Nuclear, Biological & Chemical Weapons

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[TOC]

BIOLOGICAL

General

1. Biological Warfare is defined as employment of biological agents to produce casualties in man or animals or damage to plants
2. President Richard Nixon in 1970 signed executive order banning biological agents in warfare
3. Intrinsic features of biological agents which influence potential for use as weapons include: infectivity; virulence; toxicity; pathogenicity; incubation period; transmissibility; lethality; and stability
4. Common agents: Bacillus anthracis (anthrax), botulinum toxin, Yersinia pestis (plague), ricin, Staphylococcal enterotoxin B (SEB), and Venezuelan equine encephalitis virus (VEE)
5. Lethal agents: B. anthracis, botulinum toxin, F. tularensis
6. Incapacitating agents: SEB and Coxiella burnetii
7. Active immunization effective against several biological agents; best modality for future protection
8. 10 nations capable of biologic warfare agent production: Iran, Iraq, Israel, N. Korea, China, Libya, Syria, Taiwan, Russia, USA
9. Post Exposure Prophylaxis (PEP): usually requires prolonged use of antibiotics (i.e. 4 wks)

Dispersal

1. Dispersed in aerosols of particle size 1-5 microns:
   - If inhaled, penetrate into distal bronchioles and terminal alveoli
   - Particles >5 microns filtered out in upper airway
2. Aerosols delivered by industrial sprayers with nozzles modified to generate small particle size:
   - Line source e.g. airplane or boat traveling upwind of intended target
   - Point source e.g. stationary sprayer or missile dispensing agent-containing bomblets in area upwind of target
3. Weather in target area important in biological agents e.g. aerosols:
   - High wind speeds break up aerosol cloud
   - Wind speeds of 5-10 mph ideal for dispersion
4. 50 kg of aerosol B. anthracis spores dispensed by line source 2 kilometers upwind

of population center of 500,000 unprotected people in ideal weather- kill up to 125,000 people
5. Other routes: oral, by intentional contamination of food and water, and percutaneous
6. Person-to-person spread: smallpox and pneumonic plague

[TOC]

Key Physical/Diagnostic Findings: Biological

1. Early "flu-like" symptoms: Anthrax, Glanders, Tularemia, Q Fever, Smallpox, Staph Enterotoxin B
2. Hemoptysis:
   - Anthrax
   - Plague
   - Viral Hemorrhagic Fevers
   - T-2 Mycotoxins
3. Skin findings:
   - Pustular lesions: Smallpox
   - Petechiae: Viral Hemorrhagic Fevers
   - Skin pain, sloughing: T-2 mycotoxins
   - Lymphadenopathy: Tularemia, Plague, Glanders
4. CXR:
   - Widened mediastinum: Anthrax
   - Miliary disease: Glanders
   - Pulmonary edema: Ricin
5. Diarrhea: Cholera
6. Osteoarticular findings: Brucellosis
7. Lymphadenopathy: Tularemia, Plague, Glanders
8. Pustular vesicles: Smallpox
9. Petechiae: Viral Hemorrhagic Fevers
10. Ptosis: Botulinum
11. Pulmonary Edema: Ricin
12. "Yellow rain": T-2 Mycotoxins
13. Skin pain, sloughing: T-2 Mycotxins

[TOC] [Tx]

Anthrax

Diagnosis

1. Inhalation Anthrax:
   - Most likely bioterrorism form
   - Fever, malaise, fatigue, cough, chest discomfort
   - Severe respiratory distress, hemoptysis, dyspnea, diaphoresis, stridor & cyanosis
2. Intestinal Anthrax:
   - N/V, diarrhea, abd pain, cervical adenopathy, septicemia 2-4 d later
3. Cutaneous Anthrax:
   - Most common 95-99%
   - Non-tender pruritic papule, gets serosanguinous, forms eschar with lymphadenitis; falls off in 2-3 wks
4. Shock, death within 24-36 hrs after onset of severe symptoms
5. CXR: widened mediastinum, pleural effusions
6. Gram stain of blood shows gram positive sporulating rod; too late to help pt, diagnosis must be made early based on cluster of symptoms
7. Blood, CSF, pleural fluid culture positive in 6-24 d
8. Nasal swabs or environmental samples with gram positive bacilli support dx of inhalation anthrax

History

1. Discovered in 1877
2. "Wool Sorters" or "Black Bane" disease
3. Weaponized in 1950's & 1960's by US
4. Weaponized in 1995 by Iraq

Pathophysiology

1. Bacillus anthracis:
   - Rod-shaped, gram-positive, sporulating
   - 3 toxic proteins: edema factor, lethal factor, protective antigen
2. Incubation period:
   - Inhalation: 1-6 d
   - G.I.: 2-5 d
   - Cutaneous: 1-2 d
   - May be prolonged up to 2 mths if partially treated
3. Duration: 3-5 d
4. Fatality rate:
   - Cutaneous: untreated 5-20%; treated 1%

- Inhalation: untreated 100%; treated 80% if >48 hours after symptom onset

5. Infective dose: 4,000-80,000 spores by inhalation
6. Zoonotic disease: cattle, sheep, horses, pigs, goats are hosts
7. Mode of entry ("natural"): inhalation of contaminated hair, wool, hides, flesh, blood, excreta
8. Lethality: high
9. Spore viability >40 yrs in soil
10. Spores resistant to sunlight, heat and disinfectants

Prevention

1. Vaccine: 0.5 ml SQ at 0, 2, 4 weeks, then 6, 12, 18 months for primary series, followed by yrly boosters
2. Efficacy of vaccine for cutaneous anthrax: 92.5%
3. Vaccine c-ind: <18 yo or >65 yo; pregnancy, infection with fever, steroid use
4. PEP:
   - Ciprofloxacin 500 mg PO q12h for 60 d (peds: 20-30 mg/kg PO q12h) OR
   - Amoxicillin 500 mg PO q8h for 60 d (peds: >20 kg: 500 mg PO q8h for 60 d; <20 kg: 40 mg/kg q8h) OR
   - Doxycycline 100 mg PO q12h for 60 d; continue if 1st 2 doses of vaccine not given within 30 d of completion of antibiotics
   - Pregnant: Cipro or Amoxicillin

Isolation/Decontamination

1. Disinfect with sporicidal agent (chlorine)
2. Standard healthcare worker precautions
3. Protective masks e.g. current US military M17 & M40 masks

Treatment

1. Inhalation:
   - Ciprofloxacin 400 mg q12h IV (peds: 20-30 mg/kg q12h IV, not to exceed 1 g/d) x 60 d
   - May try penicillin (4 mil units IV q4h) or doxycycline (200 mg initially, followed by 100 mg q12h) x 60 d; but any bioterrorism attack would probably use strains resistant to these antibiotics
   - Note: ciprofloxacin drug of choice for peds pts; benefits outweigh theoretical risks of cartilage growth problems
2. Supportive therapy for shock, fluid volume deficit, adequacy of airway
3. Cutaneous anthrax: treat with PO fluoroquinolones, tetracycline or amoxicillin for 60 d
4. Short course of prophylactic antibiotics delay but do not prevent disease

Disposition

1. Admit pt; standard and airborne precautions
2. Notify CDC & local health dept

3. Animal carcasses need to be burned; humans cremated

[TOC] [Tx]

Brucellosis

Diagnosis

1. Irregular fever, HA, profound weakness, fatigue, chills, sweating, arthralgias, mylagias
2. Depression and AMS
3. Splenomegaly (20-30%), lymphadenopathy (10-20%)
4. Osteoarticular findings (i.e. sacroiliitis, vertebral osteomyleitis)
5. Blood cultures require prolonged period of incubation in acute phase
6. Bone marrow cultures produce higher yield
7. Confirmation requires phage-typing, oxidative metabolism, or genotyping procedures
8. ELISA followed by Western Blot
9. Brucella titer >1:160 or 4 fold rise in titer is presumptive evidence for infection

History

1. Described by Marsten in British soldiers in Malta during Crimean war as "Mediterranean gastric remittent fever" or "Malta fever"
2. Brucella suis (found in swine) weaponized in 1954 by US

Pathophysiology

1. Brucellae are group of gram-negative, aerobic, nonmotile, cocco-baccillary organisms
2. Brucella melitensis is most common (goats and sheep)
3. Ingestion of unpasteurized dairy products
4. Incubation period of 5-60 d; average of 1-2 mths
5. Infective dose: 10-100 organisms
6. Duration: wks to mths
7. Low mortality rate (5% of untreated cases)

Prevention

1. No approved human vaccine
2. Avoid unpasteurized milk and cheese

Isolation/Decontamination

1. Standard precautions for healthcare workers

2. 0.5% hypochlorite soln

Treatment

1. Acute brucellosis: adults: doxycycline 200 mg/d PO plus rifampin 600-900 mg/d for 6 wks
2. Alternative: ofloxacin 400 mg/d PO and rifampin 600 mg/d PO
3. Rifampin, a tetracycline, and an aminoglycoside indicated for infections with complications e.g. meningoencephalitis

Disposition

1. Admit; standard precautions
2. Notify CDC & local health dept

[TOC] [Tx]

Cholera

Diagnosis

1. N/V, HA, intestinal cramping with no fever, hypokalemia
2. Painless voluminous diarrhea:
   - Fluid losses up to 20 L/d
   - "Rice water" grayish diarrhea may exceed 1 L/hr
   - Micro exam of stool samples - few or no red or white cells
3. Death from severe dehydration, hypovolemia and shock
4. Darkfield or phase contrast microscopy: direct visualization of darting motile vibrio

History

1. Doesn't easily spread from person-to-person; not effective biological weapon
2. Epidemic in Peru caused 250,000 cases in 1991

Pathophysiology

1. Vibrio cholerae is short, curved, motile, gram-negative, non-sporulating rod
2. Produces enterotoxin that inhibits absorbtion and enhances intestinal secretion; toxin is heat labile
3. Found in uncooked shellfish and raw seafood
4. Mortality (untreated) is 60%
5. Incubation period 4 hrs to 5 d; average 2-3 d
6. Infective dose: 10-500 organisms
7. Duration: >1 wk
8. Transmission:
   - Direct/indirect fecal contamination of water, foods, by heavily soiled hands or utensils
   - Not viable in pure water
   - Food transmission can be prevented by thorough cooking
9. Most US cases associated with foreign travel
10. Survive up to 24 hrs in sewage; 6 weeks in impure water containing organic matter
11. Withstand freezing for 3 to 4 d
12. Killed by dry heat at 117 deg C, by steam and boiling, by exposure to ordinary disinfectants, chlorination of water

Prevention

1. Licensed, killed vaccine available:
   - Provides 50% protection lasting 6 mths

- 0.5 ml IM or SQ at 0 and 4 wks, booster q 6 mths

Isolation/Decontamination

1. Standard precautions for healthcare workers
2. Enteric precautions and careful hand-washing
3. Use bactericidal solutions (hypochlorite)

Treatment

1. Oral rehydration therapy
2. IV fluid replacement with persistent vomiting or high rates of stool loss (>10ml/kg/hr); early & rapid rehydration can reduce mortality to <1%
3. Tetracycline (500 mg q6h x 3 d) or doxycycline (300 mg once or 100 mg q12h x 3 d)
4. Tetracycline resistance: ciprofloxacin (500 mg q12h x 3 d) or erythromycin (500 mg q6h x 3 d) or cotrimoxazole 5 mg/kg PO bid for 3 d

Disposition

1. Admit if:
   - dehydrated and cannot take PO fluids
   - Immunocompromised
   - Severe electrolyte disturbance
   - Elderly
   - Acid/base disturbance
2. Enteric precautions
3. Notify CDC & local health dept

[TOC] [Tx]

Glanders

Diagnosis

1. Fever, rigors, sweats, myalgia, HA, pleuritic CP, cervical adenopathy, splenomegaly, generalized papular/pustular eruptions
2. Methylene blue stain of exudates reveal scant small bacilli
3. CXR: miliary lesions (1 cm in diameter), small multiple lung abscesses, or bronchopneumonia
4. B. mallei cultured from infected secretions using meat nutrients
5. Blood cultures may turn positive in 48 hrs

History

1. WWI spread deliberately by agents of Central Powers to infect large numbers of Russian horses and mules on Eastern Front; affected convoys
2. No naturally acquired cases in humans in US in 59 yrs
3. Used by Japanese in WWII on POWs

Pathophysiology

1. Burkholderia (formerly Pseudomonas) mallei, a gram-negative bacillus
2. Incubation period of 10-14 d by inhalation
3. Primarily in veterinarians, horse, donkey or mule caretakers, abattoir workers
4. Duration: death in 7-10 d in septicemic form
5. Bio weapon: aerosol infection
6. Invades nasal, oral, conjunctival mucous membranes, by inhalation, and by invading lacerated skin
7. Attack rate: 46%

Prevention

1. No human vaccine
2. PEP: TMP-SMX

Isolation/Decontamination

1. Standard precautions for healthcare workers
2. 0.5% hypochlorite soln

Treatment

1. Few antibiotics evaluated in vivo
2. Tetracycline + streptomycin
3. Alt: streptomycin + chloramphenicol
4. PEP: animal models suggest TMP-SMX

Disposition

1. Admit; contact and respiratory precautions
2. Notify CDC & local health dept

[TOC] [Tx]

Plague

Diagnosis

1. Bubonic Plague:
   - Transmitted by bite of infected fleas
   - Incubation: 2-10 d
   - Prominent warm, tender lymph nodes (buboes): 1-10 cm in diameter in groin, axilla or neck
   - Occ. meningitis
2. Pneumonic Plague:
   - Most likely bioterrorism form
   - Incubation: 2-3 d
   - Rapid onset
   - High fever, chills, headache, hemoptysis, progressing to dyspnea, stridor, cyanosis; death from respiratory failure, circulatory collapse, and bleeding diathesis
3. N/V/D in 1/3, abd pain (17%)
4. May progress spontaneously to septicemic form, with GI symptoms, spread to CNS, lungs with ARDS (50% mortality)
5. Gram or Wayson stain of lymph node aspirates, sputum, or CSF
6. Plague bacilli cultured on standard media
7. CXR: lobar pneumonia, cavitation

History

1. Used as weapon in 14th century (infected corpses catapulted into enemy strongholds)
2. Potential agent in 1950's & 1960's by USA
3. Investigated by Japan in WWII

Pathophysiology

1. Yersinia pestis, rod-shaped, anaerobic, non-motile, non-sporulating, gram-negative coccobacillus
2. Zoonotic dz of rodents (e.g. rats, mice, ground squirrels)
3. Found on every continent except Antartica & Australia
4. Largest number of cases: Tanzania, Vietnam, Zaire
5. Most US cases in Western US
6. Respiratory droplets infectious until pts get 72 hrs therapy
7. Killed by 15 minutes exposure to 72 deg C
8. Infective dose: <100 organisms
9. Duration: 1-6 d

10. Transmitted by fleas or domestic cat
11. Aerosol of bacillus viable for 1 hr at distance of 10 km
12. Mortality:
    - Untreated bubonic plague: 50-60%
    - Untreated pneumonic plague or septicemia: 100%
    - Treated pneumonic plague (<24 hrs): 10-20%

Prevention

1. Greer inactivated vaccine
2. Vaccine: 1.0 ml IM; 0.2 ml IM 1-3 mths later; 0.2 ml IM 5-6 mths after dose 2; 0.2 ml IM boosters 6, 12, 18 mths after dose 3; then q1-2 yrs
3. Vaccine effective against bubonic plague, not effective against aerosol exposure
4. PEP:
    - Doxycycline 100 mg PO bid x 7 d OR Ciprofloxacin 500 PO bid x 7 d
    - Alt: chloramphenicol 25 mg/kg PO qid

Isolation/Decontamination

1. Standard precautions for exposure to bubonic plague
2. Droplet precautions for exposure to pneumonic plague
3. Heat, disinfectants (2-5% hypochlorite) and exposure to sunlight

Treatment

1. Treatment highly effective, if within 24 hrs of onset of symptoms
2. Plague pneumonia: fatal if treatment not initiated within 24 hrs of onset of symptoms
3. Preferred choices:
    - Streptomycin 30mg/kg divided bid IM x 10 d
    - Gentamicin 5 mg/kg IM or IV once daily
4. Alternative choices:
    - Doxycycline 100 mg IV bid x 10-14 d (after 200 mg loading dose)
    - Ciprofloxacin 400 mg IV twice daily
    - Chloramphenicol 25 mg/kg IV 4 times daily for plague meningitis, sepsis
5. Supportive therapy with IV crystalloids
6. Hemodynamic monitoring

Disposition

1. Admit; standard & droplet precautions
2. Notify CDC's plague center & local health dept

[TOC] [Tx]

Tularemia (Rabbit Fever/Deer Fly Fever)

Diagnosis

1. F/C, HA, malaise
2. Ulceroglandular: local ulcer and regional adenopathy
3. Typhoidal and pulmonary forms:
4. Most likely bioterrorism forms
5. Aerosol exposure
6. F/C, HA, weight loss, non-productive cough
7. CXR: pneumonic process in 1 or more lobes (positive in 25-50% in early stages), mediastinal adenopathy or pleural effusion
8. Routine culture possible; takes up to 10 d
9. Established retrospectively by serology

History

1. First recognized in Tulare County, California
2. Found in Japan in 1800's and in Russia in 1926

Pathophysiology

1. Francisella tularensis: small, aerobic non-motile, gram-negative cocco-bacillus
2. Contact of skin or mucous membranes with tissues or body fluids of infected animals, or bites of infected deerflies, mosquitoes, or ticks
3. Hunters and wilderness area visitors
4. Viable for wks in water, soil, carcasses, hides; for yrs in frozen rabbit meat
5. Incubation: 2-10 d
6. Killed by heat and disinfectants

Prevention

1. Live, attenuated vaccine: 1 dose by scarification
2. PEP: Ciprofloxacin 500 mg PO bid OR doxycyline 100 mg PO bid

Isolation/Decontamination

1. Standard precautions for healthcare workers
2. Destroyed by 55 deg C for 10 mins and standard disinfectants

Treatment

1. Ciprofloxacin 500 mg PO bid OR doxycyline 100 mg PO bid for 14 d
2. Alt: streptomycin 1-2 g IM in divided equal doses for 7-14 d until afebrile for 5-7 d
3. Child:
   - If >45 kg: doxycycline 100 mg PO bid
   - If <45 kg: 2.2 mg/kg PO bid
   - Ciprofloxacin 15 mg/kg PO bid

Disposition

1. Admit; standard precautions
2. Notify CDC & local health dept

[TOC] [Tx]

Q Fever

Diagnosis

1. Fever, diaphoresis, cough and pleuritic chest pain
2. Resembles viral illness or other types of atypical pneumonia
3. Mild hepatitis may occur; endocarditis may be chronic
4. Confirmed by serology (complement fixation, enzyme immunoassay or immunofluorescence)

History

1. Described in Australia as "Query fever"
2. Cause found in 1937

Pathophysiology

1. Zoonotic dz caused by rickettsia, Coxiella burnetii (intracellular, gram negative coccobacillus)
2. Inhalation of aerosols contaminated with organisms
3. Farmers and slaughterhouse workers at risk
4. Cattle, goats, sheep are natural reservoirs
5. Infective dose: 1-100 organisms
6. Incubation: 14-39 d
7. Duration: wks
8. Lethality: moderate if untreated
9. Persists for mnths on wood & sand

Prevention

1. Vaccine: IND 610 0.5 ml SQ; investigational
2. PEP: tetracycline 500 mg qid within 8-12 d of exposure x 5 d OR doxycycline x 5 d if symptomatic

Isolation/Decontamination

1. Standard precautions for healthcare workers
2. Remove all contaminated clothing
3. Soap and water or after 30 minute contact time with 5% hydrogen peroxide or 70% ethyl alcohol

Treatment (acute)

1. Tetracycline 500 mg q6h OR doxycycline 100 mg PO q12h for 2-3 wks until pt is afebrile for 1 wk
2. Alt: ofloxacin 200 mg PO q12h OR perfloxcin 400 mg IV or PO q12h for 2-3 wks until pt is afebrile for 1 wk
3. Child >8 yo: tetracycline 25 mg/kg/d in divided doses for 2-3 wks
4. For granulomatous hepatitis: prednisone PO 0.5 mg/kg/d if fever persists following antibiotics; taper over 1 mth

Disposition

1. Self-limited illness even without treatment

[TOC] [Tx]

Smallpox

Diagnosis

1. Malaise, F, rigors, N/V, HA, backache
2. 2-3 days later:
   - Macules to papules, to vesicles to pustules to scabs
   - Start on face & hands to arms, legs, trunk
   - All lesions are in same phase of development
3. Electron and light microscopy can't discriminate variola from vaccinia, monkeypox or cowpox
4. PCR diagnostic techniques accurate to discriminate between variola and other orthopox viruses

History

1. Declared eradicated in 1980 by WHO
2. Considered by Japan in WWII
3. In 1996 WHO recommended all stockpiles be eliminated by 1999

Pathophysiology

1. Variola virus: orthopox virus
2. Aerosol infectivity; high human to human transmission
3. Infective dose: 10-100 organisms
4. Incubation: 7-17 d
5. Duration of illness: 4 wks
6. Mortality:
   - 3% vacinnated
   - 30% if unvacinnated
   - 50% if develop secondary bact. pneumonia

Prevention

1. Vaccinia immune globulin 0.6 ml/kg IM within 3 d
2. Vaccine: Wyeth calf lymph vaccinia: 1 dose by scarification
3. Vaccine not used in immunosuppression, HIV, hx of eczema, pregnancy

Isolation/Decontamination

1. Quarantine with respiratory isolation
2. Droplet and airborne precautions for min of 16-17 d

3. Pts infectious until all scabs separate

Treatment

1. No effective chemotherapy
2. Cidofovir effective in vitro; adefovir, ribavirin may also be tried

Disposition

1. Admit; quarantine, respiratory isolation; droplet & airborne precautions
2. Notify CDC & local health dept

[TOC] [Tx]

Venezuelan Equine Encephalitis (VEE)

Diagnosis

1. Malaise, spiking fevers, rigors, severe HA, photophobia, myalgias
2. N/V/D, cough, sore throat
3. WBC: leukopenia and lymphopenia
4. Virus isolation from serum, and throat swab specimens
5. Neutralizing or IgG antibody in paired sera
6. VEE specific IgM present in single serum sample indicates recent infection

History

1. Weaponized in 1950's & 1960's by US

Pathophysiology

1. VEE virus is arthropod-borne alphavirus endemic in northern South America, Trinidad, Central America, Mexico, Florida
2. Acquired by mosquito bite
3. Infective dose: 10-100 organisms
4. Incubation: 1-5 d
5. Duration: days to wks
6. Lethality: low

Prevention

1. Experimental vaccine, TC-83, with good results; single 0.5 ml SQ dose
2. Alpha interferon, experimental, may be considered

Isolation/Decontamination

1. Standard precautions for healthcare workers
2. Human cases infectious for mosquitoes through 72 hrs
3. Destroyed by heat (80 deg C for 30 mins) and standard disinfectants

Treatment

1. Pts developing encephalitis need anticonvulsants
2. Maintain fluid and electrolyte balance
3. Ensure adequate ventilation

4. Avoid secondary bacterial infections

Disposition

1. Admit
2. Screened room with residual insecticide for 5 d after onset
3. Notify CDC & local health dept

[TOC] [Tx]

Viral Hemorrhagic Fevers (VHF)

Diagnosis

1. Early: severe febrile illness, decr'd blood pressure, postural hypotension, petechiae, easy bleeding, flushing of face and chest, non-dependent edema
2. Late: headache, photophobia, pharyngitis, cough, N/V/D, abd pain, G.I. bleeding, hyperesthesia, dizziness, confusion, tremor, malaise, myalgias
3. Labs: thrombocytopenia (exception: Lassa) and leukopenia (exception: Lassa, Hantaan, some severe CCHF cases); proteinuria and/or hematuria are common, is rule for Argentine HF, Bolivian HF, and HFRS
4. Specific virologic techniques to detect
5. Significant numbers of military persons affected at same time suggests VHF

History

1. Ebola virus found in Sudan & Zaire in 1976; subsequently in 1979 & 1995 in Zaire
2. Marburg disease found 3 times in Africa, once in Germany
3. Argentine hemorrhagic fever (AHF), caused by Junin virus, described in 1955 in corn harvesters
4. Bolivian hemorrhagic fever, caused by related Machupo virus, described subsequent to AHF in NE Bolivia
5. Congo-Crimean hemorrhagic fever (CCHF) is tick-borne disease, occurs in Crimea and in Africa, Europe and Asia
6. Hantavirus prior to WW II in Manchuria along Amur River, later among UN troops during Korean conflict, and in Korea, Japan, and China

Pathophysiology

1. Due to RNA viruses: Filoviridae, Ebola and Marburg viruses; Arenaviridae, Lassa fever, Argentine and Bolivian HF; Bunyaviridae, Hantavirus genus, Congo-Crimean HF (CCHF) virus from Nairovirus genus, Rift Valley fever; and Flaviviridae, e.g. Yellow fever virus, Dengue HF fever virus
2. Spread via respiratory portal of entry
3. Infective dose: 1-10 organisms
4. Incubation: 4-21 d
5. Duration: death, 7-16 d
6. Lethality: high for Zaire strain

Prevention

1. RVF inactivated vaccine

2. Ribavirin effective for Lassa fever, Rift Valley fever, CCHF, HF-renal syndrome

Isolation/Decontamination

1. Contact precautions for healthcare workers
2. Hypochlorite or phenolic disinfectants
3. Isolation measures and barrier nursing procedures

Treatment

1. Passive antibody for AHF, BHF, Lassa fever, CCHF
2. Ribavirin (CCHF, arenaviruses) 30 mg/kg IV initial dose, 15 mg/kg IV q6h x 4 d, 7.5 mg/kg IV q8h x 6 d
3. Supportive care for hemodynamic, hematologic, pulmonary, neurologic manifestations of VHF

Disposition

1. Admit; contact precautions & isolation
2. Avoid IM injections, aspirin, anticoagulant drugs
3. Notify CDC & local health dept

[TOC] [Tx]

Botulinum

Diagnosis

1. Bulbar palsies i.e. blurred vision due to mydriasis, diplopia, ptosis, dysarthria, dysphonia, and dysphagia prominent early
2. Generalized weakness, dizziness, dry mouth and throat, constipation, urinary retention
3. Flaccid descending, symmetrical paralysis and development of respiratory failure
4. Suspect biowarfare if multiple casualties present with progressive descending bulbar, muscular, respiratory weakness
5. Mouse neutralization (bioassay) most sensitive test

History

1. Researched by Iraq in 1991
2. Weaponized & deployed in over 100 munitions in 1995 by Iraq

Pathophysiology

1. Botulinum toxins, 7 neurotoxins, produced by Clostridium botulinum
2. Block acetylcholine release
3. Aerosol inhalation or foodborne
4. Symptoms in 24-36 hrs
5. Infective dose: 0.001 mcg/kg
6. Incubation: 1-5 d
7. Duration: death in 24-72 hrs if lethal
8. Lethality: high without respiratory support
9. Stable for wks in non-moving water & food

Prevention

1. DOD pentavalent toxoid for serotypes A-E: 0.5 ml SQ at 0, 2 & 12 wks; yrly boosters
2. CDC carries large quantity of antitioxin

Isolation/Decontamination

1. Standard precautions for healthcare workers
2. Toxin not dermally active
3. Hypochlorite (0.5% for 10-15 mins) and/or soap and water

Treatment

1. Skin testing for horse serum sensitivity prior to antitoxin
2. DOD heptavalent equine antitoxin for serotypes A-G: 10 ml IV
3. CDC trivalent equine antitoxin for serotypes A, B, E
4. Ventilatory support due to resp failure

Disposition

1. Admit
2. Intensive & prolonged nursing care for wks to mths
3. Notify CDC & local health dept

[TOC] [Tx]

Staphylococcal Enterotoxin B (SEB)

Diagnosis

1. F/C, HA, myalgia, non-productive cough, SOB and retrosternal chest pain
2. Fever lasts 2 to 5 d and cough persists up to 4 wks
3. N/V/D if swallow toxin; can lead to septic shock and death
4. CXR: no abnormalities
5. Large numbers of soldiers presenting with s/sym of SEB pulmonary exposure suggest intentional attack
6. Urine samples tested for SEB; lab tests not very helpful

History

1. Causes countless endemic cases of food poisoning
2. Could render up to >80% of exposed personnel clinically ill up to 2 wks

Pathophysiology

1. Staphylococcus aureus produces a number of exotoxins
2. Ingested or inhaled
3. Improperly handled foodstuffs causes food poisoning
4. Infective dose: 30 mcg/person
5. Incubation: 3-12 hrs after inhalation
6. Duration: hrs
7. Lethality: <1%
8. SEB resistant to freezing

Prevention

1. Use of protective mask
2. No human vaccine available

Isolation/Decontamination

1. Standard precautions for healthcare workers
2. Hypochlorite (0.5% for 10-15 mins) and/or soap and water
3. Destroy any contaminated food

Treatment

1. Oxygenation and hydration
2. In pulmonary edema, ventilation with PEEP and diuretics
3. Acetaminophen for fever, cough suppressants
4. Ventilatory support for inhalation exposure

Disposition

1. Admit
2. Min 2 wk recovery
3. Notify CDC & local health dept

[TOC] [Tx]

Ricin

Diagnosis

1. Weakness, fever, cough, pulmonary edema after inhalation
2. Respiratory distress and death from hypoxemia in 36-72 hrs
3. Inhaled: pathologic changes in 8 hrs, acute hypoxic respiratory failure in 36-72 hrs
4. Ingested: severe gastrointestinal symp, vascular collapse and death
5. Lab findings: nonspecific, similar to other pulmonary irritants
6. Specific serum ELISA; acute and convalescent sera collected

History

1. Significant due to wide availability; 1 million tons of castor beans processed annually in production of castor oil
2. Used in assassination of Bulgarian exile Georgi Markov in London in 1978

Pathophysiology

1. Ricin potent protein toxin derived from castor beans (Ricinus communis); native plant of India; grown in southern US
2. Not likely chemical warfare agent
3. Infective dose: 3-5 mcg/kg
4. Incubation: 18-24 hrs
5. Duration: death in 10-12d for ingestion
6. Lethality: high

Prevention

1. No vaccine or prophylactic antitoxin available
2. Use of the protective mask is best protection against inhalation

Isolation/Decontamination

1. Standard precautions for healthcare workers
2. Soap and water

Treatment

1. Pulmonary intoxication: lasix and respiratory support
2. GI intoxication: gastric decontamination with superactivated charcoal, followed by

magnesium citrate after ingestion of >1 castor bean per 10 kg body weight
3. Volume replacement of GI fluid losses
4. Supportive treatment

Disposition

1. Admit; standard precautions
2. Discharge pt who is asymptomatic at 8 hrs post exposure
3. Notify CDC & local health dept

[TOC] [Tx]

T-2 Mycotoxins "Yellow Rain"

Diagnosis

1. Skin pain, pruritus, redness, vesicles, necrosis (esp lips, fingers, nose), sloughing of epidermis
2. Nose and throat pain, salivation, nasal discharge, itching and sneezing, cough, dyspnea, wheezing, chest pain, hemoptysis
3. Weakness, ataxia, collapse, systemic hemorrhage, petechiae, shock, and death
4. Extremely debilitating due to skin and pulmonary involvement
5. Suspect if aerosol attack in form of "yellow rain" with droplets of yellow fluid affecting clothes and environ
6. Gas liquid chromatography-mass spectrometry: blood, tissue, environ samples

History

1. Used in aerosol form ("yellow rain") to produce lethal and nonlethal casualties in Laos (1975-81), Kampuchea (1979-81), and Afghanistan (1979-81)
2. > 6,300 deaths in Laos, 1,000 in Kampuchea, and 3,042 in Afghanistan

Pathophysiology

1. Trichothecene mycotoxins produced by fungi (molds) of genera Fusarium, Myrotecium, Trichoderma, Stachybotrys
2. Heat to 1500 deg F for 30 mins required for inactivation
3. Brief exposure to NaOCl destroys toxic activity
4. Stable in acidic conditions
5. Inhaled or ingested
6. Infective dose: moderate
7. Incubation: 2-4 hrs
8. Duration: may persist for 1 mth
9. Lethality: moderate
10. Stable for yrs at room temp

Prevention

1. Wear protective mask and clothing during an attack
2. No vaccine available

Isolation/Decontamination

1. Standard precautions for healthcare workers

2. Decontamination of outer clothing and exposed skin with soap and water
3. Eye exposure treated with copious saline irrigation
4. 2.5% hypochlorite and 0.25% NAOH with 30 min contact time; can irritate skin

Treatment

1. No specific antidote
2. Activated charcoal 2 g/kg PO for oral ingestions
3. M291 kit to remove skin adherent T-2
4. Eyes irrigated with normal saline
5. Supportive therapy
6. Unproven treatments: metoclopramide, magnesium sulfate, magnesium sulfate, sodium bicarbonate and dexamethasone sodium phosphate

Disposition

1. Admit; standard precautions
2. Notify CDC & local health dept

[TOC]

Biological Decontamination

Definitions

1. Contamination: intro of microorganisms into tissues or sterile materials
2. Decontamination: disinfection or sterilization of infected articles
3. Decon corridor: area inside secured zone used for decontamination
4. Warm zone: most contaminated area in decon corridor
5. Cold zone: least contaminated area in decon corridor where pt exits shower
6. Dirty side: side of decon corridor with collection containers, water hoses, etc
7. Clean side: uncluttered side of decon corridor; where team can work
8. Hazmat protective equipment:
   - Level B: chemical resistant suit, air respirator; needed in warm zone
   - Level D: gloves; for suit support
   - Don: dress in protective gear
   - Doff: remove protective gear
9. Training:
   - Awareness level: initiate code decon response
   - Operations level: assist in code decon response; 8 hrs training
10. Decon leader: highest ranking person trained in decon; reports to incident commander
11. Decon team: min of 3 people; 16 hrs training
12. Dedicated ventilation system
13. Disinfection: elimination of undesirable microorganisms to prevent transmission
14. Sterilization: killing of all organisms
15. Mechanical decontamination: remove but not neutralize agent e.g. filtering of drinking water
16. Chemical decontamination: use of disinfectants in form of liquid, gas or aerosol

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Exposure

1. Dermal exposure:
   - Treat by soap and water
   - Use brush to ensure mechanical loosening from skin surface structures
   - Rinse with copious amounts of water
   - Wash areas with 0.5% Na hypochlorite soln with contact time of 10 to 15 mins

2. Mix 0.5% Na hypochlorite soln:
    - 1 part Clorox & 9 parts water (1:9) as standard stock Clorox is 5.25% Na hypochlorite soln
    - Apply soln with cloth or swab
    - Make fresh daily with pH in alkaline range
3. Do not use chlorine soln with open abdominal wounds or brain and spinal cord injuries
4. Non-cavity wounds:
    - Chlorine soln instilled and removed by suction
    - Irrigation with saline
    - Prevent chlorine soln from being sprayed into eyes; corneal opacities result
5. Clean fabric clothing or equipment with 5% hypochlorite soln
6. Bio agents harmless:
    - Dry heat 2 hrs at 160 deg C
    - Autoclave with steam at 121 deg C
    - 1 atm of overpressure (15 lbs/sq inch) for 20 mins
7. Solar UV radiation has disinfectant effect in combination with drying

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Environment

1. Equipment:
    - Contact time of 30 mins prior to normal cleaning
    - Hypochlorite is corrosive to metals and injurious to fabrics, so rinse and oil metal surfaces
2. Rooms & fixed spaces:
    - Gases or liquids in aerosol form (e.g. formaldehyde)
    - Combine with surface disinfectants
3. Environmental:
    - Spray with dust-binding spray to minimize reaerosolization
    - Chlorine-calcium or lye used
    - Expensive

[TOC]

Isolation Precautions

Standard Precautions

1. Wash hands after patient contact
2. Use gloves when touching blood, body fluids, secretions, excretions
3. Use mask, eye protection, and gown during procedures
4. Contaminated patient-care equipment and linen handled to prevent transfer of microorganisms
5. Handle sharps carefully and use mouthpiece or other ventilation device in CPR
6. Pt in private room if contamination risk

Airborne Precautions

Standard precautions plus:

1. Pt in private room with negative air pressure, six air changes/hr, appropriate filtration of air before air discharged from room
2. Use respiratory protection when entering room
3. Limit movement and transport of pt
4. Use mask on pt if pt needs to be moved

Droplet Precautions

Standard precaution plus:

1. Pt in private room or with someone with same infection
2. Maintain at least 3 ft between pts
3. Use mask when working within 3 ft of pt
4. Limit movement and transport of pt
5. Use mask on pt if pt needs to be moved

Contact Precautions

Standard precautions plus:

1. Pt in private room or with someone with same infection
2. Use gloves when entering room
3. Change gloves after contact with infective material
4. Use gown when entering room if pt contact anticipated or if pt has diarrhea, colostomy or uncovered wound
5. Limit movement or transport of pt
6. Ensure pt-care items, bedside equipment, surfaces cleaned daily
7. Dedicate noncritical pt-care equipment to single pt, or cohort of pts with same pathogen

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[TOC]

CHEMICAL

General

1. Solids, liquids, or gases, depending on temp pressure
2. Riot-control agents solids at usual temp pressure
3. Munitions:
   - Liquids
   - After munition detonation, agent dispersed as liquid or aerosol
   - Aerosol: collection of small solid particles or liquid droplets suspended in gas (steam is form of aerosol)
   - "Tear gas" is aerosolized solid
4. Vapor: gaseous form of substance at temp < boiling point of substance at given pressure
5. Tendency of chemical agent to evaporate depends on chemical composition, temp, air pressure, wind, nature of underlying surface
6. Volatility: inversely related to persistence; more volatile substance is, more quickly it evaporates
7. Liquid exposure is most important hazard; needs proper wearing of chemical protective clothing
8. Penetration of shrapnel or clothing contaminated with liquid chemical agent gives IM/IV exposure
9. Chemical agents as aerosolized liquid droplets, vapor, or gas directly contact eyes, skin, or (through inhalation) respiratory tree

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Effective/Lethal Doses & Concentrations

1. ED50, ID50 denote effects (E) or incapacitation (I) in 50% of group
2. LD50, lethal dose kills 50% of group
3. Lower LD50, less agent is required, more potent is agent
4. ED50, LD50 values for given agent - site-specific i.e. LD50 for mustard absorbed through dry, unabraded skin > LD50 for mustard absorbed through eye
5. Comparison of amounts of chemical agent encountered as aerosol, vapor, or gas uses concentration-time product or Ct
6. Ct: agent concentration (in mg/m3) multiplied by time (in mins) of exposure; exposure to concentration of 4 mg/m3 of soman (GD) vapor for 10 mins gives Ct of 40 mg-min/m3; exposure to 8 mg/m3 for 5 mins gives same Ct
7. Haber's law: Ct associated with biological effect is constant even though concentration time components may vary within certain limits i.e., 10 min exposure

to 4 mg/m3 of soman = 5-minute exposure to 8 mg/m3 =1 min exposure to 40 mg/m3

8. Ct not exact measure of inhalation exposure

Overview

1. Lung-damaging (pulmonary) agents:
   - Phosgene (CG), perflurorisobutylene (PFIB), product of Teflon combustion
   - HC smoke (a smoke containing zinc), oxides of nitrogen (from burning munitions)
   - CG: liquid at low temps
2. Cyanide:
   - Not good warfare agent
   - Large LCt50; exposures below lethal Ct cause few effects
   - High volatility; concentrations difficult to achieve on battlefield
   - High concentrations only for few mins in open air
   - Kills quickly at high concentrations
   - Evaporates < 24 hrs
   - Hydrocyanic acid (AC) cyanogen chloride (CK)
   - AC, CK: liquid at low temps
3. Vesicants:
   - Mustard (sulfur mustard, H, HD), Lewisite (L), phosgene oxime (CX)
   - Mustard less volatile than GB, but more volatile than VX
   - Mustard persists > 24hrs
   - Named due to vesicles (blisters) on skin
   - Damage eyes, airways by direct contact
4. Nerve agents:
   - Inhibit AChE
   - Effects result of excess acetylcholine
   - GA (tabun), GB (sarin), GD (soman), GF, VX
   - GB evaporates < 24 hrs
   - VX persists > 24 hrs
5. Incapacitating agents:
   - BZ, glycolate anticholinergic compound related to atropine, scopolamine, hyoscyamine
   - Agent 15, Iraqi agent chemically identical to BZ
6. Riot-control agents:
   - Used during civil disturbances
   - CS, used by law enforcement officials, military
   - CN (Mace), sold in self- protection devices

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* For more information visit www.pepid.com

[TOC]

Key Physical/Diagnostic Findings: Chemical

1. Odors:
   - Cyanide: burnt almonds
   - Phosgene, Pulm agents: newly mown hay/freshly cut grass
   - Mustards: garlic, horseradish, mustard
   - Lewisite: fruit, geranium
   - Nerve agents: gasoline
   - Ethyldichloroarsine: fruity, but biting & irritating
   - CN: apple blossom
   - CS: pepper
2. Skin:
   - Blisters: mustards, lewisite
   - Urticaria: phosgene oxime
   - Diaphoresis: nerve agents
   - Dryness/redness: incapacitating agents
   - Burning/pain: riot control agents
3. Pulmonary:
   - Edema: nerve agents, pulmonary agents

[TOC] [Tx]

Pulmonary Agents

Diagnosis

1. Eye and airway irritation, dyspnea, chest tightness, delayed pulmonary edema
2. Smell of newly mown hay or freshly cut grass or corn
3. Classification based on H2O solubility
   - Water soluble: acrolein, NH3, chloramine, HCl, SO2, riot control agents
     - Rapid onset, easily absorbed in mucous membranes of eyes, nose, oropharynx (very irritating)
     - Rarely effect lower respiratory tract
   - Low H2O soluble: NOx, phosgene
     - Delayed onset, penetrate deeply into lungs causing non-cardiogenic pulmonary edema
   - Intermediate soluble: both properties of H2O & non-H2O agents
4. CXR: hyperinflation, pulmonary edema

History

1. John Davy first synthesized phosgene in 1812
2. First battlefield use of phosgene at Verdun in 1917 by Germany
3. Phosgene was not used in WWII

Pathophysiology

1. Absorbed by inhalation; penetrate to level of respiratory bronchioles and alveoli
2. Phosgene (CG):
   - low solubility agent, gas, industrial purposes
   - CG odor threshold: 1.5 mg/m3; irritates mucous membranes at 4 mg/m3; LCt50 is approx 3200 mg-min/m3
   - CG 2 x as potent as chlorine
3. Perfluoroisobutylene (PFIB):
   - toxic pyrolysis product of tetrafluoroethylene; encountered in military material (e.g. Teflon)
   - PFIB 10 x more toxic than CG
4. Oxides of nitrogen (NOx): components of blast weapons or may be toxic decomposition products
5. Obscurant Smoke (e.g., HC smoke): toxic compounds, cause same effects as phosgene

Isolation/Decontamination

1. Chemical protective mask
2. Vapor - fresh air
3. Liquid - copious water irrigation

Treatment

1. Terminate exposure
2. ABCs, supportive measures:
   - May need PPV with PEEP
   - IV fliuds for hypotension
   - Bronchodilators for bronchospasm
3. Strict bed rest
4. Steroids in HC smoke
5. Chlorine: watch for bact. superinfection

Disposition

1. Admit
2. Notify CDC & local health dept

Military Detection/Treatment Kits
(See Chemical Agent ID/Detection)

1. MINICAMS, Monitox Plus, Draeger tubes, Individual Chemical Agent Detector (ICAD), M18A2, M90, M93A1

[TOC] [Tx]

Cyanide (AC, CK)

Diagnosis

1. Consider in:
   - Closed space smoke inhalation/fire victim OR suicide with coma/acidosis
   - Laboratory worker who suddenly collapses
   - Ingestion of nitrile compound; ingestion of artificial nail remover
   - ICU: pt on nitroprusside with MS changes, acidosis
2. Bitter almond odor (detectable by 40-50%)
3. Hypoxic symptoms: HA, SOB, confusion, seizure, coma
4. Shock (hypotension with tachy or bradycardia)
5. Incr'd lactic acid/coma
6. Dec. A-V O2 difference (inc. VO2 saturation)
7. Assoc. abd. pain/emesis; skin cherry-red or cyanotic seizures, respiratory and cardiac arrest
8. Elevated blood AC:
   - Mild effects (flushing, tachycardia) at 0.5-1.0 mcg/ml
   - Coma, convulsions and death at 2.5 mcg/ml
   - Obtundation at 1-2.5 mcg/ml
9. Lab: plasma lactate concentration >8 mmol/L, 94% sensitive & 70% specific for blood cyanide concentration >1 mg/L

History

1. Used by French in WWI without notable military success
2. US maintained small number of cyanide munitions during WWII
3. Japan allegedly used cyanide against China during World War II
4. Iraq may have used cyanide against Kurds in 1980's

Pathophysiology

1. Binds cellular cytochrome oxidase causing chemical asphyxia
2. Hydrogen cyanide, hydrocyanic acid (AC); cyanogen chloride (CK)
3. AC is rapidly acting lethal agent limited by high LCt50 and high volatility
4. AC is least toxic of "lethal" agents
5. Death occurs within 6-8 mins after inhalation
6. Exist as liquid in munitions, vaporize on detonation; major threat from vapor
7. Absorbtion:
   - Inhalation: 58-77%
   - Oral: 50%
8. Half life: 0.7-2.1 hrs
9. LCt50s by inhalation:

- AC: 2500-5000 mg-min/m3
- CK: 11,000 mg-min/m3

10. LD50s:
    - AC: IV is 1.1 mg/kg
    - AC: skin is 100 mg/kg
11. Fatal dose: hydrogen cyanide:
    - Inhalation: (<1 hr): 110-135 ppm
    - Oral: 0.6-1.5 mg/kg
    - Dermal exposure of 10% sodium cyanide to large body surface area causes symptoms in 20 mins

Decontamination

1. Skin decontamination not necessary
2. Remove wet contaminated clothing
3. Clean underlying skin with soap and water

Treatment

1. Antidote (adult): sodium nitrite 10 ml IV and sodium thiosulfate 50 ml IV (target methemoglobin 10-20%)
2. 100% O2; activated charcoal for oral exposure
3. Remove to fresh air (if O2 not available)
4. Mechanical ventilation as needed
5. Circulatory support with crystalloids and vasopressors
6. Correct metabolic acidosis with IV sodium bicarbonate (1-2 meq/kg)
7. Seizure control with benzodiazepines
8. Administration of 100% O2
9. Investigational: hydroxcobalamin 4 g (can bind 200 mg of cyanide) administered with 8 g of thiosulfate

Disposition

1. Admit all symptomatic pts to ICU
2. Asymptomatic pts observed for 2 hrs, then discharged
3. Survival after 4 hrs (in acute exposure) associated with full recovery
4. Notify CDC & local health dept

Military Detection/Treatment Kits
(See Chemical Agent ID/Detection)

1. M256A1, M272 kit, ICAD, M18A2, and M90 detectors detect AC

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* For more information visit www.pepid.com

[TOC] [Tx]

Mustards (H, HD)
Sulfur Mustard (H), Liquid Mustard (HD)

Diagnosis

1. Skin: erythema and blisters (may be delayed up to 8 hrs)
2. Eyes: conjunctivitis, corneal opacity, damage, lacrimation, blepharospasm
3. Airway: mild to marked airway damage; pneumonitis within 1-3 d
4. GI effects and bone marrow stem cell suppression
5. Odor: garlic, horseradish, or mustard
6. Leukocytosis, fever, sputum production
7. Thiodiglycol measured by Theater Army Medical Laboratory (TAML)

History

1. First synthesized in early 1800s
2. First used during WWI by Germany in July 1917
3. Italy allegedly used in 1930's against Abyssinia
4. Egypt apparently used in 1960's against Yemen
5. Iraq used in 1980's against Iran and Kurds

Pathophysiology

1. Oily liquid with color from light yellow to brown
2. Fair skinned more at risk for adverse dermal effects
3. Dissolves in sweat or ECF; prefers heat, humidity
4. Mustard can't be isolated in blister fluid
5. Persists in soil for wks
6. Case fatality rate: 2-4%
7. WBC <200 is harbinger for fatality
8. Toxic dermal dose: 0.1% soln
9. Primarily liquid hazard; <100 deg F; vapor hazard >100 deg F; freezes 57 deg F
10. Persistence: liquid: 1-2 d
11. Sulfur Mustard (H):
    - Danger to life/health: 0.003 mg/m3
    - LCt50 vapor:
        - unprotected 1500 mg/min/m3
        - resp protection 10,000 mg/min/m3
12. Liquid mustard (HD):
    - LD50: skin 100 mg/kg
    - Ocular injury: 200 mg/min/m3

- Dermal absorbtion: 2000 mg/min/m3

Decontamination

1. 0.5% hypochlorite soln
2. M291 kit
3. H2O in large amounts (not hot)
4. If no H2O, use Fuller's earth
5. Remove all contaminated clothing
6. Towels soaked in 0.2% chloramine
7. Towels soaked in H2O (Dakin soln) placed over wounds for first 2 hrs helpful

Treatment

1. Skin: calamine, silver sulfadiazine 1% bid
2. Eye: homatropine ophthalmic ointment
3. Pulmonary: antibiotics, bronchodilators
4. Do not fluid resuscitate as in thermal burns
5. Petroleum jelly placed on eyelid margins may prevent eyelid adherence
6. Colony stimulating factor helpful in leukopenia
7. Systemic analgesics
8. O2, early use of PEEP or CPAP

Disposition

1. Admit
2. Notify CDC & local health dept

Military Dectection/Treatment Kits
(See Chemical Agent ID/Detection)

1. M256A1, M272, MINICAMS, ICAD, M18A2, M21, M90, M93A1 Fox, Bubbler, CAM, DAAMS, M8 paper, or M9 paper

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[TOC] [Tx]

Lewisite (L)

Diagnosis

1. Skin: gray area of dead epithelium with 5 mins, erythema within 30 mins, blisters in 2-3 hrs, severe tissue necrosis
2. Eyes: blepharospasm, conjunctival edema
3. Airway: pseudomembrane formation, nasal irritation
4. Intravascular fluid loss, hypovolemia, shock, organ congestion, leukocytosis, miosis, immediate pain on contact
5. Odor: fruity or geranium
6. Lab: blood arsenic >7 mcg/100ml is abnormal

History

1. First synthesized by US Army captain Wilford Lee Lewis in 1918
2. May have been used by Japan in China (1937-1944)

Pathophysiology

1. Damages eyes, skin, and airways by direct contact
2. Absorbed from skin, eyes, respiratory tract, ingestion, and via wounds
3. Increases capillary permeability; produces hypovolemia, shock, organ damage
4. Oily, colorless liquid; low water solubility; persists in ground plants for wks
5. Trivalent arsenic compound; produces systemic toxicity e.g. hemolysis
6. More volatile than mustard
7. Half life: 55-75 hrs
8. Nasal irritation at 8 mg-min/m3; odor noted at 20 mg-min/m3
9. Dermal dose: lethal: 38 mg/kg (2 ml on skin)
10. Dermal absorbtion: 100,000 mg/min/m3
11. Liquid causes vesication at 14 mcg
12. LD50 applied to skin is 2.8 grams

Decontamination

1. M291 kit
2. 5% hypochlorite soln immediately
3. Water in large amounts
4. Rubber gloves/goggles
5. Ocular: remove contact lenses, irrigate with 0.9% saline or H2O for 15 mins
6. Topical or ocular 5% BAL ointment within 15 mins of dermal or 2 mins of ocular

exposure

Treatment

1. Antidote: British-Anti-Lewisite (BAL, dimercaprol):
   - 3 mg/kg q4h IM for 2 d
   - Then q6h on 3rd day
   - Then q12h up to 10 d
   - Avoid SQ leakage
2. Immediate decontamination
3. Symptomatic management of lesions

Disposition

1. Admit
2. Notify CDC & local health dept

Military Detection/Treatment Kits
(See Chemical Agent ID/Detection)

1. M256A1, M272, MINICAMS, the ICAD, M18A2, M21, M90, M93A1 Fox, Bubbler, CAM, and DAAMS, M8 paper, or M9 paper

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[TOC] [Tx]

Phosgene Oxime (CX)

Diagnosis

1. Burning, irritation, wheal-like skin lesions, eye and airway damage
2. Conjunctivitis, lacrimation, lid edema, blepharospasm
3. Pleasant smell of freshly mown hay
4. No distinct lab findings

History

1. Used in WWI gas warfare
2. Developed by Russia and Germany before WWII
3. Military interest as CX penetrates garments and rubber quicker than other chemical agents

Pathophysiology

1. CX is urticant or nettle agent, causes corrosive type of skin and tissue lesion
2. Vapor extremely irritating; vapor and liquid cause tissue damage upon contact
3. Solid at temp < 95deg F
4. LCt50 inhalation: 1500-2000 mg-min/m3
5. LD50 skin: 25 mg/kg

Decontamination

1. Irrigation with H2O in large amounts
2. 0.5% hypochlorite soln
3. M291 kit

Treatment

1. Immediate decontamination
2. Symptomatic management of lesions
3. Parenteral prednisone 1 g IV
4. Aerosolized dexamethasone & theophylline for pulmonary involvement is experimental

Disposition

1. Admit

2. Notify CDC & local health dept

Military Detection/Treatment Kits
(See Chemical Agent ID/Detection)

1. M256A1, M18A2, M90, M93 Fox, MINICAMS, ICAD, M21, Bubbler, CAM, DAAMS, M8A1, M8 paper, or M9 paper

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[TOC] [Tx]

Ethyldichloroarsine (ED)

Diagnosis

1. Dermal and ocular toxicity
2. Erythema, eye pain, photophobia, shivering, thirst, muscle weakness, hemolysis with hemoglobinuria and jaundice
3. Nasal and throat toxcity < 1 min
4. Odor of gas: fruity, but biting & irritating
5. Garlicky breath odor

History

1. Made by Germans in 1918

Pathophysiology

1. Rapid hydrolysis; short persistency
2. Stable in steel
3. Liberates arsine gas
4. Attacks brass at 50 deg C
5. Destructive to rubber & plastics
6. Lethal dose: 3,000-5,000 mg/min/m3
7. Skin absorbtion: 100,000 mg/min/m3

Decontamination

1. Protective mask
2. Impermeable protective clothing
3. Hypochlorite 0.5% soln used on skin
4. Live steam or alkaline solns (e.g. sodium hydroxide) used to decontaminate closed spaces

Treatment

1. Morphine sulphate for pain
2. Diphenhydramine for pruritis
3. Silver sulfadiazine 1% to prevent skin infection
4. Monitor for hemolysis-blood transfusions may be needed

Disposition

1. Admit if hemolysis present
2. Notify CDC & local health dept

Military Detection/Treatment Kits
(See Chemical Agent ID/Detection)

1. M256A1, MINICAMS, M18A2, M21, M90, M93A1, CAM, DAAMS, M8, and M9 paper

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[TOC] [Tx]

Nerve Agents (GA, GB, GD, GF, VX)

Tabun (GA), Sarin (GB), Soman (GD)

Diagnosis

1. Vapor; small exposure: miosis (takes up to 2 mths to normalize), rhinorrhea, mild difficulty breathing
2. Liquid on skin; small to moderate exposure: localized sweating, nausea, vomiting, feeling of weakness
3. Large exposure (vapor or skin): loss of consciousness, convulsions (soman likely), apnea, flaccid paralysis, miosis, copious secretions, sinus bradycardia
4. Lab: erythrocyte cholinesterase activity; levels <10% of normal indicates severe exposure

History

1. Developed in pre-WWII Germany
2. US has stockpiles contains the nerve agents sarin (GB) and VX
3. Matsumoto GB attack 1994
4. Tokyo subway GB attack 1995

Pathophysiology

1. Organic esters of phosphoric acid; cause cholinergic syndromes through AChE inhibition
2. Most toxic of known chemical agents; liquids
3. Tabun (GA), Sarin (GB), Soman (GD)
4. Lethal dermal dose (70 kg adult):
   - Sarin: 1.7 g
   - Tabun: 1 g
   - Soman: 100 mg
   - VX: 6 mg
5. Onset of action (G compounds): 5 mins by inhalation; 1 hr by dermal
6. G agents are volatile: dermal and inhalation threat
7. VX: low volatility; dermal threat
8. Agent: LCt50; ICt50; MCt50; LD50 (skin):
   - GA: 400; 300; 2-3;1000
   - GB: 100; 75; 3; 1700
   - GD: 70; UNK; <1; 50
   - GF: UNK; UNK; <1; 30

- VX: 50; 35; 0.04; 10

Decontamination

1. M291 kit
2. M258A1 kit
3. 1-5% Hypochlorite soln; can destabilize these agents
4. Contaminated equipment: 10% hypochlorite soln
5. Large amounts of water
6. If bleach not available use gentle blotting with alkaline soap

Treatment

1. Charcoal if ingested
2. Pretreatment: pyridostigmine bromide 30 mg q8h x 21 tabs (esp soman)
3. MARK I Kits (atropine 2 mg & pralidoxime chloride 600 mg)
4. Diazepam 10 mg to decrease convulsive activity and reduce brain damage caused by prolonged seizure activity
5. Pralidoxime chloride:
   - IV 1-2 g over 10 mins
   - Repeat in 1 hr if weakness occurs then q4-12h
   - Give within 3 hrs post sarin exposure; may not work for tabun or soman
6. Obidoxime:
   - May work against tabun, sarin or GF
   - 250 mg IM or slow IV
   - Repeat q2h up to total of 750 mg
7. Atropine 10-20 mg IV cumulatively in 2-3 hrs; warfare agents require < insecticides
8. Moderate skin exposure: 1 Mark I kit; 18 hr observation
9. Severe skin exposure: 3 Mark I kits & diazepam
10. Ventilate & suction airway for respiratory distress
11. 100% O2

Disposition

1. Admit
2. Notify CDC & local health dept

Military Detection/Treatment Kits
(See Chemical Agent ID/Detection)

1. M256A1, CAM, M8 paper, M9 paper, M8A1, M8

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* For more information visit www.pepid.com

[TOC] [Tx]

Incapacitating Agents (BZ, Agent 15)

Diagnosis

1. 3-quinuclidinyl benzilate (BZ)
2. Mydriasis, dry mouth, dry skin
3. Incr'd DTRs; decr'd LOC; confusion; disorientation
4. Illusions and/or hallucinations; denial of illness; short attention span; impaired memory
5. Stage 1 (0-4 hrs): parasympathetic blockade and mild CNS effects
6. Stage 2 (4-20 hrs): stupor with ataxia and hyperthermia
7. Stage 3 (20-96 hrs): full-blown delirium
8. Stage 4: paranoia, deep sleep, reawakening, crawling, climbing automatisms, eventual reorientation

History

1. In 600 BC Solon's soldiers threw hellebore roots to contaminate enemy water supply
2. In 184 BC Hannibal's army used belladonna plants to induce disorientation
3. Bishop of Muenster in AD 1672 used belladonna in assault on Groningen
4. In 1908, 200 French soldiers in Hanoi became delirious and experienced hallucinations after being poisoned
5. After WWII, US investigated wide range of possible nonlethal, psychobehavioral, chemical incapacitating agents including psychedelic indoles e.g. lysergic acid diethylamide (LSD-25), marijuana derivatives
6. 3-quinuclidinyl benzilate, assigned NATO code BZ, weaponized in 1960's
7. In 1998, Iraq accused of stockpiling large amounts of glycolate anticholinergic incapacitating agent: Agent 15

Pathophysiology

1. BZ is glycolated anticholinergic related to atropine, scopolamine, hyoscyamine
2. Competitive inhibitor of acetylcholine
3. Half-life of 3-4 wks in moist air; even heat-producing munitions can disperse it
4. Persistent in soil and water; soluble in propylene glycol, DMSO
5. ICt is 112 mg-min/m3
6. Duration 72-96 hrs

Decontamination

1. Flush skin and hair with soap and water

2. Remove clothing

Treatment

1. Antidote: physostigmine IM: 45 mcg/kg; IV: 30 mcg/kg slowly (1 mg/min); PO: 60 mcg/kg if patient cooperative (dilute in juice); titrate q60 mins to mental status
2. Support, IVF
3. Observation
4. Physical restraints

Disposition

1. Admit
2. Notify CDC & local health dept

Military Detection/Treatment Kits
(See Chemical Agent ID/Detection)

1. No field detector available

[TOC] [Tx]

Riot Control Agents (CS, CN)

Diagnosis

1. Burning and pain on mucous membranes and skin, eye pain and tearing, tingling of exposed skin
2. Burning in nostrils, respiratory discomfort, bronchospasm (may be delayed 36 hrs)
3. No detection method
4. No specific lab tests

History

1. Used in France before WWI; first chemical agents deployed during WWI
2. CS synthesized by Corson and Stoughton in 1928
3. US used CS extensively in Vietnam
4. Used by police forces e.g. Ireland, France, Russia, US

Pathophysiology

1. Irritants, lacrimators, and "tear gas"
2. Used by law enforcement
3. High LCt50 and a low effective Ct50
4. Duration: few mins
5. CN gas is "Mace"
6. CS gas is "Tear gas"
7. CS & CN are SN2 alkylating agents
8. CN: chloroacetophenone: apple blossum odor
9. CS: ortho-chlorobenzylidene-malononitrile: pepper odor

Decontamination

1. Eyes: flush with water, saline; rubbing eyes may prolong effect
2. Skin: flush with lots of water, alkaline soap and water, or mildly alkaline soln (6% sodium bicarbonate or 3% sodium carbonate)
3. Do not use hypochlorite soln

Treatment

1. Usually none is necessary; effects are self-limiting
2. Pulmonary: asthma, emphysema may need O2, bronchodilators, assisted ventilation

3. Skin: calamine for erythema

Disposition

1. Effects of exposure disappear within 30 mins
2. Admit only if assisted ventilation needed or bronchospasm does not resolve

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[TOC]

Chemical Decontamination

General

1. M291 Kit is best universal dry decontaminant for skin
2. Fresh 0.5% hypochlorite soln with alkaline pH is best universal liquid agent
3. Hypochlorite soln for use on skin and soft tissue wounds only
4. Do not use hypochlorite in abdominal wounds, open chest wounds, on nervous tissue, or in eye
5. Surgical irrigation soln used in abdomen and chest
6. Copious amounts of water, normal saline, or eye solutions used for eye
7. Certification: process decontamination facility; M8 paper; M9 tape; M256A1; or by CAM

Physical Methods

1. Flush with water or aqueous solns e.g. hypochlorite soln
2. Adsorbent materials e.g. soap detergents, earth, flour
3. M291 resin: carbonaceous adsorbent, polystyrene polymeric, ion exchange resins

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Chemical Methods

1. Water/soap wash: fresh or sea water via hydrolysis
2. Oxidation chlorination: hypochlorite soln, alkaline pH
3. Alkaline hydrolysis esp nerve agents

Wound Contamination

1. Initial: bandages removed, wounds flushed, bandages replaced; tourniquets replaced; splints cleaned
2. Vesicants and nerve agents present hazard
3. Thickened agents: chemical agents mixed with acrylate to increase persistency
4. Foreign materials: little risk with individual fibers left in wound

5. Assessment: CAM used; takes 30 secs; detects vapor
6. Hypochlorite: 0.5% effective
7. Wound exploration/debridement: use well-fitting (thin), butyl rubber gloves; hypochlrorite 0.5% used in deep, non-cavity wounds
8. Instruments placed in 5% hypochlorite for 10 mins

[TOC]

Chemical Agent ID/Detection

Paper, CM Agent Detector: M8

1. Identifys type of agent present in liquid form on battlefield
2. Takes 30 secs; false positive with insecticides, petroleum, antifreeze

---

Paper, CM Agent Detector: M9

1. Detects presence of liquid agent, but doesn't identify specific agent or type of agent
2. Detects nerve or blister agent as small as 100 microns in dia
3. False positive with insecticides, petroleum, antifreeze

M256A1 Chemical Agent Detection Kit

1. Detect and identify chemical agents present either as liquid or as vapor
2. Consists of M8 paper and 12 foil-wrapped detector tickets
3. Contains eel enzymes as reagents to detect low concentrations of chemical vapors

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Chemical Agent Monitor (CAM)

1. Detects nerve and blister agents as vapors only

Chemical Agent Alarm: M8A1

1. Remote continuous air sampling alarm
2. Samples air for presence of nerve agent vapors (GA, GB, GD, VX) only

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Water Testing Kit, Chemical Agents: M272

1. Detects water contamination by nerve agent, blister agent, cyanide ("blood" agent), or Lewisite

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Decontamination Kit, Skin: M258A1

1. Removes & destroys liquid chemical agents on skin

Decontaminating Kit, Skin: M291

1. Adsorbs and neutralizes liquid chemical agents present on skin

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Decontamination Kit, Individual Equipment: M295 (DKIE)

1. Decontaminates individual equipment through physical removal and absorption of chemical agent

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[TOC]

Radiation Exposure

Exposure Levels

1. Rad (radiation absorbed dose): special unit of absorbed dose
2. Rem (roetgen equivalent man):
   - Biologic effect of radiation
   - Unit of radiation dose equivalent
   - Equal to absorbed dose in rads x relative biologic effectiveness of radiation in question
3. Gy: measures absorbed dose (1 joule of energy absorbed in 1 kg of material)
4. Whole-body dose (rem):
   - 5-100: asymptomatic; decr'd leukocytes & platelets; chromosome aberrations
   - 100-200: N/V, anorexia, decr'd lymphocytes within 48 hrs, fatigue <24 hrs
   - 200-400: N/V 2-4 d, skin erythema, epilation, decr'd leukocytes & platelets
   - 400-600: N/V/D, 50% mortality within 30 d, decr'd lymphocytes within 48 hrs
   - 600-1000: acute radiation syndrome, N/V/D, GI hemorrhage, incr'd mortality within 14 d, lymphocyte depression <48 hrs
   - >1000: rapid onset GI, CNS, CVS complications, lymphocytes = 0 <48 hrs, 100% mortality within 72 hrs
5. Sleeping next to human - 0.1 mR
6. Flying in aircraft - 0.5 mR
7. 3-mile Island accident - 1.5 mR
8. Exposure to consumer products e.g. smoke detectors - 3.5 mR/yr
9. Nuclear weapon fallout - 4.5 mR
10. Single CXR - 12-17 mR
11. Working in capitol building - 20 mR
12. Cosmic rays & terrestrial sources - 25 mR/yr
13. Medical diagnostics - 93 mR/yr
14. Radon - 200 mR/yr
15. Smoking tobacco - 280 mR/pack yr
16. Radiation worker - 5000 mR/yr
17. Decrease in sperm count - 15 R
18. Cancer Rx - 5000 R

Exposure Risks

1. 10 R: incr'd risk of genetic abn between 1 in 1,300 to 1 in 20,000
2. 10 R - can cause prenatal death
3. 1 R over few mins: incr'd risk of cancer between 1 in 2,000 and 1 in 100,000
4. Max allowable exposure - 100 mR/yr: public member not working with radiation
5. Exposure to other than background radiation is of short duration and occurs after entering area where there is radiation source
6. Contamination: radioactive material is on surface - external; entered body - internal
7. Tissue damage caused by radiation same as thermal or chemical burn
8. Radiation burns and hair loss doesn't appear acutely

Management

1. No symptoms 6 hrs post exposure: exposure <50 rems
2. Symptoms 2-6 hrs post exposure: exposure 200 rems
3. Symptoms <2 hrs: exposure > 400 rems - acute radiation syndrome
4. Follow ABCs; stabilize pt first
5. CBC, differential, UA, PT/PTT, platelets, total lymphocytes count (TLC)
6. TLC at 48 hrs predictive of prognosis
7. Internal contamination: 24 h urine & feces x 4 d
8. T&C for HLA typing if pt needs BM transplant due to BM depression (may need GCSF/epogen)
9. Follow ABCs; stabilize pt first
10. Potassium Iodide may protect thyroid
11. Consider and treat all blast, fall or chemical injuries
12. Consult nuclear medicine specialist for geiger counters
13. Contact Radiation Emergency Assistance Center (REAC/TS)

Specimen Collection

1. Control contamination: use protective clothing, control ventilation
2. Conduct total body survey
3. Document areas of contamination - location and amount of activity
4. Obtain cotton swabs of eyes, ears, nose, mouth, any wounds
5. Save areas of debrieded tissue and bandages as specimens
6. Special attention to body orifices, such as mouth, nose, eyes, and ears because of rapid absorption of radioactive material

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Decontamination

1. Contamination monitoring:
    - Skin, clothing, shoes (beta & gamma radiation): GM counter
    - Skin, clothing (alpha radiation): proportional counter
2. External decontamination: use Betadine, hydrogen peroxide, Phisohex, or Dakins soln
3. Eyes: rinse with stream of water from inner canthus to canthus; avoid contamination of lacrimal duct
4. Ear: external rinsing, ear syringe used to rinse auditory canal, provided tympanic membrane intact
5. Oral cavity: brush teeth with toothpaste, frequent rinsing of mouth with 3% hydrogen peroxide soln
6. Gastric lavage if radioactive materials swallowed
7. After decontamination & stabilization - transfer to definitive care unit
8. Collect all clothes/gowns/gloves etc in one bag
9. Keep in contact with decon team at scene
10. Decontaminate staff
11. Contact Radiation Emergency Assistance Center (REAC/TC)

[TOC]

Internal Contamination Treatment of Radioactive Elements

[A], [B], [C], [E], [F], [G], [I], [L], [M], [P], [R], [S], [T], [U], [Y], [Z], [Key]

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1. Americium:
   - DTPA
   - Start chelation ASAP
2. Arsenic:
   - Lavage
   - Dimercaprol in massive exposure
3. Barium:
   - Lavage, purgatives
   - Use sodium or magnesium sulfate with and after stomach lavage will precipitate insoluble barium sulfate
4. Calcium:
   - Lavage, purgatives
   - Calcium, lasix
   - Use sodium salt of EDTA in massive exposure over 3-4 hr to avoid tetany
   - Lasix enhances urinary excretion
5. Californium:
   - DTPA, lavage, purgatives
6. Carbon:
   - No treatment
   - Collect samples for low-energy beta count in lab
7. Cerium:
   - DTPA, lavage, purgatives
8. Cesium:
   - Prussian blue, lavage, purgatives
9. Chromium:
   - Lavage, purgatives
   - No treatment for anionic forms
   - DTPA or DFOA for cationic forms
   - Charcoal to reduce G.I. absorbtion
10. Cobalt:
    - Lavage, purgatives
    - Penicillamine for trial in large exposures
11. Curium:
    - DTPA, lavage, purgatives
12. Europium:
    - Lavage, purgatives
13. Fission products:
    - Lavage, purgatives

- Gamma-ray spectroscopy of air may identify radionuclides

14. Fluorine:
    - Aluminum hydroxide gel
    - PO aluminum hydroxide gel reduces absorbtion in G.I. tract
15. Gallium:
    - Consider penicillamine
16. Gold:
    - Dimercaprol or penicillamine
    - No therapy for colloidal gold
17. Iodine:
    - Potassium iodide, lavage
    - Early administration
18. Iron:
    - Lavage, DFOA
    - Penicillamine chelates iron
    - Egg yolk decreases G.I. absorbtion
19. Lanthanum:
    - Lavage, purgatives
    - DTPA
    - Use CaEDTA if CaDTPA not available
20. Lead:
    - Lavage, EDTA
21. Mercury:
    - Lavage, penicillamine
    - Alt: dimercaprol
    - Gastric lavage with egg white soln OR 5% sodium formaldehyde sulfoxide OR 2-5% sodium bicarbonate soln
22. Phosphorus:
    - Lavage, aluminum hydroxide, phosphates
    - Severe overdose: parathyroid extract IM + oral phosphates
23. Plutonium:
    - DTPA
    - Alt: DFOA initially; CaEDTA less effective
24. Polonium:
    - Lavage, purgatives
    - Dimercaprol; beware toxicity in low exposure
    - Alt: penicillamine
25. Potassium:
    - Purgatives, diuretics, aluminum hydroxide
    - Use PO liquid potassium for dilution
26. Promethium:
    - DTPA
    - Chelation ASAP
27. Radium:
    - Magnesium sulfate, lavage, purgatives
    - 10% magnesium sulfate soln for gastric lavage
    - PO sulfates reduce intestinal absorbtion
28. Rubidium:
    - Prussian blue

29. Ruthenium:
    - Lavage, purgatives
    - Chlorthalidone enhances urinary excretion
30. Scandium:
    - Lavage, purgatives
    - DTPA; can use EDTA instead
31. Sodium:
    - Lavage, diuretic
    - 1 L 0.9% sodium chloride IV after diuretic e.g. lasix
32. Strontium:
    - Aluminum phosphate, lavage
    - Strontium or calcium IV
    - Consider corticosteroid; watch adverse reactions
33. Technetium:
    - Potassium perchlorate reduces thyroid dose
34. Thorium:
    - DTPA
    - Treatment not effective for thorotrast
35. Tritium:
    - Forced H2O
    - Samples for low-energy beta count in lab
36. Uranium:
    - DTPA with 4 hrs
    - Sodium bicarbonate protects kidneys
37. Yttrium:
    - DTPA
    - CaETA used if CaDTPA unavailable
38. Zinc:
    - Lavage, DTPA
    - Zinc sulfate or CaEDTA used as diluting agent if CaDTPA unavailable

Key:

DTPA = diethylenetriaminepentaacetic acid
CaEDTA = calcium salt of ethylenetriaminepentaacetic acid
EDTA = ethylenetriaminepentaacetic acid
DFOA = deforoxamine or desferrioxamine

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* For more information visit www.pepid.com

[TOC]

Radiation Injury Treatment Scheme

1. Triage: prodromal symptoms, biological/physical dosimetry
2. Standard Emergency care
3. Combined injury: treat with surgery, burn care, wound care, observation as needed

Treatment based on level of exposure

1. Mild <2 Gy:
   - Close observation
   - Daily CBC/platelets
2. Moderate 2-5 Gy:
   - Reverse isolation
   - ICU
   - Gut decontamination
   - Growth factors
3. Severe 5-10 Gy:
   - Reverse isolation
   - ICU
   - Gut decontamination
   - Possible colony stimulating factors, hematopoietic growth factors, marrow transplant if whole body exposure >4 Gy
4. Lethal >10 Gy:
   - Symptomatic/supportive care
   - Marrow transplant

CBC evaluation

1. Severe platelets <20 x 10 to power 9/L:
   - Active bleed: random donor platelets:
     - Allosensitization: sibling/parent single match donor
     - No allosensitization: continue random platelets
   - No active bleed: continue observation
2. Absolute neutropenia <0.5 x 10 to power 9/L, <38 deg C
3. Absolute neutropenia with fever:
   - Cultures, empiric antibiotics:
     - Organism identified: specific antibiotics
4. Symptomatic anemia: PRBCs

[TOC]

Primary Blast Injury (PBI)

General Management

1. Initiate life support
2. Hx: distance from explosion, underwater or in enclosure
3. PE: ruptured tympanic membrane; retinal air emboli; SQ emphysema; ecchymoses
4. CBC, CXR, CT chest, abdomen, head if H&P suggests pathology
5. Limit physical activity
6. Air evacuation: risks include cabin pressure, oxygenation worse at altitude
7. Most life-threatening is damage to air containing organs

Respiratory System

1. At most risk after tympanic membrane
2. Dyspnea, CP, cough, hemoptysis
3. PE: tachypnea, cyanosis, dullness to percussion, decr'd breath sounds, crepitus
4. Pulmonary contusion invariably present:
   - Hemorrhage & eosinophilic edema in alveolar spaces
   - Respiratory insufficiency depends on degree of hemorrhage
5. Parenchymal laceration: hemothorax
6. Barotrauma: tearing of alveolar septae - pneumothorax, air embolism, SQ emphysema
7. Treatment:
   - O2, non-invasive ventilation; be aware of tension pneumo
   - Mechanical ventilation may cause arterial air emboli
8. Circulatory support: hypotension due to blood loss, GI hemorrhage, air emboli

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Arterial Air Emboli

1. Blindness, focal neuro deficit

2. Chest pain, LOC
3. PE: air in retinal vessels, focal neuro deficits, tongue blanching
4. Give supplemental O2, pt in left lateral decubitus position
5. Consider mechanical ventilation, hyperbaric therapy

G.I. System

1. Overshadowed by life-threatening pulmonary PBI
2. Edema, hemorrhage, organ rupture:
   - Gas containing organs more affected
   - Damage to solid organs from secondary or tertiary blast injury
3. Pain, N/V/D
4. PE: absent BS, guarding, rebound tenderness
5. Hemodynamically unstable: resuscitate & peritoneal lavage, then laparotomy
6. Hemodynamically stable: CT with IV contrast
7. Do CT before lavage or get false positive lavage
8. CT negative & signs of peritoneal injury:
   - Peritoneal lavage
   - If non clotting blood >10cc - exploratory laparotomy
9. Exploratory laparotomy in hemoperitoneum, hematoma, extraluminal contrast, organ injury; get CXR first
10. Abdominal complaints with negative CT and lavage: monitor closely to R/O abscess

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Auditory System

1. Damage to middle & inner ear
2. Tympanic membrane rupture, hearing loss, tinnitus, vertigo
3. No specific therapy for acoustic trauma
4. Tympanic rupture: remove debris, irrigate canal
5. Perform primary closure if >1/3 of membrane damaged

[TOC]

IMPORTANT EMERGENCY CONTACTS

[A], [C], [G], [N], [O], [R]

National Poison Control Center Hotline: 1-800-222-1222
CDC (404) 639-3311

Agency for Toxic Substances & Disease Registry (ATSDR)
1600 Clifton Rd NE
Atlanta, GA 30333
(888) 422-8737

American Chemical Society
1120 Vermont Ave NW
Washington, DC 20005
(800) 227-5558

Association of American Railroads
Bureau of Explosives
50 S. Street, NW
Washington, DC
(202) 639-2222

Canadian Transportation Emergency Center (CANUTEC)
Ottawa, Canada
(613) 996-6666

Center for Disease Control
Atlanta, GA
(404) 639-3311
www.cdc.gov

Chemical Transportation Emergency Center (CHEMTREC)
1300 Wilson Blvd
Arlington, VA
(800) 424-9300
www.chemtrek.com

COLORADO
Rocky Mountain Poison and Drug Center
1010 Yosemite Circle, Building 752

Denver, CO 80230
(800) 332-3073
(303) 739-1123

Gulf War Veterans Syndrome Hotline
(800) 749-8367

National Response Center & Terrorist Hotline (Oil & Chemical spills)
US Coast Guard Headquarters
2100 2nd St SW, Rm 2611
Washington, DC 20593
(800) 424-8802

Ontario Regional Poison Control Center
The Hospital for Sick Children
555 University Avenue
Toronto, Ontario M5G 1X8
(416) 813-5900
(800) 268-9017 (Ontario only)

Radiation Emergency Assistance Center/Training Center (REAC/TS)
Oak Ridge Institute for Science & Education
PO Box 117
Oak Ridge, TN 37831
(865) 576-3131 (days)
(865) 576-1005 (24 hr)

[TOC] [INRX]

Ciprofloxacin (Cipro)

Dosing

- Adult: 200-400mg IV q12h; 250-750mg po bid
  - [250($2.91), 500, 750; 5% suspension: 5mL = 250mg; 10% suspension: 5mL = 500mg]
  - ClCr < 30ml/min give q24hr
- Peds: not indicated

Note

- Do not use oral suspension in NG tube; to prepare, add microcapsules to diluent

Indications

- *Bacillus anthracis, B. fragilis, Campylobacter jejuni, Citrobacter* spp., *Enterobacter cloacae*, *Enterococcus faecalis, E. coli*, *H. influenzae*, *Haemophilus parainfluenzae*, *Klebsiella pneumoniae*, *M. catarrhalis, N. gonnorhoeae, Proteus mirabilis*, *Providencia* spp., *Pseudomonas aeruginosa*, *Salmonella typhi, Serratia* spp., *Shigella* spp., *S. pneumoniae*

C-Ind

- Do not use in children; avoid with CNS disorder/seizures

ADR's

- Photosensitivity, headache, restlessness, toxic psychosis, convulsions (very rare)
- Nausea, vomiting, diarrhea, abd. pain, rash

Pregnancy Category: C

Kinetics

- t1/2 = 4-6hr, renal/liver
- Inhibits hepatic CYP1A2

Mechanism of Action

- See Quinolones [General Information]

Overdose

- Supportive Tx, lavage; dialysis may be effective

Interactions
See also **Quinolone Rx Intrxns****

- **alosetron****: "incr'd" [alosetron levels or activity increased by ciprofloxacin]
- antacids: "decr ciprofloxacin" [antacids generally decrease levels or activity of ciprofloxacin]
- aluminum: decr ciprofloxacin
- **antipyrine****: incr'd
- benzodiazepines: incr'd
- beta blkrs: incr'd
- **caffeine****: incr'd
- **clomipramine****: incr'd
- clozapine: incr'd
- **cyclosporine****: incr'd
- didanosine: decr ciprofloxacin
- foscarnet: seizures
- H2 blkrs: decr ciprofloxacin
- **imipramine****: incr'd
- iron: decr ciprofloxacin
- **lidocaine****: incr'd
- **olanzapine****: incr'd
- **ondansetron****: incr'd
- pentoxifylline: incr'd
- phenytoin: incr'd
- PPIs: decr ciprofloxacin
- **R-warfarin****: incr'd
- retinoids: phototox.
- **riluzole****: incr'd
- **ropinrole****: incr'd
- sucralfate: decr ciprofloxacin
- **tacrine****: incr'd
- **theophylline****: incr'd
- zinc: decr ciprofloxacin

** Concomitant use contraindicated; high potential for dangerous or fatal interaction
* Concomitant use only with caution; potential for dangerous interaction

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Doxycycline (Vibramycin, Periostat)

Dosing

- Adult:
  - VIBRAMYCIN: 50-100mg IV/PO bid; may take with food [50, 100($.43), 25 & 50mg/5ml]
  - PERIOSTAT: 20mg po bid, 1 hour ac, for 9-12mos [20]
- Peds: Not indicated

Indications

- Vibramycin: *Acinetobacter* spp., amebiasis (adjunct), *Bacteroides* spp*., Bartonella bacilliformis, Borrelia recurrentis, Brucella* spp*., Campylobacter fetus, C. trachomatis*, *E. coli, Francisella tularensis,* granuloma inguinale, *H. ducreyi, Klebsiella* spp., *Listeria monocytogenes,* lymphogranuloma venereum, *Mycoplasma pneumoniae, N. gonnorhoeae,* ornithosis, psittacosis, *Rickettsiae*, *Shigella* spp., *S. aureus,* strep, *T. pallidum, U. urealyticum, V. cholerae, Yersinia pestis*
  - Off-label: *B. burgdorferi*
- Periostat: Tx of periodontal disease

C-Ind

- Children < 8yrs old, lactating mothers

ADR's

- Photosensitivity, liver failure

Pregnancy Category: D

Kinetics

- t1/2 = 15-25 hrs, liver/renal

Mechanism of Action

- See Tetracyclines [General Info]
- Periostat: inhibits collagenase to protect connective tissue of gums (NOT

antimicrobial at this low dose)

Interactions
See also **Tetracycl. Rx Intrxns*****

- antacids: "decr doxycycline" [antacids generally decrease levels or activity of doxycycline]
- barbiturates: decr doxycycline
- **bismuth***: decr doxycycline
- carbamazepine: decr doxycycline
- contraceptives (PO): "decr'd" [contraceptive (PO) levels or activity generally decreased by doxycycline]
- EtOH: decr doxycycline
- iron: decr doxycycline
- methotrexate: incr'd
- **methoxyflurane***: nephrotox.
- penicillins: decr'd
- phenytoin: decr doxycycline
- sucralfate: decr doxycycline
- warfarin: incr'd

** Concomitant use contraindicated; high potential for dangerous or fatal interaction
* Concomitant use only with caution; potential for dangerous interaction

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Penicillin G (Wycillin, Bicillin LA, Bicillin CR)

Dosing

- Adult: 6-24 million units/day IV divided q4-6hr
- Peds: 100,000-250,000 u/kg/d in 6 doses
- Also available as sustained action IM preparations:
  - Procaine (Wycillin): 0.6-1.2 million units, IM lasts 24 hrs
  - Benzathine (Bicillin LA): 1.2 million units IM lasts 2-4wks
  - Bicillin CR: procaine and benzathine combos for IM use:
    - 150,000/150,000; 300,000/300,000; 600,000/600,000; 1,200,000/1,200,000; 300,000/900,000

Indications

- Susceptible strep infections, syphilis

C-Ind

- Allergy to procaine, allergy to penicillins, cephalosporins, imipenem

ADR's

- Allergy 5-10%, neurotoxicity w/ high doses and renal failure, bleeding abnormalities

Pregnancy Category: B

Kinetics

- t1/2 = 0.5-0.6hr, renal

Mechanism of Action

- See Penicillins [General Information]

Interactions
See also Penicillins Rx Intrxns

- acyclovir: "incr'd" [acyclovir levels or activity generally increased by penicillins]; "incr penicillins" [acyclovir generally increases levels or activity of penicillins]

- aspirin: incr'd; incr penicillins
- cephalosporins: incr'd; incr penicillins
- chloramphenicol: decr penicillins
- chlorpropamide: incr'd; incr penicillins
- clofibrate: incr'd; incr penicillins
- contraceptives (PO): decr'd
- ganciclovir: incr'd; incr penicillins
- indomethacin: incr'd; incr penicillins
- macrolides: decr penicillins
- **methotrexate***: incr'd; incr penicillins
- **mycophenolate***: incr'd; incr penicillins
- neomycin: decr penicillins
- NSAIDs: incr'd; incr penicillins
- **probenecid***: incr'd; incr penicillins
- salicylates: incr'd; incr penicillins
- sulfinpyrazone: incr'd; incr penicillins
- tetracycline: decr penicillins
- thiazides: incr'd; incr penicillins
- vitamin C: incr'd; incr penicillins

** Concomitant use contraindicated; high potential for dangerous or fatal interaction
* Concomitant use only with caution; potential for dangerous interaction

[TOC] [INRX]

Rifampin (Rimactane)

Dosing

- Adult: 600mg PO/IV qd [150, 300]
  - Meningococcal carriers 600mg qd x 4 days
  - Haemophilus carriers 600mg bid x 2d (children 20mg/kg qd x 4d, neonates 10mg/kg qd x 4d)
- Peds: 10-20mg/kg qd
- Take on empty stomach

Indications

- Tuberculosis, *N. meningitidis* (carriers only)
- Off-label: *H. influenzae* (type B); combo Rx: group A beta-hemolytic strep, aspergillosis, *Bartonella henselae, C. jeikeium, Chlamydia trachomatis, L. monocytogenes,* leprosy, *N. gonorrhoeae, M. catarrhalis, F. tularensis, Brucella* spp., *N. meningitides, S. pneumoniae, S. aureus, Staphylococcus epidermidis*

ADR's

- Increased LFT's, red secretions and urine

Pregnancy Category: C

Kinetics

- t1/2 = 2-3hr, liver
- Induces hepatic CYP2C9, CYP2C19, CYP3A4

Mechanism of Action

- Inhibits DNA-dependent RNA polymerase; potent enzyme inducer (see Enzyme Induction and Inhibition - General Principles)

Interactions
See **Rifampin Rx Intrxns****

** Concomitant use contraindicated; high potential for dangerous or fatal interaction

* Concomitant use only with caution; potential for dangerous interaction

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Ofloxacin (Floxin, Oflox)

Dosing

- Adult: 400mg slow IV bid (Floxin) or po (Oflox)
  - ClCr 10-50ml/min give qd
    - If <10ml/min, give 200mg qd
- Peds: not indicated
- Take on empty stomach

Indications

- *C. trachomatis, Citrobacter* spp., *Enterobacter* spp., *E. coli*, *H. influenzae, Klebsiella pneumoniae*, *N. gonorrhoeae, Proteus mirabilis*, *Pseudomonas aeruginosa*, *S. aureus, S. pneumoniae*

C-Ind

- Do not use in children; avoid with CNS disorder/seizures

ADR's

- Photosensitivity, nausea, headache, dizziness

Pregnancy Category: D

Kinetics

- t1/2 = 6-10hr, renal

Mechanism of Action

- See Quinolones [General Information]

Interactions
See also Quinolone Rx Intrxns

- antacids: "decr ofloxacin" [antacids generally decrease levels or activity of ofloxacin]
- aluminum: decr ofloxacin
- benzodiazepines: "incr'd" [benzodiazepine levels or activity generally increased by

ofloxacin]

- beta blkrs: incr'd
- cimetidine: incr ofloxacin
- didanosine: decr ofloxacin
- H2 blkrs: decr ofloxacin
- hypoglycemics (PO): dysglycemia
- insulin: dysglycemia
- iron: decr ofloxacin
- NSAIDs: seizure
- pentoxifylline: incr'd
- phenytoin: incr'd
- PPIs: decr ofloxacin
- probenecid: incr ofloxacin
- procainamide: incr'd
- retinoids: phototox.
- sucralfate: decr ofloxacin
- zinc: decr ofloxacin

Tetracycline (Actisite, Panmycin, Sumycin, Tetracap, Tetracyn, Tetralan)

Dosing

- 250-500mg po/IV/IM qid [250, 500($.15), 125mg/5ml]
- Take on empty stomach
- Actisite: Fill periodontal pocket w/adequate fiber; remove after 10d [12.7mg/23cm fiber]

Indications

- PO/IV/IM: *Acinetobacter* spp., amebiasis (adjunct), *Bacteroides* spp*., Bartonella bacilliformis, Borrelia recurrentis, Brucella* spp*., Campylobacter fetus, C. trachomatis*, *E. coli, Francisella tularensis,* granuloma inguinale, *H. ducreyi, Klebsiella* spp., *Listeria monocytogenes,* lymphogranuloma venereum, *Mycoplasma pneumoniae, N. gonnorhoeae,* ornithosis, psittacosis, *Rickettsiae*, *Shigella* spp., *S. aureus,* strep, *T. pallidum, U. urealyticum, V. cholerae, Yersinia pestis*
  - Off-label: *B. burgdorferi*
- Actisite: periodontitis

C-Ind

- Children < 8 yrs old, lactating mothers, sulfite sensitivity

ADR's

- Photosensitivity, liver failure, pain with IM/IV use, negative nitrogen balance, enamel agenesis, pseudotumor cerebri/encephalopathy
- Possible hematotoxicity, neuromusc. blockade

Pregnancy Category: D (systemic), C (periodontal fiber)

Mechanism of Action

- See Tetracyclines [General Info]

IV Compatibility

- Not spec.: cimetidine, dopamine, lidocaine, norepinephrine, KCl, vit B/C

IV Incompatibility

- Not spec.: aminophylline, ampho B, ampicillin, Ca gluconate, carbenicillin, cefazolin, erythromycin, furosemide, heparin, hydrocortisone, pentobarbital, Na bicarb

Interactions
See also **Tetracycl. Rx Intrxns***,
Drug Binding in GI Tract

- antacids: "decr tetracycline" [antacids generally decrease levels or activity of tetracycline]
- atovaquone: "decr'd" [atovaquone levels or activity decreased by tetracycline]
- **bismuth***: decr tetracycline
- cholestyramine: decr tetracycline
- colestipol: decr tetracycline
- contraceptives (PO): decr'd
- digoxin: incr'd
- food: decr tetracycline
- iron: decr tetracycline
- methotrexate: incr'd
- **methoxyflurane***: nephrotox.
- penicillins: decr'd
- sucralfate: decr tetracycline
- warfarin: incr'd
- zinc: decr tetracycline

** Concomitant use contraindicated; high potential for dangerous or fatal interaction
* Concomitant use only with caution; potential for dangerous interaction

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[TOC] [INRX]

Erythromycin

Dosing

- Adult: 250-500mg po qid, 333mg tid, EES 400-800mg qid
  - Base: use for oral bowel prep. E-Mycin, Ery-Tab, PCE, Filmtabs, Eryc [250,333,500]:1g po 19, 18, and 9hr pre-op with neomycin
  - IV = lactobionate; 500-1000mg q6hr over 60 min
  - Estolate: avoid in pre-existing liver disease
    - Ilosone [250, 500, 125/5ml, 250/5ml]
  - Stearate: Eramycin, Erythrocin, Wyamycin
  - Ethylsuccinate: EES, EryPed
- Peds: 30-50mg/kg/d divided q6hr
- Take on empty stomach if possible; PCE, EES okay with food; base has poorest absorption

Indications

- Group A -hemolytic strep, *Bordetella pertussis, C. diphtheriae, C. trachomatis, E. histolytica, H. influenzae, Legionella, Listeria, Mycoplasma pneumoniae, N. gonorrhoeae, S. aureus, S. pneumoniae, Treponema pallidum, U. urealyticum*
- Off-label: *Campylobacter jejuni, Calymmatobacterium granulomatis, Haemophilus ducreyi*, prophylaxis in colorectal surgery, anthrax, tetanus, Lyme dz

C-Ind

- Hypersensitivity
- See **Interactions****

ADR's

- GI upset, cholestatic jaundice w/ estolate, phlebitis w/ IV, ototoxicity

Pregnancy Category: B

Kinetics

- t1/2 = 1.4hr
- Metabolized by P450 enzyme CYP3A4
- Inhibits CYP1A2, CYP3A4

Mechanism of Action

- See Macrolides [General Information]

IV Compatibility

- Additive: ampicillin, cimetidine, hydrocortisone, lidocaine, pentobarbital, KCl, Na bicarb, verapamil
- Y-site: amiodarone, esmolol, heparin, vit B/C
- Not spec.: Ca gluconate, vancomycin

IV Incompatibility

- Additive: aminophylline, heparin, vit B/C
- Syringe: ampicillin, heparin
- Not spec.: carbenicillin, cefazolin, epinephrine, tetracycline

Interactions
See also **Macrolide Rx Intrxns**

- See **Erythromycin Rx Intrxns****

** Concomitant use contraindicated; high potential for dangerous or fatal interaction
* Concomitant use only with caution; potential for dangerous interaction

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Cotrimoxazole (trimethoprim/sulfamethoxazole, Bactrim, Septra, Cotrim)

Dosing

- Adult: 160mg TMP/800mg SMX IV q12hr [TMP 80mg/SMX 400mg per 5 ml IV prep];
  - One tab po bid [SS 80TMP/400SMX or DS 160/800($.51)]
    - ClCr 15-30ml/min give 1/2 dose
    - ClCr < 15ml/min: do not use
  - For *Pneumocystis carinii* 15-20mg/kg/d TMP/75-100 mg/kg/d SMX IV/PO divided q6h
- Peds: 0.5ml/kg/dose po bid [40/200mg per 5ml]

Indications

- *Enterobacter* spp., *E. coli*, *H. influenzae, Klebsiella* spp., *M. morganii*, *Pneumocystis carinii, P. mirabilis*, *P. vulgaris, Shigella* spp., *S. pneumoniae*
- Off-label: prophylaxis of recurrent UTI; Tx of acute/chronic prostatitis; Tx of resistant head lice (concurrent w/topical permethrin)

C-Ind

- Term pregnancy, lactation, < 2mo age, porphyria, G-6-PD deficiency, sulfa sensitivity
- ClCr < 15ml/min

ADR's

- Photosensitivity, bone marrow suppression, erythema multiforme, asthma in sulfite-sensitive pts., aseptic meningitis (rare)
- Rash, aseptic meningitis (rare)

Pregnancy Category: C

Kinetics

- t1/2 TMP = 8-10hr, t1/2 SMX = 10-12hr, liver/renal
- Inhibits hepatic CYP2C9

Mechanism of Action

- See Sulfonamides [General Information]

Interactions
See also **Sulfonamides Drug Interactions***

- 6-mercaptopurine: "decr'd" [6-mercaptopurine levels or activity increased by cotrimoxazole]
- azathioprine: leukopenia
- chlorpropamide: incr'd
- contraceptives (PO): decr'd
- cyclosporine: decr'd
- dapsone: incr'd; "incr cotrimoxazole" [diuretics generally increase the levels or activity of cotrimoxazole]
- **disulfiram***: disulfiram rxn
- diuretics: incr cotrimoxazole
- glipizide: incr'd
- glyburide: incr'd
- indomethacin: incr cotrimoxazole
- MAOIs: incr cotrimoxazole
- methotrexate: incr'd
- **metronidazole***: disulfiram rxn
- N-acetylprocainamide: incr'd
- **PABA***: decr cotrimoxazole
- phenytoin: incr'd
- pimozide: decr'd
- probenecid: incr cotrimoxazole
- procainamide: incr'd
- salicylates: incr cotrimoxazole
- sulfonylureas: incr'd
- thiopental: incr'd
- tolbutamide: incr'd
- warfarin: incr'd

** Concomitant use contraindicated; high potential for dangerous or fatal interaction
* Concomitant use only with caution; potential for dangerous interaction

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Streptomycin

Dosing

- Tuberculosis
  - Adults: 15mg/kg (max 1g) IM qd, or 25-30mg/kg (max 1.5g) IM 2-3x per week
  - Children: 20-40mg/kg (max 1g) IM qd, or 25-30mg/kg (max 1.5g) IM 2-3x per week
- Tularemia
  - Adults: 1g IM qd or bid for 7-14d until patient is afebrile for 5-7d
  - Peds: Not specified
- Plague
  - Adults: 1g IM qd or bid for min 10d
  - Peds: Not specified
- Streptococcal Endocarditis
  - Adults:
    - 1g IM bid for 7d, then 500mg bid for 7d, concomitant with penicillin
    - If >60 yo, 500mg bid for entire 14d
  - Peds: Not specified
- Enterococcal Endocarditis
  - Adults: 1g IM bid for 2wks, then 500mg bid for 4wks., concomitant with penicillin
  - Peds: Not specified
- Concomitant use with other drugs
  - Adults: 1-2g IM divided q6-12h; do not exceed 2g per day
  - Peds: 20-40mg/kg/day IM divided q6-12h
  - [Ampule = 1g streptomycin in 2.5mL]

Note

- For tuberculosis, do not exceed 120g total over course of Tx; d/c in case of toxicity or organism resistance
- For endocarditis, d/c streptomycin in case of ototoxicity
- Reduce dosage in case of renal impairment: serum conc. should not exceed 20-25ug/mL

Indications

- Endocarditis (enterococcal, streptococcal), plague, tuberculosis, tularemia

C-Ind

- Hypersensitivity to streptomycin or other aminoglycosides; severe hypersensitivity to sulfites

ADR's

- Risk of severe neurotoxic reactions inc. in patients with renal disease or pre-renal azotemia, especially irreversible vestibular damage
- Respiratory paralysis if drug is given after anesthesia or musc. relaxants
- Vestibular ototoxicity, facial paresthesia, fever, urticaria, edema, eosinophilia, deafness, leukopenia, pancytopenia. Nephrotoxicity (rare)

Pregnancy Category: D

Kinetics

- Peak plasma conc. 1h; t1/2 = 24h, urine

Mechanism of Action

- Interferes with normal bacterial protein synthesis

Overdose

- Support as needed

Interactions

- carboplatin: ototox.
- **ethacrynic acid***: ototox.
- nephrotox. Rx: "incr'd" [nephrotox. drug levels or activity generally increased by streptomycin]
- neurotox. Rx: incr'd

** Concomitant use contraindicated; high potential for dangerous or fatal interaction
* Concomitant use only with caution; potential for dangerous interaction

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Chloramphenicol (Chloromycetin)

Dosing

- Adult: 50-100mg/kg/day IV q6hr
- Peds: 50-100mg/kg/day IV divided q6hr meningitis
- Peaks 10-20mg/L, troughs 5-10mg/L

Indications

- Use only as alternative for treatment of meningitis, typhoid, or rickettsial infection

C-Ind

- Do not use oral or topical

ADR's

- Aplastic anemia (with po or topical), gray baby syndrome, reversible bone marrow suppression, digital paresthesia, minor disulfiram-like reactions

Kinetics

- t1/2 = 4hr, liver

Mechanism of Action

- Inhib bacterial protein synth. by binding to 50S ribosomal subunit; mainly bacteriostatic

Interactions

- aztreonam: "decr'd" [aztreonam levels or activity decreased by chloramphenicol]
- barbiturates: incr'd; "decr chloramphenicol" [barbiturates generally decrease the levels or activity of chloramphenicol]
- cephalosporins: decr'd
- cimetidine: incr chloramphenicol
- **dicumarol***: incr'd
- entacapone: incr'd
- hydantoins: incr'd
- iron salts: decr'd

- penicillins: decr'd
- rifampin: decr chloramphenicol
- sulfonylureas: incr'd
- tolcapone: incr'd
- vit B12: decr'd
- **warfarin***: incr'd

** Concomitant use contraindicated; high potential for dangerous or fatal interaction
* Concomitant use only with caution; potential for dangerous interaction

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Gentamicin (Garamycin)

Dosing

- Adults:
  - Load 2mg/kg IV/IM; 1-2mg/kg q8hrs
  - Peak 5-10mg/L; trough 0.5-1.5mg/L
  - Dosing intervals: 8hr if ClCr > 90ml/min and < 60yrs
    - 12hr if ClCr 60-90ml/min or > 60yrs
    - 24hr if ClCr 25-60ml/min
    - 48hr if ClCr 10-25ml/min
    - following dialysis in ESRD
  - Extended interval dosing (q 24hr+)
    - First dose: 7mg/kg IV based on Lean Body Weight
    - Subsequent doses: consult pharmacologist
    - See Aminoglycoside - General Information for contraindications for extended internal dosing
- Peds: 2.5mg/kg q 8hrs (< 7 day old q12-24hrs)
- Monitor: peak, trough, renal and auditory function

Indications

- Usually first line aminoglycoside: Gram-neg. infection, *P. aeruginosa, Proteus, E. coli, Klebsiella, Enterobacter, Serratia, Citrocbacter,* Staph
- Off-label: PID

C-Ind

- Prior Aminoglycoside toxicity

ADR's

- Nephrotoxicity if trough > 2mg/L; ototoxicity

Pregnancy Category: D

Kinetics

- t1/2 = 2-3hr(NRF)
- k(hr-1) = 0.0024(ClCr)+0.01;

- Vd = 0.25-0.4 L/kg

IV Compatibility

- Additive: cimetidine, clindamycin, verapamil
- Syringe: clindamycin
- Y-site: amiodarone, esmolol, vit B/C

IV Incompatibility

- Additive: ampho B, ampicillin, cefazolin, dopamine, furosemide, heparin
- Syringe: ampicillin, heparin
- Y-site: furosemide, heparin
- Not spec.: carbenicillin

Interactions
See also **Aminoglyc. Rx Intrxns***

- ampho B: nephrotox.
- carboplatin: nephrotox., ototox.
- cefalothin: nephrotox.
- cefdinir: nephrotox.
- cefpidime: nephrotox.
- cisplatin: nephrotox.
- cyclosporine: nephrotox.
- diuretics (loop): ototox.
- **ethacrynic acid***: ototox.
- indomethacin: "incr gentamicin" [indomethacin increases the levels or activity of gentamicin]
- itraconazole: decr gentamicin
- ketoconazole: decr gentamicin
- methoxyflurane: nephrotox.
- mezlocillin: decr gentamicin
- miconazole: decr gentamicin
- **neuromusc. blkrs***: "incr'd" [neuromuscular blocker level or activity increased by gentamicin]
- piperacillin: decr gentamicin
- ticarcillin: decr gentamicin
- vancomycin: nephrotox.
- warfarin: incr'd

** Concomitant use contraindicated; high potential for dangerous or fatal interaction
* Concomitant use only with caution; potential for dangerous interaction

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Cidofovir (Vistide)

Dosing

- Adult: 5mg/kg IV over 1hr, once/week x 2wks
  - Serum creatinine inc. 0.3-0.4mg/dl above baseline: Reduce to 3mg/kg IV
  - Serum creatinine inc. >0.4mg/dl above baseline: D/C therapy
- Peds: not established

Indication

- CMV retinitis in AIDS patients

Note

- Probenecid must be administered w/each dose: 2g PO 3h before cidofovir, 1g at 2h and again at 8h after completion of cidofovir infusion
- 1 L saline IV with each cidofovir infusion; 1 add'l liter if pt can tolerate

C-Ind

- Hypersensitivity to cidofovir or probenecid
- Serum creatinine >1.5mg/dl, ClCr <55ml/min, urine protein >100mg/dl (2+ proteinuria)
- Direct intraocular injection

ADR's

- Vomiting, diarrhea, anorexia, abd. pain, headache, asthenia, alopecia, rash, anemia, renal toxicity, dyspnea, pneumonia, hypotony, fever

Pregnancy Category: C

Kinetics

- Cmax = 7.3-19.6 mcg/ml

Mechanism of Action

- Inhibits viral DNA synthesis in CMV

Overdose

- Probenecid 1g PO tid x 3-5d
- Rigorous IV hydration w/normal saline 3-5d

Interactions:

- nephrotox. Rx: incr'd (D/C 7d prior)

[TOC] [Tx]

Ebola Virus (Viral Hemorrhagic Fever)

Diagnosis

1. Incubation period 5-21 days
2. Non-specific flu-like prodrome with weakness, diarrhea, nausea & vomiting, abdominal pain, HA, sore throat, conjunctivitis, then:
3. Bleeding ranging from ecchymosis to gingival bleeding, severe GI bleed, pulmonary and intracranial hemorrhage
4. Late sequelae: chest pain, deafness, blindness, dysesthesias, circulatory & pulmonary collapse

Pathophysiology

1. Discovered 1976
2. Virus family Filoviradae
3. Host reservoir unknown (bats speculated)
4. Kikwit, Zaire, Gabon, South Africa recent cases
5. Transmitted from humans to humans by direct body fluid contact, also by touching cadaver at burial!

Treatment

1. AVOID SPREADING DISEASE!
   - Universal precautions, private room/barriers
   - TB-like precautions if respiratory symptoms
   - Decontaminate, autoclave or incinerate all waste
   - Minimize body and blood contact
2. No specific therapy available
   - Aggressive support needed

Disposition

1. Admit all suspected cases with precautions as above

[TOC] [INRX]

Ribavirin (Rebetol, Virazole)

Dosing

- Virazole: Aerosol 12-18 hours per day x 3-7 days [20mg/ml]]
- Rebetol:
  - <75kg: 400mg PO qam, 600mg qhs
  - >75kg: 600mg PO qam, 600mg qhs
  - [200]

Indications

- Virazole: Severe RSV infection
- Rebetol: Hepatitis C (in combo w/PEG-Intron; this combo more effective than Rebetron)
- Off-label: influenza A & B

C-Ind

- Hypersensitivity, pregnancy

ADR's

- WARNING: May cause deterioration of resp. function in pts on ventilator
- HA, conjunctivitis, pharyngitis, cardiac arrest, hypot'n, brady/tachycardia, bronchospasm, pulm. edema, dyspnea, rash

Pregnancy Category: X

Kinetics

- t1/2 = 9.5 h

Mechanism of Action

- Unknown; may act as guanosine or xanthosine analog

Overdose

- Supportive Tx

Interactions

- Not reported

[TOC] [INRX]

Acetaminophen (Tylenol, Tylenol Ext. Rel., Panadol, Tempra)

Dosing

- Adult:
  - 325-650mg po/pr q 4hr prn
  - Extended Relief: 2 caplets (130mgs) q 8hr prn (650 mgs)
- Peds: 10-15mg/kg po/pr q 4hr prn
- Available as:
  - 80mg,160mg, 325mg & 500mg cap/tab
  - 160mg/5ml soln, 80mg/0.8mg drops
  - 80mg, 120mg, 325mg & 650mg suppository
  - 650mgs time release tabs
  - Many other dosage forms, check label carefully!

Indications

- Potent analgesic & antipyretic activity with weak anti-inflammatory activity

C-Ind

- Hepatitis or hepatic dysfunction, alcoholism

ADR's

- Incr. LFT's, hepatic necrosis, fever, neutropenia, pancytopenia

Pregnancy Category: B

Kinetics

- 80-85% conjugated for renal excretion, 15-20% metabolized via P-450; see toxicology section
- Metabolized by hepatic P450 enzyme CYP2E1

Mechanism of Action

- Unknown

Overdose

- See Acetaminophen OD

Interactions
See also Rx Binding in GI Tract

- anticoag. (PO): "decr'd" [anticoagulant levels or activity generally decreased by acetaminophen]
- barbiturates: "incr acetaminophen" [barbiturates generally increase the levels or activity of acetaminophen]
- carbamazepine: incr acetaminophen
- cholestyramine: decr acetaminophen
- colestipol: decr acetaminophen
- EtOH: incr acetaminophen
- isoniazid: incr acetaminophen
- phenytoin: incr acetaminophen
- primidone: incr acetaminophen
- rifabutin: incr acetaminophen
- rifampin: incr acetaminophen

[TOC] [INTRX]

Furosemide (Lasix)

Dosing

- Adult: 1mg/kg up to 20-40mg IV; edema: 20-320mg po qd/bid to max 600mg/d [20, 40, 80]
- Peds: 2 mg/kg po qd/bid or 1 mg/kg IV/IM to max 6 mg/kg [10mg/ml, 40mg/5ml]
- HTN: 40mg po bid
- IV route twice as potent as PO (F=50%)
- Oral route less effective with food

Indications

- Use when fluid-retention refractory to thiazides, or impaired renal function

C-Ind

- Sulfa allergy

ADR's

- Ototox.; decr. K+, Mg++, Ca++; incr. uric acid/gout,glucose,lipids; photosensitivity; incr. patent ductus arteriosus during neonatal period

Pregnancy Category: C

Kinetics

- Onset po < 60min, IV 5min; duration po 6-8hr, IV 2hr

Mechanism of Action

- Loop diuretic; inhib. reabs. of Na+ & Cl- at prox. & dist. tubules and loop of Henle

Overdose Management

- See Diuretics - General Information

IV Compatibility

- Additive: cimetidine, epinephrine, heparin, nitroglycerin, KCl, verapamil
- Syringe: heparin
- Y-site: epinephrine, fentanyl, heparin, norepinephrine, nitroglycerin, KCl, vit B/C

IV Incompatibility

- Additive: diazepam, dobutamine, gentamicin
- Y-site: dobutamine, esmolol, gentamicin
- Not spec.: tetracycline

Interactions
See also Loop Diur. Rx Intrxns, Rx Binding in GI Tract

- ACE inhibitors: "incr'd" [ACE inhibitor levels or activity generally increased by furosemide]
- aminoglycosides: ototox. & nephrotox.
- beta adrenergics: hypokal.
- calcium: decr'd
- carbenoxolone: hypokal.
- cephaloridine: nephrotox.
- cephalothin: nephrotox.
- cholestyramine: "decr furosemide" [cholestyramine decreases the levels or activity of furosemide]
- cisplatin: ototox.
- clofibrate: incr'd; incr furosemide (in pts. w/ hypoalbuminemia)
- colestipol: decr furosemide
- digitoxin: incr'd
- digoxin: incr'd
- magnesium: decr'd
- NSAIDs: decr furosemide
- phenobarbital: decr furosemide
- phenytoin: decr furosemide
- potassium: decr'd
- sodium: decr'd
- SSRIs: hyponatr.
- terbutaline: hypokal.
- tubocurarine: incr'd

[TOC]

Sodium Thiosulfate AD [Cyanide, Antineoplastics]

Dosing

- Adults:
  - Cyanide poisoning: 12.5g IV (infuse over 10 min) [25% sol'n]
  - Mechlorethamine HCl extravasation: 2ml 10% sol'n through IV cannula for every 2mg mechlorethamine HCl extravasated; remove needle, then inj 10ml of 1/6 molar sol'n SC
  - Cisplatin extravasation: 2ml 10% sol'n through IV cannula for every 100mg cisplatin; remove needle, then inj 10ml of 1/6 molar sol'n SC
- Peds (Cyanide poisoning): 7g/sq. m. IV (max. 12.5g)

Note

- Preparation of 1/6 molar sol'n:
  - 4ml 10% sol'n + 6ml sterile water
  - 1.6ml 25% sol'n + 8.4 ml sterile water

Indications

- Cyanide poisoning (alone or adjunct to Na nitrite or amyl nitrite)
- Off-label: Extravasation of mechlorethamine HCl, cisplatin

Pregnancy Category: C

Mechanism of Action

- Supplemental source of sulfur for hepatic detoxification enzymes

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[TOC]

Sodium Bicarbonate AD

Dosing

- Adults:
  - 1-2mEq/kg IVP boluses
  - Use if QRS >=100-200ms. or hypotension
  - Keep serum pH nl. 7.45-7.55
  - Bolus administration efficacious to resolve cardiac toxicity

Indications

- All Class 1 antidysryhthmics (quinidine, procainamide, encainide, flecainide)
- TCA's
- Antihistamines (H1 blockers and nonsedating varieties)
- Cocaine
- Amantidine
- Ethylene alcohol, methanol
- Na+ channel blocking drugs in general
- Salicylates, phenobarbital, chlorpropaminde (see Urinary Alkalinization)

Pregnancy Category: C

ADR's

- Hypernatremia, alkalosis

Mechanism of Action

- Via inc. extracellular sodium concentration and serum pH; exact mechanism still unclear

Note

- Nebulized NaHCO3 for chlorine gas, hydrogen chloride, phosgene

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Calamine (Lotion & Caladryl)

Dosing

- Apply lotion qid prn
- Peds: same as adult
- Available OTC

Indications

- Poison ivy/oak itching

C-Ind

- None

ADR's

- Avoid topical diphenhydramine/calamine (Caladryl) formulation (may get contact dermatitis and may absorb excessive amount of diphenhydramine)

Pregnancy Category: N

Interactions

- None expected

Silver Sulfadiazine (Silvadene, SSD Cream)

Dosing

- Apply 1-2x/d to burn

Indications

- Broad spectrum coverage including anaerobes and *Candida albicans* (also Gram-positive and Gram- negative organisms)
- Up to 10% of sulfadiazine may be systemically absorbed
- Available as 1% cream - 50g and 400g containers

C-Ind

- Sulfonamides may increase possibility of kernicterus, therefore do not use in pregnant women near term, in premature infants or in infants < 2mo
- Sulfa allergy, G6PD deficiency

ADR's

- Hypersensitivity, burning, rash, interstitial nephritis

Pregnancy Category: C

Interactions

- proteolytic enzymes (topical): "decr'd" [proteolytic enzymes (topical) levels or activity decreased by sulfadiazine]

Homatropine (Isopto Homatropine)

Dosing

- Adult: 1-2 drops soln, cycloplegia and mydriasis 1-3d [2,5%]
- Peds: use lower concentration in children

Indications

- Can be used for iritis and uveitis; can also be used in patients allergic to atropine; about 1/10 as potent as atropine, but the effects may last for days
- Weak cycloplegic agent; may be used for peroperative dilation regimen and postoperatively

C-Ind

- Sensitivity to homatropine

ADR's

- Blurry vision, sensitivity to light

Interactions

- None expected

Morphine (Roxanol, MS Contin, MS IR)

Dosing

- Adults:
  - Oral: 10-30mg q4hr, or 30mg sr q8-12h (don't chew)
  - SQ/IM: 5-20mg/70kg q4hr
  - IV: 2.5-15mg/70kg slow iv over 3-5min q4hr
  - Rectal: 10-20mg q4hr
  - Epidural: 5-10mg q24hr
  - Intrathecal: 0.2-1mg q24hr + available infusion of naloxone
- Peds:
  - Intermittent: 0.1-0.2mg/kg q2-4hr im/iv/sq to a maximum of 15mg/dose (po route not recommended because of poor absorption)
  - Continuous: 0.025-2.0mg/kg/hr iv/sq (average: 0.06mg/kg/hr)

Indications

- Acute & chronic pain, post-op pain, anesth. supplement, labor
- Dyspnea d/t acute left vent. failure & pulmonary edema

C-Ind

- Respiratory disease/depression

ADR's

- Constipation, nausea, respiratory depression, hypotension, sedation, urinary retention

Pregnancy Category: B; D if used for prolonged periods or near term

Kinetics

- Conjugated in liver & excreted in urine

Mechanism of Action

- Principal opium alkaloid; narcotic agonist

Overdose

- See Opioids OD

IV Compatibility

- Additive: dobutamine, verapamil
- Syringe: atropine, fentanyl, glycopyrrolate, heparin(?), hydroxyzine
- Y-site: amiodarone, dobutamine, esmolol, fentanyl, heparin, KCl, Na bicarb, vit B/C

IV Incompatibility

- Additive: aminophylline, heparin, meperidine, Na bicarb
- Syringe: heparin(?), meperidine, pentobarbital
- Not spec.: diazepam

Interactions
See also Narcotic Analg. Rx Intrxns

- CNS depr.: "incr'd" [CNS depr. drug levels or activity generally increased by morphine]
- lidocaine: "incr morphine" [lidocaine increases the levels or activity of morphine]
- rifampin: decr morphine
- selegiline: serotonin synd.
- trovafloxacin (PO): decr'd

[TOC] [INRX]

Diphenhydramine (Benadryl, Nytol)

Dosing

- Adult: 25-50mg IV/IM/PO q6h (300mg/day)
- Peds: 5mg/kg/day; 12.5-25mg q4-6h (150mg/day) in 6-12 yo; also in kids 2-6 yo 6.25mg q4-6h (37.5mg/day) [tabs 25,50, elixir 12.5mg/5ml]
- Syrups may contain expectorants such as ammonium chloride and sodium citrate, although benefit may be minimal if at all

Indications

- Used for allergic reactions, prevention of motion sickness and as a sleeping aid because of its high sedative properties
- Syrup indicated for cough suppressant activity
- OTC (Nytol) used as sleep aid (50mg po qhs)
- Use in elderly for mild Parkinsonism

C-Ind

- No driving or operating machinery, no alcohol

ADR's

- Sedation, confusion, anticholinergic side effects, etc.

Pregnancy Category: B

Kinetics

- Onset 15-30min; peak 1-2h; duration 4-6h

Mechanism of Action

- Has low to moderate antihistamine properties and moderate to high anticholinergic and antiemetic properties

Overdose

- See anticholinergic syndrome

Interactions

- CNS depr.: "incr'd" [CNS depr. drug levels or activity generally increased by diphenhydramine]
- fluconazole: "incr diphenhydramine" [fluconazole increases the levels or activity of diphenhydramine]
- itraconazole: incr diphenhydramine
- ketoconazole: incr diphenhydramine
- macrolides: incr diphenhydramine
- MAOIs: incr'd; incr diphenhydramine
- mibefradil: incr diphenhydramine
- miconazole: incr diphenhydramine
- protease inhibs: incr diphenhydramine
- quinine: incr diphenhydramine
- SSRIs: incr diphenhydramine
- zileuton: incr diphenhydramine

Pyridostigmine (Mestinon)

Dosing

- Adult: 60-120mg po tid [tab 60, solution 60mg/5ml]; SR 180mg po qd/bid [180] to max 1.5g/d titrated to response
- Peds: 7mg/kg/d divided into 5-6 doses

Indications

- Myasthenia gravis; antidote for nondepolarizing neuromusc. blkrs

C-Ind

- Caution in epilepsy, asthma, recent MI, hypertension, dysrhythmia, peptic ulcer

ADR's

- Cholinergic effects including bradycardia and cardiac standstill; bromide sensitivity

Pregnancy Category: NA

Kinetics

- po onset 30-45min, duration 3-6hr; liver

Mechanism of Action

- Anticholinesterase agent which inhibits the metabolism of acetylcholine thereby enhancing its cholinergic effects

Overdose

- Atropine 0.5-1mg SC/IV q 2 h

Interactions
See also Anticholinesterase Rx Intrxns

- procainamide: "decr pyridostigmine" [procainamide decreases the levels or activity of pyridostigmine]

- tacrine: incr pyridostigmine

[TOC]

Atropine AD (Organophosphates)

Dosing

- For poisonings:
  - Adult: 0.5-2mg initialty, then 2-4mg IV q 5-10 min
  - Peds: 0.05mg/kg IV q 5 min prn
  - Titrate dose to drying of secretions

Indications

- Cholinesterase inhibitors (organophosphates, carbanates)
- Bradydysrhythmias (ACLS doses quite smaller; 0.5-1.0mg IV q 5 min, max 0.04mg/kg)

C-Ind

- See Atropine in pharm. section

Pregnancy Category: C

ADR's

- See Atropine in pharm. section

Mechanism of Action

- Blockage of acetylcholinesterase receptors

[TOC]

Pralidoxime AD (Protopam, 2-PAM)

Indication

- Organophosphate poisoning

Dosing

- 1-2g IV preferred (im, SQ if no IV access). 25-50mg/kg children (max 1gm) IV over 5-10min or as infusion in 100 ml saline over 15-30 min. Repeat in 1 hour if weaknes or fasciculations not repeated
- Maintaince infision 1% solutein 16m in 100ml NSS as 200-500ml/hr (5-10mg/kg/hr children)
- Use with atropine, which affects muscarinic receptors; Pralidoxime's actions most striking at nicotonic sites (inc. muscle strength 10-40 min)

C-Ind

- Caution in myasthenia gravis

Pregnancy Category: C

ADR's

- Pain at site transient dizziness, blurred vision; hypertension, tachycardia, laryngospasm, muscle rigidity
- Resp./cardiac arrest if given too fast IV

Kinetics

- Onset = 5-15min

Mechanism of Action

- Binds to organophosphates and breaks alkyl phosphate-cholinesterase bond to restore activity of acetylcholinesterase

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* For more information visit www.pepid.com

[TOC] [INRX]

Diazepam (Valium, Diastat)

Dosing

- Adult:
  - 2.5-5mg increments IV up to 0.2mg/kg; maint. 2-10mg po tid/qid
  - Initiate with 2-2.5mg po qd/bid for elderly [2,5,10, 5mg/ml]
- Peds:
  - NLT 6 mos. old (po)
  - NLT 30 days old (inj.) 0.12-0.8mg/kg/24h tid/q 1d
- Slow IVP (5mg/min) children NMT 0.25mg/k
- Seizure Control: 5-10mg slow IVP/IM q10min to control or max 30mg; maint.
  - Peds: 1mo-5y/o 0.2-0.5mg IVP/IM q2-5min to max 5mg; > 5y/o 1mg IVP/IM q2-5min to max 10mg/ maint. > 6m/o give 1-2.5mg po tid/qid initially
- Rectal Gel:
  - 2-5 y/o: 0.5mg/kg
  - 6-11 y/o: 0.3mg/kg
  - >12 y/o: 0.2mg/kg [2.5, 5, 10, 15, 20]
- Endoscopy: < 20mg; IV; reduce dose of narcotic by 1/3

Indications

- Anxiety, acute EtOH withdrawal, musc. relaxant, anticonvulsant, pre-op prep
- Off-label: panic attacks

C-Ind

- Hypersensitivity

ADR's

- Sedation, ataxia, confusion, memory impairment, dizziness, drowsiness, muscle weakness; phlebitis if too rapid IVP

Pregnancy Category: D

Kinetics

- t1/2 = 20-70 hrs (active metabolite)
- Metabolized by hepatic P450 enzyme CYP2C19, CYP3A4

Overdose Management

- See "Benzodiazepines OD" in overdose chapter

IV Compatibility

- Additive: verapamil
- Y-site: dobutamine
- Not spec.: aminophylline, cefazolin

IV Incompatibility

- Additive: dobutamine, furosemide
- Syringe: glycopyrrolate, heparin
- Y-site: heparin, KCl, vit B/C
- Not spec.: atropine, epinephrine, hydroxyzine, lidocaine, meperidine, morphine, norepinephrine, pentobarbital, Na bicarb

Interactions
See also **Benzo. Rx Intrxns***

- cimetidine: "incr diazepam" [cimetidine increases the levels or activity of diazepam]
- **clarithromycin***: incr diazepam
- clozapine: cardioresp. collapse
- CYP3A4 induce.: decr diazepam
- **CYP3A4 inhibs.***: incr diazepam
- disulfiram: incr diazepam
- **erythromycin***: incr diazepam
- EtOH: "incr CNS depr." [EtOH generally increases the levels or activity of CNS depr. drugs]
- **fluconazole***: incr diazepam
- **fluoxetine***: incr diazepam
- **fluvoxamine***: incr diazepam
- isoniazid: incr diazepam
- **itraconazole***: incr diazepam
- **ketoconazole***: incr diazepam
- labetalol: incr diazepam
- levodopa: exacerb. parkinsonism
- metoprolol: incr diazepam
- **mibefradil***: incr diazepam
- **miconazole***: incr diazepam
- omeprazole: incr diazepam
- propranolol: incr diazepam
- quinolones: incr diazepam

- rifampin: decr diazepam

** Concomitant use contraindicated; high potential for dangerous or fatal interaction
* Concomitant use only with caution; potential for dangerous interaction

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[TOC]

Physostigmine AD (Antilirium)

Dosing

- 0.5-1mg SLOW IVP; keep atropine nearby for immediate use; max = 2mg
- Peds: 0.02mg/kg SLOW IVP to max 2mg

Note

- Rarely used; indicated only when life-threatening Sx related to anticholinergic toxicity
- Useful for diagnostic as opposed to therapeutic reasons

C-Ind

- Salicylate allergy

Pregnancy Category: C

ADR's

- Seizure, cardiovascular collapse, bradycardia, cholinergic Sx, hallucinations

Kinetics

- Onset 5-10min, duration 30-60min

Mechanism of Action

- Indirect acting parasympathomimetic via inhibition of acetylcholinesterase

[TOC] [INRX]

Penicillins: General Information

- Basic Penicillin
  - Penicillin G (Wycillin, Bicillin LA, Bicillin CR)
  - Penicillin V (Pen-Vee K, Veetids)
- Penicillinase (Beta-lactamase) Resistant Penicillins
  - Dicloxacillin (Dynapen, Pathocil)
  - Nafcillin (Nafcil, Unipen)
  - Oxacillin (Prostaphlin, Bactocill)
- Amino Penicillins
  - Amoxicillin (Amoxil, Polymox)
  - Amoxicillin/Clavulanate (Augmentin)
  - Ampicillin (Principen, Omnipen)
  - Ampicillin/Sulbactam (Unasyn)
- Anti-Pseudomonal Penicillins
  - Mezlocillin (Mezlin)
  - Piperacillin (Pipracil)
  - Piperacillin/Tazobactam (Zosyn)
  - Ticarcillin (Ticar)
  - Ticarcillin/Clavulanate (Timentin)

General

- Act via inhibition of biosynthesis of cell wall mucopeptide
- Beta-lactam antibiotics include the penicillins, the cephalosporins and Imipenem
- Aztreonam is a monobactam antibiotic

C-Ind

- Allergy to penicillins, cephalosporins, imipenem

ADR's

- Allergy 5-10%, neurotox. w/ high doses and renal failure, bleeding abnormalities

Pregnancy Category: B

Kinetics

- t1/2 for most < 1hr

Interactions

- See Penicillins Rx Intrxns
