreasing. (First dose may be given with sorbitol.) WBI may help if not improving.
- Alkalinize the urine early to trap the salicylate molecule in the ionized form in the urine and facilitate excretion by giving intravenous sodium bicarbonate boluses and a bicarbonate infusion at twice maintenance rate.
- Replace potassium to maintain the potassium-hydrogen exchange in the renal tubules and to maintain urinary alkalinization.
- Assess serial salicylate levels every 1-2 hours, along with serum glucose, potassium, bicarbonate, and creatinine levels until the salicylate levels are less than 30 mg/dL.
- Hemodialysis is effective for salicylate removal and may be required continuously to remove tissue stores.

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O'Malley GF. Emergency department management of the salicylate-poisoned patient. *Emerg Med Clin North Am.* 2007 May;25(2):333-46.