



DETECTING AIRWAY OBSTRUCTION IN YOUNG CHILDREN

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DECLARATION

Named inventor on patent owned by TKI Perth, licensed to Thorasys,
Canada.

no royalty payments!



DETECTING AIRWAY OBSTRUCTION IN YOUNG CHILDREN

- Airway obstruction secondary to
 - Narrowing of airway lumen by
 - Inflammation: central (croup) or peripheral
 - Mucus: peripheral
 - Foreign body: central
 - Congenital abnormality: central
- Central airway obstruction
 - likely to increase R_{aw}
 - detectable on spirometry
- Peripheral airway obstruction
 - likely to be heterogenous
 - may increase R_{aw} and decrease compliance (increase reactance)
 - maybe detectable on spirometry
 - likely to result in ventilation inhomogeneity



DETECTING AIRWAY OBSTRUCTION IN YOUNG CHILDREN

Techniques for measuring lung function in Preschoolers

- Spirometry
- Interrupter Technique
 - Rint (resistance)
- Plethysmography
 - Specific Resistance
- Gas dilution techniques
 - FRC, gas mixing indices
- Forced Oscillation
 - Resistance and Reactance (lung stiffness)



SPIROMETRY IN YOUNG CHILDREN

- Adult criteria not suitable for young children
 - Start of manoeuvre
 - No end-inspiratory pause
 - Rapid rise to peak flow
 - Back extrapolated volume <5%, <0.15L or <0.1L
 - End of manoeuvre
 - Exhale for 6 s
 - Plateau on volume-time/no change for 1 s
 - Repeatability
 - 2 largest FVC (or FEV₁) within 200ml or 5%

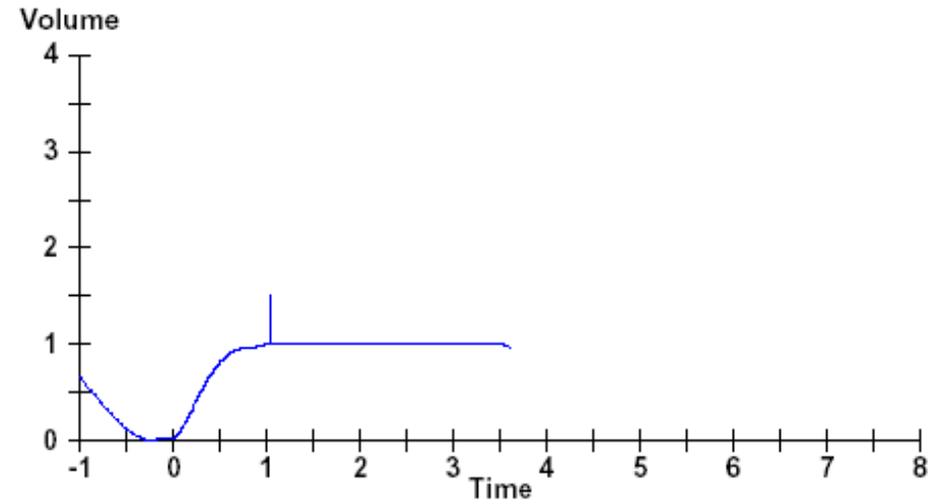
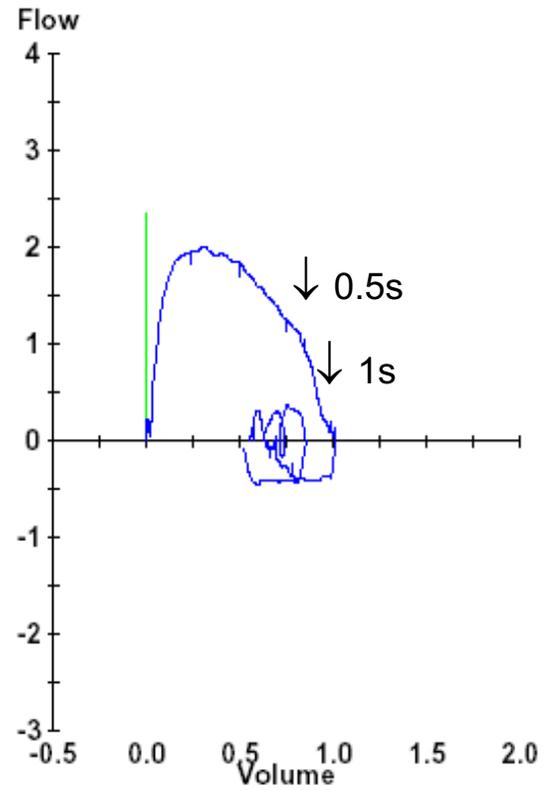


SPIROMETRY IN YOUNG CHILDREN

- Physiological meaning is different in young children
 - Utility of spirometry relies on:
 - Taking a full inspiration to TLC
 - Maintaining expiratory flow limitation
 - Exhaling to RV
- Common problems with spirometry in young children
 - Failure to take full inspiration
 - Slow onset of expiration
 - Early termination of expiration
 - Can not blow long enough
 - Very unlikely to maintain expiratory flow limitation



A common result with young children



PRED ---
PRE
POST



DETECTING AIRWAY OBSTRUCTION BY SPIROMETRY

- Airway obstruction indicated by
 - $FEV_1/FVC < 80\%$
 - Below age-specific LLN (GLI)
- Failure to inhale to TLC or exhale to RV leads to underestimation of FVC
- Underestimating FVC means underestimation of airway obstruction
- $FEV_1 \approx FVC$ in preschoolers



RAINE STUDY COHORT - PERTH

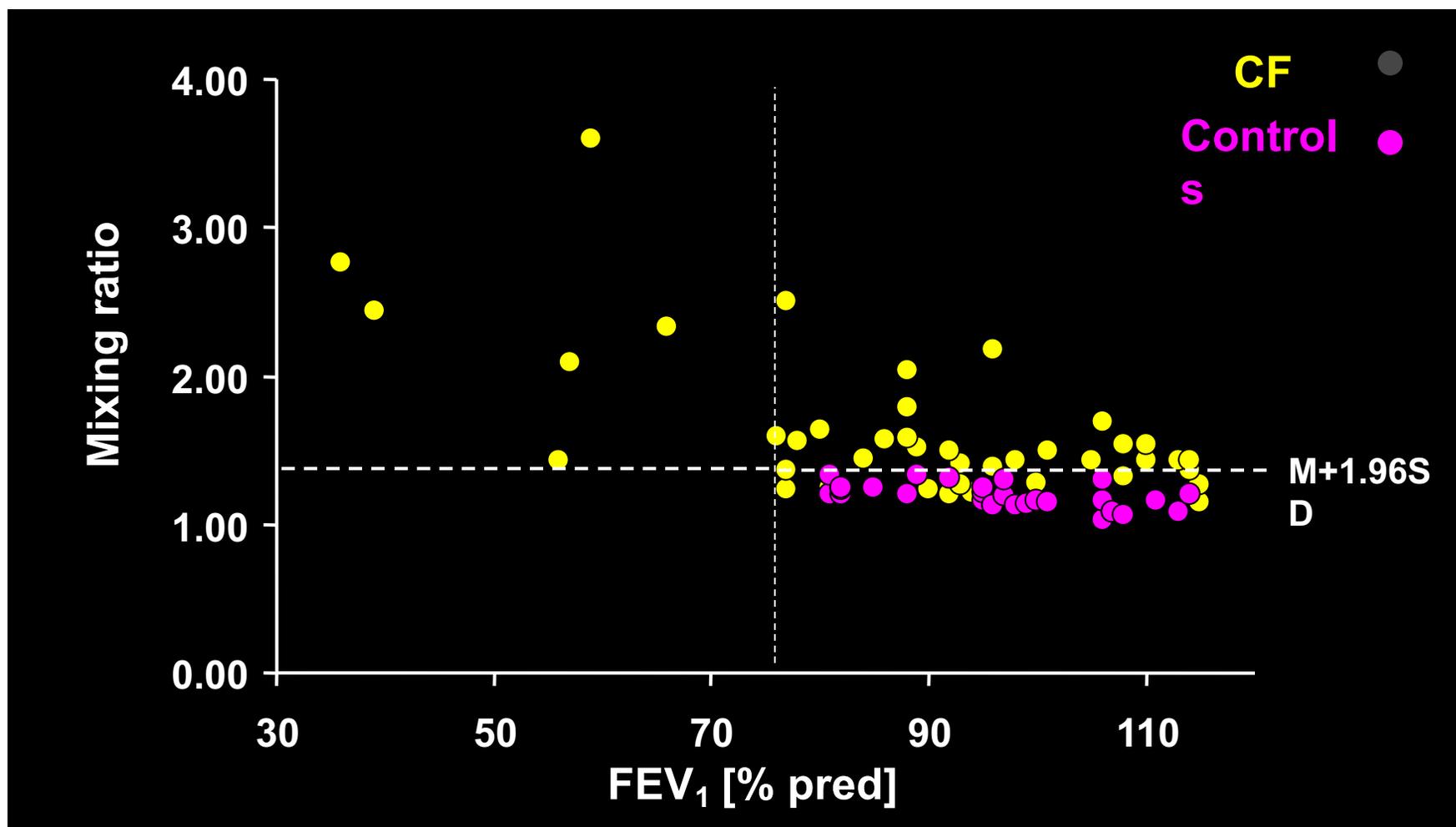
	Non asthma (n=1365)	Asthma (n=308)	p
FVC (l)	1.17 (0.22)	1.16 (0.23)	0.530
FEV ₁ (l)	1.09 (0.19)	1.06 (0.20)	0.023
FEF ₂₅₋₇₅ (l/s)	1.52 (0.46)	1.42 (0.44)	0.001
FEV ₁ /FVC	0.94 (0.07)	0.93 (0.08)	0.002

MBW

- Tracer gas switched in and equilibrated (wash-in)
- Tracer gas switched out and breathing recorded until $1/40^{\text{th}}$ of equilibration concentration (wash-out)
- Nitrogen washout:
 - 100%O₂ “washes out” N₂
 - No wash-in phase
- LCI = cumulative net expired volume/FRC
 - ↑ with ventilation inhomogeneity related to uneven airway obstruction (time-constant inhomogeneity)
- FRC = net volume of inert gas exhaled/ Δ gas concentration



Assessment of gas mixing



Gustaffson: Swedish children with CF

FORCED OSCILLATION TECHNIQUE

- Child seated with arms by side
- Cheeks supported by child and technician
- Nose-clip
- Data collected during gentle tidal breathing
- Multi-frequency forcing function
- Reports R and X averaged across multiple breathing cycles

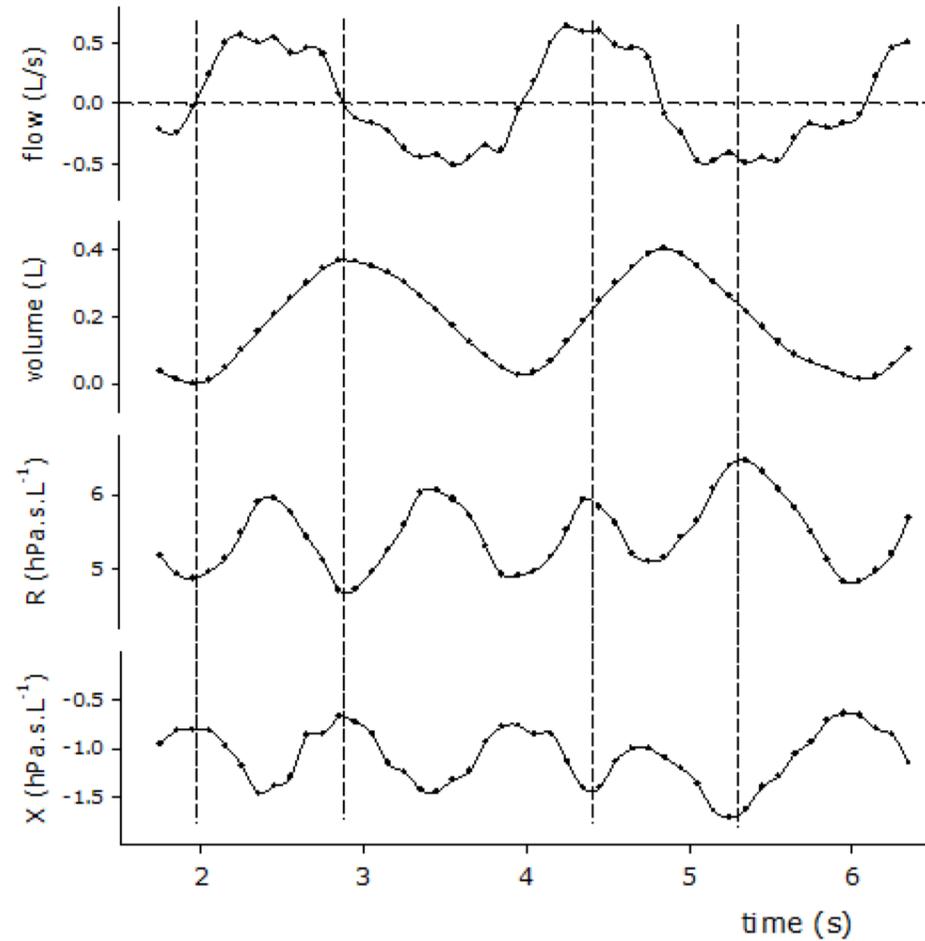


FOT IN PRE-SCHOOL CHILDREN

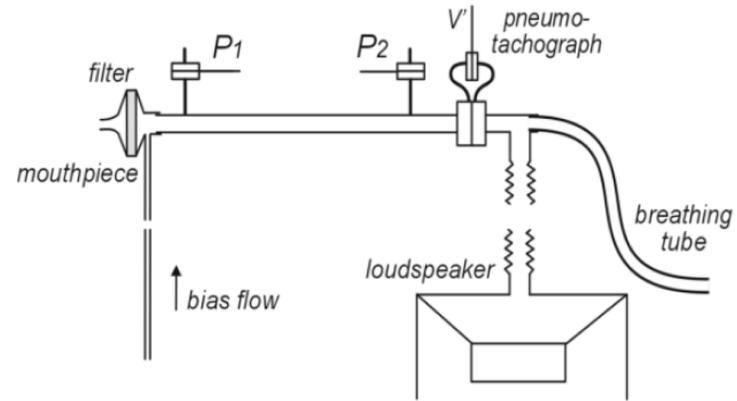
- Detection of airway obstruction
 - successful in asthmatic children >3years
 - pseudorandom noise(4-32Hz), 16s sampling period
(Delacourt 2000 AJRCCM 161:730-36)
 - successful in asthmatic children in emergency department
 - sinusoidal pressure wave (8 and 16Hz), 15-20s sampling period (Ducharme 1997 Chest 111:1519-25)



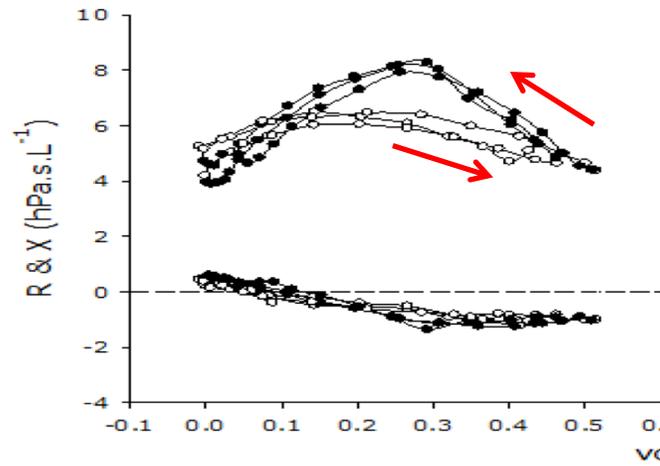
Dynamic FOT during tidal breathing



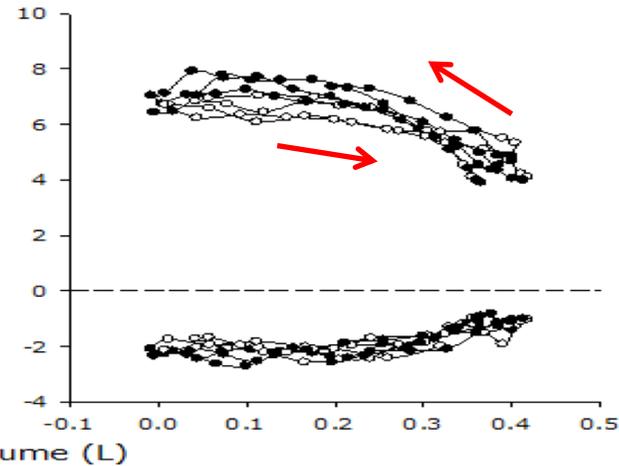
ASSESSING AIRWAY OBSTRUCTION IN PRE-SCHOOLERS



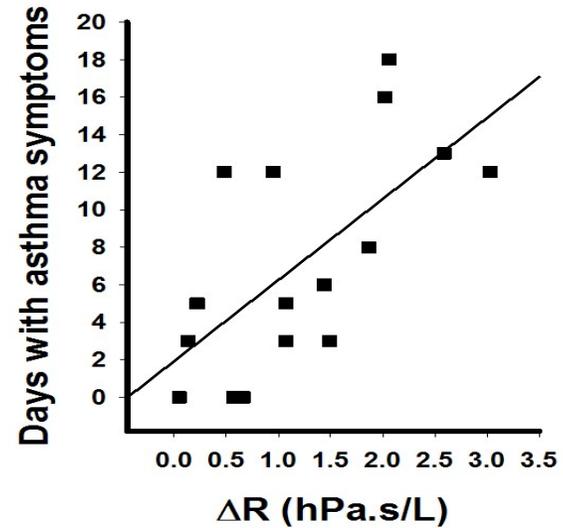
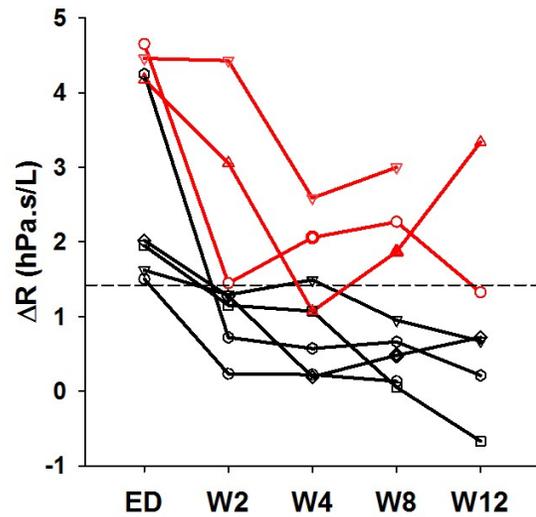
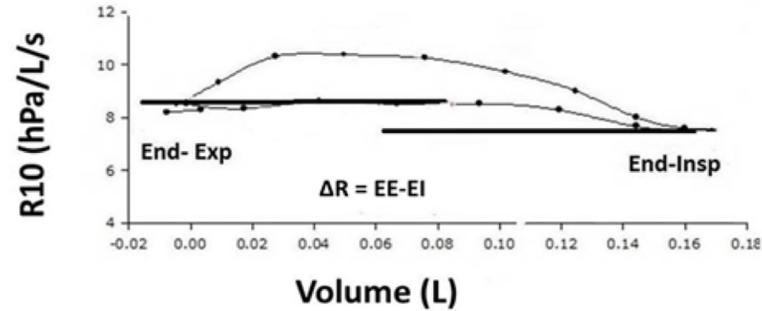
Healthy



Asthma

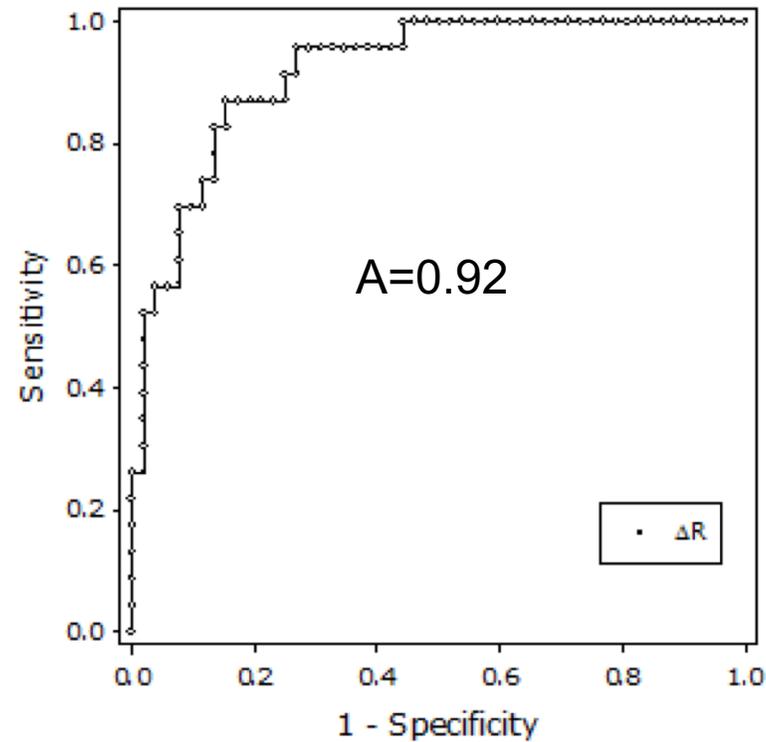


Assessing airway obstruction in pre-schoolers

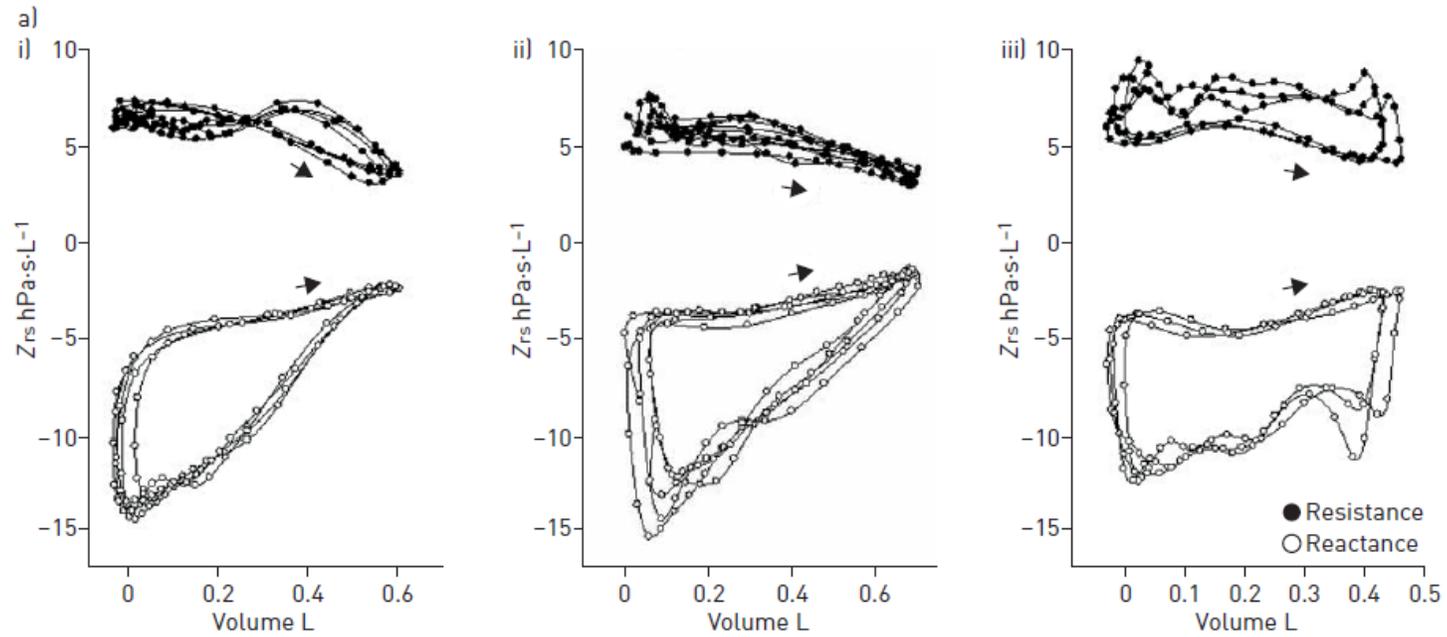


Ability of ΔR to detect airway obstruction

- 26 children 3-6 y with acute wheeze, 75 age-matched controls
- ΔR 1.42 optimal cut-off for detecting airway obstruction



Adults with COPD



Change in lung function with positive pressure

