ASTHMA

PATHOPHYSIOLOGY:

- Final common pathway is AIRWAY INFLAMMATION limiting airflow (multifactorial):
    - Oedema
    - Inflammation (incl. vascular congestion)
    - Mucous production
    - Bronchial hyperreactivity --> BRONCHOCONSTRICTION
- AIRWAY MODELLING --> permanent re-structuring
    - Characterized by decreased response to treatment over time
    - Due to presence of repetitive or chronic airway inflammation
    - Wall thickening, subepithelial fibrosis, mucous gland metaplasia, EPITHELIAL HYPERTROPHY --> DECREASED ELASTICITY OF AIRWAY
    - SHORTER LIFE EXPECTANCY
- EARLY ASTHMATIC RESPONSE:
    - Release of preformed mediators (HISTAMINE)
    - Usually resolves within an hour
    - Results in bronchial smooth muscle constriction and airway oedema
- LATE ASTHMATIC RESPONSE:
    - Occurs at 4-6 hours
    - Occurs as a result of cytokines
- ASPIRIN-EXACERBATED RESPIRATORY DISEASE:
    - TRIAD OF:
        - Aspirin sensitivity
        - Asthma
        - Nasal polyps
    - Common precipitant of life-threatening asthma
    - Decreased PGE2 related mast cell stabilization
    - Benefit from anti-leukotriene medications (ZAFIRLUKAST, MONTELUKAST✓ LT receptor blockers)
- EXERCISE-INDUCED:
    - *Strongly associated with ATOPY*
    - Occurs in 90% of those with persistent asthma
    - Aetiology unclear.
- MENSTRUATION-ASSOCIATED:
    - Affects 40% of asthmatic women
    - Fluctuations in oestrogen and progesterone are postulated as causal factors.

CLINICAL FEATURES:

SYMPTOMS:

- COUGH:
    - May be only symptom
    - Nocturnal worsening characteristic
    - Likely related to sub-epithelial vagal stimulation
- SOB:
    - Wide inter-individual variations perceived by asthmatic subjects
    - Those with blunted response have higher morbidity and mortality
- WHEEZING:
    - Reflects high air movement velocity and turbulence
    - Decreases with severe obstruction because air movement velocity is insufficient to produce sound *--> THE SILENT CHEST !!*

Also involved = GORD:

- Can lead to airway narrowing through a vagally-mediated mechanism or through aspiration.

HISTORICAL COMPONENTS:

- SLOW-ONSET:
    - Progressive, over 6 hours
    - Triggered by URTI
    - Profound inflammation, slower response to treatment
    - SLOW-ON, SLOW-OFF
- SUDDEN ONSET:
    - Male predominance
    - Triggered by allergens, exercise !
    - Bronchospastic aetiology with *more severe obstruction*
    - Faster response to treatment

PREDICTORS OF SEVERITY/DEATH:

- ASTHMA HISTORY:
    - Previous ICU
    - >= 2 hospitalisations for asthma in past year
    - >= 3 ED visits
    - Long-term steroid use
    - > 2 canisters of MDI per month
- SOCIAL HISTORY:
    - Low socioeconomic status
    - Illicit drug use
    - Serious psychosocial issues
- COMORBIDITIES:
    - Especially CVS disease

BRIEF HISTORY OF CURRENT EXACERBATION:

- Onset
- Triggers
- Severity of symptoms compared with previous
- Comorbidities

PHYSICAL ASSESSMENT:

- Grading:
  - Mild: sentences
  - Moderate: phrases
  - Severe: words
- Tachypnoea (RR>40), tachycardia >120
- Sitting upright denotes severe airway obstruction
- Cyanosis is UNCOMMON --> left shift O2-Hb dissociation curve
- Pulsus paradoxus --> INSPIRATORY FALL IN SYSTOLIC BP >10MMHG
  - rare but signifies severe disease
- WHEEZING does NOT designate presences, severity or duration of asthma and correlates poorly with degree of functional derangement

DIAGNOSTIC STRATEGIES:

- PULMONARY FUNCTION TESTS (SPIROMETRY):
  - Physicians tend to underestimate degree of severity in asthma, hence routine use of PFTs
  - PEV1/PVC as standard, percentage predicted
- ABG:
  - Modest fall in $PaCO_2$ in mild disease due to hyperventilation
  - Normalises with worsening obstruction and then increases with worsening hypoxaemia
  - *NO VALUE to determine need for I&V*

DESPITE PFT'S improving, some patients have fall in SaO_2 due to pulmonary vasodilation and worsening VQ mismatch

- OTHER BLOOD TESTS:
  - FBC: Leukocytosis of little value (↑'d by salbutamol/steroids)
  - Electrolyte abnormalities common with salbutamol use
    - Low K, Mg, PO_4
- RADIOLOGY --> CXR to assess for complications:
  - Pneumonia
  - Pneumothorax
  - Pneumomediastinum
  - CCF
- ECG:
  - Right heart strain (reversible) with severe asthma

DIFFERENTIALS (LIST):

- CARDIAC:
    - Valvular
    - CCF
- COPD exacerbation
- Upper airway obstruction
- Endobronchial disease
- PE
- Anaphylaxis
- Vocal cord dysfunction

MANAGEMENT OF ACUTE EXACERBATIONS OF ASTHMA:

MAIN GOAL IS TO REVERSE THE ACUTE AIRFLOW OBSTRUCTION

OXYGEN ADMINISTRATION: aim sats >90%

ADRENERGIC MEDICATIONS:

- Some controversies surrounding use of RACEMIC salbutamol
    - (S-isomer in animals does not have bronchodilator activity)
    - Newer medication is R-ISOMER or LEVOSALBUTAMOL
        - Lower dose required
- Nebulised vs MDI with spacer:
    - Similar bronchodilation & side effects, but more supervision required.
- IV SALBUTAMOL:
    - Recommended for use in severe non-responsive acute asthma
    - LOADING DOSE: 4microg/kg over 2-5 minutes
        - followed by infusion of 1-5 microg/kg/min
    - LIMITED EVIDENCE: consider esp. when inhaled therapy is not feasible
- IV ADRENALINE with caution in those over 40 !!
    - Consider subcutaneously in those who cannot inhale or are experiencing sever bronchospasm without central access
- TERBUTALINE: longer acting beta-2 agonist
- LONG-ACTING BETA-2 AGONISTS:
    - SALMETEROL:
        - ADJUNCTIVE AGENT , but for chronic, not acute episodes
        - Onset of action 20 minutes hence not indicated for acute attacks.

CORTICOSTEROIDS:

MAIN ACTION IN AIRWAY IS INHIBITION OF RECRUITMENT OF INFLAMMATORY CELLS AND INHIBITION OF RELEASE OF PRO-INFLAMMATORY MEDIATORS/CYTOKINES

- Systemic steroids should be given promptly to all patients with moderate to severe attacks or those experiencing an incomplete response to initial beta-2 agonist therapy
    - Effect begins within hours and peaks OVER 24 HOURS
- SPEEDS RESOLUTION OF AIRWAY OBSTRUCTION AND REDUCES RELAPSE RATE
- ORAL ~ IV STEROIDS
    - Give IV if patient is very ill, unable to swallow & vomiting
- SIDE EFFECTS:
    - Hyperglycaemia
    - HypoK+
    - Fluid retention
    - Mood alterations (psychosis rare)
    - HT
    - Peptic ulcers
- INHALED STEROIDS IN ED:
    - Those treated with inhaled steroids less likely to be admitted (regardless of whether they received systemic)
    - Reminders:
        - Rinse mouth to decrease DYSPHONIA, ORAL CANDIDIASIS
- SMALL PROPORTION ARE STEROID RESISTANT & ARE ON MORE POTENT IMMUNOSUPPRESSIVES

ANTICHOLINERGICS:

- E.G. IPRATROPIUM BROMIDE:
    - quaternary derivative of atropine that is poorly absorbed from mucosal surfaces (hence less side effects)
- Override the smooth muscle constrictor & secretory consequences of the parasympathetic nervous system
- Combination with beta-2 --> improvement in PFTs and reduction in hospitalizations, especially in those with more severe disease
- Can give 500microg with first three doses of salbutamol (i.e. q20min)

MAGNESIUM SULPHATE:

- Relaxes bronchial smooth muscle by purported inhibition of calcium channels & cholinergic neuromuscular transmission
- Might obviate need for intubation
- Give 2-3g over 20minutes
- SIDE EFFECTS:
    - Flushing
    - Loss of DTRs
    - Hypotension
    - Respiratory depression

METHYLXANTHINES:

- OUTDATED
- THEOPHYLLINE = ORAL, AMINOPHYLLINE = IV
- Thought to be beneficial due to increased respiratory drive (central effect)
- NARROW THERAPEUTIC INDEX
    - TOXIC TO CVS, GIT, CNS and metabolic systems

LEUKOTRIENE MODIFIERS:

- NEWER MEDICATIONS
- ZAFIRLUKAST, MONTELUKAST
    - oral medications that are highly selective antagonists of LT receptors
- Given in acute exacerbation
    - improved PFTs, but did not decrease admissions to hospital.

SEVERE, NEAR-FATAL AND FATAL ASTHMA:

- DEFINITION OF SEVERE ASTHMA:
    - MAJOR:
        - >50% of year on oral steroids
        - Has needed high dose IV steroids
    - MINOR:
        - Controller medication required
        - Daily use of beta-2 agonist
        - Near fatal event in past
        - >1 ED visit per year
- STATUS ASTHMATICUS:
    - Refers to severe bronchospasm that does not respond to aggressive therapies within 30-60 minutes
- NEAR FATAL ASTHMA:
    - Identified by respiratory arrest or EVIDENCE OF RESPIRATORY FAILURE ($PaCO_2$ >50mmHg)
    - TWO TYPES:
        - Slow onset, gradual deterioration over days, usually superimposed on poorly controlled asthma
        - Rapid onset [illegible] less than three hours
            - Greater hypercapnia, shorter ventilation due to more rapid recovery

APPROACH TO CRITICALLY ILL ASTHMATIC:

NON-INVASIVE STRATEGIES:

- HIGH-DOSE CONTINUOUS NEBULISED BETA-2 AGONIST & ANTICHOLINERGICS
- MAGNESIUM SULPHATE
- ORAL PREDNISONE

- HELIOX (controversial)
- NON-INVASIVE VENTILATION:
    - CPAP/BIPAP:
        - Improves oxygenation & reduces respiratory muscle fatigue by increasing FRC and compliance
        - BiPAP better tolerated by children
        - Need to be alert with intact airway reflexes
- IV KETAMINE:
    - Dissociative anaesthetic with potent bronchodilatory effects
    - Increases airway secretions and emergence phenomenon

INTUBATION AND VENTILATION STRATEGIES:

- WITH EXCEPTION OF APNOEA & COMA, THERE ARE NO ABSOLUTE INDICATIONS FOR INTUBATION
    - Consider if:
        - Worsening acidaemia
        - Hypoxaemia
        - Exhaustion
        - Depressed mental status
- KETAMINE AS INDUCTION AGENT IN RSI:
    - Opioid that DOES NOT RELEASE HISTAMINE (i.e. fentanyl NOT morphine) should be used as sedative
- VENTILATOR STRATEGY:
    - PERMISSIVE HYPERCAPNIA:
        - Providing adequate oxygenation & ventilation while MINIMISING HIGH AIRWAY PRESSURE, BAROTRAUMA AND SYSTEMIC HYPOTENSION
    - HIGH FIO2
    - Aim pH 7.15 -7.20 with hypercarbia
        - No consensus on upper limit of $PaCO_2$, but > 100mmHg can lead to CV collapse
    - Low tidal volumes (6-8mL/kg) with RR 6-8/min.
    - Aim to prevent excessive
        - Intrinsic PEEP
        - Breath stacking
        - Barotraumas
    - *Low rate, high inspiratory flow rate provide prolonged time for expiration*
- PNEUMOTHORAX should be considered whenever sudden deterioration occurs, especially with coincident rise in peak pressures and falling oxygen saturation
    - PRE-EMPTIVE THORACOSTOMIES

TREATMENT OF REFRACTORY CRITICALLY ILL ASTHMATIC (I.E. NEAR FATAL):

- Consider GA with isoflurane in OT
- EXTERNAL LATERAL CHEST COMPRESSION WHEN PATIENTS CANNOT EXHALE
- CARDIOPULMONARY ARREST MAY RESULT FROM UNRECOGNISED BAROTRAUMA
    - EMPIRICAL BILATERAL TUBE THORACOSTOMY
- ECMO if still no improvement