Journal of Paediatric Respirology and Critical Care

Use of the interrupter technique in assessment of lung function

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Introduction

Lung function test is a challenging task in young children. Measuring of airway resistance becomes popular recently. Most of the technique requires only minimal cooperation of children. One of the technique, the interrupter technique, will be reviewed in the current article. The interrupter technique is based on measurement of airflow and mouth pressure, assuming that alveolar pressure and mouth pressure rapidly equilibrate during a sudden occlusion. Resistance of the interrupter technique or Rint is equal to the occlusion pressure divided by the airflow measured immediately before interruption. Commercial device is available which is small and portable.

Procedures

All measurements should be made with the child seated, wearing a nose clip. Child mouth seals the mouthpiece. Child breathes quietly through the mouthpiece and bacterial filter with cheek supported. Cheek support may help to decrease the upper airway compliance. We should not used standard oral-nasal face mask for measuring Rint as nasal resistance contributes a lot to the total airway resistance. For technical aspect, most commercial devices use flow as the interruption trigger, occlusion should be made with a valve closing in less than 10 milliseconds and lasting for 100 milliseconds. Both inspiratory and expiratory Rint were being used in previous studies. Practically, expiratory Rint should be used as there is a higher flow during expiration and the signal to noise ratio should be better during expiration. Child should perform at least five acceptable maneuvers and the median of all technically acceptable occlusions should be reported.

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Technically Acceptable Manoeuvre

The pressure-time curve (Figure 1a) should show (1) a sharp increase in pressure immediately following occlusion, (2) a series of high frequency oscillations and (3) a smooth increase in pressure. Figure 1b showed that part (3) of the curve is flat which indicates leaking around the mouthpiece during procedure.

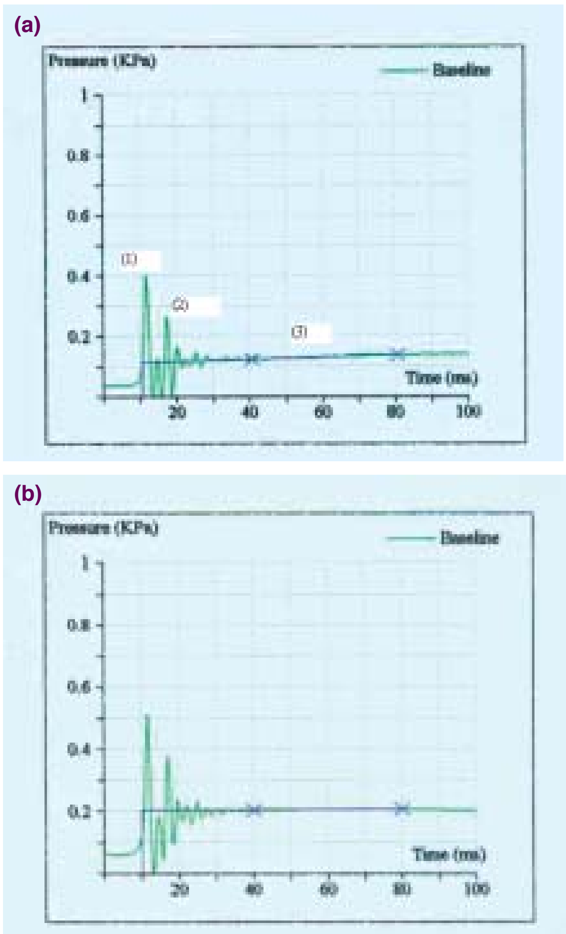

Figure 1. (a) Normal pressure time curve; (b) Leaking around mouthpiece during procedure.

Normal Values

Reference values were published, mainly in white children.

Merkus et al[1] (208 White children) reported the following equation for expiratory Rint: logRintE=0.645-0.00668*height in cm

Lombardi et al[2] (284 White children) reported an alternative equation for expiratory Rint: RintE= 2.276287-0.013710*height in cm

Mckenzie et al[3] (236 White, Afro-caribbean and Bangladeshi children) reported another equation for expiratory Rint: log RintE=0.528-0.00569*height in cm

Is Rint Useful Clinically?

Young children can perform Rint because minimal cooperation is required. The whole procedure takes only a few minutes. However, the inter-individual variability in healthy children results in marked overlap between asthmatic and healthy children which limits the use of baseline Rint measurement.[4] McKenzie et al reported a bronchodilator response ratio of >1.22 had 76% sensitivity and 80% specificity for wheeze in children.[5] Beydon et al showed that a 35% decrease in resistance after bronchodilatation had a likelihood ratio of 3 for diagnosing children with asthma.[6] Interrupter technique with 35% decrease in Rint was showed to have a sensitivity of 73% and specificity of 83% in discriminating those with positive post-exercise bronchodilator response (FEV1 rise >10%).[7] However, Rint was reported to have poor sensitivity, 33%, and specificity of 80% to discriminate children with FEV1 <80%.[8] Nielsen et al reported sensitivity of 24% and specificity of 92% for separating children with and without asthma.[9] Boccaccino et al found no correlation between FEV1 and Rint values either before or after albuterol.[10] A study in cystic fibrosis children suggested that it was not appropriate to use Rint as a simple alternative for FEV1 in children with cystic fibrosis when assessing airway responsiveness.[11] Moreover, Beydon et al showed that the mean bronchodilator change for expiratory Rint was -12% (95% CI, -46-+22%) in healthy children.[12]

Exercise challenge test was reported. Kannisto et al showed that a ≥15% increase of Rint after exercise had 80% sensitivity and 93% specificity in detecting ≥15% increase in post exercise peak flow.[13]

Limitation

Interrupter technique assumes that mouth pressure and alveolar pressure rapidly equilibrate after interruption. In case of ventilation dishomogeneities or severe bronchial constriction, the time for equilibration may increase and alveolar pressure will be underestimated.

Conclusion

Rint is a simple method to measure airway resistance. It can be performed by young children. The device is commercially available. Reference values in white children are available. Local data is limited. However, the clinical use of Rint is not well established as there is marked overlap of baseline Rint between healthy and asthma children and the cut-off point of positive bronchodilator response for Rint is not well established. Further study is required to standardise method in measuring Rint and to study the use of Rint in bronchodilator response and challenge tests.

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