**Contents**

# 1) ANTIBIOTICS

## I) CLASSIFICATION

### A) Antibacterials

#### i) Penicillins

**-** interfere with cell wall synthesis

**a) First generation: Penicillin**

active against:streptococci, Listeria, syphilis, Lyme, strep pneumo (some), actinomyces
- gentamicin must be added for serious infections due to enterococci

**b) penicillinase-resistant penicillins: oxacillin (po), methicillin (IV), nafcicillin (IV), cloxacillin (IV and po?), dicloxacillin (IV?)**
- indications: S. aureus, except MRSA

**c) 2nd generation penicillins**: **ampicillin (IV), amoxicillin (oral)**
- active against gram negatives
- indications: H. Flu, E.Coli (cystitis)

**d) 3rd generation (extended spectrum): semisynthetic penicillins: piperacillin, ticarcillin, carbenicillin**
- more active against gram negatives:
- indications: Pseudomonas, G- rods (Klebsiella, Enterobacter, Serratia, Proteus)
- less effective for hospital acquired infections than third-generation cephalosporins and imipenem.
- in the treatment of the more serious infections due to gram-negative bacilli, these penicillins always should be used in combination with an aminoglycoside

#### ii) cephalosporins

**a) first-generation cephalosporins: cefalothin, cefazolin** (begin with “cefa”) (longer half-life)
- more active than newer cephalosporins against S.aureus and streptococci

**b) Second-generation cephalosporins** (contain “X”)
**1) cefuroxime**: H. influenzae, S. pneumoniae, Moraxella, and N. meningitidis, +/- Staph
**2) cefoxitin:** anaerobes, gono

**c) Third-generation cephalosporins:** (“T” in first 6 letters; “T” for third)
**cefotaxime, ceftriaxone, ceftazidime**
- gram negatives
**- ceftazidime:** Pseudomonas
**- ceftriaxone:** gonococcus

#### iii) carbapenems: Imipenem

- has the broadest and most potent antibacterial spectrum of any antibiotic currently in use
- imipenem exhibits a unique facility in penetrating to the periplasmic space of gram-negative bacilli, passing through porin channels in the cell membrane.

Indications:
- gram-positive cocci, enterococci, gram-negative bacilli, P. aeruginosa
- serious infections due to highly resistant organisms, especially aerobic gram-negative bacilli
- mixed infections

#### iv) monobactams: Aztreonam

- primary indication: substitution in a patient with immediate hypersensitivity to a penicillin or cephalosporin
- indications: N. meningitidis, N. gono, and H. influenza (gram negatives)
- no activity against gram-positive organisms or anaerobes

**v) glycopeptide antibiotic: Vancomycin**
- action: blocks capsule synthesis, ie. "cell wall interference"
- active against Gram positives
- alternative drug for patients with infection due to staphylococci or streptococci who are unable to tolerate penicillins and cephalosporins
- nearly all species of aerobic and anaerobic gram positive cocci and bacilli
- Acive against: S. aureus (including MRSA), coagulase-negative staphylococci, S. pneumonia, streptococci, Clostridium, enterococci.
Side effects: nephrotoxicity, ototoxicity

**vi) Bacitracin, Gramicidin**
- cell wall interference
indications: gram-positive cocci

**vii) Aminoglycosides: gentamicin, tobramycin, streptomycin, amikacin, neomycin**
- action: 30 and 50S
Active against: S. aureus, gram negative rods
Synergism with penicillin against enterococci, streptococci, and staphylococci
Indications: serious infections due to gram-negative rods

**viii) Tetracyclines: doxycycline, minocycline, and tetracycline**
- acts on 30S
- active against gram-positive organisms, trachoma, Lyme disease
side effects:
1) photophobia (skin)
2) GI upset
3) diarrhea
4) potentiates coumadin
5) stains teeth
6) decreased Calcium
7) decreased Fe absorption
8) may cause IIH

**ix) Macrolides: erythromycin**, **azithromycin, clarithromycin, spiramycin**
- act on 50S
- active against gram-positive bacteria, chlamydia, mycoplasmas, syphilis, Lyme disease, and some gram-negative organisms (Neisseria gonorrhea)
- spiramycin is used (in Europe) to prevent fetal transmission of toxoplasmosis

**x) Clindamycin, lincomycin**
- active against 50S
- activity against Bacillus and other anaerobes, toxoplasmosis, S. aureus, S. pneumonia, strep viridans, and diphtheria
- side effect: pseudomembraneous colitis

**xi) Chloramphenicol**
- inhibits 50S
- activity against Gram negatives (N. meningitidis, H. influenzae), S. pneumoniae, anaerobes (Bacillus), spirochetes, chlamydiae; some against staph and strep

**xii) Spectinomycin**
- inhibits 30S
-use: only for gono in Pen allergy patients

**xiii) Nitroimidazoles: metronidazole**
- inhibits DNA synthesis
- indications: anaerobic infections (eg. Bacillus)

**xiv) Fluoroquinolone: norfloxacin, ciprofloxacin, ofloxacin**
- act on DNA synthesis (DNA gyrase)
Active against gram negative rods, H. influenzae, and N. gonorrhea; moderately active against S. aureus and P. aeruginosa

**xv) Sulfonamides and trimethoprim (TMP), sulfadiazine**
- act on folate (and thus DNA) synthesis
- active against gram-positive and gram-negative organisms
Indications: chlamydial infections (including trachoma), Pneumocystis, toxoplasmosis
- teratogenic

**xvi) Pyrimethamine**
- folate antagonist
- toxoplasmosis
- teratogenic

**xvii) Rifampin**
- interferes with bacterial RNA polymerase (messenger RNA synthesis)
- effective against gram-negative and gram-positive organisms, fungi, and mycobacteria.
- Indications: tuberculosis and leprosy; used in combination in staphylococcal infections; prophylaxis against meningococcal or H. influenza

**xviii) Polymyxin B and Polymyxin E (colistin)**
- disrupt the structure of the bacterial cell membranes by detergent action
- active against gram negative bacteria (incl. Pseudomonas); no activity against gram-positive organisms.

**xvix) Antibiotic combinations**
Polysporin?: polymixin (G-) + neomycin (staph and G-) + bacitracin (G+)
Polytrim: polymixin (G-) + trimethoprim (both)

**C) Antivirals**
**A) Systemic**
**1) Acyclovir**
- oral 200-800mg: 5x/day
- activated by herpes thymidine kinase
- Acyclovir triphosphate then competes for dGTP, and is incorporated onto growing viral DNA
- indication: HSV, ARN, PORN, BARN
- side effects: renal toxicity, dehydration, gastrointestinal distress and headache; rare: CNS toxicity

**2) Gancyclovir**
- Induction dose is 5 mg/kg IV every 12 hours for 14 days
- maintenance dose is 5 mg/kg/day IV
- virus-specific thymidine kinase.
- indication: CMV
- side effects: bone marrow: neutropenia and thrombocytopenia, nausea, neurotoxicity, hepatic dysfunction, fever, rash, phlebitis; also carcinogenic, teratogenic and induces azoospermia.

**3) Foscarnet: renal**
- Induction: 60 mg/kg TID IV for 2 to 3 weeks; maintenance: 90 to 120 mg/kg/day
- inhibition of viral specific DNA polymerases and RNA polymerases (reverse transcriptases)
- indication: CMV
- activity: CMV, HSV 1 and 2, VZV, and EBV, and **HIV**
- side effects: renal toxicity, anemia, hepatic enzyme elevation, CNS dysfunction, headaches, nausea GI disturbances, mucous membrane erosions, and diabetes insipidus
- neutropenia and thrombocytopenia are not seen
- patients may live longer on Foscarnet than gancyclovir, but more side effects

**4) Famcyclovir (oral penciclovir)**
- 250-750mg TID
- indication: HZV treatment (zoster)
- activity: HSV-1, HSV-2, HZV, and EBV
- side effects: none reported

**5) Valaciclovir (Valtrex)**
- 1g po TID
- valine ester of acyclovir
- bioavailability of acyclovir is five times better than acyclovir
- Toxicity is negligible

**6) AZT (zidovudine)**
side effect: b.m. supression (additive with gancyclovir)

**A) Topical**
**1) Trifluridine (Viroptic)**
**-** 1% drops: 9x/day
- pyrimidine
- viral thymidylate synthetase
- HSV treatment
- HSV-1, HSV-2, ±adenovirus

- side effects: toxicity, follicular conjunctivitis, pseudopemphigoid

**2) Idoxyuridine (Herplex)**

- 0.5% ointment: 5x/day
- pyrimidine
- viral DNA polymerases
- HSV treatment
- HSV-1, HSV-2
- side effects: toxicity, follicular conjunctivitis, pseudopemphigoid

3**) vidarabine (Ara A)**

**-** 3% ointment: 5x/day
- purine nucleoside
- viral DNA polymerase
- HSV treatment
- HSV-1, HSV-2, VZV  CMV
- side effects: toxicity, follicular conjunctivitis, pseudopemphigoid

**4) acyclovir (Zovirax)**

- ointment 3%
- pyrimidine
- viral DNA polymerase
- HSV treatment
- HSV-1, HSV-2, VZV, EBV, ±CMV
- side effects: toxicity, follicular conjunctivitis, pseudopemphigoid

**C) Antifungals**

**1) Polyenes**

- punch holes in cell membrane and therefore other drugs penetrate better; broad spectrum

**a) amphotericin B**

- IV and topical (0.5%): Q15-30 min for initial 24-48 hours
- broad spectrum (filamentous fungi and yeast)
- side effects: chills, renal; monitor serum creatinine whlie on Ampho
- more active against Candida than natamycin
- equally effective against various filamentous fungi
- topical administration of amphotericin B drops produces low levels of the compound in the corneal stroma, enhanced by the absence of epithelium and the presence of stromal inflammation.
- drops should be protected from light and kept chilled on ice or refrigerated

**b) natamycin**

- topical (5%): Q1h
- broad spectrum of sensitivities, especially to Fusarium species (filamentous fungi and yeast)

**c) nystatin**

- ointment (3%)
- active against Candida

**d) pimaricin**

- suspension (5%) or ointment (1%)

"remains the most reliable topical antifungal agent in a for treatment of superficial ocular injuries or prophylaxis with high-risk injuries for oculomycosis"

**2) Imidazoles**

**a) ketoconazole**

- topical treatment of keratitis (from IV or pill)
- high vitreous concentrations with systemic therapy

**b) fluconazole**

- high vitreous concentrations with systemic therapy

**c) clotrimazole**

- Aspergillus, (not Fusarium); usually used in derm

**d) miconazole (Monistat)**

- activity against Candida, Cryptococcus, Aspergillus, Microsporum; usually used in gynecology.
- topical treatment of keratitis (from IV)

**3) pyrimidines**: **flucytosine**

- indications: Candida keratitis that have not responded clinically to amphotericin B and in which 5-FC is added to the topical regimen.
- crosses blood-ocular barrier well (found in CSF in high levels); treatment for cryptococcal meningitis

**D) Anti Parasitic** - see specific treatments

**E) Treatment of Specific Infections**
**A) Bacterial**
**1) Gonorrhea**
1) urethritis: ceftriaxone 2g/day IM; corneal ulcer: 1g Q12h IV
**and**
2) doxycycline 100 mg BID for 1 week or azithromycin 1g oral x 1 dose (for chlamydia)
AAO: for conjunctivitis only: ceftriaxone: 1 g IM x 1; IV for corneal ulcer

*Pen allergic patients*:
1) Spectinomycin 2 mg IM x 1 dose **or** ciprofloxacillin: 500mg BID po for 5 days
**and**
2) doxycycline 100 mg BID or azithromycin 1g oral x 1 dose

Also ointment for gono conjuctivitis: erythro or tobra or ciloxan

*Neonatal*
1) Ceftriaxione: 125mg IM x 1 or cefuroxime (25mg/kg) IV BID x 7 days
2) topical erythromycin
3) saline irrigation of conjunctiva 4x-6x per day

**2) Syphilis**
1) congenital: Pen G 50000u/kg IV BID x 10 days
2) acquired syphilis: Pen G 2.4 million units IM x 3 weekly doses
3) neurosyphilis: Pen G 2.4 million units IV x 10 days + 3 injections of 2.4 million Qweek (3 weeks)
*Pen allergic*
1) doxycycline: 100 mg BID x 28 days **or** erythromycin 500 mg QID x 28 days

**3) Chlamydia**
**a) adult inclusion**
- doxycycline: 100 mg BID x 7 days **or** erythromycin 500 mg QID x 7 days **or** azithromycin 1g oral x 1 dose
- other sources say 3 weeks
**b) trachoma**
- oral and topical erythro **or** tetra for 3 weeks

**4) Lyme disease**
1) Pen G (IV)
**or**
2) Ceftriaxone (IV)
*Pen allergy*: tetra or erythro

**5) TB:** 3 or more agents
1) isoniazid
2) rifampin
3) pyrazinamide
4) ethambutol

**6) Staph conjunctivitis**
1) erythro ointment

**7) Meningococcus**
1) Pen IV
or 2) chloramphenicol IV

**B) Viral**
**1) ARN**
1) IV Acyclovir
2) anticoagulants (heparin and coumadin)
3) +/- steroids

**2) PORN**
1) Acyclovir + Ganciclovir/foscarnet

**3) CMV**
1) Gancyclovir
i) IV: induction + maintenance
ii) injections
iii) implants: 1x per 6-12 months
2) Foscarnet IV: induction + maintenance

**C) Fungal**
**1) candida endophthalmitis**
with systemic candidiasis: IV +intravitreal (10 ug) + topical amphotericin; consider vitrectomy
with ocular candidiasis only: intravitreal (10 ug) + topical amphotericin; consider vitrectomy
- can add oral fluconazole

**2) orbital Mucormycosis**
1) control metabolic abnormality
2) surgical debridement
3) local ampho B (no IV?)
4) hyperbaric oxygen

**3) orbital Aspergillus**
1) surgical debridement
2) local ampho
3) IV ampho B
**or** 4) flucytosine
5) +/- Rifampin

**D) Parasitic**
**1) Toxoplasmosis**
- treat for 6 weeks except steroids
A) *active disease* (parasites)
1) Sulfadiazine: 4 g load then 1 g QID x 6 weeks (Septra or Bactrim)
+ 2) Clindamycin: 300 mg po QID (or tetracycline if can't tolerate)
+ 3) Pyrimethamine (100 mg load then 25 mg po Qday) + Folinic Acid (5mg po Qday)
+/- 4) 60-80 mg prednisone po Qday x 1-2 weeks if threatening optic nerve or macula or severe vitiritis
5) topical steroids if have anterior uveitis
** need CBC 2x/week if on pyrimethamine (decreases RBC, WBC, platelets)

B) *pregnan*t or breast feeding
1) Sulfadiazine or trisulfapyrimidine - no pyrimethamine (CPS syas sulfadiazine contraindicated in pregnancy)
**or** 2) spiramycin (erythromycin family) - (Europe)
maybe 3) clindamycin?
C) *for cysts*
1) atovaquone
D) *prophylaxis*
1) Septra
2) doxycycline or tetracycline

**2) Pneumocystis choroiditis**
1) Septra/Bactrim (TMP/Sulfa) IV
**or**
2) pentamidine IV

**3) Acanthamoeba ulcer**
A) *Topical* - give all 3
1) Brolene (propamidine)
2) neomycin (aminoglycoside; readily available)
3) clotrimazole 1% suspension
4) cyclohexamide?
B) *Oral* - give 1
1) ketaconozole
**or** 2) fluconazole

**4) Toxocara**
1) topical steroids for inflammation (bug is dead and there is just 1 bug)
2) vitrectomy if tractional bands form or worsening on meds

**5) Phthiris Pubis**
1) Remove the nits manually
2) smother the adult organisms with a bland ointment such as Vaseline or anticholinesterase ointment (Eserine)
3) treat the pubic area with medicated shampoo, lotion, or cream such as Kwell
4) treat partner (see g.p.)

**6) onchocerciasis**
1) Ivermectin (oral) - 1 single annual oral dose

**7) Loa Loa**
- the African eyeworm, causes swellings in the eyelid during its period of wandering throughout the body
1) diethylcarbamazine (kills both adult and larval forms)
and 2) surgical removal of the adult worm when feasible

**8) Leismaniasis**
- skin granuloma which ulcerates and crusts
1) Metronidazole

**F) Treatment of infection classes**
**A) Bacteria**
**1) G+ cocci**
1) Beta lactams (first generation cephalosporins)
or 2) vancomycin
or 3) bacitracin
or 4) neomycin (amino) - staph only

**2) G+ rods (diphteria)**
1) Pens
or 2) aminoglycosides

**3) G+ filaments**
1) non-TB (acid fast) mycobacteria: Amikacin
2) Nocardia: sulfas
3) Actinomyces: Pen

**4) Pen resistant Staph and Strep**
1) methicillin
or 2) 1st gen cephalosporin

**5) G- cocci (Neisseria)**
1) 3rd generation cephalosporin
or 2) fluoroquinolone
or 3) erythro
or 4) Tetra

**6) G- rods**
1) aminos: Genta/Tobra/Amikacin
or 2) 2nd or 3rd generation cephalosporin
or 3) 3rd generation Pen (pipercillin)
or 4) fluorquinolones

**7) Treatment - G+ conjunctivitis (any choice)**
1) erythro
or 2) bacitracin - polymyxin
or 3) trimethoprim - polymyxin (polytrim)

**8) Treatment - G- conjunctivitis (any choice)**
1) aminoglycoside (genta, tobra)
or 2) fluorquinolone (ciloxan, ocuflox)

**9) treatment of G+ cocci keratitis**
1) Cefazolin (50 mg/ml)
or 2) Vanco (50mg/ml)

**10) treatment of G- rod keratitis**
1) Tobra (14 mg/ml)
or 2) Ciloxan 0.3%

or 3) ceftazidime (50 mg/ml)

**11) treatment of G- cocci (gono) keratitis**
1) 3rd generation cephalosporin (50 mg/ml); either Ceftriaxone or Ceftazidime

**12) Post-op endophthalimitis (Staph or gram -)**
1) intravitreal aminoglycoside (G-) + vancomycin (or Ancef) (Staph)
**and** 2) topical aminoglycoside (or ceftriaxone) + vanco
**and** 3) topical steroid

**13) post traumatic endophthalmitis**
1) intravitreal Vanco or Clinda (treat Bacillus, Staph)
**and** 2) intravenous Vanco or Clinda

**14) orbital cellulitis (< 5 yo)**
1) Clox (Staph, strep) + Ampi (H.flu)

**15) orbital cellulitis (> 5 yo)**
1) Cloxacillin IV (Staph and strep)

**B) Fungi**
**1) Fungal corneal ulcers (give both oral and topical)**
A) *Topical*
1) Candida and Aspergillus: Amphotericin
2) Fusarium: Natamycin
- can consider also using topical ketoconazole (undiluted from IV solution)
B) *Oral*
1) Candida: oral fluconazole
2) filamentous: oral ketoconazole

**IV) Antibiotics differentials**

**ABC's that Interfere with cell wall synthesis**

1) Penicillins
2) cephalosporins
3) carbapenems (imipenem)
4) Vancomycin (effective against G+ only)
5) Bacitracin (G+)
6) Gramicidin (G+)

**Drugs that affect cell membranes**

1) polymixin and colistin
2) polyenes: amphotericin, nystatin and natamycin?

**Antibiotics acting on ribosomes**

1) tetra 30S
2) erythro 50S
3) clinda 50S
4) chloramph. 50S
5) aminos 30S and 50S
(bacteriocidal)
6) spectino. 30S

## II) GLAUCOMA MEDS

### 1) CHOLINERGICS (Parasympathomimetics)
### i) direct - muscarinic agonists

sites: iris sphincter, ciliary body
*Formats*
a) Pilocarpine: .5, 1, 2, 4, 6%
- direct muscarinic agonist
- gel form causes gel keratopathy

b) Pilopine gel (4% pilocarpine); apply Qday
c) Ocusert: 20 or 40 ug/ hour; apply Qweek; less miosis
d) Miochol - acetylcholine 1%
e) Miostat - carbachol 0.01%
i) action: ⇑ t.m. outflow, ⇓ uveal scleral flow

*Side Effects:*
A) *local*
1) post. synechiae (from breakdown of blood/aqueous barrier)
2) ASCC (from post. synech.)
3) Acute ACG
4) Aqueous misdirection
5) RD
6) iris cysts (treated with phenylephrine 2.5%)
7) punctal occlusion/stenosis/scarring
8) cells in AC, KP's, (from breakdown of blood aqueous barrier)
9) hyperemia
10) contact dermatitis
11) corneal haze
12) brow ache

B) *systemic* (toxicity)
1) salivation
2) nausea
3) sweating
4) diarrhea
5) hypotension
6) muscle tremors
7) slurred speech
8) abdominal cramps

### ii) indirect - ACh esterase blockers
### A) Topical

1) Phospholine iodide (echothiophate (0.125%?)) - irreversible
2) Carbachol - direct and indirect muscarinic agonist

*Side Effects*
- similar to pilocarpine but also:
1) cataracts
2) blocks both plasma cholinesterase (butyrylcholinesterase, i.e.“pseudocholinesterase”) as well as neuromuscular junction cholinesterase and therefore prevents succinylcholine breakdown by plasma

cholinesterase during anesthesia which will prevent normal diaphragm function leading to prolonged respiratory paralysis

*Indications*
1) glaucoma (aphakes and pseudophakes only)
2) phtyriasis pubis (like insect repellant)

*Relative contraindications*
1) asthma
2) Parkinson's
3) hypertension
4) GI spasm
5) GU obstruction/spasm
6) post-MI

**B) Systemic**
Reversible cholinesterase inhibitors
A) testing for myasthenia
1) edrophonium (Tensilon)
- given IV
- 2 mg then 8 mg for 10 mg total
2) neostigmine (Prostigmine)
- given IM for testing in kids; wait 45 minutes after

B) treatment of myasthenia
1) pyridostigmine (Mestinon)
- 60-180 mg p.o. BID to QID
2) neostigmine (Prostigmine)
- 75-300 mg p.o. per day (given QID)

C) Other
1) Eserine (physotigmine)
- reversible
- used in atropine overdose: 0.25mg SQ Q15min
- crosses blood brain barrier (tertiary amine) - others don't
2) DFP (diisopropyl phosphofluoridate) - irreversible
3) Humorsol (demecarium bromide) - irreversible
4) Pralidoxime (PAM) - irreversible
- used for overdose of organic phosphates

**iii) muscarinic antagonists**
- onset: all less than 1 hour except atropine (1-3 hours)

| **Formats** | **onset** | **recovery** | **side effect** |
|---|---|---|---|
| a) Atropine 1% | 60 min | 7-10 d | flushing, fever, delirium |
| b) Scopolamine 0.5% | 30 min | 3-7 d | |
| 3) Homatropine 1% | 60 min | 1-3 d | ataxia |
| 4) Cyclopentalate 0.5-1% | 30 min | 1 day | psychosis, seizure |
| 5) Tropicamide 0.5-1% | 20 min | 6 hours | |

*Side Effects*
A) *Local*
1) local irritation
2) maceration of eyelids
3) conj. hyperemia

B) *Systemic*
1) confusion
2) excitement
3) fever
4) flushing
5) tachycardia
6) dry mouth
7) hallucinations
Contraindications: (Atropine): Down's, babies, albinos
Note 1 drop 1% atropine (.05 cc) = 0.5 mg

To give Atropine:
- give BID for 3 days in ointment or drop form and not day of exam for ointment
- give Qday for infants (1 eye AM, 1 eye PM)

**iv) nicotinic agonists**
i) depolarizing: succinylcholine, decamethonium
- non-competitive antagonists of Ach which are eliminated by pseudocholinesterase
- not to use in trauma
- not to use if patient is on anti-cholinesterase (Phospholine Iodide)

ii) nondepolaizing: curare like: tubocurarine, pancuronium, atroconium, vecuronium
- competitive antagonists for ACh
- can use anti-cholinesterases to eliminate drug as they will increase ACh levels and thus eliminate the drug

**2) ADRENERGICS**
**Note:** systemic: beta1: heart; beta2: lung

**i) alpha 1 agonists**
Format:
i) Direct: phenylephrine, naphazoline, oxymetazoline
ii) Indirect: cocaine, Paradrine (dihydroxyamphetamine)
action: dilates pupil (dilator muscle)

**ii) alpha 1 antagonists**
format: thymoxamine (direct); guanethidine (indirect)
i) action: constricts pupil without cycloplegia (blocks dilator muscle)
- reverses action of phenylephrine
- useful for angle closure glaucoma (no c.b. swelling)

**iii) alpha 2 agonists**
format:
1) apraclonidine 0.5% or 1% (Iopidine): pre- and post-laser
2) brimonidine 0.2% (Alphagan): TID for COAG
i) action: ⇓ aqueous secretion
- indications: pre and post laser
side effects:
1) conj. blanching
2) irritation
3) dry mouth
4) lethargy
5) vasovagal attacks ? (rare)

**iv) beta 2 agonists**
format: epinephrine 2%, dipivefrin 0.1% (Propine)
i) action: ⇑ outflow at T.M., (small ⇑ aqueous production), ⇑ uveoscleral outflow
- acts by decreasing cAMP and thus block NA/K ATPase
i) duration: 12-24 hours
iii) effect: ⇓ IOP by 10-30%

*Side Effects:*
A) *Local*
1) CME post-cataract
2) mydriasis → acute ACG
3) follicular conjunctivitis
4) punctal occlusion
5) HSV exacerbation
6) adrenochrome deposits
B) *Systemic*
1) systemic hypertension
2) headache
3) extra systole

Contraindications: post-ECCE

**v) beta 1 and 2 antagonists**
format:
1) Betoptic (betaxolol 0.25%, 0.5%); action beta1 >> beta2 (100x); 85% as effective as timolol; "one sixth of the efficacity and one sixth of the side effects"
2) Betagan (levobutalol 0.25%, 0.5%); beta1 = beta2
3) Timoptic: (timolol 0.25%, 0.5%); beta1 = beta2
4) Metipranolol: (0.3%) - similar to Timolol
5) Ocupress: (carteolol 1%)
6) Betoptic S: (0.25%) - solution? which penetrates better and lower dose needed
action:
- beta2 agonism on c.b.: ⇑ aqueous production
- beta2 agonism on t.m.: ⇑ outflow
- net result of beta 2 antagonism: ⇓ aqueous production
frequency: all are Qday or BID

*Side effects*
A) *Local*
1) irritation
2) allergy
3) corneal anesthesia
4) punctate keratitis
5) dry eye
B) *Systemic*
1) bradycardia
2) heart block
3) bronchospasm
4) impotence
5) depression
6) abdominal cramp?
7) headaches
8) fatigue
9) dizziness
10) hallucinations

**5) Carbonic anhydrase inhibitor**
- 1 in 15000 will get aplastic anemia
action: decreased aqueous secretion through carbonic anhydrase
1) Diamox (acetazolamide) QID; 62.5, 125, 250, 500; sustained release BID
2) Neptazane (methazolamide) 25, 50, 100; BID
3) Trusopt (Dorzolamide 2%): TID

*Side effects:*
1) paresthesias
2) psych: malaise, depression, wt. loss
3) *decreased* urine production
4) GI: diarrhea, nausea, metallic taste
5) K+ depletion (minor)
6) renal stones (10x); (not reported yet with Neptazane)
7) metabolic acidosis (Diamox)
8) inhibit breakdown of ASA, coumadin, hypoglycemics, digoxin

9) myopia (like all sulfas --> c.b. swelling --> push lend forward
10) aplastic anemia (not reported yet with Neptazane)

Precautions:
1) cirrhosis of liver (prevents NH4 excretion)
2) renal stones
3) pregnancy (teratogen)
4) diabetic ketoacidosis
5) COPD (respiratory acidosis)
6) on thiazides or corticosteroids (hypokalemic)
7) on Digitalis (hypokalemia → arrhytmias)
8) renal insufficiency (Diamox decreases renal output)
9) adrenal insufficiency (are hyperkalemic?)

Indications: 1) glaucoma
2) CME
3) pseudotumor cerebri

**6) Prostaglandin Agonists**
Xalatan (latanaprost 0.005%) QDay
action: PGF2$\alpha$ agonist (analogue)
mechanism: increased uveal scleral flow
side effects:
1) increased iris pigment (increased melanosomes)
2) burning
3) conj. hyperemia
4) punctate keratitis

**7) Osmotic agents**
1) *IV agents*
a) mannitol (20%)
- dose: 350-500 cc (1-2 g per kg; 70 kg = 70 g = 350 cc of 20%)
b) urea
2) *oral agents*
a) glycerin: raises blood glucose
b) isosorbide: no effect on blood glucose; causes diarrhea
*side effects*
1) cardiac overload (less for glycerin)
2) subarachnoid or subdural hemorrhage
3) urinary retention
Precaution: heart failure, renal failure, large prostate (put in catheter for men)

**Glaucoma Meds - Actions**
**Decreases aqueous production (aqueous supressants)**
1) beta antagonists (timolol)
2) alpha 2 agonists (apraclonidine)
3) carbonic anhydrase inhibitors (dorzolamide)

**Increased aqueous production**
1) beta 2 agonists (dipivefrin)

**Increased outflow at t.m.**
1) cholinergic agonist (pilo)
2) beta 2 agonists (dipivefrin)

**Decreased outflow at tm**
1) beta antagonists

**Increased uveal scleral flow**
1) PG agonists (latanaprost)
2) adrenergics: Propine (Dipivefrin) and epinephrine

**Mechanism by which steroids cause glaucoma**
1) inhibit release of lysosomes which normally digest GAG's; GAG's accumulate in angle
2) block PG synthesis; PG's facilitate uveal scleral outflow
3) decrease phagocytic activity of endothelium

**III) ANTIINFLAMMATORIES**

**1) Vaoconstrictors (alpha 1 agonists)**

1) naphazoline
2) phenylephrine
3) tetrahydrozoline
4) oxymetazoline

**2) Antihistamines**

A) *oral*
1) Benadryl (diphenhydramine) dose: 15mg IM
Indications: allergic reactions, anaphylaxis prophylaxis
B) *topical*
2) Livostin (levocabastine 0.05%)
3) pheniramine (Naphcon A)
4) antazoline
5) pyrilamine

**3) Mast cell Stabilizers**

1) Alomide (lodoxamide 0.1%)
2) Opticrom (Cromolyn Sodium 4%)
Indications: vernal, atopic KC, allergic KC, hay fever

**4) NSAIDs**

A) *Topical*
1) Flurbiprofen (Ocufen): pupil dilation
2) Diclofenac (Voltaren): post-op infl.
3) Ketorolac (Acular): allergic conjunctivitis
indications: CME, allergic conjunctivitis, pain relief, uveitis (not as good as steroids), vernal, atopic KC

B) *Oral*
1) Indomethacin (Indocin): 25 TID
2) Ibuprofen (Motrin): 400 QID
3) Ketorolac
4) Naproxen (Naprosyn): 250 BID
Indications: scleritis
Side effects: GI (N & V, diarrhea); consider H2 blocker with it

**5) Corticosteroids**

- inhibit release of arachidonic acid from phospholipids
- supress release of lytic enzymes
- prevent macrophages from being attracted to sites of inflammation by interfering with MIF (migration inhibition factor);
- cause increase in neutrophils by delamination from vessel walls
- cause sequestering of lymphocytes?
- topical acetate (Pred Forte) or alcohol (suspensions) penetrate better than phosphate (Inflammase) (solution) when epithelium is intact

| History prior to therapy with oral steroids | Possible tests |
|---|---|
| 1) peptic ulcers, esophagitis, gastritis | stool guaiac (OB) |
| 2) osteoporosis | bone density assessment (post-menop. women) |

| | |
|---|---|
| 3) diabetes mellitus | glucose tolerance test |
| 4) hypertension | |
| 5) CV disease | |
| 6) on diuretics (hypokalemia) | serum potassium |
| 7) TB or other chronic infection | CXR, PPD |
| 8) immunocomprimised | CBC |
| 9) psychological disorders | |
| 10) taking anticoagulants (interferes with action) | |

**Steroid-Responsive Ophthalmic Conditions (Duanes')**

A) *anterior segment*

1) Contact dermatitis of the eyelids and conjunctiva
2) Allergic blepharitis and conjunctivitis
3) Vernal conjunctivitis
4) Phlyctenular conjunctivitis and keratitis
5) Ocular pemphigus
6) Mucocutaneous conjunctival lesions
7) Acne rosacea keratitis
8) Interstitial keratitis
9) EpisCleritis and scleritis
10) Sclerosing keratitis
11) Nonspecific keratitis
12) Certain chemical burns of the cornea
13) Superficial punctate keratitis
14) Marginal (sensitivity) corneal ulcers (staph related)
15) Disciform keratitis
16) Immune reaction after keratoplasty

B) *Uveitis*

1) Sympathetic ophthalmia
2) Herpes zoster
3) Iritis and iridocyclitis
4) Most forms of posterior uveitus

C) *Other*

1) Pseudotumor of the orbit
2) Temporal arteritis (giant cell arteritis)
3) Juvenile xanthogranuloma
4) Optic neuritis (various acute forms and dysthyroid types)
5) Progressive thyroid (malignant) exophthalmos
6) Neonatal hemangioma of eyelids

**Pre-steroids workup**

1) CBC, SMA-7
2) glucose tolerance
3) stool occult blood
4) CXR
5) PPD
6) check BP

**Measures to diminish side effects of oral steroids**
1) watch caloric intake
2) restrict salt intake
3) potassium supplement
4) prophylaxis for ulcers (losec, pepcid)
5) give alternate day steroids
6) double dose during periods of stress
7) minimize calcium loss (supplements, estrogen)

**Side effects of topical steroids**
1) glaucoma
2) cataracts
3) exacerbation of bacterial and viral infections (especially: HSV)
4) scleral melt
5) ptosis
6) mydriasis

**Oral side effects**
1) hyperglycemia
2) supression of systemic steroids
3) bone loss
4) muscle wasting
5) worsening systemic infections (especially TB)
6) peptic ulcers
7) hypertension
8) potassium loss (diuresis)
9) diminished immunity
10) pseudotumor cerebri
11) growth retardation in kids

| **Generic Name** | **Trade Name** | **Potency** | **Dose** | **IOP Ý** | **Forms** |
|---|---|---|---|---|---|
| Cortisol (standard) | | 1 | | | natural |
| Dexamethasone | Decadron | 40 | | | gtt (0.1%), IV |
| Fluorometholone | FML | | | | gtt (0.1%) |
| Hydrocortisone | Solucortef | 0.8 | | 20 | IV/IM |
| Medroxyprogesterone | Medrysone | | | | gtt (1%) |
| Methylprednisolone | Solumedrol | 5 | | | IV |
| Prednisolone | PredForte | 4 | | | gtt (1%) |
| Prednisone | Prednisone | 4 | | 5 | po |

**Indications for topical steroids**
A) *Lids*
1) severe blepharitis
B) *Conjunctiva*
1) allergic reaction (to drops) conjunctivitis
2) contact blepharoconjunctivitis
3) Reiter's conjunctivitis
4) phlyctenules
5) atopic and vernal KC (short course)
6) GPC (short course)

7) episcleritis
8) BRLH of conj.
C) *Cornea*
1) peripheral marginal infiltrates
2) active Luetic IK (with syst. Pen)
3) active HSV IK (disciform)
4) Thygeson's - weak steroid (FML, medrysone)
5) Adeno - controversial (Adeno and Thygeson's both recur when steroid D/C'ed)
6) Mooren's
7) peripheral marginal thinning (with infiltrate only)
D) *Trauma* (controversial)
1) alkali burn for up to 2 weeks
2) hyphema
E) *Intraocular*
1) Iritis/cyclitis
2) Pars planitis/vitritis
3) endophthalmitis after therapeutic vitrectomy

**Indications for p.o. steroids**
1) TRO with o.n. compression
2) OID
3) severe uveitis
4) lethal midline granuloma

**When not to use topical steroids**
1) corneal marginal melt from CTD or rosacea
2) HSV epithelial disease
3) Fuch's iridocyclitis
4) scleritis (useless)

**SubTenon's**
1) 0.1 cc of Triamcinolone (40 mg) and 0.1 cc of Betamethasone (6 mg)

**6) Immunosuppressives**
**A) cytotoxic agents**
**I) Dapsone**
i) action: interferes with PMN function
ii) indications: OCP
iii) dose: 100 mg/day
iv) side effects: hemolytic anemia
v) precautions:
a) check (test) for G6PD deficiency
b) check history for Sulfa allergy
c) CBC Qweekly

**B) alkylating agents**
- cross-link DNA and thus inhibit division of WBC's
i) action: interfere with cell division (eg. PMN's)
**I) chlorambucil (Leukeran)**
*indications:*

**II) cyclophosphamide (Cytoxan)**
*indications:*
a) Wegener's (drug of choice)
b) lethal midline granuloma
c) OCP (after Dapsone)

**C) antimetabolites for uveitis**
i) action: inhibit nucleotide synthesis
ii) side effects: B.M. suppression
**I) azathioprine (Immuran)**
*indications:*
a) necrotizing scleritis
b) OCP after cyclophosphamide
**II) methotrexate**
indications:
a) necrotizing scleritis
b) OCP after Dapsone
c) RA - works well with few side effects if used < 6 months

**Other Diseases Treated with immunosuppresives**
1) VKH
2) SO
3) Behcet's
4) necrotizing scleritis
5) serpiginous (AAO - uveitis)

**D) antimetabolites for glaucoma**
**I) 5 fluorouracil**
I) indications: trabeculectomy
dose:
a) 50 mg/cc for 5 min during trab (give 0.1cc)
b) injections: 50mg/cc (give 0.1cc); old: give daily injections for 2 weeks 180 degrees away from bleb
now: give 3-4 injections 90 degrees away from bleb
- give only for high IOP after suture release or if vessels growing near bleb
**II) mitomycin**
dose: 0.3 mg/cc (0.2-0.5) for 3 (1-5) min (0.1 cc)
I) indications: trabs, pterygium, symblepharon release

**E) cyclosporin**
- decreased T cell activity through inhibition of interleukin action (synthesis?)
*side effects:*
1) CNS: muscle tremor, seizures, confusion?
2) GI: liver toxicity, nausea and vomiting
3) CVS: hypertension
4) mucocutaneous: gingivitis, hirsuitism
5) GU: renal toxicity - <u>most common</u>
6) anemia, <u>not</u> leukopenia
7) increased ESR
Oral dose effective in:
1) VKH

2) Behcet's
*Topical effective in:*
1) vernal
2) ligneous

**F) Colchicine**
- useful in Behcet's
- antimitotic (acts on microtubules)

**Side effects of Immunosuppressives**
1) malignancies (leukemia, lymphoma)
2) teratogenesis
3) opportunistic infections
- Always follow with internist

## IV) ANESTHETIC AGENTS

### 1) General anesthesic agents

neuroleptanalgesia: Droperidol (tranquilizer) + Fentanyl (analgesic):
- decreased motor activity, analgesia
- side effects: resp. depression, muscle rigidity, hypotension

### 2) Local Anesthetics

- The smaller fibers, which are autonomic in nature, are blocked first. They are followed by the sensory fibers and finally the largest fibers, which are motor or proprioceptive.
- Epinephrine can be added to the anesthetic solution in dilute concentrations (1:200,000) to counter the vasodilation of the local anesthetic and produce a longer-acting block.
- p-Aminobenzoic acid (PABA) is a metabolite formed in the hydrolysis of the ester-linked anesthetic compounds.
- This substance induces allergic reactions in a small percentage of the population and is responsible for all the allergic reactions encountered with the ester-linked local anesthetics.
- Allergic reactions to the amino amides are rare.
- esters are lipophilic and penetrate cornea better; amides are lipophobic (old notes)?

A) Amide (locals)
1) lidocaine (Xylocaine) 1-4%
- lasts 1-2 hours
- toxic dose: 15 (25?) ml of 2%
- prefered topical anesthetic for conjunctival biopsy
2) Bupivicaine (Marcaine) 0.5%
- lasts 8 hours
- toxic dose: 35 ml of 0.5%
B) Ester (topicals)
1) proparacaine 0.5%
- lasts 20 minutes
2) benoxinate 0.4%: in Fluress
3) Tetracaine 0.5%

| Agent (Trade Name) | Class | Conc. | Max. Dose | Poten. | Onset | Duration |
|---|---|---|---|---|---|---|
| Procaine (Novocaine) | Ester | 1%-4% | 500 mg | 1 | 7-8 min | 30-45 min |
| Lidocaine (Xylocaine) | Amide | 1%-2% | 500 mg | 2 | 4-6 min | 40-60 min |
| Bupivacaine (Marcaine) | Amide | 0.5% | 175 mg | 8 | 5-11 min | 4-12 hr |

### 3) Topical Anesthetics

a) Proparacaine: 0.5%; little irritation; ester
b) Tetracaine 0.5%; moderate irritation but penetrates deeper; ester
c) Cocaine 1-4%; irritating to cornea; ester
d) Lidocaine: little irritation

### Toxic effects of topical anesthetics

1) epithelial cell metabolism with lactic acid accumulation
2) alterations in cell membrane permeability

3) inhibition of cell mitosis and migration
4) epithelial microvilli loss → results in instability and rapid breakup of the tear film
5) retard healing of corneal erosions

## V) OTHER MEDS

### 1) Fluorescein (C20 H10 Na2)

- stains and pools in epithelial defects

A) IV - 5 ml of 10% solution; 80% protein bound, 20% free

*Complications:*

1) mild reactions: nausea: 5% (vomit less)

2) moderate adverse reactions: syncope, thrombophlebitis, temperature elevation, nerve palsy, and local tissue necrosis: less than 1%

3) severe adverse: laryngeal edema, bronchospasm, anaphylaxis, circulatory shock, and MI

4) 1 death per 200 000 (Yanuzzi)

B) Oral

C) Topical

a) Fluress drops: 0.25% fluorescein + Benoxinate 0.4% (anesth) + Iodine (antiseptic) + preserv.

b) Fluress Minims: 2% + anesth; no preservative

c) Fluorexon 0.35%: does not stain contact lenses; no preservative

D) Paper strip

### 2) Rose Bengal

- stains devitalized cells and areas where mucin layer is lost
- antiviral properties
- photosensitizer

A) Topical: 1%

B) Paper strip

### 3) Collagenase Inhibitors

1) N-Acetylcysteine (Mucomist) - comes as 20%; can be diluted to 10%

- unstable
- chelates divalent ions and breaks disulfide bonds
- collagenases appear 1 week post-trauma and sterile ulcers appear 2-3 weeks post-trauma if epithelium not healed
- Dose: Q2H post trauma (start at 1 week post-trauma?) to block action of collagenases

2) Ascorbate (Vit C)

a) topical (10%): q2hr x 1 week post alkali burn, then QID until epithelium healed

b) oral: 8 g Qday (2g QID)

- an essential cofactor in the rate-limiting step of collagen formation (probably not a significant factor in burns)
- appears to be useful in reducing sterile stromal ulceration

3) Citrate (+/- EDTA?)

topical: 10% Q1H

oral: 2g po Q6H

- calcium chelator: decreases the membrane and intracellular levels of calcium
- impairs chemotaxis, phagocytosis, and release of lysosomal enzymes of PMN's
- inhibits the metalloprotease enzymes (including collagenase) of PMN's and injured keratocytes

4) Penicillamine

- chelator
- used in Wilson's (copper chelation)

5) tetracycline
- calcium chelator
- used post-burn

**4) Vitamin A Analogs**
- applied topically: tretinoin (retinoic acid) 0.01%
- treatment of:
1) advanced keratoconjunctivitis sicca
2) Stevens-Johnson syndrome
3) ocular cicatricial pemphigoid
4) radiation keratitis

**5) Wydase (Na Hyaluronidase)**

**6) epinephrine**
- 1:100 000 in local anesthetic
- blanches skin, decreases bleeding, keeps anesthetic from dissapating
Other indications:
1) anaphylaxis (dose: 0.3 ml (0.3 mg) of 1:1000 (0.1%));
- EpiPen delivers this amount but has 2ml total (enough for 6 injections; 6 x 0.3 ml = 1.8 ml)
- EpiPenJr has 0.15 mg epinephrine (delivers 0.3 ml of 1:2000)
2) asthma attack
Note: 1:1000 means 1g in 1000cc or 1 mg per cc

**7) Amicar (Aminocaproic acid)**
- inhibits fibrinolysis
- secondary effects:
1) CNS: nausea, vomiting, vertigo, confusion
2) CVS: postural hypotension, bradycardia, arrhythmia, thrombosis
3) skin: pruritis, cutaneous eruptions, erythema
4) myopathy, cramps
5) nasal stuffiness
*Dosage:*
1) for hyphema: **50mg/kg Q4H** max 30g/day
2) for life-threatening: 5g oral or IV then 1g Q1h
Contraindications: when DIC is going on (do Pt/PTT before giving) - only one in CPS

**8) tranexamic acid**
- inhibits fibrinolysis
- less gastric upset, lower dose given, less frequent

**9) TPA (tissue plasminogen activator)**
- intracameral injection of 5 to 10 µg of in 0.1 ml of BSS
- dissolves fibrin clot within minutes to hours

**10) cough suppresion**
1) IV lidocaine
2) codeine or DM

**11) Osmotic Agents (see glaucoma)**

A) *Intravenous*
1) mannitol (20%)
dose: 1-2 g/kg IV (350 cc for 70 kg) over 30 minutes
onset: 30-60 min
duration: 6 hours
2) urea (30%)
dose: 1-2 g/kg
onset: 30-45 min
duration: 5 hours

B) *Oral*
1) glycerine (glycerol) (50%)
dose: 1-1.5 g/kg
onset: 30-60 minutes
duration: 5 hours
2) isosorbide (50%)
dose: 1-2 g/kg
onset: 30-60 minutes
duration: 5 hours

**12) Dry eye Meds**
A) *Preserved Drops*
Hypotears
Natural tears

B) *Non-Preserved drops*
Refresh: carboxymethylcellulose sodium 0.5% (Allergan)
Tear Gel (Ciba Vision)
Cellufresh carboxymethylcellulose sodium 1% (Allergan)

C) *Ointment*
Lacrilube

D) *Depot*
Lacriserts

**13) Hyperosmotic drops**
1) Muro 128 (5% NaCl vs 0.9% in serum)
2) glucose 40%

**Warnings**
1) D/C ASA 7 days pre-op
2) D/C Phospholine iodide 6 weeks pre-op

## 6) SUTURES

### A) Non-absorbable

**1) Nylon**
- degrades slowly with time
- gets tighter after surgery
- place at 80-90% depth
- cuts through tissue post-op
- skin, cornea, sclera

**2) silk**
- loosens after surgery
- place at ½ thickness
- tissue dissolves around suture post-op
- skin, lid margin, sclera (old)

**3) Prolene**
- iris work
- canthoplasty (LTS)

**4) Polyester (Mersilene )**
- canthoplasty (LTS)

**5) Dacron**
- mesh for orbital implants

**6) Supramyd**
- frontalis suspension

### B) Absorbable

**1) plain gut (collagen)**
- skin, conj

**2) chromic gut**
- conj

**3) Vicryl (polyglactin)**
- skin, subQ, tarsus, EOM, conj

**4) Dexon (polyglycolic acid)**
- subQ, tarsus, EOM?

**5) Polydioxanone (PDS)**
- canthoplasty (LTS)

| **Absorbable** | **half life (strength)** | **absorption time** |
|---|---|---|
| 1) plain gut (collagen) | 7-10 days | 10 weeks |
| 2) chromic gut | 10-14 days | 13 weeks |
| 3) Vicryl (polyglactin) | 3 weeks | 2-3 months |
| 4) Dexon (polyglycolic acid) | | 3 months |
| 5) Polydioxanone (PDS): | 4 weeks | 6 months |

### C) Applications

**I) Plastics**

1) skin: 6-0 or 7-0 plain or nylon; silk
2) sub Q skin: Vicryl, Dexon
3) lid (including tarsus) margin: silk
4) tarsus: 6-0 Vicryl
5) canthoplasty (LTS): Mersilene, Prolene, PDS

**II) Ophthalmic (globe)**

1) conjunctiva: 8-0 plain or Vicryl
2) Tenon's: 6-0 Vicryl
3) cornea: 10-0 nylon (9-0 for expulsive hemorrhage)
4) sclera: 8-0 nylon
5) muscle: 6-0 Vicryl (double armed)
6) iridoplasty, iris fixated IOL's: Prolene

# Management of Medical Emergencies

**A) Cardiac Arrest - patient unconscious and not breathing**
1) Try to arouse patient; cardiac thump
2) call for help (code)
3) open the airway (head tilt and chin lift); use oral airway piece
4) AR (better with AMBU bag with oxygen)
5) check pulse (carotid pulse)
6) continue AR (12 per minute) and if no pulse, then chest compresions (80 per minute)
CPR: 1 person: 15:2; 2 persons: 5:1
7) start IV with D5W or NS
8) Intubate, then ventilate at 12-15 breaths/minute, not stopping for compressions

**B) Pre-treatment for allergies**
1) Benadryl: 15 mg po ?
2) prednisone: 60 mg po?

**C) Anaphylaxis** (0.5% of F/A)
1) epinephrine: 1:1000 0.5 ml SQ (0.5 mg) or IM (or EpiPen:0.3mg epi) or Anakit: 0.6 ml IM (1:1000); given to limb opposite the F/A
2) start IV with D5W ½NS
3) oxygen
4) Aminophyline: 6 mg/kg IV over 30 min
5) Hydrocortisone: 500 mg IV Q6h
6) intubation if still can't breathe
7) crycothrotomy or tracheostomy if can't intubate
8) observe for 6 hours
* mild cases (i.e. no breathing difficulties) and prophylactic: Benadryl 15 mg IM

**D) Seizures** (toxic reactions to local anesthetic, other causes: low Ca, Na, glucose, or Mg**)**
1) check time, vital signs (ABC), EKG
2) establish IV line
3) begin oxygen administration
4) place patient on side
5) insert oral airway; (taped tongue blade or bite block if necessary)
6) draw bloods: SMA-16 (lytes, glucose, Ca, Mg), toxicology screen, drug levels of anti-convulsants seizure-causing or meds, CBC, ABG (if possible)
7) 50 ml ampule of D50 IV
8) Valium (diazepam): 10 mg (or Ativan 10 mg) over 5 minutes → push may cause resp depression?
9) Dilantin (phenytoin): 1 g over 20 minutes (monitor BP, HR, EKG)
10) If seizures over 20 minutes: repeat Valium 10 mg then phenobarbital 1g over 10 minutes [or thiopental sodium (100 mg)
11) If seizures continue: anesthesia notified for general anesthesia and paralysis with intubation with EEG monitoring
12) Later work up tests: RFT's, LFT's, LP, CT, urinalysis

**E) Toxic Reaction of Local Anesthetics**
**Causes:**
1) large dose
2) rapid absoption (inadvertent intravenous, intraarterial)

3) slow detoxification (i.e. liver disease)

**Signs:**
1) *Stimulation*
a) CNS
i) cortex: restlessness, tremors, convulsions
ii) medulla: N & V
b) cardiac: increased BP and HR
2) *Depression* (seen with accidental intradural anesthesia as well)
a) CNS
i) cortex: sleepiness, coma (cortex), N&V
ii) medulla: sighing, dyspnea, respiratory arrest
b) cardiac: decreased HR and BP

Quick treatment is necessary to prevent CNS damage from hypoxia ! (6 min)
**Treatment:** (concerned about respiratory arrest)
1) secure airway (tongue blade if seizing)
2) Oxygen air bag
3) intubation with laryngoscope if air bag not effective
4) IV line
5) IV valium 10 mg over 5 minutes (slowly)
6) suction vomiting if occurs

**F) Toxic Reactions to epinephrine**
- similar to local anesthetics
1) CNS Stimulation: restlessness, tremor
2) cardiac stimulation: increased HR and BP
But does not produce either convulsions or decreased HR or BP
**Treatment:** oxygen mask

**G) Reaction to tensilon (cholinergic overdose)**
Signs: nausea, vomiting, sweating, diarrhea, decreased HR
How to give Tensilon:
1) 2 mg IV test dose
2) 8 mg IV 45 seconds later if the first dose has no effect
3) may give atropine 0.4 mg IV in coadministration

**H) Treatment of cholinergic overdose** (eg. phospholine Iodide, tensilon)
1) atropine IV 0.4 mg;
2) Repeat Q3 -10 minutes
3) Usually no more than 2 mg. necessary
**TensilonTest** (edrophonium) 2mg test dose than 8 mg (may give atropine 0.4 mg IV concurrently)

**I) Atropine overdose** (drops: 1%)
Signs: flushing, fever, increased HR, delirium
**Treatment:**
A) Mild case: discontinue drug
B) severe case: physostigmine 0.25mg subQ Q15 minutes

**H) Treatment of Malignant Hyperthermia:**

causes: succinylcholine, halothane, inhalational anesthetics (enflurane, isoflurane)
*Procedure:*
- 4 things to do: stop OR, hyperventilate, cool patient, keep urine going
- 4 meds to give: Dantrolene, bicarb, mannitol (+/- Lasix), insulin (with glucose)
1) Stop anesthetics immediately and conclude surgery ASAP
2) hyperventilate with 100% oxygen (8-10l) and monitor with pulse oximeter
3) Dantrolene: 2mg/kg initial bolus with additional 1mg/kg Q5 minutes doses up to total of 10mg/kg
4) Arteries: arterial line if possible for: ABG's, temperature, BP
5) Veins: electrolytes, PT/PTT/fibrinogen (have IV line)
6) Cardiac: EKG
7) NaHCO3: 1-2 mEq/kg increments guided by arterial pH and pCO2 (also helps K+ to enter cell)
8) Cool patient:
a) IV iced NS 1litre Q 10 min x 3 (total 3 litres); NO Ringer's lactate (has K+)
b) lavage stomach, bladder, rectum, peritoneal and thoracic cavities
c) cool skin with ice and hypothermia blanket
9) maintain urine output (should be at least 2 cc/kg/h (150 cc/ hour) to prevent renal damage from myoglobin)
a) insert catheter to monitor urine output
b) mannitol 20 g IV (100 cc of 20%) (x 4 max)
c) Lasix (furosemide): 1 mg/kg IV (x 4 max)
10) check potassium
a) if hyperkalemia → give 10 units insulin with 50 cc of D50 ampule
b) recheck potassium and glucose

**Notes**
1) Don't give calcium channel blockers
2) continue dantroline for 3 days at 1mg/kg IV Q6h
3) Swan Ganz inserted if necessary
4) For arrhythmias: Procainamide: 1g over 10 minutes

## EMERGENCY MEDICATIONS

| Medication | Dose | Situation |
|---|---|---|
| epinephrine | 0.5 ml of 1:1000 Q5min | anaphylaxis, asystole |
| atropine | 0.5 -1 mg Q5min | asystole, bradycardia |
| Benadryl | 20 mg. | anaphylaxis |
| valium | 10 mg | seizures |
| hydrocortisone | 500 mg Q6h | anaphylaxis |
| NaHCO3 | 70 mEq (1 per kg) | acidosis |
| CaCO3 | 200 mg | hyperkalemia |
| glucose | D50 - 10 ml | hypoglycemia |
| aminophyline | 420 mg (6/kg) | bronchospasm |
| Dantrolene | 200 mg then 100 mg Q5 min | MH |