Obstructive Sleep Apnea in Children

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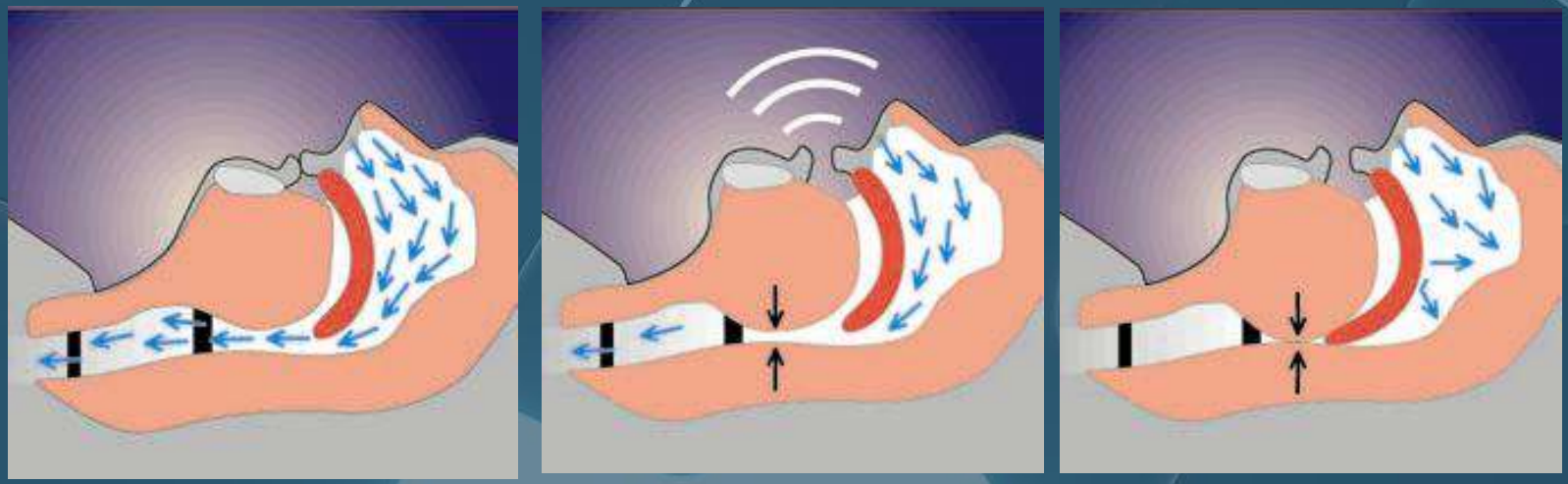
Objectives

- To challenge the current paradigm of OSA
  - Discuss the pathophysiological mechanisms of upper airway dysfunction
  - Discuss end-organ dysfunction associated with OSA
  - Discuss challenges in diagnosing OSA

Is This All Sleep Disordered Breathing Is?

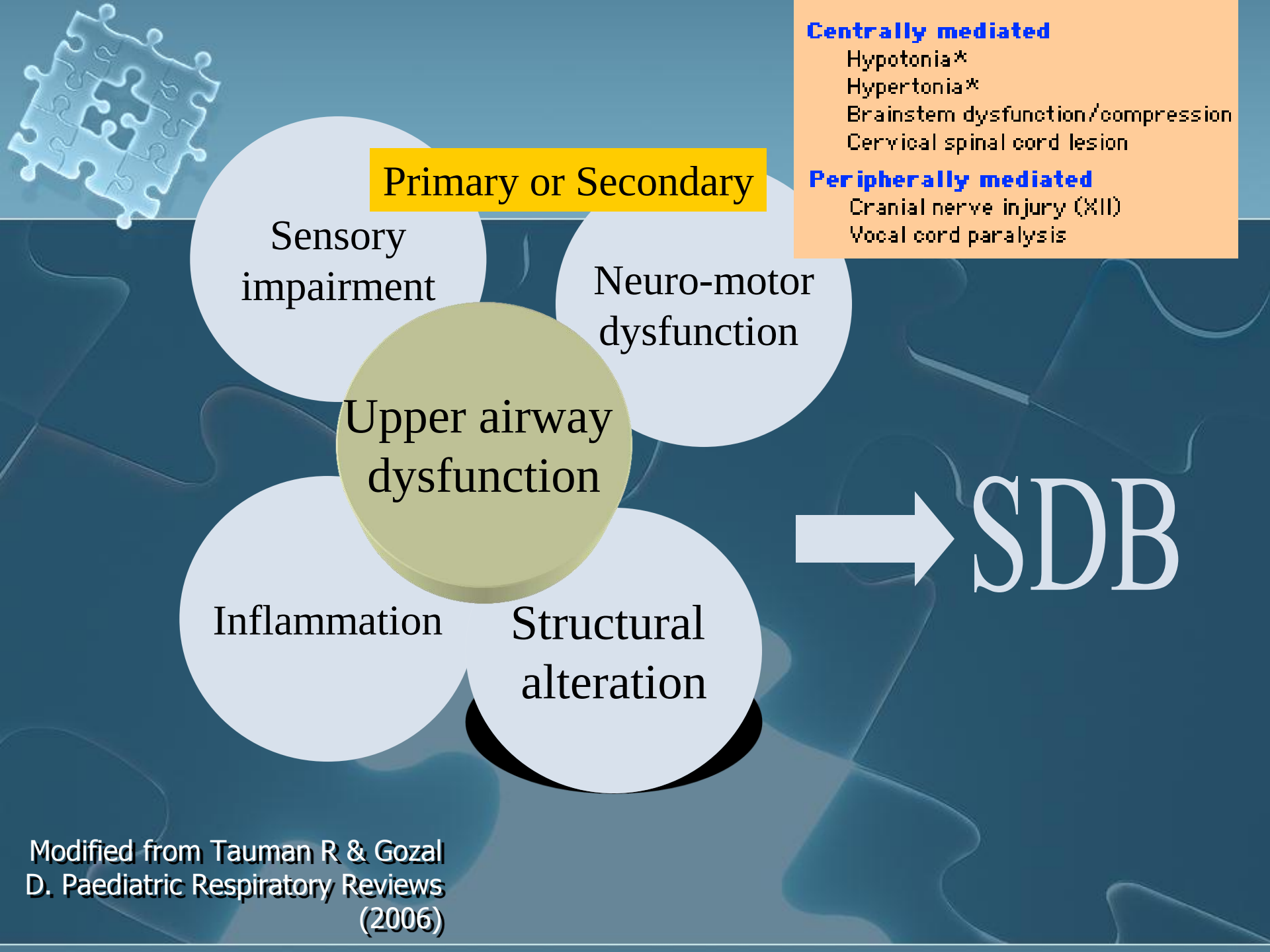


Proposed Phenotypes of OSA

Symptom	Type 1 OSA	Type 2 OSA
Daytime Sleepiness	+	+ + + +
Weight gain/Obesity	+	+ + + +
Hyperactivity	+ + + +	-
Lymphoid hyperplasia	+ + + +	+ +
Hypertension	+	+ + + +
LV Dysfunction	+	+ + + +
Insulin Resistance	-	+ + + +
Psychiatric Problems	+	+ + +

Other proposed types:
Craniofacial
Neuromuscular

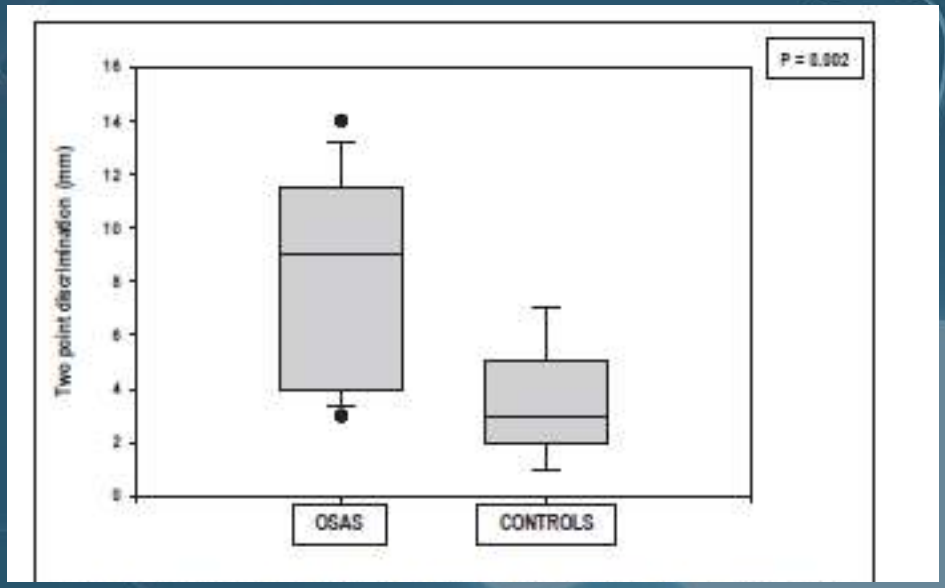
Gozal, Am Thor Proceedings 2008



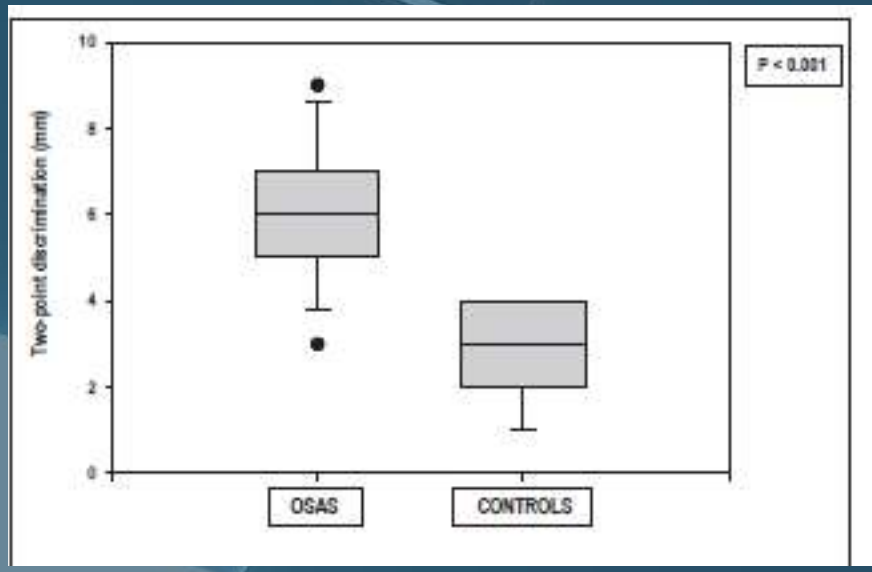
Modified from Tauman R & Gozal D. Paediatric Respiratory Reviews (2006)

Sensory Impairment

- Cause or effect?
  - Older children



Tongue



Anterior Palate

Tapia, 2010, Sleep

Hypotonia and SDB

Endoscopic data

Obstruction

- Deviated nasal septum
- Chronic rhinitis
- Adenoidal
- Tonsillar

Collapse

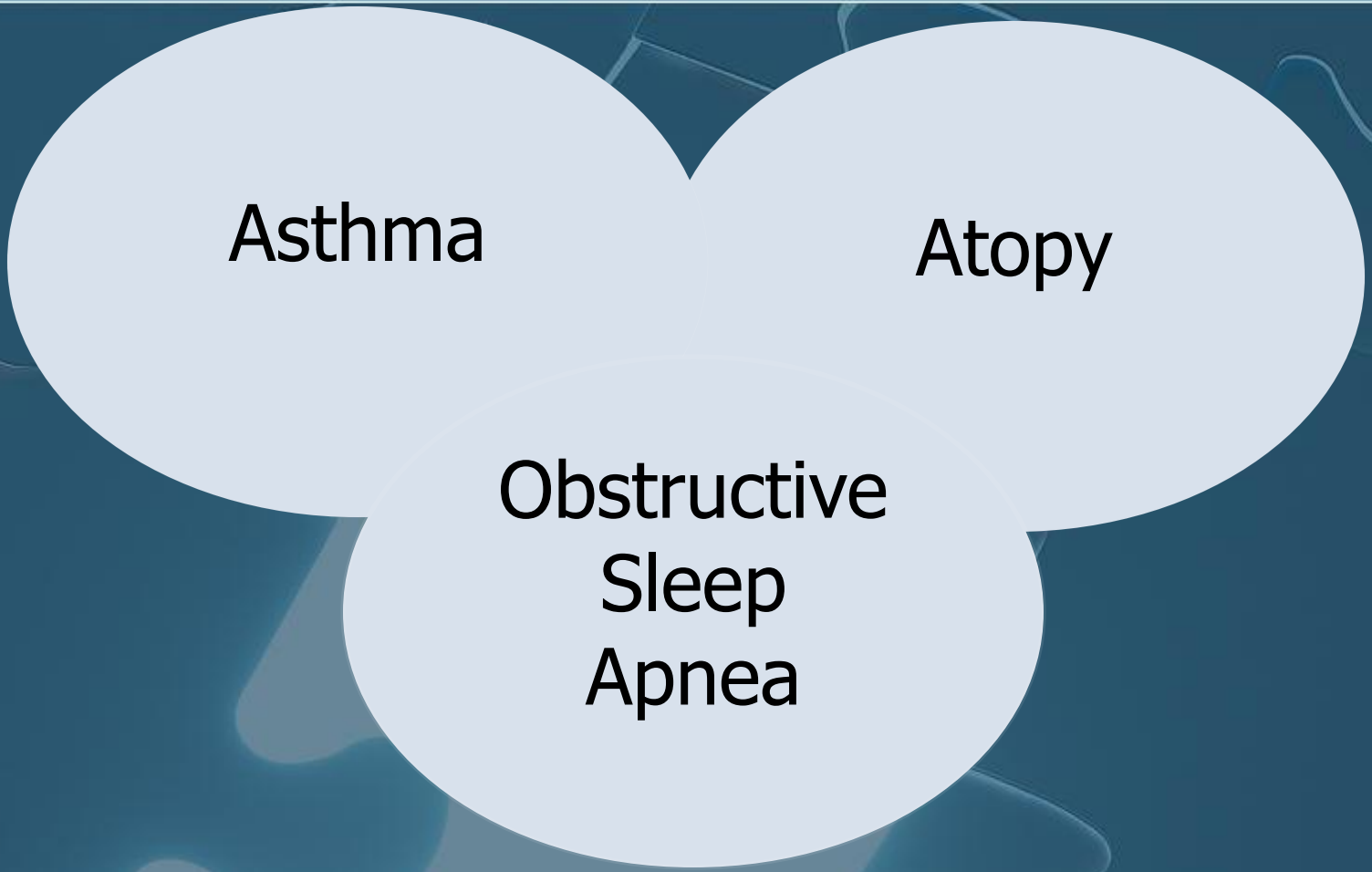
- Circumferential pharyngeal
- Lateral pharyngeal
- Laryngeal
- Tongue base

Summary for DS

- Down syndrome children exhibit a collapsing pattern more than other children with SDB
- Lingual collapse is significant but not universal
- Neuro-motor dysfunction overrides structural alterations in this group
- SNP may direct surgery and help avoid unnecessary adeno-tonsillectomies

- Fung et al. 2012, Archives of Otolaryngology

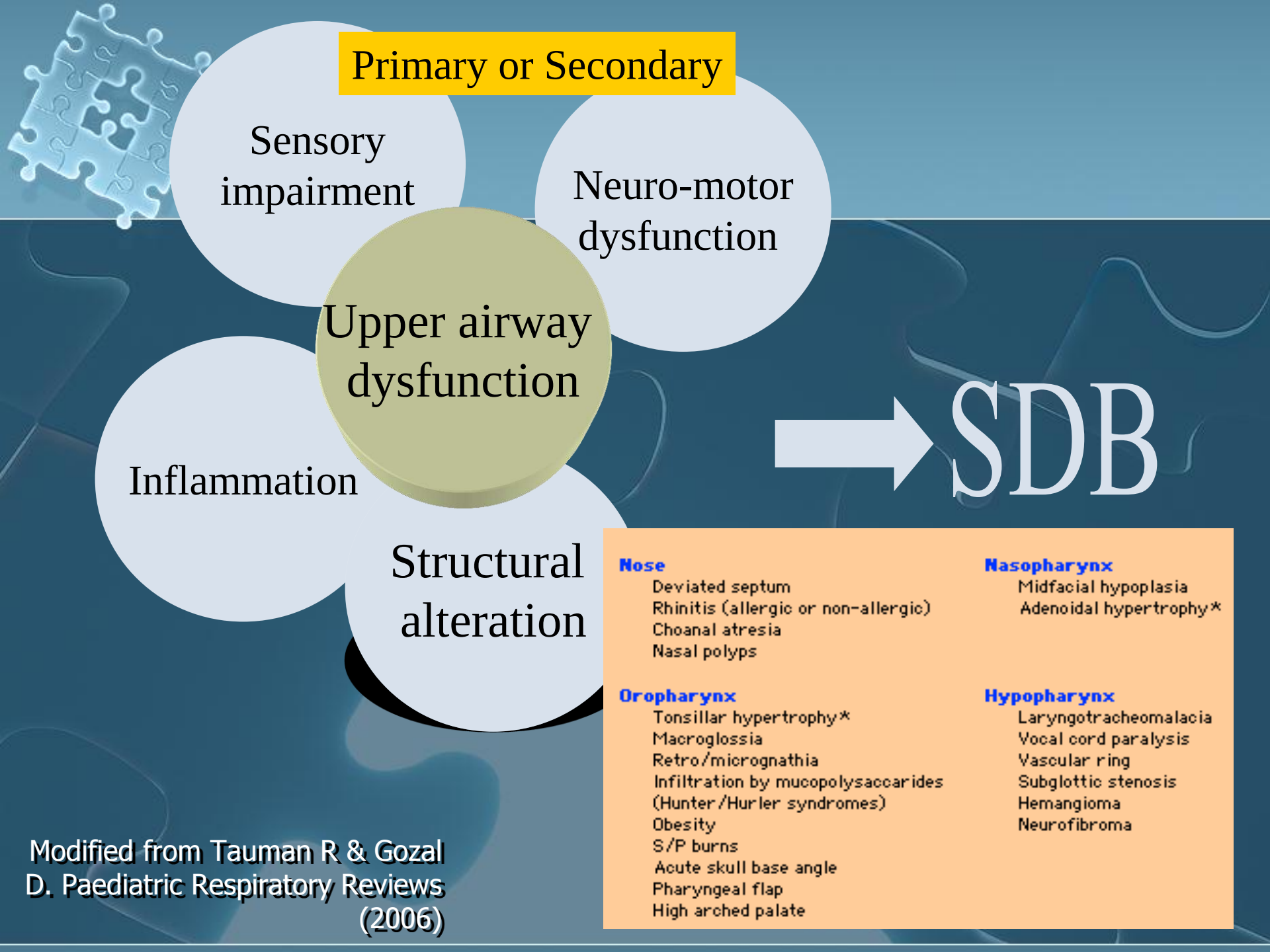
The United Airways Disease



Common genetic and environmental risk factors

Inflammation

- SDB
  - Inflammatory markers identified
    - CRP, oxidative species, cytokines, eNO
  - Evidence that treating inflammation improves SDB



Modified from Tauman R & Gozal D. Paediatric Respiratory Reviews (2006)

Obesity

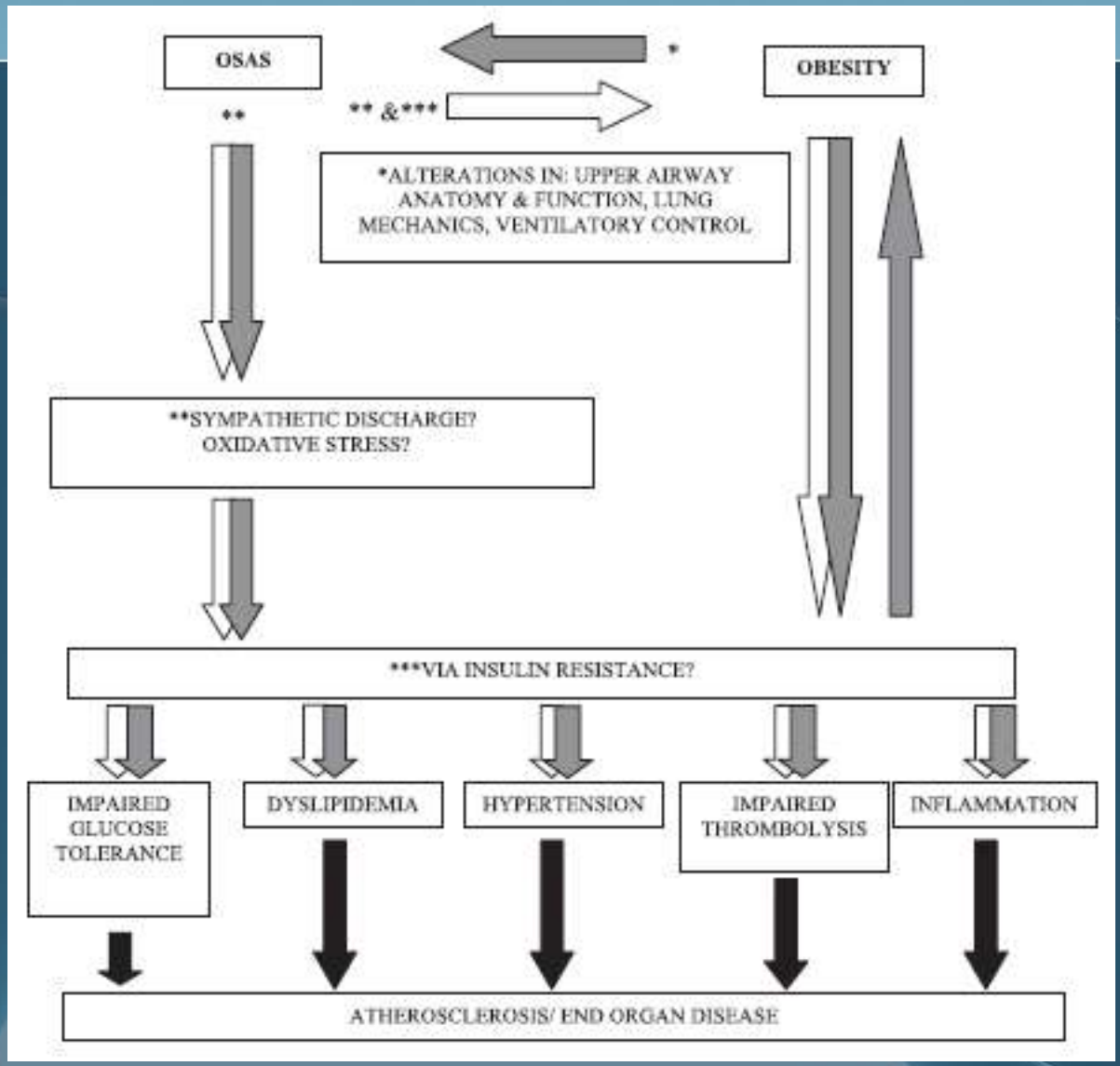
- Risk factor for OSAS (OR 4.5)
- Obesity more prevalent in studies evaluating SDB
- Surgery (T&A) does not cure majority of those with OSAS

Redline, AJRCCM, 2005
Bhatacharjee, AJRCCM, 2010
Mitchell, OtoHNS, 2004

Obesity

- Pathophysiology:
  - Anatomic factors
    - Hormonal, inflammatory
    - Possible soft tissues restricting airway
    - Craniofacial structure
  - Functional factors
    - Increased airway collapsibility
      - Neuromotor tone, increased resistance
      - ? Possible higher Pcrit
  - Chest wall mechanics
  - Altered ventilatory responses

Childhood Obesity and SDB



Arens, 2010, J Appl Phys.

End Organ Dysfunction

- Metabolic Derangements
- Cardiovascular dysfunction
- Neurocognitive dysfunction

SDB and Metabolic Syndrome

- Adjusting for sex, age, race and prematurity, adolescents with OSA
  - Adjusted OR of Met S: 6.49 (95% CI, 2.52, 16.70)
  - Degree of AHI and lower minimum SaO_2 increased odds of Met S
- Adjusting for BMI and sex, OSA predisposed to
  - Increased insulin resistance
  - Higher BP
  - Higher LDL

Redline, 2007, AJRCCM

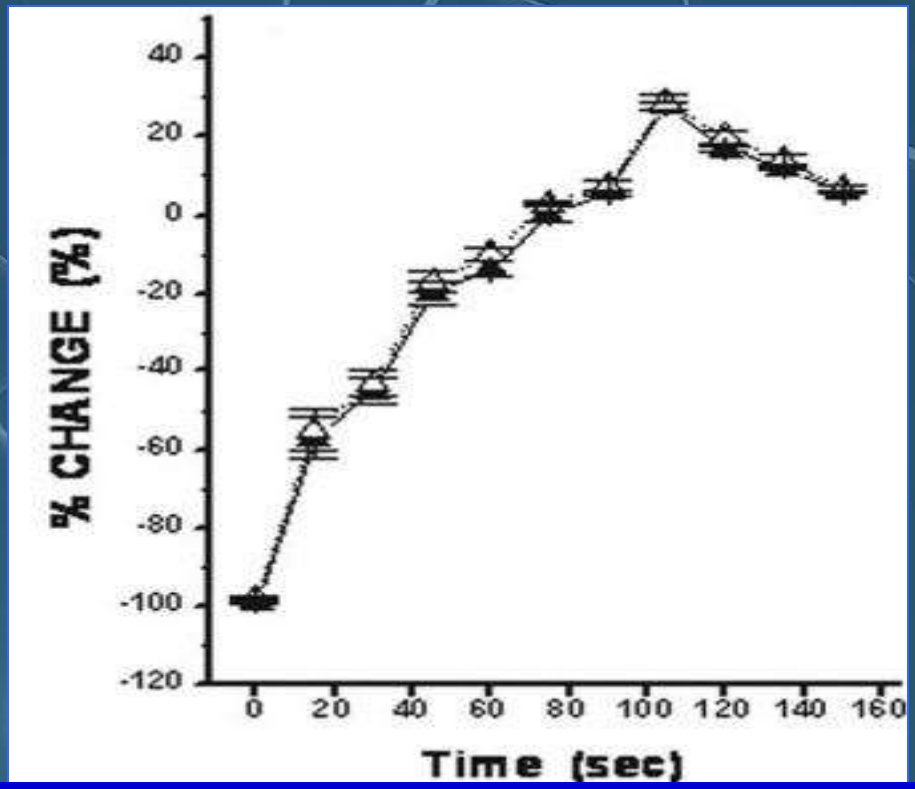
End Organ Dysfunction

- Cardiovascular morbidity
  - Blood pressure regulation
  - Cardiac function
    - End diastolic dysfunction
    - Left ventricular remodelling
  - Endothelial functioning
    - CRP, myeoid related protein 8/14

Amin. AJRCCM, 2002; Amin. Hypertension, 2008
Wang, J Am Coll Cardiol, 2007
Bhattacharjee et al, Prog CV Disease, 2009; Bhattacharjee Circulation, 2007; Bhattacharjee, Sleep, 2010

End Organ Dysfunction

controls

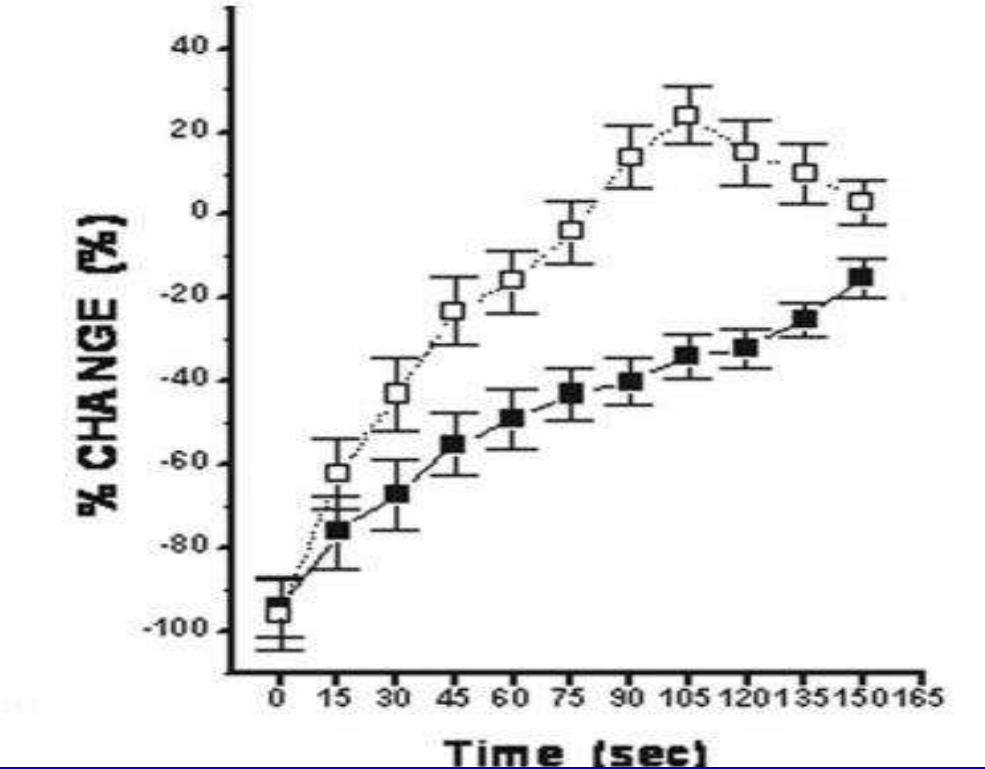


n=8

- Time to reach baseline cutaneous flow was (mean) 69 seconds

Bhattacharjee et al, Circulation, 2007

Pre and Post Adenotonsillectomy

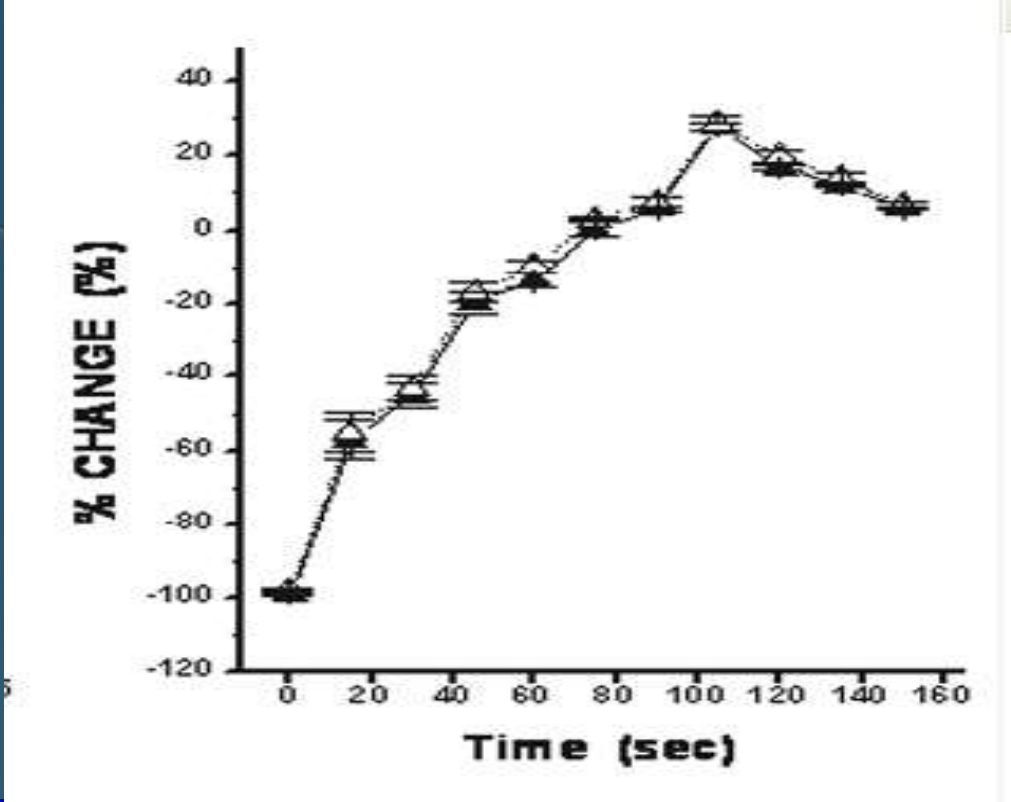


n=26

- Baseline cutaneous flow pre T+A was > 113 seconds
- Normalized to 60-80 seconds post surgery

Pre and Post Adenotonsillectomy

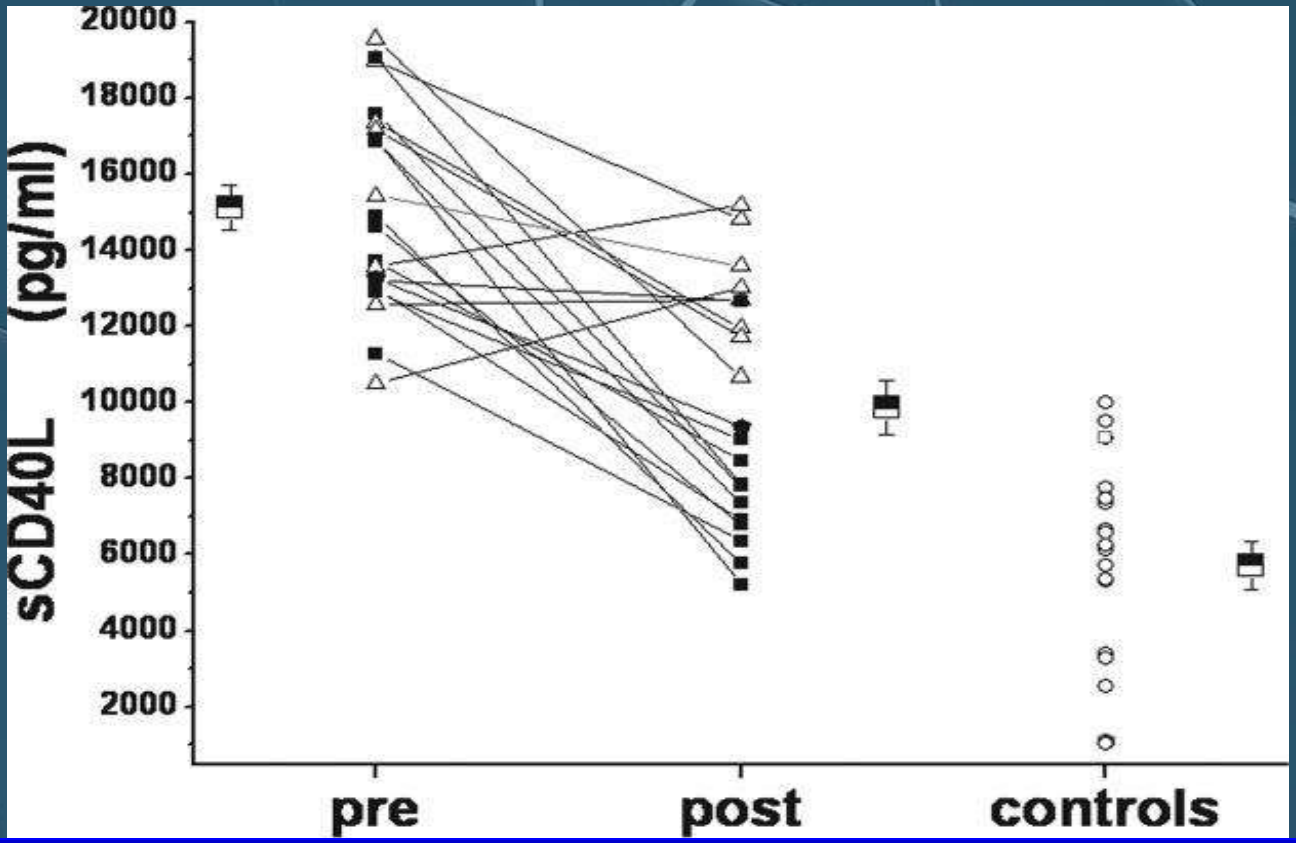
Family history of CVS Disease



n=6

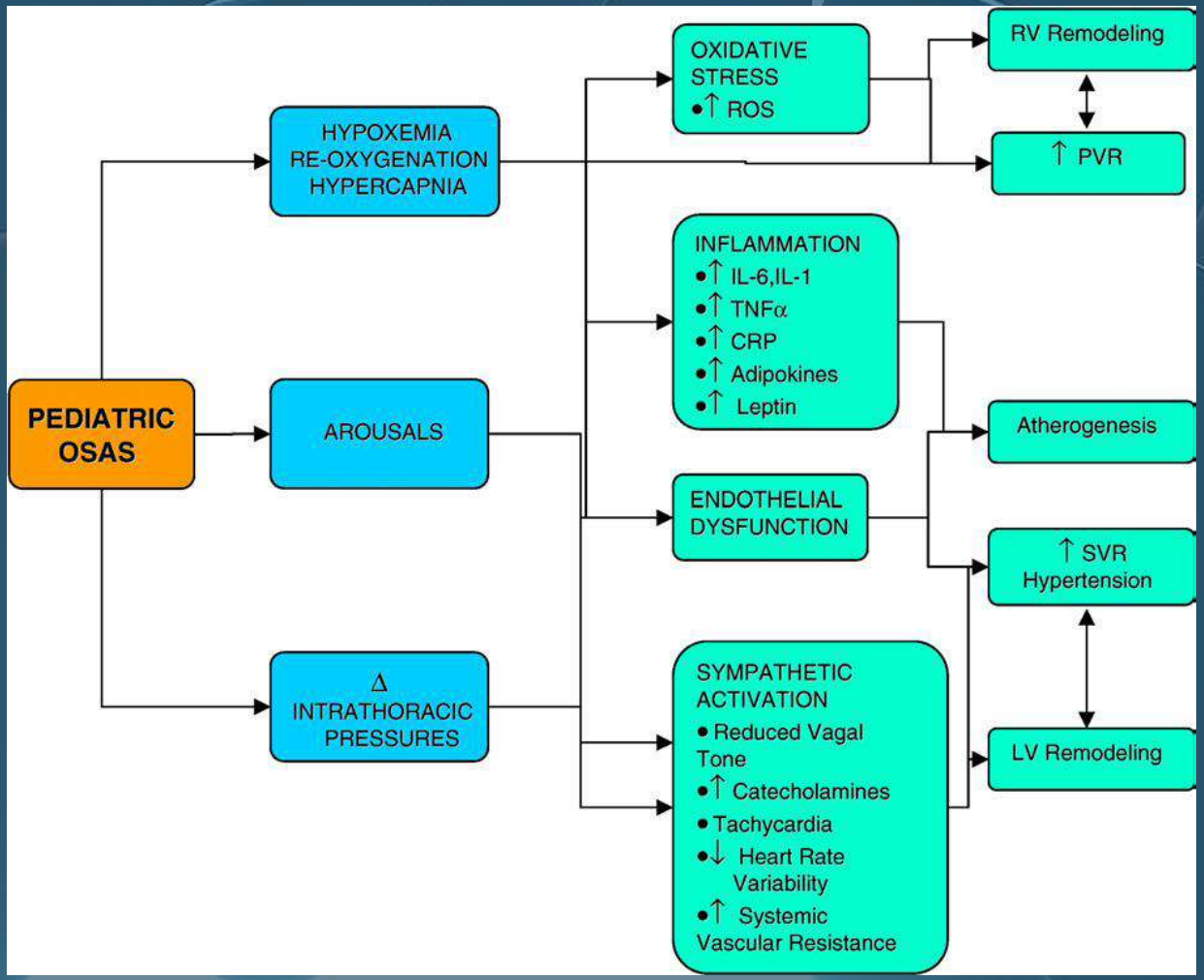
- Baseline cutaneous flow pre T+A was > 113 seconds
- Did not normalise post surgery

Inflammatory Marker: sCD40L



- sCD40L high in OSA but significantly reduced post T+A but still higher than controls

CV Dysfunction and SDB



Bhattacharjee, Sleep Medicine, 2010

OSA and Neurocognition

- Link between habitual snorers with OSA and neurocognition
- Link between habitual snorers without OSA and neurocognition
- Increased risks for neurobehavioural deficits in the context of OSA are
  - Obesity
  - Hypoxemia and sleep fragmentation

Beebe DW, Sleep 2006
Gruber R, Sleep 2007

OSA and Neurocognition

Variable	No-snoring (n=87)	No-OSA (n=112)	OSA (n=146)
Age	6.4 ± 0.3	6.4 ± 0.2	6.3 ± 0.3
BMI	16.7 ± .04	16.9 ± 0.5	17.0 ± 0.4
AHI	0.0 ± 0.0	0.8 ± 0.3	8.6 ± 2.2 *
Minimum SaO_2	93.1 ± 0.6	90.6 ± 0.7	81.6 ± 2.7 *
2 abnormal NC tests no (%)	0	3 (2)	16 (11) *
APOE e4 no (%)	0	16 (14)	72 (49) *

- APOEe4 allele increased among children with cognitive deficits and OSA

Summary

- OSA is common and can affect many children with physical and neurocognitive consequences
- OSA can be related to adenotonsillar hypertrophy but that is not the only factor to consider
- Evaluating factors that might contribute to the OSA will help target appropriate treatment