NON-CONTACT ASSESSMENT OF ACUTE BRONCHODILATOR’ RESPONSE DURING TIDAL BREATHING IN COPD PATIENTS

Pierantonio Laveneziana [1,2], Claudia Llontop [3], Marie-Cécile Niérat [1], Agnès Bellocq [1,2], Christian Straus [1,2], Thomas Similowski [1,3]

[1]Sorbonne Universités, UPMC Université Paris 06, INSERM, UMRS1158 Neurophysiologie respiratoire expérimentale et clinique, Paris, France; [2]Assistance Publique-Hôpitaux de Paris (AP-HP), Groupe Hospitalier Pitié-Salpêtrière Charles Foix, Service des Explorations Fonctionnelles de la Respiration, de l’Exercice et de la Dyspnée (Département "R3S", Pôle PRAGUES), Paris, France; [3]AP-HP, Groupe Hospitalier Pitié-Salpêtrière Charles Foix, Service de Pneumologie et Réanimation Médicale (Département "R3S", Pôle PRAGUES), Paris, France.

Abstract

Introduction: The effects of bronchodilators (BD) are traditionally assessed using forced expiratory maneuvers. Real-life evaluation of BD is desirable. Structured light plethysmography (SLP) is a non-contact, non-invasive method of assessment of breathing pattern during tidal breathing. We used SLP (Pneumacare, UK) to evaluate the BD' effects on breathing pattern during tidal breathing in COPD patients.

Materials and Methods: Measurements were taken during tidal breathing, pre and post short-acting BD in 41 COPD patients (31M, 65±8yrs, mean post-BD FEV1=63±23%predicted). The relative (%) contribution of Thorax (T) and Abdomen (A), the T/A phase and the Konno-Mead angle (KM) were recorded. Inspiratory capacity (IC) and dyspnoea (visual analog scale, VAS) were also measured.

Results: In 29 patients who showed an increase in post-BD IC>130mL, the following tidal breathing variables changed significantly (p<0.05): T/A phase: -3.4%, relative T: -6 %, A contribution: + 6%, KM: + 1.6. VAS score also significantly decreased (2±0.7cm). In the remaining 12 patients no significant changes were observed.

Discussion/conclusion: SLP was able to detect a change in T/A contribution in tidal breathing in COPD patients who increased their IC (lung deflation) and decreased their dyspnoea after BD. This pattern may suggest a more efficient contribution of the diaphragm to tidal breathing in COPD patients who did recruit IC after BD. This preliminary data suggest that a non-contact approach and analysis of resting quiet breathing may permit to predict the perceptual (dyspnoea) and volume (IC) response to BD.

Background

- The effects of BD are traditionally assessed using forced respiratory maneuvers.
- Real-life (i.e., during tidal breathing) evaluation of BDs is desirable.
- One major difficulty when studying tidal breathing comes from the so-called "observer effect".
- Likewise, using a mouthpiece and a nose clip to measure ventilatory flow with a pneumotachograph introduces a major perturbation to breathing (probably because it "ungates" respiratory sensations that are normally filtered out by the brain) and therefore constitutes a stimulus that modifies the respiratory behaviour.

Objectives

- To evaluate the effects of short-acting BDs on breathing pattern, thoraco-abdominal contribution and dyspnoea during resting quiet breathing in COPD patients using Structured Light Plethysmography, a new non-contact method of assessment of breathing pattern during tidal breathing.

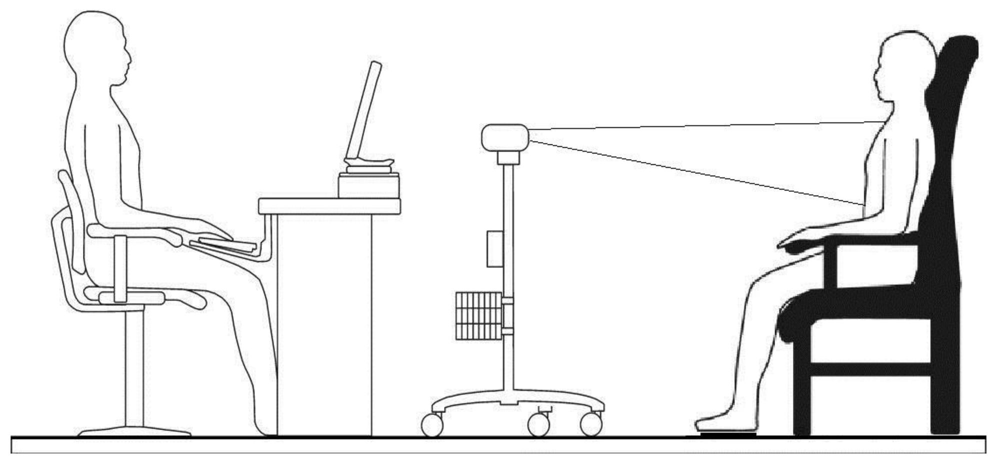
Methods

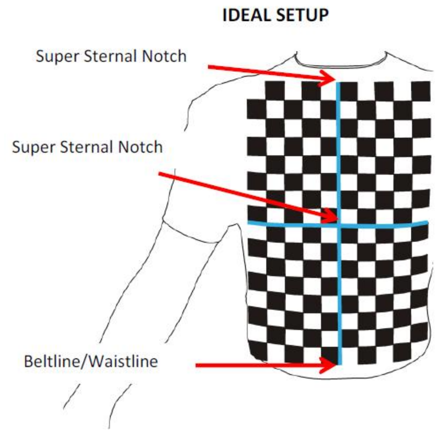
- Stable COPD patients undergoing Pulmonary Function Testing (PFT) pre and post administration of short acting BD, with normal BMI and with no evidence of a restrictive ventilatory defect (TLC <5th percentile of the predicted value, ERS/ATS Guidelines 2005).
- SLP recording (5 minutes) pre and post short-acting BD:
  - the relative (%) contribution of Thorax (T) and Abdomen (A),
  - the T/A phase
  - the Konno-Mead angle (KM angle)
- Inspiratory capacity (IC)
- Dyspnoea intensity changes (visual analog scale, D-VAS)

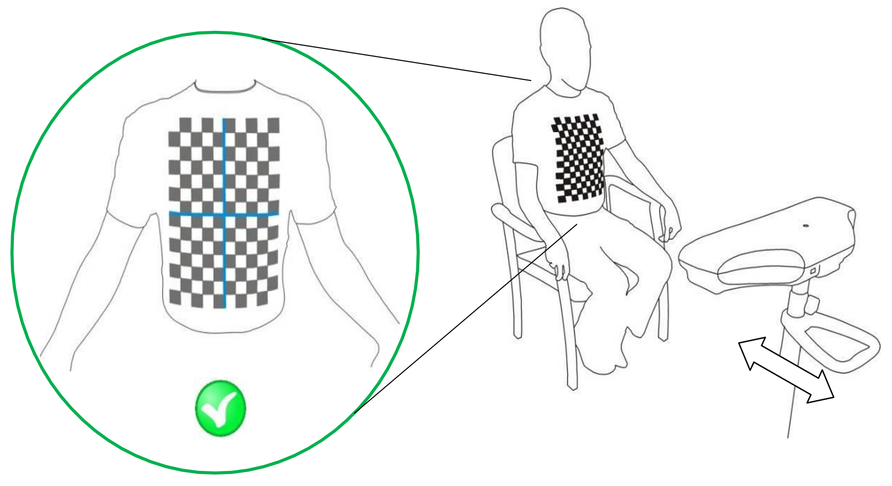
Health technologies being assessed

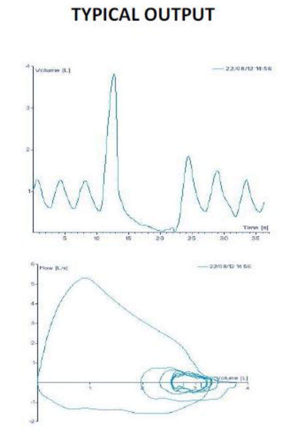
Thora 3D ™ the new technology being assessed, provides real time rapid non-contact assessment of lung function utilizing structured light technology and advanced imaging processing. This technology utilizes SLP (Structured Light Plethysmography) and can be performed while sitting in a chair or at supine in bed. In summary

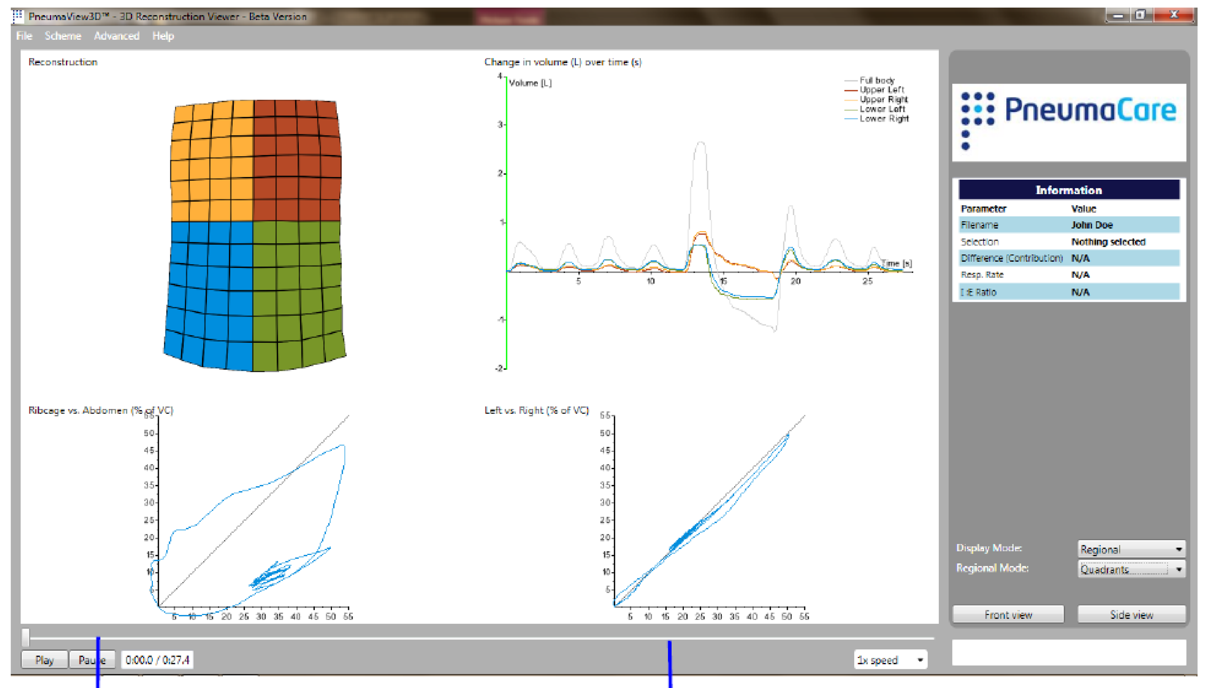
- Structured light is projected on to the patient’s chest
- Cameras film the movement of the grid over time
- Software utilizes video to create 3D view of chest movement and calculates volume of air moved
- Output is delivered in 3D regional output on the user interface

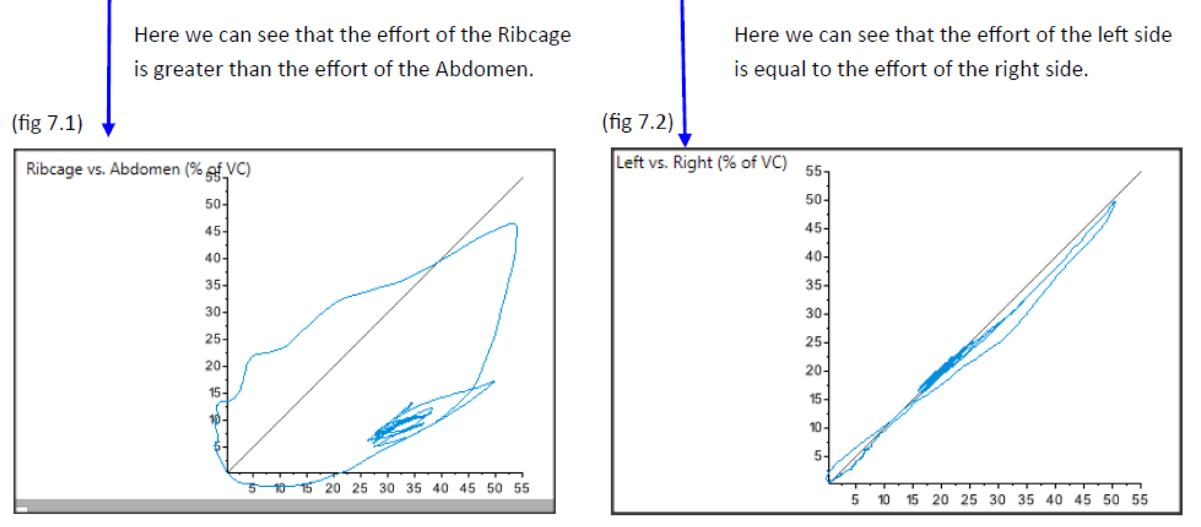












Deflators (n=29) vs Non-deflators (n=12)

	Deflators (n = 29)		Non-deflators (n = 12)	
	pre-BD (mean ± SD)	post-BD (mean ± SD)	pre-BD (mean ± SD)	post-BD (mean ± SD)
Age, yrs	66 ± 8		64 ± 6	
Sex, M/F	20/9		11/1	
BMI	24 ± 3		24 ± 4	
FEV_1, L	1.5 ± 0.5	1.7 ± 0.7*	1.8 ± 0.8$	1.9 ± 0.9
FEV_1, % predicted	57 ± 20	63 ± 23*	60 ± 23$	61 ± 25
IC, L	2.4 ± 0.6	2.8 ± 0.6*	2.9 ± 0.9	2.8 ± 0.9
D-VAS, cm	3.8 ± 1.3	1.8 ± 1.1*$	2.6 ± 1.2$	2.0 ± 1.0 *
T contr, %	49 ± 12	47 ± 13*	41 ± 11	39 ± 14
A contr, %	51 ± 11	53 ± 12*	59 ± 9	61 ± 16
T/A phase	7.8 ± 4.0	8.2 ± 4.6	7.7 ± 5.6	10.3 ± 6.0
KM angle	2.7 ± 12.8$	0.4 ± 13.2*	-11.6 ± 10.8	-13.5 ± 19.2

Conclusions

- SLP detected a change in T/A contribution in tidal breathing in COPD patients who deflated their lungs (increase in IC) after BD.
- This pattern may suggest a more efficient contribution of the diaphragm to tidal breathing in this subgroup of COPD patients after BD, which was not observed in those COPD who did not recruit IC after BD.
- This preliminary data suggest that SLP-related breathing pattern analysis during resting quiet breathing predicts the perceptual and volume response to bronchodilator.