**Steroids: Friend or Foe**

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**Objectives**

- Discuss the pharmacokinetics and potential adverse events of corticosteroids
- Discuss appropriate delivery and dosage regimens for common adult ORL pathology
- Discuss pediatric considerations with the use of corticosteroids
- Participate in an interactive discussion of the use of steroids in ORL patients

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**Definitions**

**Anabolic steroids**

Man-made substances related to sex hormones

**Corticosteroids**

Similar to adrenal hormones produced in response to stress associated with illness or injury. Include cortisone, hydrocortisone and prednisone.

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**How do corticosteroids work?**

- Mimic the effects of natural adrenal hormones
- Higher doses suppress inflammation and the immune response
- Produces multiple glucocorticoid and mineralocorticoid effects
- Metabolized in the liver (CYP450)
- Excreted in urine (half-life 18-36 h)

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**Administration Routes**

- **Topical**
  - Divided by potency classes I-IV
  - Used on skin, eye, ear, and mucous membranes
- **Inhaled**
  - Used to treat nasal mucosa, sinuses, bronchi and lungs
- **Oral**
- **Parenteral**
### Common Corticosteroids

- **Betamethasone**
- **Budesonide**
- **Dexamethasone**
- **Fluticasone propionate**
- **Methylprednisolone**
- **Prednisone**
- **Triamcinolone**

### Betamethasone

- **Route:** topical  
  **Class:** II-IV  
- **Dosage:** variable  
- **Side effects:** acne, burning, itching, dry skin, changes in skin color  
- **Systemic absorption varies with application site, area, occlusion and patient specific factors**

### Nasal Steroids

- **Flunisolide**  
  - **Indications:** allergic rhinitis, nasal polyps, non-allergic rhinitis, turbinate hypertrophy  
  - **Category C**

### Budesonide

- **Route:** nasal  
- **Dosage:** 32 mcg/spray, 1-4 sprays / nostril daily  
- **Indications:** nasal polyposis, allergic rhinitis, turbinate hypertrophy  
- **Adverse reactions:** septal perforation, nasal oral candidiasis, epistaxis, pharyngitis, cough  
- **Category B for use in pregnancy**

### Fluticasone propionate

- **Route:** nasal spray  
- **Dosage:** 50 mcg/spray, 2 sprays/nostril daily  
- **Indications:** allergic rhinitis, non-allergic rhinitis, polyposis, turbinate hypertrophy  
- **Adverse reactions:** septal perforation, nasal ulcer, glaucoma, cataracts, epistaxis, headache, nasal burning  
- **Category C**

### Mometasone

- **Route:** Nasal Spray  
- **Dosage:** 2 sprays/nostril daily to bid  
- **Indications:** allergic rhinitis, nasal polyps, non-allergic rhinitis, turbinate hypertrophy  
- **Adverse reactions:** IOP increase, glaucoma, nasal ulcer, epistaxis, URI symptoms  
- **Category C**
Prendisone

- **Route:** oral
- **Dosage:** Variable with condition
- **Indications:** acute sinusitis, sudden sensorineural hearing loss, polyposis, Herpes Zoster, Bell’s Palsy
- **Category C**

Adverse Reactions

- adrenal insufficiency
- immunosuppression
- diabetes
- steroid psychosis
- GI ulceration/perforation
- osteoporosis/osteopenia
- seizures
- tendon rupture
- glaucoma
- anaphylaxis
- headache
- vertigo
- nervousness
- mood swings
- elevated BP
- elevated BS
- muscle weakness
- increased appetite
- Cushing’s syndrome

Withdrawal

High dose steroids for > 1 week produce adrenal suppression

- 5 days or less can be abruptly stopped
- recovery takes 1 week
- 6-10 days: reduce to replacement dose
- taper over 4 or more days
- recovery takes 2-4 weeks
- 11-30 days: reduce to 2x replacement dose
- taper 25% every 4 days
- recovery takes 1-3 months

Sudden Sensorineural Hearing Loss

- **Definition**
  - A loss of 30 dB
  - over three contiguous frequencies
  - occurs over 72 hours or less
- Usually unilateral
- Accompanied by tinnitus and/or vertigo
- Incidence 5-20 /100,000
- Men = Women

Oral Steroid Therapy

- Give immediately, better if within 2 weeks
- Prednisone 1 mg/kg (max 60 mg/d)
- Full dose for 7-14 d then taper (do not divide)
- Repeat audiogram at 1 week and completion of course
- Monitor potential side effects

Additional References:

Intratympanic Steroids
- Can be given immediately or as salvage therapy
  - Dexamethasone 10 mg/ml (stock)
  - Methylprednisolone 40 mg/ml
- Inject 0.4-0.8 ml into middle ear space every 3-7 days for total of 3-4 sessions
- Anterosuperior myringotomy, small gauge needle
- Maintain otologic position for 15-20 minutes
- Audiogram before each injection and at completion
- Inspect TM for healing

Acute Sinusitis
- Infection that occurs if obstruction or congestion leads to bacterial growth in the paranasal sinuses
- Swelling, and inflammation create further blockage, which may cause the sinuses to close up completely
- Primary objectives for treatment of sinusitis are reduction of swelling, eradication of infection, draining of the sinuses, and ensuring that the sinuses remain open.

Nasal Polyposis
- An inflammatory condition of unknown etiology
- Most common tumors of the nasal cavity
- Approximately 30% of patients with nasal polyps test positive for environmental allergies
- Increased prevalence in adults with aspirin sensitivity and children with cystic fibrosis
- Primary problems are decreased sense of smell and nasal congestion

Classic Ramsey Hunt Syndrome
- Vesicular rash of ear/mouth
- Facial paresis or paralysis
- Vertigo and ipsilateral hearing loss
- Tinnitus
- Otalgia
- Headaches
- Dysarthria
- Gait ataxia
- Fever
- Cervical adenopathy

Support treatment with only saline nasal irrigation, decongestants, antihistamines, and expectorants are appropriate for a minimum of 7-10 days for patients with mild-to-moderate symptoms, and may be used for longer.
- Antibiotics are not helpful for patients with mild-to-moderate symptoms, so they should not be prescribed for at least the first 7 days.
- Nasal spray corticosteroids are important for reducing the inflammatory response in the nasal passages and airways.
- Severe cases may require a burst of oral steroids
Treatment Goals

- Limit the severity and duration of the pain
- Shorten the duration of the shingles episode
- Reduce complications

Corticosteroids

- Decreases inflammation
- Give larger dose acutely then taper
- Interacts with multiple medications
- Contraindicated in severe infections, peptic ulcer disease, hepatic dysfunction

Bell’s Palsy

- Unilateral facial muscle weakness
- Can occur at any age
- Associated with viral exposure
- Usually temporary but can be permanent
- Symptoms improve in a few weeks with complete recovery in 6 months
- Can recur
- Treat with oral steroids (40mg/day with slow wean)

Discuss pediatric considerations with the use of corticosteroids

- Disorders commonly treated with Steroids in Pediatric Otolaryngology
- Complications specific to pediatrics
- Proceed with caution

Disorders commonly treated with Steroids in Pediatric Otolaryngology

- Granulation Tissue
- Nasal obstruction
- Otitis externa
- Otitis media with tubes/TM perforation
- Tonsillectomy
- Tonsil hypertrophy
- Airway Disorders - croup, extubation, stenosis
- Hemangioma
Tracheostomy Tube Granuloma
- Granulation can occur anywhere on the body where there is disruption of the skin/mucosa
- Commonly seen around trachs due to excessive movement, irritation, infection, predisposition
- Commonly treated with triamcinolone cream applied to granuloma bid for up to 10 days
- Suprastomal granuloma also common
  - Off label use of ciprofloxacin/dexamethasone gtts

Tympanostomy Tube Granulation
- Presents as bloody or recurrent otorrhea
- Treatment: topical steroid +/- abx
  - Ciprofloxacin/dexamethasone gtt's- 4 drops bid for 7-14 days
  - Ofloxacin and dexamethasone ophthalmic drops 2 gtt's each bid
  - Always recheck to see ensure ear is healthy

Acute Otitis Externa
- Definition: infection and/or inflammation of EAC
- Etiology: moisture in ear canal, trauma, cerumen impaction, purulent secretions, dermatologic disorders
- Presentation: severe pain/throbbing, itching, aural fullness, otorrhea
- Diagnosis: movement of pinna, otoscope (meatus inflamed, cellulitis, furuncle, otorrhea)

Treatment: Acute Otitis Externa
- Extensive cleaning of EAC
- Antibiotic/corticosteroid otic drops
- Otic wick
- Acetic acid drops
- keep the ear dry
- analgesia

Treatment: Acute Otitis Media with Tympanostomy Tubes or TM perforation
- Presents as painless otorrhea
- Antibiotic/corticosteroid otic drops
  - Dosing: 4 gtts bid x 7d
  - Technique
  - Advantages: Increased MIC
  - Reduced antibiotic resistance and tx failure
- Precautions: overuse can lead to fungal infection
- Extensive cleaning of EAC
- Water precautions
- No systemic antibiotics required

Nasal Obstruction from Turbinate Hypertrophy
- Symptoms may include mouth breathing, sleep disordered breathing, ETD, post nasal drip, alteration in smell and taste
- Treatment with Nasal steroids
  - Most are FDA-approved for children ≥6 yrs
  - Fluticasone and mometasone in children ≥2y
  - Minimal side effects (no systemic SE)
  - irritation and nose bleeds
  - Possible transient vertical growth affect
  - some increased risk for cataracts and glaucoma particularly in children with family history or predisposition who are otherwise prone to them
  - Routine annual ophtho exam recommended
Allergic Rhinitis: Mucosal Abnormalities

- Common problem in older children/adults
- Symptoms:
  - Watery rhinorrhea and nasal obstruction
  - History of seasonal sneezing, itching
- Typical findings on PE:
  - Edema of nasal mucosa and blue boggy turbinates
- Treatment (based on sx/sx/severity/pattern)
  - antihistamines, nasal steroids/sprays

Proper Technique for Nasal Steroid Administration

- Clear nasal mucus
- Tilt head down toward the floor
- Use opposite hand to administer into nostril aiming outward toward turbs
- Pump the nasal spray while sniffing gently

Neonates are Obligate Nose Breathers

- Swelling of nasal mucosa
- Decreased pain as measured by lower pain scores and longer latency times to analgesic administration

Nasal Obstruction: Mucosal Abnormalities

- Swelling of nasal mucosa
- Respiratory distress of infant
- Discourage use of blue bulb
- Clear nasal passages
- Decadron opthalmic drops

Tonsillectomy and Adenoidectomy

- AAO-HNS Tonsillectomy Guidelines 2011 Statement – Intraoperative Steroids
- Clinicians should administer a single, intraoperative dose of intravenous dexamethasone to children undergoing tonsillectomy.
  - Dose: 0.5mg/kg (lower dose effective)
- Strong recommendation based on randomized controlled trials and systematic review of randomized controlled trials with a preponderance of benefit over harm
- Benefits:
  - Decreased incidence of PONV up to 24 hrs postop
  - Decreased times to first oral intake
  - Decreased pain as measured by lower pain scores and longer latency times to analgesic administration

Tonsillectomy/Adenoidectomy

- Difficult recovery
  - Pain, irritability, otalgia, poor oral intake, stridor/stentor
  - Irritation of nerve endings
  - Inflammation
  - Pharyngeal muscle spasm
- Consider dose or two of oral steroids
Severe Tonsil Hypertrophy
- Severe symptoms: respiratory distress, dysphagia, drooling, trismus
- Mononucleosis
- Treatment:
  - Vary based on diagnosis
  - Steroids have significant impact on symptoms

Respiratory Distress: Airway Considerations
- Anatomic Considerations
  - Smaller and narrower
- Airway stenosis
- Croup
- Extubation

Poussieux’s Law: Tubular Fluid Dynamics
- Flow within the system is related to the radius of the tube to the fourth power
- Triangular aperture of the normal infant larynx is approx 7mm x 4 mm (A=14 mm²)
- 1 mm of edema = cross-sectional area reduced to 5 mm²
- 35% of normal

Respiratory Signs and Symptoms
Croup and Subglottic Stenosis
- Severity of symptoms based on degree of obstruction
- Respiratory symptoms
  - Biphasic stridor, croupy cough, retractions, cyanosis and nasal flaring
- Feeding difficulties
- FTT
- Voice disturbance if VC involved
- Mild to moderate may be asymptomatic until inflammatory process (mirrors croup)
- May be identified with difficulty with intubation/extubation

Croup - Laryngotracheobronchitis
- An obstructive disease of the airway that generally follows an upper respiratory tract infection
- Occurs primarily in children 2-3 yrs
- Characterized by subglottic edema
- Symptoms include: fever, inspiratory stridor, hoarseness and a barking cough, restlessness, retractions
- “steeple sign”

Croup Management
- Most cases are treated as outpt
  - maintaining adequate hydration
  - cold humidification
  - rest and reassurance
  - Steroids
- Need for airway intervention is rare
Subglottic Stenosis
- Narrowing of the subglottic airway
- Third most common congenital anomaly of the airway
- Signs and Symptoms: dependent on staging (Cotton-Meyer)
- Medical Management
  - Multifactorial, varies dramatically
  - Supportive (grades 1 – II)
  - Medications:
    - Supportive
      - Steroids (oral, IV, inhaled)
      - Racemic epinephrine
      - Supplemental O2
      - Anti-reflux medications

Hemangiomas
- Benign vascular tumors composed of endothelial cells
- Most common tumor of childhood (incidence 10% in infants)
- Growth phases
  - Proliferative phase: usually lasts 6-9 months (individualized)
  - Involution phase: may last up to 10 years
- Treatment is individualized
  - Observation, laser, drug therapy, surgery

Treatment with Steroids
- Until recently, prednisolone - first line medical treatment
- Administered typically orally, also IV topically or intra-lesional
- Most effective in treating hemangioma when initiated during proliferative phase (first 6m)
- Dose: 2.0mg/kg/d - 4.0mg/kg/d qd or bid.
- Response typically seen in 2-4 weeks, in about 85% of patients
- Once growth of the hemangioma has slowed or stopped the medication is often slowly tapered
- If taper is done too quickly there can be new growth

Treatment with Propranolol
- Propranolol (non selective beta blocker) is now mainstay treatment
- Induces early involution in hemangiomas even during the proliferative phase (Launois-Lehman, 2008)
- Multiple studies verify rapid, successful treatment
- Small risk of bradycardia, hypotension, bronchospasm and hypoglycemia
- Treatment failures

"I have to tell you...I worked with a pediatrician once that said that steroids were the ‘nectar of the gods’...and he is so right...it makes EVERYTHING better”
(Melissa—August 16, 2012)
Hypothalamic-pituitary-adrenal (HPA) suppression

- More pronounced in young children and pts receiving high doses for prolonged periods
- Acute adrenal insufficiency (adrenal crisis)
- Avoid abrupt withdrawal
- Stress dosing prior to surgery, with illness of times of unusual stress
- Tapering schedules

Immunosuppression with Corticosteroid Use

- May increase susceptibility to infections - reduce exposure
- Prolonged use may increase incidence of secondary infection
- May mask acute infection
- Immunosuppression
  - May limit response to vaccines
  - NO Live Virus immunizations should be given while using steroid medications and until the patient has been off the steroid for at least 1 month
- Avoid exposure to Chicken-pox
- Do not use in patients with ocular herpes simplex, viral hepatitis, cerebral malaria, latent TB, chickenpox, measles

Impact of Bones

- Inhibition of bone growth
  - Systemic
  - Inhaled
- Osteoporosis
- Fractures
  - Increased risk with >4 courses of corticosteroids

Emotional Disturbances

- Mood swings
- Personality changes
- Increased appetite
- Psychiatric disturbances including depression, euphoria, insomnia
  - Pre-existing psych conditions may be exacerbated
- Increase in adverse neurodevelopment outcomes (including CP) in preemies treated with high dose dEX for BPD prevention (2-5mg/kg/day)
  - No clinical benefit over lower doses (Watterberg, 2010)

Cardiomyopathy

- Case reports of steroid-induced obstructive cardiomyopathy
  - Case report in child with subglottic stenosis
    (Balyi et al, 2005, IJPO)
  - Multiple reports in premature infants
    (Ishmael et al, IJPO, Flens et al)
- Signs and Symptoms
  - Tachycardia, new cardiac murmur, increased oxygen requirements, decreased UO, decreased peripheral perfusion

Proceed with Caution

- Impact of steroids on white count
- Rebound effect
- Many drug interactions
  - Antacids, antidiabetic agents, amphotericin, loop diuretics, quinolones, NSAIDS
- Food interactions - systemic use
  - May require diet increase in potassium, vitamins A, B6, C, D, folate, calcium, zinc and phosphorus
  - Decrease sodium
- Diabetics - monitor glucose levels closely
Questions?