Asymptomatic children with underlying respiratory disease have less airway reactance on intra-breath oscilometry

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Introduction

It is currently difficult to predict whether pre-school aged children with atopy or allergic disease will develop asthma. Intra-breath oscillometry measures may be useful in detecting airway obstruction in children[1,2], however, there is limited data.

What's oscillometry?

Oscillometry measures impedance in the respiratory system- the restrictions to airflow. Impedance is composed of airway resistance(R) and reactance(X) measures, which move in opposite directions throughout the respiratory cycle (Figure 1). Reactance measures lung elasticity or how readily the lungs expand.

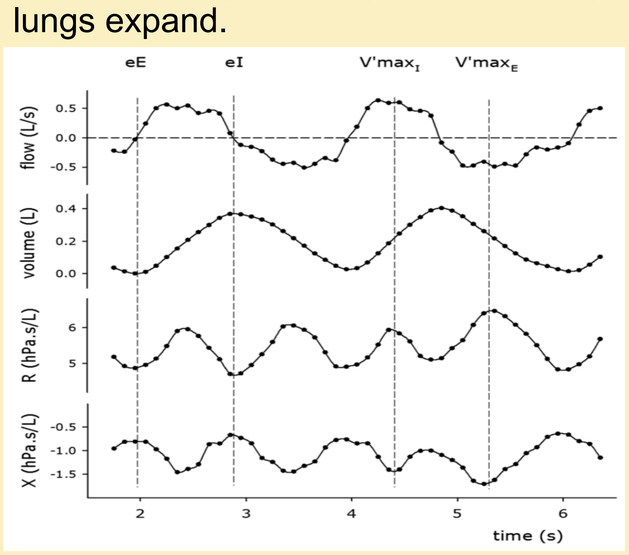

Figure 1. Respiratory cycle and associated oscillometry measures from Czovek et al.[1]
R = resistance; X = reactance; eE = end expiratory; eI = end inspiratory; V'max$_I$ or maxI = maximum inspiratory flow; V'max$_I$ or maxE = maximum expiratory flow.

We aimed to compare intra-breath oscillometry measures of reactance in a large cohort of asymptomatic pre-school aged children with and without underlying atopy or allergic respiratory disease.

Methods

The Barwon Infant Study (BIS) is a birth cohort study (n=1074). At 4 years of age, oscillometry was performed. Intra-breath changes in impedance were monitored with a single 10 Hz tracking signal. All regular breathing periods were selected for analysis by a single investigator. Clinical manifestations of childhood allergic disease were identified by parent report, clinical examination and testing including skin-prick testing (SPT) to aeroallergens.

Results

Table 1. Reactance measures by group

Reactance (X) measures (hPa s/L)	Participants without atopy or respiratory disease (n = 183) Median (25%-75%)	Allergic sensitisation to aeroallergens (n = 95) Median (25%-75%)	Wheeze (n = 98) Median (25%-75%)	Atopic wheeze (n = 32) Median (25%-75%)	Doctor-diagnosed asthma (n = 72) Median (25%-75%)
Whole expiration (XmeanE)	-2.05 (-2.74, -1.44)	-2.22 (-3.17, -1.44) p=0.26	-2.17 (-3.11, -1.48) p=0.17	**-2.72 (-3.55, -1.92) p=0.01**	-2.23 (-3.08, -1.75) p=0.062
Whole inspiration (XmeanI)	-1.73 (-2.35, -1.20)	-1.78 (-2.35, -1.16) p=0.96	-1.82 (-2.45, -1.42) p=0.31	-1.88 (-2.52, -1.39) p=0.51	-1.90 (-2.56, -1.49) p=0.10
Difference between meanE and meanI (XmeanE-XmeanI (ΔXmean))	-0.22 (-0.66, -0.09)	-0.29 (-0.90, 0.03) p=0.13	-0.33 (-0.79, 0.01) p=0.22	**-0.62 (-1.28, -0.31) p<0.001**	-0.33 (-0.90, 0.01) p=0.22
End-expiration (XeE)	-1.16 (-1.71, -0.64)	-1.21 (-1.99, -0.63) p=0.70	-1.39 (-2.40, -0.76) p=0.068	-1.43 (-2.45, -0.86) p=0.16	**-1.50 (-2.35, -0.86) p=0.028**
End-inspiration (XeI)	-1.63 (-2.15, -1.01)	-1.51 (-2.32, -0.95) p=0.97	-1.52 (-2.12, -1.17) p=0.94	-1.45 (-2.41, -1.06) p=0.92	-1.64 (-2.23, -1.14) p=0.58
Difference between eE and eI (XeE-XeI (ΔX))	0.38 (-0.04, 0.77)	0.34 (-0.06, 0.66) p=0.56	**0.13 (-0.29, 0.50) p=0.006**	0.26 (-0.20, 0.48) p=0.072	**0.11 (-0.27, 0.47) p=0.005**

In comparison to those without atopy or respiratory disease:

- Children with wheeze had less difference in ΔX
- Children with doctor-diagnosed asthma had more negative end expiratory reactance (XeE) and less difference in ΔX
- Children with atopic wheeze had more negative overall expiratory reactance (XmeanE) and greater difference in ΔXmean (Table 1)

Conclusions

Children with underlying respiratory disease had reduced airway reactance, indicating reduced lung elasticity, even when asymptomatic. Follow-up studies are required to examine if reduced reactance at pre-school age is predictive of confirmed diagnosis of asthma at school age.

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