FEASIBILITY OF R INTERRUPTER TECHNIQUE IN ASTHMATIC PRESCHOOL CHILDREN

Thesis

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By

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ABSTRACT

The incidence of pediatric asthma is increasing in most countries. Pulmonary function tests (PFTs) are used to determine asthma severity in preschool children, and are seldom performed in preschool children due to little cooperation, coordination. Interrupter resistance technique (Rint) is one of the easiest ways to assess respiratory resistance during tidal breathing with minimal subject cooperation. It has, therefore, been largely used in young children unable to perform reliable spirometry. The technique is good enough to allow assessment of bronchial reactivity.

The aim of this observational cross- sectional study is to assess the feasibility of performing interrupter resistance technique (Rint) in asthmatic preschool children as a noval technique which needs minimal cooperation in this young age group. Our results showed that only 18.8 % of children aged 2-3 years succeeded in performing the test, while 100 % of children aged above 3 years succeeded in performing the test.

Key Words:

(Asthma, Interrupter resistance technique, Preschool children)

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List of Abbreviations

ABD: Abdomen
ACQ: Asthma control questionnaire
ACT: Asthma control test
AHR: Airway hyperresponsiveness
Ar: Aragon
ASM: Airway smooth muscle
ATAQ: Asthma therapy assessment questionnaire
ATS: American thoracic society
BDR: Bronchodilator responsiveness
BHR: Bronchial hyperresponsiveness
BMI: Body mass index
C-ACT: Child-asthma control test
CDC: Centers for Disease Control and Prevention
CO2: Carbon dioxide
Crs: Respiratory system compliance
CV: Coefficient of variation
eNO: Exhaled nitric oxide
eNOS, (NOS3): Endothelial nitric oxide synthase
ERS: European thoracic society
ETS: Environmental tobacco smoke
EV: Extrapolated volume
FEF: Peak expiratory flow rate
FENO: Functional exhaled nitric oxide
FEV1: Forced expiratory volume in one second
FOT: Forced oscillation technique
FRC: Functional residual capacity
FVC: Forced vital capacity
GINA: Global initiative for asthma
He: Helium

H_2O_2: Hydrogen peroxide

IL-1β: Interleukin 1β

Irs: Inertance

kPa/L/sec: kilo paskal/ litre/second

MDC: Macrophage-derived chemokines

MEFVC: Maximal expiratory flow volume curve

N2: Nitrogen

nNOS: Neuronal nitric oxide synthase

NO: Nitric oxide

O2: Oxygen

OFCs: Oral food challenges

Pamb: The ambient pressure

Pdif: Pressure difference

PFTs: Pulmonary function tests

PH2O: The pressure of water vapor at body temperature

Pinit: Initial pressure

Pm: Mouth pressure

Ppb: Part per billion

RC: Rib cage

Rint: Interrupter resistance technique

Rrs: Respiratory system resistance

RSV: Respiratory syncytial virus

SBOL: Single breath on-line measurement

SF6: Sulfur hexa floride

SIDS: Sudden infant death syndrome

sRaw: Specific airway resistance

t: Time

TAA: Thoraco abdominal motion asynchrony

TARC: Thymus and activation-regulated chemokines

tE: Total expiratory time

TGV:	**Thoracic gas volume**
Th2:	**T helper 2 lymphocytes**
TLC:	**Total lung capacity**
TMB:	**Tetramethyl benzidine**
TNF-α:	**Tumour necrosis factor α**
tPTEF:	**Time to peak tidal expiratory flow**
Trs:	**Tidal time constant of the respiratory system**
V̀:	**Flow**
ΔV:	**Indicates the volume (pressure) swing by child's thoracic excursion during tidal breathing in the box of plethysmography**
VC:	**Vital capacity**
Ve:	**Expired tidal volume**
VEGF:	**Vascular endothelial growth factor**
Vpleth:	**Plethysmographic volume**
Vptef:	**Volume at peak tidal expiratory flow**
Zrs:	**Impedance**

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INTRODUCTION

The incidence of pediatric asthma is increasing in most countries. Pulmonary function tests (PFTs) are used to diagnose and determine asthma severity, along with clinical symptoms and medication requirements (***Beydon et al, 2003***).

Long-term cohort studies have established that PFT results in children with asthma are correlated with asthma severity and with pulmonary function impairement in adulthood (***Rasmussen et al, 2002***).

Normal lung function is one of the goals of asthma management in international guidelines (***British Thoracic Society, 2003***).

Forced expiratory maneuvers are used in school children and in adults. However, preschool children may be too young to perform acceptable and reproducible forced expiratory maneuvers (***Vilozni et al, 2001***).

The realisation that insults to the developing lung may have life-long effects and that much of the burden of respiratory disease in childhood and later life has its origins in infancy and early childhood has emphasized the need to develop and standardise sensitive methods of assessing respiratory function in infants and young children (***Frey et al, 2000 (a) and Stocks et al, 2000***).

It is difficult to obtain reliable lung function testing in preschool children because little cooperation and coordination can be expected at this age. Spirometric reference values for children

have been obtained in children as young as 5 years of age but reliable measurements are often not feasible (***Peter et al, 2001***).

In recent years, PFTs that do not require active cooperation, such as the interrupter resistance technique or forced oscillation technique, have been evaluated for estimating airflow resistance in healthy (***Lombardi et al, 2001 and Malmberg et al, 2002***) and in preschool children who have asthma or who are wheezing (***Nielsen et al, 2001and Delacourt et al, 2001a***).

The measurement of airway resistance by the interrupter method (Rint) has been developed by a number of groups for clinical use and as a research tool. The method is particularly suitable for subjects who cannot undertake standard lung function tests, such as preschool children and school children who are unable to undertake spirometry (***Bridge et al, 1999 & Bridge and McKenzie, 2001a***).

The ability to monitor the progress of lung disease and to measure the effect of therapeutic intervention in these groups is quite limited (***McKenzie et al, 2002***). Much is already known about the technical aspects of the measurement of Rint, and its repeatability in young children (***McKenzie et al, 2001a***).

The interrupter technique is a non invasive simple technique for estimating flow resistance, an important determinant of lung function, especially in children too young to accomplish forced respiratory maneuvers in a reproducible manner. The interrupter technique is easy to use in young children. Several recent studies used interrupter resistance (Rint) measurements in wheezy and / or

asthmatic young children, particularly for testing bronchoreactivity (***McKenzie et al, 2000*** & ***Beydon et al, 2001***).

Modern applications of the technique have been evaluated (***Phagoo et al, 1996***), and it has been demonstrated that within-subject variability of Rint measurements is sufficiently small to study the response to bronchoconstricting (***Phagoo et al, 1996***) and bronchodilating agents in young children (***Bridge et al, 1999***).