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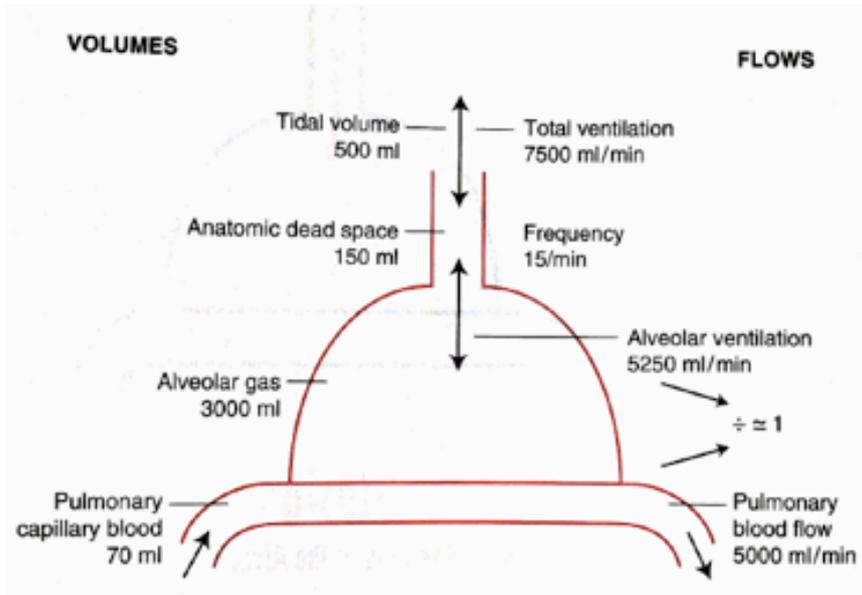
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# Practical Anaesthesia

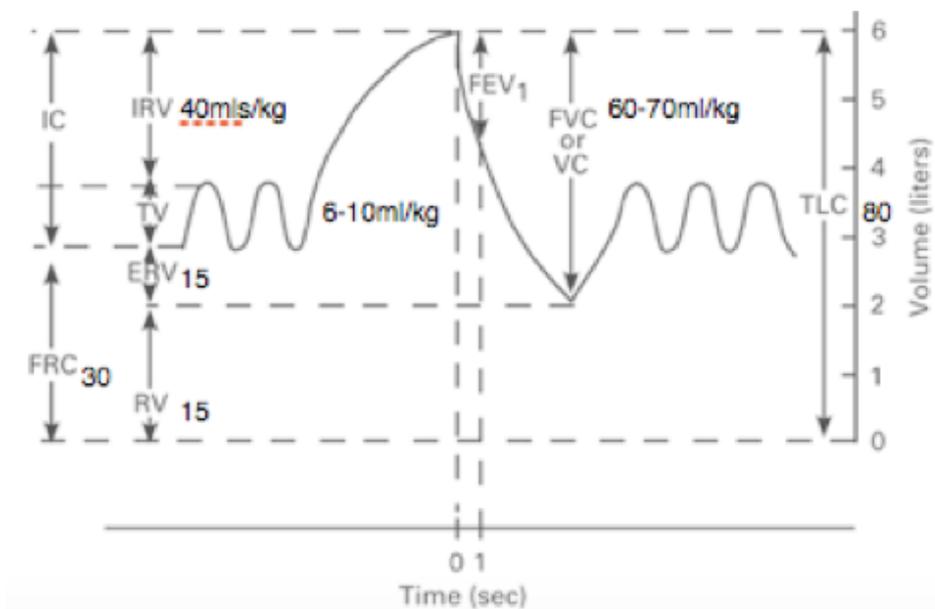
## Volumes

- Prime role of lung = gas exchange



## Static Volumes

- This = spirometry trace which includes a max insp & expiratory effort:
- Volumes:



- RV = residual volume (15-20ml/kg)
  - Volume left after forced expiration
- ERV (10-15ml/kg)
  - Volume forcefully expired after normal tidal exp
- IRV = (45ml/kg) volume inspired over norm tidal insp

All above values can be measured by spirometry.  
spirometry cannot measure RV

- Volumes added together = capacity
  - Total lung capacity (**75-80ml/kg**) (RV+ERV+TV+IRV)
  - Vital capacity (**60-70ml/kg**) (TV+IRV+ERV)
  - Functional residual capacity (**30ml/kg**) (ERV+RV)

## Tissue Hypoxia

- hypoxaemic hypoxia=
  - ▶ ↓FiO<sub>2</sub>
  - ▶ ↓ventilation - opioids, stridor, inadequate reversal
  - ▶ VQ mismatch - Ptx, effusion
  - ▶ Shunt
  - ▶ Impaired diffusion - oedema, aspiration
- Hypaemic hypoxia =
  - ▶ anaemia
  - ▶ COHb
- Circulatory = diff types of shock
- Histotoxic - cyanide

## Effects of Surgery/Anaesthesia on Function

- Anaesthesia:
  - ▶ FRC
    - decreases by 20% (diaphragm relaxes -> moves cranially & ribs move inward)
    - in obese up to 50%
    - use PEEP to mitigate effects
    - FRC maintained during ketamine anaesthesia
  - ▶ TV encroaches upon CC
    - ↳ worse in smokers, elderly, underlying resp disease
  - ▶ increased atelectasis -> increased shunt
  - ▶ intubation halves dead space
  - ▶ ↑risk of post op infection
  - ▶ response to hypercapnia and hypoxaemia blunted
- Surgery:
  - ▶ upper abdo/Tx surgery causes:
    - profound ↓lung volume
    - VC ↓ed by 50-60%
    - FRC ↓30%
  - ▶ peripheral surgery has minimal effects

## Risk factors for Pulmonary Complications

- patient:
  - ▶ abnormal findings on examination or CXR
  - ▶ smoking (within 8 weeks)
  - ▶ >50yr
  - ▶ lung disease incl pHTN
  - ▶ lots of co-morbidity eg OSA, COPD, heart failure, obesity
  - ▶ history of malignancy
  - ▶ albumin <30g/dl
- procedure factors:
  - ▶ long surgery
  - ▶ upper abdominal, thoracic surgery, neuro/head & neck, vascular

- ▶ emergency surgery
- ▶ residual NMB

# Assessment of Resp Function

## Preoperative

### HISTORY

- respiratory disease
- admissions to hospital/ICU
- find out baseline level of functioning
- symptoms (cough, sputum, fever, haemoptysis)
- smoking
- reversible disease and treatments (bronchodilation and steroids)
- screen for cardiac disease & OSA

### Roizen's Classification of Dysnoea:

- 0 – walk @ normal pace on level ground
  - I – walk as far as I like, provided I can take my time
  - II – specific street block limitation
  - III – around home only
  - IV – breathless @ rest
- ↳ ≥grade 2 should prompt for further investigation

### EXAMINATION

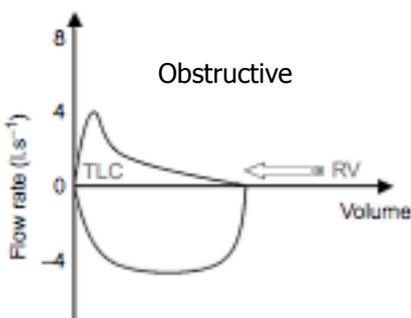
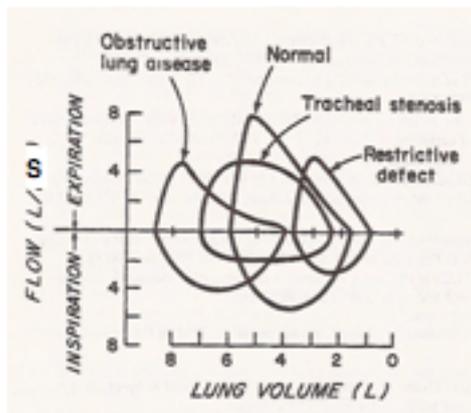
- SpO<sub>2</sub>
- focal respiratory signs
- RHF signs
- formal test of exercise tolerance:
  - ▶ stair climbing
  - ▶ 6min walk test - >2000feet correlates well with PFTs but impractical for those with limited mobility

### INVESTIGATIONS

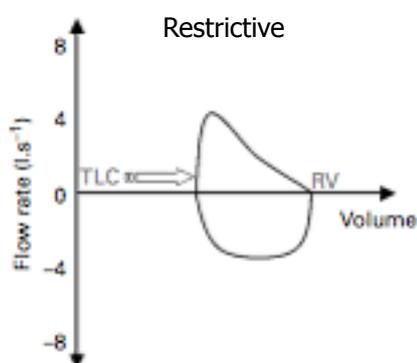
- **Peak Flow:**
  - ▶ best of 3 attempts,
  - ▶ age related,
  - ▶ normal = 400-600L/min
  - ▶ if <200 ≈ cough will be impaired
- **spirometry:**
  - ▶ FVC, FEV<sub>1</sub>, ratio (norm = 70%)
  - ▶ FEV<sub>1</sub> <1L = coughing & secretion clearance will be impaired
  - ▶ Obstructive = ratio <70% ≈ should check reversibility with bronchodilator
  - ▶ Restrictive = Norm or high ratio (>70%) + ↓FEV<sub>1</sub> & ↓FVC
  - ▶ if course of steroids - should rpt PFTs
  - ▶ should not order routinely by surgery (except thoracics) but for:
    - those with SOB & wish to differentiate from CVS disease
    - COPD & asthma
    - unable to functionally assess pre-operatively

- **flow-volume loops:**

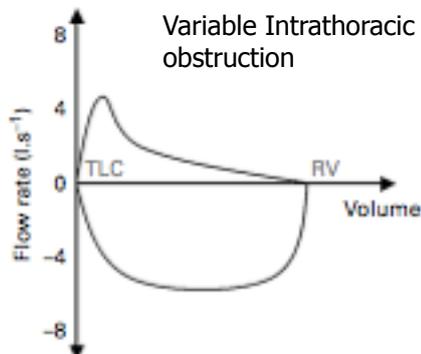
- information on obstructive,
- restrictive lung disease and extrinsic and intrinsic airway obstruction



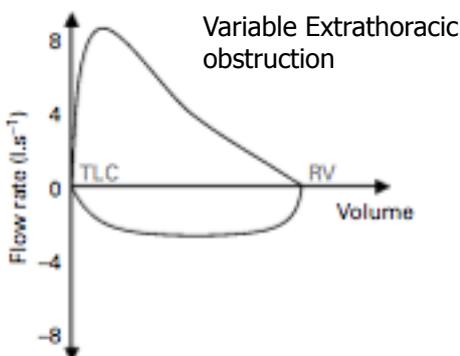
- ↑TLC - due to ↓AWR & optimise compliance
- ↓gradient upstroke: due to ↓ caliber airways
- ↓peak flow: due to ↑AWR & ↓recoil pressure
- ↓gradient downslope: due to:
  - ↓ caliber airways
  - earlier onset dynamic airways compression
- ↑RV - due to gas trapping



- ↓TLC - due to ↓ compliance
- N gradient upstroke
- ↓peak flow: due to start at lower lung volume
- ↑gradient downslope: due to:
  - fibrotic interstitium provides traction limiting dynamic compression
- ↓RV - due to later closing capacity



NB: pattern reversed in +ve PV



NB: pattern reversed in +ve PV

- **diffusion capacity (TLCO):**
  - ▶ differentiates restrictive pattern:
    - intrinsic =  $\downarrow$  DLCO  $\approx$  ILD
    - extrinsic = normal DLCO  $\approx$ 
      - Obesity
      - neuromuscular disease
      - Thoracic wall problems eg kyphoscoliosis
  - ▶ differentiate obstructive pattern:
    - emphysema =  $\downarrow$
    - other causes = normal
  - ▶ Isolated low DLCO:
    - smoking
    - Anaemia
    - R to L shunt
    - Pulmon vasc disease eg pHTN
  - ▶ diffusion of CO in a single breath held for 10 seconds (normal 17-25mL/min/mmHg)
  - ▶ can be given correct value for size
  - ▶ common to use percentage value compared to predicted
- ABG: CO<sub>2</sub> retention, PaO<sub>2</sub> on RA (used as baseline postoperatively)
- CXR:
  - ▶ reasonable indications to do:
    - >50
    - high risk surgery incl upper abdo, aorta, oesophageal, Tx surgery
  - ▶ low yield test
  - ▶ abnormalities are predictive of complications
- CT chest:
  - ▶ cysts, lungs, masses, pneumothorax, interstitial disease, PE, aorta integrity
- V/Q scans:
  - ▶ useful in predicting effect of a lung resection on pulmonary performance
- CPET:
  - ▶ most studied in lung resection
  - ▶ role in Ix unexplained SOB in non cardio-pulmonary surgery
  - ▶ max O<sub>2</sub> uptake & AT predict survival & post op complications

## Ventilator Pressure & Flow / Time

Pressure Ventilation:



Volume ventilation



### RISK INDEXs

- predicts post op resp failure
- Arozullah Risk index - gives % risk:
  - ▶ factors:
    - **type of surgery**
    - **emergency surgery**
    - COPD
    - albumin <30g

- urea >30mg/dl
- dependant functional status
- age >70
- ↳ bolded = most impt
- Canet Risk index:
  - ▶ 7 RFs to stratify into low/medium/high risk
  - ▶ RFs:
    - old
    - low pre-op O<sub>2</sub>
    - resp infection in past month
    - preop anaemia
    - upper abdo/thoracic surgery
    - surgery >2hrs
    - emergency surgery

# Strategies to ↓ Post Op Pulmonary Complications

## PreOperative

- quite smoking - best >8weeks
- regular resp meds eg bronchodilators
- pre-op steroids if havent been fully medically optimised
- delay elective surgery if resp tract infection
- only give Abx if LRTI
- pre-op inspiratory muscle training & chest physio:
  - ▶ breathing exercises
  - ▶ aerobic exercise
  - ▶ incentive spirometry
  - ▶ education on active breathing & forced expiration techniques

## Intraoperative

- chose procedure lasting <4hrs if possible
- avoid open upper abdo surgery if possible
- regionals or spinal/epidural - if high risk pt
- avoid long acting NMBs if very high risk
- laparoscopic surgery where possible
- lung protective ventilation:
  - ▶ VT 6-8ml/kg of IBW
  - ▶ PEEP 6-8cmH<sub>2</sub>O
  - ▶ recruitment manoeuvres every 30min( ↳ ARDS NET & IMPROVE STUDIES)

## Postoperative

- early mobilisation
- upright positioning
- regular clinical review -> aggressive early treatment
- chart RR and SpO<sub>2</sub>
- PAR/MET or HCU/ICU care
- physiotherapy & incentive spirometry
- titrated O<sub>2</sub> for 72hrs esp if on opioids:
  - ▶ anaesthesia can alter central chemoreceptors ⇒ ↓CO<sub>2</sub> stimuli for up to 72hrs
  - ▶ target SpO<sub>2</sub>/PaO<sub>2</sub>/PaCO<sub>2</sub> based on pre-op levels
  - ▶ use venturi masks if hypoxic vent drive
- humidified O<sub>2</sub>
- careful fluid balance

- invasive monitoring
- analgesia (simple -> LA -> advanced)

## HDU/ICU Admission

**Table 5.1** Reasons for post-operative ICU or HDU admission

Predictable	Unpredictable
Borderline or established failure of gas exchange preoperatively	Unexpected perioperative complications (e.g. fluid overload, haemorrhage)
Intercurrent respiratory infection (with urgent surgery)	Inadequate or ineffective regional analgesia with deterioration in respiratory function
Chest disease productive of large amounts of secretions (e.g. bronchiectasis)	Unexpectedly prolonged procedure
Major abdominal or thoracic surgery	Acidosis
Major surgery not amenable to regional analgesia and necessitating systemic opioids	Hypothermia
Long duration of surgery	Depressed conscious level/slow recovery from anaesthetic/poor cough

## Respiratory Infections (in Adults)

- delay elective surgery if have thought LRTI with fever & cough
  - ↳ chest auscultation is not an accurate predictor ∴ should still cancel if no added sounds
- simple coryza - can continue if:
  - ▶ no pre-existing resp disease
  - ▶ not having major abdo/thoracic surgery
- laryngospasm more likely if recent URTI but now asymptomatic

## Smoking

- Cigarette smoke contains
  - ▶ nicotine (a highly addictive substance)
  - ▶ + >4700 other chemical compounds
  - ▶ 43 compounds are known carcinogens
- smoking is associated with morbidity eg COPD, lung Ca, IHD, vascular disorders
- Smoking associations:
  - ▶ increased airway irritability – coughing, laryngospasm and desaturation on induction & airway manipulation
  - ▶ increased mucous production + decreased mucociliary clearance -> increased risk of respiratory events during anaesthesia and post-operative atelectasis/pneumonia
  - ▶ ↑risk in:
    - asthma,
    - abdominal surgery
    - obesity
  - ▶ CO binds to Hb and reduces O<sub>2</sub> carriage
    - may reaxh 15% in heavy smokers
    - gives a false reading on SpO<sub>2</sub>
- ∴ consider:
  - ▶ avoid des
  - ▶ deeper anaesthesia with opioids, NMBs
  - ▶ avoid instrumenting airway (but ↑ed risk of laryngospasm)
  - ▶ LA to cords

**Positive effects of quitting**

1 day = lower carboxyhaemoglobin and nicotine levels, and improved oxygen delivery to tissues

3 Weeks = improved wound healing

6-8 weeks = reduced sputum volumes (back to non-smoking levels) and improved pulmonary function

6 Months = improved immune function

# By Disease

## Asthma

- = reversible airway obstruction from:
  1. bronchospasm
  2. mucous production
  3. inflammation
- differentiation from COPD:
  - ▶ childhood symptoms
  - ▶ diurnal variation - worse in am
  - ▶ specific triggers ie allergens
  - ▶ no prev smoking
  - ▶ ↑ed response to Rxs

## Preoperative HISTORY

- cough
- wheeze
- SOB/SOBOE
- sputum
- precipitants/triggers
- treatments
- admissions - ICU admission
- exercise tolerance
- recent viral infections
- allergies (NSAIDS and aspirin)
  - ↳ 21% aspirin induced asthma in adult asthmatics (paeds 5%)

## EXAMINATION

- SpO<sub>2</sub>
- RR
- WOB
- hyperinflation
- wheeze

## INVESTIGATIONS

- serial PF's at home
- ABG's rarely required
- ECG: RA or RVH, R axis, RBBB

## MANAGEMENT

- treat based on severity:
  - ▶ mild (PEFR >80% predicted & min symptoms):
    - just continue routine meds
    - give short acting  $\beta$  agonist prior to surgery
  - ▶ moderate (PEFR 50-80%):
    - add inhaled corticosteroid to routine  $\beta$  agonists 1/52 prior to op
  - ▶ severe (<50% & >20% diurnal variation):
    - consider course of preoperative steroids (prednisone 40mg OD for 7/7)
    - resp physician review
- if any URTI symptoms then postpone surgery
- assoc of nasal polyps in atopic patients
- drugs:
  - ▶ beta-agonists (salbutamol, salmeterol)

- ▶ anti-cholinergics (ipratropium)
  - ▶ inhaled steroids (fluticasone, beclomethasone)
  - ▶ oral steroids (prednisone)
  - ▶ leukotriene antagonists (montelukast)
  - ▶ mast cell stabiliser (disodium cromoglycate)
  - ▶ phosphodiesterase inhibitor (aminophylline)
- stop smoking for 8weeks!!
  - preoperative physio
  - nebulised salbutamol for premedication
  - consider RA
- 
- do not GA pt for elective surgery who is not optimised

## Intraoperative

- incidence of bronchospasm/laryngospasm during routine op in asthmatics ~2%
    - ↳ ↑ed if >50yrs & active disease
  - decrease bronchospasm associated with intubation (alfentanil 5mcg/kg, lignocaine 1mg/kg, LA to cords)
  - avoid histamine releasing drugs (morphine, mivacurium, atracurium)
  - short acting agents ideal
  - potent opioids helpful ie alfentanil or remi
  - avoid intubation if possible - may provoke bronchospasm
  - ventilation:
    - ▶ limit PIP
    - ▶ lower VT
    - ▶ prolonged I:E ratio (1:3 - 1:5)
    - ▶ watch for air trapping ⇒ barotrauma, ↑CO<sub>2</sub>, acidosis
  - humidify all gases
  - avoid NDNMBs if possible: consider roc/suggamadex as neostigmine muscarinic effects can cause bronchospasm
  - prophylactic anti-emetics as aspiration ⇒ bronchospasm
  - extubate sitting high
- 
- severe bronchospasm:
    1. FiO<sub>2</sub> 1.0 + PEEP
    2. bag
    3. nebulised salbutamol 5mg
    4. IV salbutamol (load 10mcg/kg [max 250mcg] -> 5-20mcg/min)
    5. adrenaline 10mcg boluses -> 0.1-1mcg/kg/min)
    6. MgSO<sub>2</sub> (load 4g IV -> 1g/hr)
    7. ketamine increments 10-20mg IV
    8. increase volatile
    9. ipratropium 0.5mg nebuliser
    10. aminophylline 5mg/kg IV
    11. hydrocortisone 200mg IV
    12. permissive hypercapnia in order to maintain O<sub>2</sub>

## Postoperative

- monitoring for: bronchospasm, sputum retention, atelectasis, infection, respiratory failure
- severe disease -> admit to ICU
- epidural anaesthesia (if indicated)
- titrated O<sub>2</sub>
- review steroids and dose daily

# COPD

## Preoperative

### HISTORY

- include 2 diseases:
  - ▶ chronic bronchitis
    - = chronic productive cough for 3 months in 2 successive yrs where other causes excluded
    - small airway inflam  $\Rightarrow$  air trapping  $\Rightarrow$   $\downarrow$ VQ matching & poor resp mm mechanics
  - ▶ emphysema :
    - = histological diagnosis of abnormal & permanent enlargement of airspaces distal to terminal bronchioles
    - loss of structure  $\Rightarrow$   $\downarrow$ gas transfer &  $\downarrow$ VQ match
- ↳ can be hard to distinguish 2 clinically
- cough, SOB, wheeze + sputum production
- frequency of exacerbations & hosp visits
- $\downarrow$ exercise capacity - stairs & 6MWT
- nutritional status - alb <30g  $\approx$  predictor of problems
- home O<sub>2</sub> - indications:
  - ▶ PaO<sub>2</sub> <54
  - ▶ PaO<sub>2</sub> 55-60 **and** pHTN or polycythaemia
- MET's
- limitations on ADL's

### RISK FACTORS

- smoking
- occupational exposure to dust and atmospheric pollution
- poor socio-economic status
- repeat viral infections
- alpha 1 anti-trypsin deficiency
- regional variation

### EXAMINATION

- emphysema: thin, cachexia, increased WOB, hypoxic, develop CO<sub>2</sub> retention late
- chronic bronchitis: overweight, oedema, poor respiratory effort, CO<sub>2</sub> retention
- most patients = combination of both
- walk patient (correlates well with pulmonary function tests)

### INVESTIGATIONS

- SpO<sub>2</sub> on RA
- PFTs & DLCO - obstruction &  $\downarrow$ DLCO
- CXR - not mandatory but useful if recent change in symptoms
- ABG - perform if SpO<sub>2</sub> <95% or significant  $\downarrow$ ex tolerance
- ECG: right heart strain, right ventricular hypertrophy
- ECHO (PHT and RHF)
- FBC – polycythaemia
- Albumin

### GOLD Criteria for COPD

- All PFTs must have FEV<sub>1</sub> < FVC < 0.7 ie fix with obstructive problem:

	Severity	FEV1
Stage 1	Mild	>80%
Stage 2	Mod	50-80%
Stage 3	Severe	30-50%

	Severity	FEV1
Stage 4	Very Severe	<30%

## MANAGEMENT

- stop smoking - 8weeks
- daily bronchodilators -  $\beta$  agonists & antimuscarinics
- cont normal meds periOp
- if persistent symptoms ie wheeze, functional limitation  $\Rightarrow$  give periop steroid course +/- resp physician r/v
- if severe symptoms - plan for HDU/ICU post op
- other preop strategies:
  - ▶ pre-Op Chest physio ot  $\downarrow$  sputum burden
  - ▶ pulmonary rehab
  - ▶ nutritional supplementation

## Intraoperative

- as per asthma
- avoid GA if possible
- epidural can  $\downarrow$  opioid need & be beneficial post op
- avoid intubation if possible however, there are many patients who must be intubated
- be vigilant for pneumothorax

## Postoperative

- extubate sitting up
- mobilise early
- chest physio
- titrated O2
- antibiotics early for any symptoms or signs of infection
- continue all respiratory medications
- HDU

## Bronchiectasis

- similar features to COPD:
  - ▶ inflamed & easily collapsible airways
  - ▶ airflow obstruction
  - ▶ frequent hospitalisations
- diagnosis:
  - ▶ daily purulent sputum cough
  - ▶ CT: bronchial wall thickening & dilatation of bronchi & bronchioles
- acquired condition from
  - ▶ infection - CF, rheumatic disease, infections, allergic bronchopulmonary aspergillosis
  - ▶ impaired drainage - dyskinetic cilia, smoking
  - ▶ airway obstruction - FB aspiration
  - ▶ +/- defect in host defence

## Preoperative

### HISTORY

- causes: cystic fibrosis or recurrent infections
- cough, SOB, sputum

### EXAMINATION

- SpO2
- chest signs

- PHT signs

## INVESTIGATIONS

- CXR: bronchiectatic changes = signet ring changes
- spirometry
- ABG
- sputum culture

## MANAGEMENT

- may need 3-10 days prior to major elective surgery of:
  - ▶ preoperative IV antibiotics - guide by sputum cultures
  - ▶ physio
- pre-op prednisone (if indicated) - if on chronic then ↑dose by 10mg
- ?colonised with *Pseudomonas aeruginosa* -> ceftazidime + gentamycin OR imipenem + gentamycin
- may co-existing asthma as well
- consult with respiratory physician - need total optimisation to ↓risk
- maximal bronchodilators (nebulisers)
  
- postpone surgery if in an exacerbation

## Intraoperative

- RA if possible
- if GA required will need regular suctioning of secretions
  - ↳ ∴ (unless v short procedure) need ETT to aid in suctioning
- appropriate analgesia
- extubate sitting up

## Postoperative

- physio immediately
- titrated O<sub>2</sub>
- IV antibiotics for ≥3d post op
- nutrition
- consult with respiratory physician if concerned

# Cystic Fibrosis

- periop complication rate in CF ~10%

## Preoperative

- abnormal Cl<sup>-</sup> channel in epithelial cells (CFTR) on chromosome 7
- causes:
  - ▶ loss of Cl<sup>-</sup> transport ⇒ abnormal Na/Cl balance needed to make thin mucus layer
  - ▶ CF = viscous mucus which less well cleared by cilia
- exocrine failure of excretion:
  - ▶ respiratory:
    - progressive lung disease - frequent LRTI, chronic hypoxaemia, cor pulmonale
    - nasal problems - chronic sinusitis & polyps
  - ▶ pancreatic - insufficiency & Cf related DM
  - ▶ hepatobiliary problems - 2nd to obstruction: biliary cirrhosis, portal HTN
  - ▶ meconium ileus
  - ▶ infertility
  - ▶ osteoporosis
  - ▶ chronic recurrent abdo pain
  - ▶ coagulopathy from decreased absorption of vitamin K

## HISTORY

- neonates -> meconium ileus

- frequent chest infections - almost all have symptoms of bronchiectasis
  - nutritional requirements
  - other systems
  - nasal polyps
  - right heart failure signs (cor pulmonale)
- 
- medications: pancreatic enzyme supplementation and antibiotics

## **EXAMINATION**

- weight
- respiratory reserve
- new chest signs
- general examination; cachexia

## **INVESTIGATIONS**

- FBC
- U+E
- sputum (m, c, s)
- CRP
- ECG
- CXR (bullae, pneumothorax) -> CT if indicated
- spirometry (obstructive picture)
- ABG
- ECHO (pulmonary hypertension)
- functional Ax: 6MWT or CPET

## **MANAGEMENT**

- exclude or treat active chest infections
- chest physio prior to OT
- discuss with respiratory physician
- GORD cares
- may come forward for lung or hepatic transplantation

## **Intraoperative**

- as per Bronchiectasis
- avoid opioids to minimise constipation
- high risk of barotraumas
- use sevo (less irritant to airways)
- avoid nasal tubes if possible

## **Postoperative**

- close monitoring post op for chest infections (increased risk)
- early extubation
- monitor nutrition - 80% will have malabsorption
- early mobilization
- physio early
- multi-modal analgesia with opioid minimisation
- may need HDU
- humidified O2
- post op ventilation if FEV1 <1litre

## **Restrictive Lung Disease**

- ↓TLC, ↓Vc & ↓Vt
- due to disease of lung parenchyma, pleura, chest wall or neuromuscular apparatus

## Preoperative

### HISTORY and EXAMINATION

- intrinsic or extrinsic

- intrinsic = **pulmonary fibrosis** from

1. idiopathic (sarcoidosis, idiopathic interstitial pneumonias, cryptogenic organising pneumonia)
2. autoimmune disorders (RA or scleroderma)
2. inhaled dusts (asbestosis, coal, copper)
3. allergenic substances (farmers lung, bird fanciers lung)
4. drugs (amiodarone, chemo/radio)
5. ARDS

- extrinsic = **mechanical causes** outside lung

1. kyphoscoliosis
2. ankylosing spondylitis
3. severe obesity
4. abdominal pathology causing splinting of diaphragm

- WOB optimised by taking many, small breaths
- often like sitting up right
- exercise tolerance important

### INVESTIGATIONS

- as guided by cause
- ABG (if CO<sub>2</sub> high then has very late stage disease)
- PFT's & DLCO
  - ▶ do if not repeated in last 8wks
  - ▶ volumes will be reduced
  - ▶ VC <15ml/kg ≈ severe dysfunction
- CXR

### MANAGEMENT

- intrinsic = oral steroids, immunosuppressants, lung transplant
- extrinsic = treat cause if possible
- discuss with patients respiratory physician

## Intraoperative

- use RA if possible
- minimise IPPV & airway instrumentation
- IPPV; high rate, small volume, minimise PAP
- if on steroids may need an increased dose
- monitor closely for pneumothorax

## Postoperative

- ICU/HDU
- NIV
- extubate sitting up
- titrated O<sub>2</sub>
- physio
- analgesia
- mobilise early
- treat respiratory infection early

# Obstructive Sleep Apnoea

- see obesity SSU

## Sarcoidosis

- systemic disease characterised by formation of non-caseating granulomas which occur anywhere and then heal via fibrosis.
- sites affected:
  - ▶ Lung (50%)= mediastinal lymphadenopathy, pleural, peri-bronchial and alveolar granulomata, bronchial stenosis.
  - ▶ Airway mucosa = nose, nasopharynx, tonsils, palate or larynx
  - ▶ Heart (20%) = RVF, conduction abnormalities via infiltration ie VT, cardiomyopathy
  - ▶ Other:
    - CNS - dementia, seizures, headache
    - Skin
    - Uveitis
    - Hypercalcaemia

## Preoperative

### HISTORY

- 20-40yrs
- black
- pulmonary symptoms (cough, SOB, decreased ETT)
- ENT symptoms (nasal obstruction, sinusitis)
- cardiac symptoms
- steroid dose and duration
- other immunosuppressants

### INVESTIGATION

- Bloods: organ dysfunction & hypercalcaemia (Rx with steroids)
- CXR: pulmonary changes
- ECG: conduction abnormalities, RVH
- PFT's: restrictive pattern
- DLCO: decreased capacity
- ABG: hypoxaemia

### MANAGEMENT

- steroids
- immunosuppressants

## Intraoperative

- avoid GA if possible
- consider epidural if significant respiratory disease & major abdominal surgery
- give appropriate steroid cover

## Postoperative

- sit up
- good analgesia
- chest physio
- incentive spirometry

# Anaesthesia After Lung Transplant

- indications for surgery post transplant:
  - ▶ complications of transplant

- ▶ complications of immunosuppressive Rx
- ▶ underlying condition ie emphysema, pulmon fibrosis, primary pHTN, CF
- ▶ unrelated

- reason for transplant:
  - ▶ systemic disease burden
  - ▶ immunosuppression (on cyclosporine)

## Effects of Transplant

- transplanted lung denervated ⇒ problems below anastomosis:
  - ▶ ↓cough reflex
  - ▶ ↓mucosal sensitivity
  - ▶ ↓ciliary clearance
 ↳ ⇒ ↓sputum clearance & ↑risk of post op infection
- **not** affected =
  - ▶ airway reactivity
  - ▶ hypoxic vasoconstriction
- lymphatic drainage severed -> re-established after 4 weeks -> initially very vulnerable to APO
- acute allograft rejection can occur at any time and v difficult to differentiate from infection
- if double lung transplant:
  - ▶ heart denervated ∴
    - higher resting HR (90-100)
    - ↑risk of arrhythmia

## Preoperative

### HISTORY

- status of graft: episodes of rejection, immunosuppression levels
- evidence of rejection or infection
- if single lung transplant:
  - ▶ try to identify status of native lung
  - ▶ DLT and OLV may be useful
- obliterative bronchiolitis & chronic rejection:
  - ▶ signs = dry cough & SOB
  - ▶ 8-12 months post transplant
- prev trachy - ?subglottic stenosis
- Evaluate other disease systems - immunosuppressive effects
- coordinate with transplant service

## Intraoperative

- stress dose steroids
- aseptic technique
- if ETT need to protect anastomosis:
  - ▶ tube just through cords
  - ▶ inflate cuff very carefully & monitor pressures
- if LMA/BMV - risk of silent aspiration as no carinal cough reflex
- if DLT -> use fiberoptic scope to place
- protective lung vent strategies ++
- minimise neuromuscular blockade
- minimise opioids
- careful fluid balance - restrictive strategy
- aim to extubate early

## Postoperative

- ICU
- monitor for infection or rejection