OBESITY & PULMONARY PERSPECTIVES

Vishwanath gella

EPIDEMIOLOGY OF OBESITY

- Obesity- responsible for approximately 365,000 preventable deaths in 2000 second only to tobacco smoking
- Between 1980 and 2004- the prevalence of obesity doubled from 15% to 33% in adults and the prevalence of overweight tripled from 5.5% to 17% in children
- India-prevalence of abdomenal obesity- 44% of women versus 25.6% of men corresponded with that of metabolic syndrome

International Journal of Cardiology 97 (2004) 257– 261

Int J Obes Relat Metab Disord. 2001 Nov;25(11):1722-9.

High prevalence of diabetes, obesity and dyslipidaemia in urban slum population in northern India.

Misra A, Pandey RM, Devi JR, Sharma R, Vikram NK, Khanna N.

Department of Medicine, All India Institute of Medical Sciences, New Delhi, India. anoopmisra@hotmail.com

Erratum in:

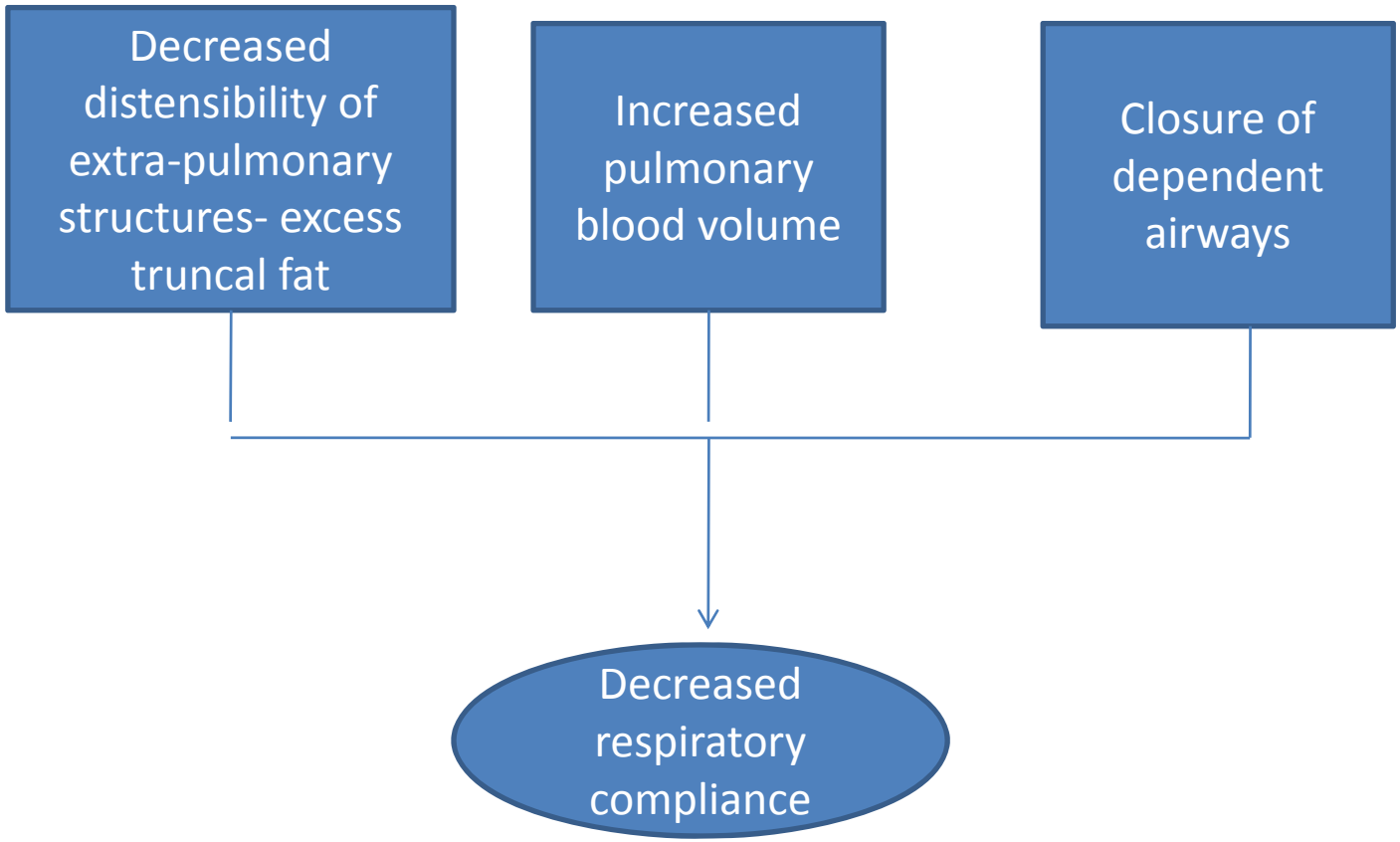
Int J Obes Relat Metab Disord. 2002 Sep;26(9):1281..

- Based on body mass index (BMI), obesity was more prevalent in females (15.6%) than in males (13.3%)
- classifying obesity based on percentage body fat (%BF), 10.6% of males and 40.2% of females were obese
- High waist-hip ratio (WHR)- observed in 9.4% of males and 51.1% of the females

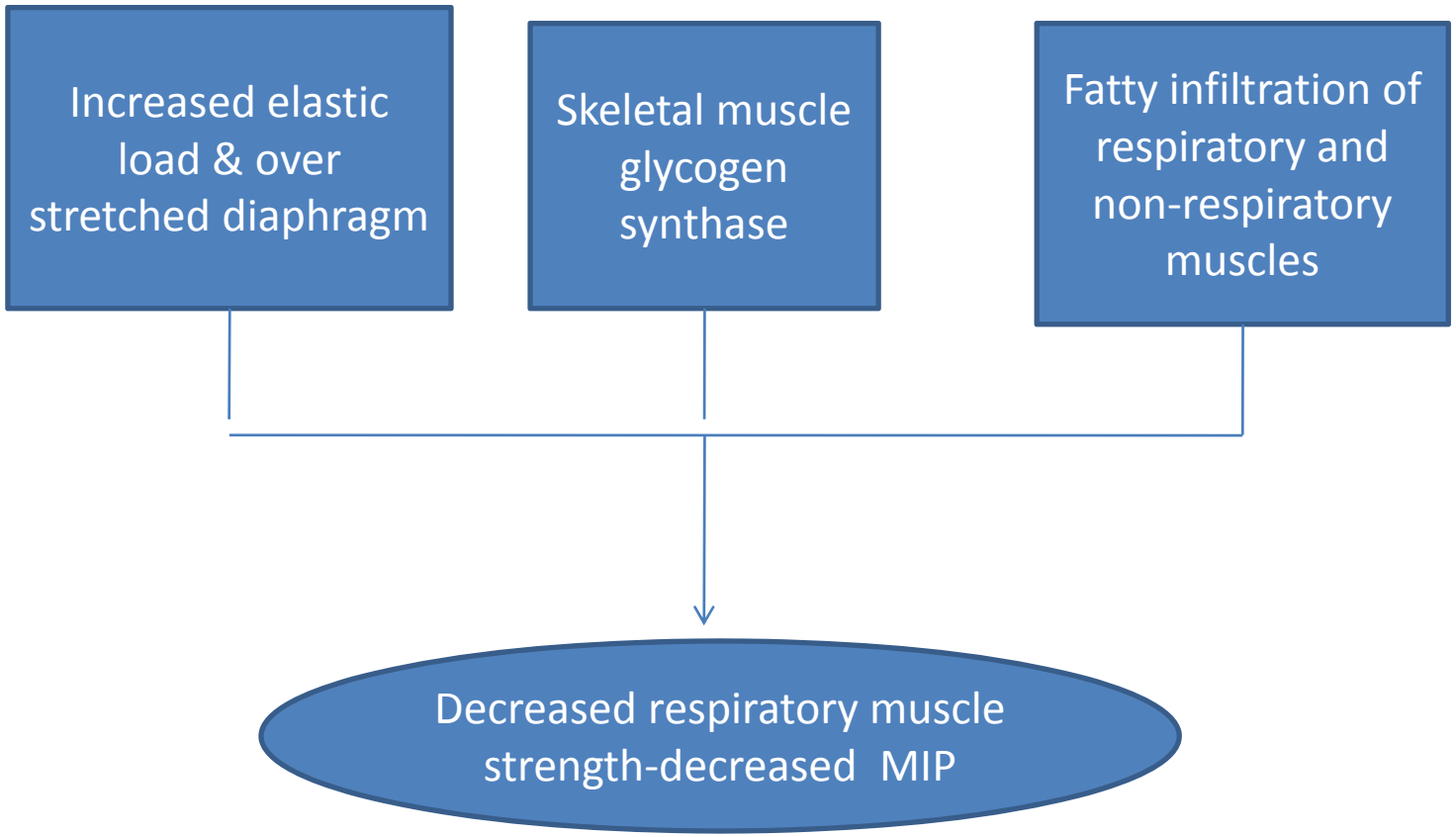
Phenotypic Features of Obesity and the Metabolic Syndrome in South Asians

- Average BMI lesser in south asians
- High percentage of body fat despite having lower BMI
- Morbidities(DM, HTN, Dyslipidemia) occur at lower BMI
- Altered distribution of fat
- “Metabolically obese” although having normal BMI

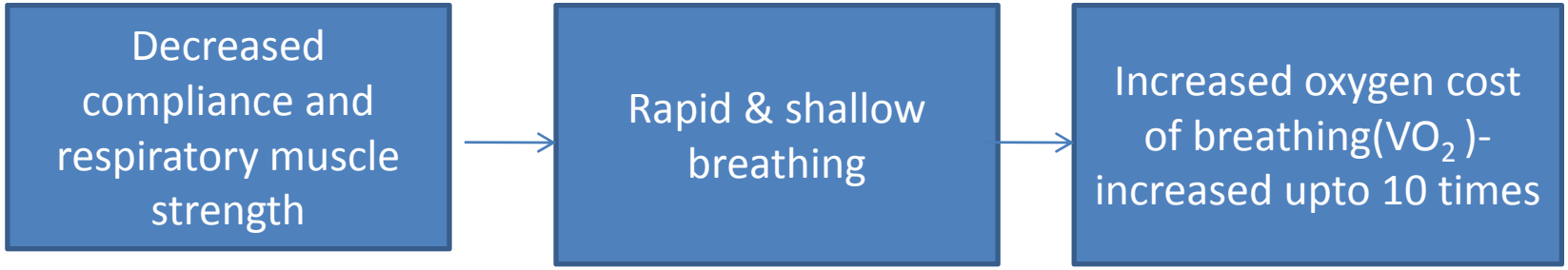
Altered resting and exercise respiratory physiology



Respiratory muscle strength



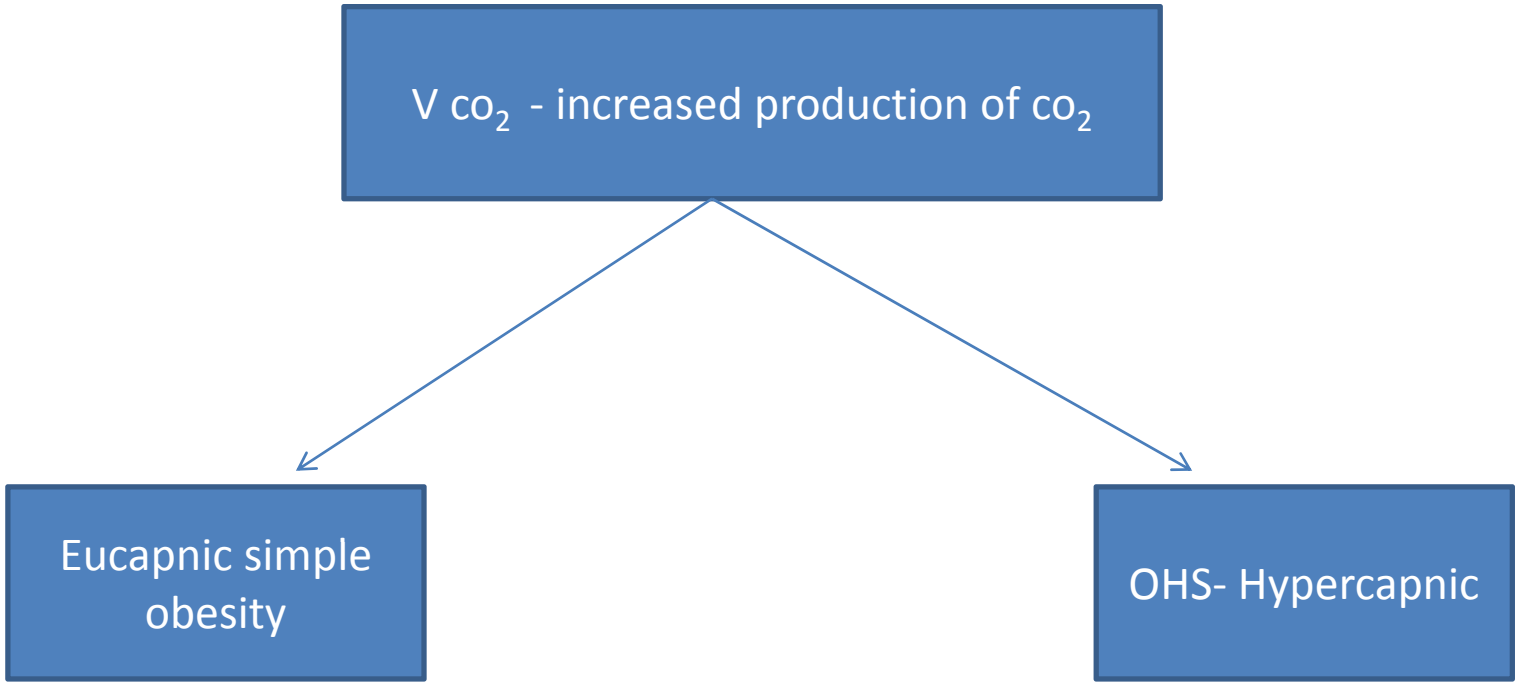
INCREASED WORK OF BREATHING AT REST



- Kress and colleagues- 16% reduction in oxygen consumption (VO_2) seen after elective intubation, mechanical ventilation, and anesthesia from their resting baseline values as compared with a less than 1% reduction in eight controls

Effect on spirometry,DLCO & gas exchange

- Vital capacity-decreased secondary to decreased respiratory compliance(decreased lung volumes), increased thoracic gas trapping
- Decreased FEV1- age, type of fat distribution and severity of obesity
- FEV1/FVC- normal or increased (rarely decreased)
- DLCO- increased, decreased or normal
- Gas exchange-atelectasis of basal lung portion, altered v/p ratio, increased P(A-a)o_2, hypoxemia


V co_2 - increased production of co_2
Eucapnic simple obesity
OHS- Hypercapnic

Inflammatory and immunological consequences of obesity

- Adipose tissue -endocrine organ
- Leptin upregulates TH1 response
- Adiponectin which decreases inflammation-reduced
- Recruitment of monocytes and secretion of numerous adipokines
- Body fat distribution- visceral or central obesity(more inflammatory markers)- Insulin resistance
- Weight loss- decrease in proinflammatory cytokines and increase in adiponectin

Adipose tissue-role in inflammation and insulin resistance

Leptin-immunoregulation

Obesity & OSA

- Obstructive apnea
- Hypopnea
- Criteria
- Prevalence- in Western countries 24% of men and 15% of women have OSA and 4% of men and 2% of women have OSA with symptoms of sleepiness
- India- A semi-urban community in Delhi, Duration: Two years (2003 to 2005)- prevalence rates of 13.74% and 3.57%, respectively, for OSA and OSA syndrome (OSAS)

- How does obesity lead to narrowing of the upperairway?
- 1 S.D increase BMI – 4 fold increase in OSA
- 10% weight gain-32% increase in the AHI and a sixfold increase in the risk for developing moderate to severe OSA
- Peppard and colleagues- showed that a 10% weight loss was associated with a 26% decrease in the AHI (preferential visceral weight loss)

- OSA leading to obesity-reduces physical activity and exercise performance, reduces energy metabolism, and reduces motivation secondary to

  depression
- Dietary weight loss
- Medical weight loss- sibutramine(no sufficient evidence)
- Bariatric surgery- BMI>40 kg/m^2 or >35 with significant co-morbidity such as OSA
- CPAP

•Effect of weight loss on AHI is not long lasting and many studies have shown recurrence of OSA despite maintaining weight loss

•Most patients require CPAP therapy after bariatric surgery

•Auto-titrating CPAP- beneficial in the post-operative period

Obesity-hypoventilation syndrome(OHS)

- OHS

-Obesity-(defined as a body mass index [BMI] >30 kg/m2),

-sleep-disordered breathing(90%-OSA, 10%-sleep hypoventilation)

-chronic daytime alveolar hypoventilation (defined as $PaCO_2$>45 mm Hg and PaO_2 <70 mm Hg)

OHS- Diagnosis of exclusion, other conditions leading to hypoventilation should be ruled out before making a diagnosis of OHS

•A retrospective analysis of 126 patients with OHS and found the 1-, 2-, and 5-year survival rates to be 97%, 92%, and70%, respectively

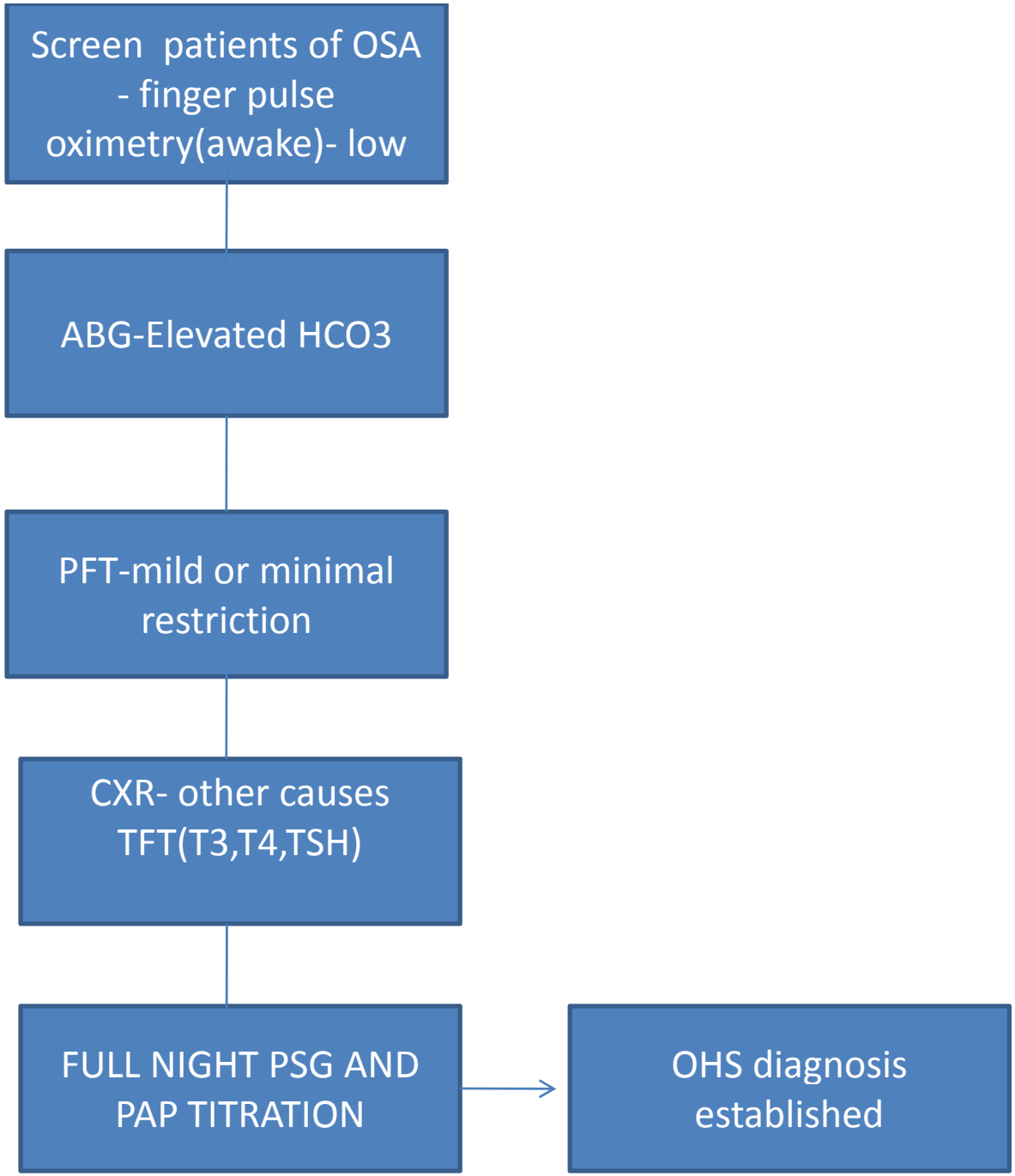
•5-year survival rate in CPAP adherent patients with OSA was 96%.

•18-month mortality rate -patients with untreated OHS was higher than that for the control cohort of 103 patients with obesity alone (23% versus 9%)

Pathophysiology of OHS

- CNS responses- Hypercapnic ventilatory response and hypoxic ventilatory responses are blunted
- Effective treatment of sleep-disordered breathing leads to a reversal in these defects in the majority of patients
- Leptin resistance- leptin is thought to increase the hypercapnic ventilatory drive

- ABG-increased serum HCO3- BEST SCREENING TOOL
- Hypoxemia during wakefulness

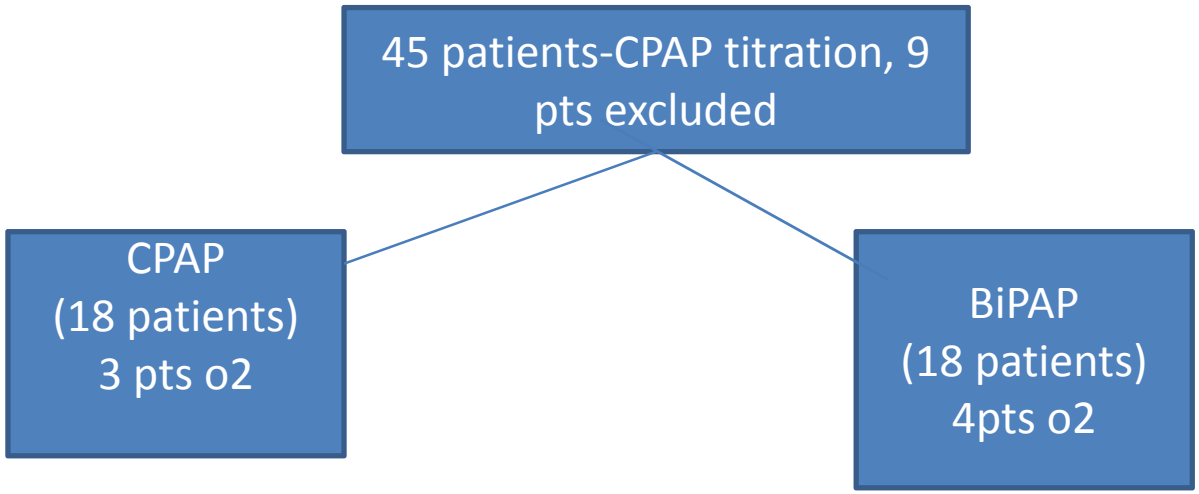

Screen patients of OSA - finger pulse oximetry(awake)- low
ABG-Elevated HCO3
PFT-mild or minimal restriction
CXR- other causes TFT(T3,T4,TSH)
FULL NIGHT PSG AND PAP TITRATION
OHS diagnosis established

Thorax. 2008 May;63(5):395-401. Epub 2008 Jan 18.

Randomised trial of CPAP vs bilevel support in the treatment of obesity hypoventilation syndrome without severe nocturnal desaturation.

Piper AJ, Wang D, Yee BJ, Barnes DJ, Grunstein RR.

Respiratory Failure Service, Royal Prince Alfred Hospital, Missenden Rd, Camperdown, Sydney, NSW 2050, Australia. ajp@mail.med.usyd.edu.au



- After 3 months of treatment- No significant difference in the day time hypercapnia, hypoxemia, compliance with treatment and quality of sleep

Other options

- Weight reduction
- Nocturnal oxygen therapy
- Tracheostomy
- Medroxy-progesterone- small studies, mixed results

  -impotence and venous thromboembolism-adv eff
- Average volume assured PSV(consistent tidal volume and combined with the comfort of PSV)

Obesity cardiomyopathy and pulmonary hypertension

- Obesity is a independent risk factor for CHF
- Suspected in obese patients without HTN, DM, CAD
- Diastolic dysfunction> systolic dysfunction
- Weight reduction-reverses systolic and diastolic dysfunction
- Obesity can lead to pulmonary hypertension by causing OSA

Obesity and thrombo-embolic disease

- Mechanism
- Obese females & Oral contraceptive pills- higher risk of PE & DVT
- Relative risk for DVT & PE- depends on age
- Obese individuals- at risk of recurrent PE(9.3%-normal BMI, 16.7%- over-weight, 17.5%- obese)

Obesity and ALI

- Conceptually- inflammation associated with obesity is thought to increase the lung injury in pts with ALI/ARDS
- Studies- obese patients no increase in mortality
- Confounding factors- DVT prophylaxis, tidal volume not given according to IBW

OBESITY AND ASTHMA

- Is asthma associated with obesity?
- Does excess weight gain increase the risk of developing asthma and worsen the control of asthma?
- Does weight loss leads to improved asthma control?

OBESITY AND ASTHMA

- Modest correlation between adult asthma prevalence and obesity with RR or odds ranging from 1.0-3.0

Prospective Study of Body Mass Index, Weight Change, and Risk of Adult-onset Asthma in Women

Carlos A. Camargo, Jr, MD; Scott T. Weiss, MD; Shumin Zhang, MD; Walter C. Willett, MD; Frank E. Speizer, MD

- Nurses health study-86,000 nurses(4 year study), odds of developing asthma 2.7 times higher in women with BMI > 30 kg/m2, odds 4.7 in women with weight gain of 25 kg, dose-response effect of asthma noted

- Common predisposing factors-Environmental factors, genetic factors(beta 2 receptor polymorphisms, TNF-alpha haplotypes), OSA & GERD
- Increasing BMI was associated with increasing severity of asthma
- Medical weight loss & surgical weight loss studies – improvement in asthma control

Physiological consequences of obesity relevant to asthma

- Cohort of 1000 adults- significant association between obesity and asthma but no significant association between obesity airway inflammation as measured by eNO
- Sutherlands and colleagues- 4 groups of adults, obese and non-obese, with and without asthma, systemic inflammation is increased in obesity and type 2 cytokines increased in asthma but mechanism of obesity-asthma relationship is not secondary to systemic inflammation secondary to obesity(elevated exhaled NO and sputum eosinophils not found)

- Obese asthma and severity-Lessard colleagues, National asthma survey, ACRN- poorer asthma control in obese although the severity may not change
- Differential response to controller therapy- attenuated biological response to ICS(peters-golden, sutherland colleagues)
- May require higher doses of ICS

Obesity and airway management

- BMI >26 kg/m^2 - difficult ventilation via mask(3 fold) and difficult endotracheal intubation(10 fold)
- Pre-op assesment- review of medical records, history of difficult intubation, h/s/o OSA
- Most important step- anticipation of difficulty
- Optimization of various factors- positioning, pre-oxygenation, intubating devices and alternative airway tools

Positioning& pre-oxygenation

- Positioning

  -Classic sniffing position

  -Ramped position

  -25^{o} reverse trendlenberg position

- Pre-oxygenation

  -Forced vital capacity breathing(8 breaths, 100%, 1 minute) vs 3 minute tidal volume ventilation technique

Pre-oxygenation….

- obesity impairs the effectivenss of pre-oxygenation
- Strategies to improve FRC

  -adoption of sitting position and pre-oxygenation

  -application of CPAP at 10 cm for 5 min f/b PEEP at 10 cm for 5 minutes

  -BiPAP 17/7 before rapid-sequence intubation

Mask ventilation and tracheal intubation

- Difficult airway- difficult mask ventilation or difficult tracheal intubation
- Predictors of difficult airway:
- DMV(difficult mask ventilation) – obesity, age> 55 years, no teeth and stiffness
- Difficult intubation-
- limited neck mobility or mouth opening
- Short sterno-mental or thyro-mental distance
- Receding mandible
- Neck circumference> 40 cms
- Mallampatti score >3
- Presence of OSA, DM
- MRI/CT scans

- Awake intubation using a flexible fiber-optic bronchoscope is considered the method of choice

  when treating an obese patient with anticipated

  difficult airway
- Video-laryngoscopy

Rapid sequence induction

- No RCT'S
- Risk of acid aspiration syndrome
- Cricoid pressure
- Failed RSI-risky
- FOB intubation with sedation-safer

- Extra-glottic devices-
- LMA-difficult intubation, paramedical staff, short surgeries(CI-at risk of aspiration, laryngospasm)
- ILMA(superior for obese patients)

Obesity in ICU

- Common complications
  - Thromboembolic disease
  - Aspiration
  - Abdominal compartment syndrome
- Ventilation difficulties
- Not to be taken for granted

Aspiration

- GERD is increased in obese individuals
  - Increased intra abdominal pressures
  - Decreased LES pressures
  - Increased incidence of hiatus hernia
  - Impaired gastric mobility
  - Use of narcotic analgesics
- Use of PPI & proper positioning
  - May decrease effects of acid aspiration
  - Fear of increased pneumonia

Ventilatory & weaning difficulties

- Narrow upper airway
- Inability to clear secretions
- Impaired central drive
- Decreased respiratory muscle endurance
- Increased intra abdominal pressures
- Reduced chest wall & lung compliance
- Basal atlectasis & V/Q mismatch
- Increased cardiac pre & after load

- Large observational studies
  - a/w longer ICU stay & ventilation in trauma victims
- Medical ICUs results are conflicting
- Prophylactic NIV shown to significantly decrease re-intubation in single study
- Positioning could hold the key
  - Reverse trendenlenberg position @ 45 degrees inclination a/w increased tidal volumes & low RR

Not to be taken for granted

- Airway management
- Venous access
- Hemodynamic monitoring
- Nursing care
  - Skin folds
  - Turning difficulties
- Nutritional support
  - Increased protien breakdown
  - Calorie calculation is difficult, hypocaloric high protein diet
  - ABW= (Actual – IBW)0.25 + IBW

Drug dosing

- Altered vol of distribution(vd), binding and elimination
- Relative decrease in lean body mass and water content, increase in total body water and cardiac output
- Appropriate drug dosing- no evidence
- For lipophilic medications- larger vd -adjusted body weight(ABW) e.g: aminoglycosides
- ABW= (Actual – IBW)0.4 + IBW

Common drugs & their dosing

IBW	Actual BW	Adjusted BW	No evidence
Opioids & BDZ	LMWH(Ceiling dose)	UFH(PTTK monitoring)	Beta-lactams
Propofol	Thrombolytics(max ceiling dose)	Aminoglycosides	Amiodarone
Fluoroquinolones	Vancomycin		vasopressors
Corticosteroids			Inotropes
Neuromuscular blockers			

THANK U