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ESRF

Experiment Report Form

The double page inside this form is to be filled in by all users or groups of users who have had access to beam time for measurements at the ESRF.

Once completed, the report should be submitted electronically to the User Office via the User Portal:

https://wwws.esrf.fr/misapps/SMISWebClient/protected/welcome.do

Reports supporting requests for additional beam time

Reports can be submitted independently of new proposals – it is necessary simply to indicate the number of the report(s) supporting a new proposal on the proposal form.

The Review Committees reserve the right to reject new proposals from groups who have not reported on the use of beam time allocated previously.

Reports on experiments relating to long term projects

Proposers awarded beam time for a long term project are required to submit an interim report at the end of each year, irrespective of the number of shifts of beam time they have used.

Published papers

All users must give proper credit to ESRF staff members and proper mention to ESRF facilities which were essential for the results described in any ensuing publication. Further, they are obliged to send to the Joint ESRF/ ILL library the complete reference and the abstract of all papers appearing in print, and resulting from the use of the ESRF.

Should you wish to make more general comments on the experiment, please note them on the User Evaluation Form, and send both the Report and the Evaluation Form to the User Office.

Deadlines for submission of Experimental Reports

- 1st March for experiments carried out up until June of the previous year;
- 1st September for experiments carried out up until January of the same year.

Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report, in English.
- include the reference number of the proposal to which the report refers.
- make sure that the text, tables and figures fit into the space available.
- if your work is published or is in press, you may prefer to paste in the abstract, and add full reference details. If the abstract is in a language other than English, please include an English translation.

ESRF	**Experiment title:**	**Experiment number**: MD611
Beamline: ID17	**Date of experiment**: from: 18 November 2011 at 08:00 to: 22 November 2011 at 08:00	**Date of report**: 28/08/2012
Shifts: 12	**Local contact(s)**: NEMOZ Christian	*Received at ESRF:*

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Report:

RATIONALE: The goal of this experiment was to assess the impact of repeated exposure to a gaseous atmospheric pollutant: NO_2, on small peripheral airway function, in the sesitized Brown Norway rat; a model of allergic asthma. Our working hypothesis was that altered peripheral airway function in asthma leads to peripheral ventilation heterogeneity, a phenomenon that can be exagerated by prolonged exposure to inhaled pollutants. Furhtermore, the phase III slope of the volumetric expiratory capnogram (S3v) has been proposed as a measurement of regional ventilation heterogeneity in patients, however, the relation between this parameter and direct measurements of regional lung ventilation distribution has not been studied. In this experiment, we also assessed the changes in expiratory capnographic waveform in comparison to direct measurements of regional ventilation distribution using synchrotron imaging.

METHODS: Brown-Norway rats sensitized to ovalbumin (OVA) were divided into 2 groups: exposed either to air or to NO_2, 10 ppm, 6h/d, 5d/wk for 4 weeks. One day after the end of the exposure period, the animals were trandfered to the ESRF, anesthetized, and mechanically ventilated. We used K-edge subtraction synchrotron imaging to obtain quantitative measurements of regional ventilation ($s\dot{V}$) distributions, area of well-ventilation regions (VAA) and ventilation heterogeneity (CV of $s\dot{V}$) (Figure 1). Exhaled capnograms (eCO_2) were recorded during tidal breathing using a rapid CO2 analyzer at baseline and during intravenous infusion of methacholine (MCH, 15 µg/kg/min (γ)). The S3v of eCO_2 was computed and averaged in a minimum of 10 respiratory cycles in each experimental condition.

RESULTS: Both S3v and CV of $s\dot{V}$ increased during MCH infusion. The increase in S3v was significantly larger in NO_2 exposed animals. We found a significant correlation between the 2 parameters ($R=0.78$, $p<0.001$).

Air-OVA (n=4) **NO_2-OVA** (n=4)

m±SD	Baseline	MCH15γ	Baseline	MCH15γ
CV of $s\dot{V}$ (%)	15.3 ± 5.2	42.6 ± 25.0*	18.2 ± 8.0	49.3 ± 42.4*
VAA (% Total Lung Area)	93.8 ± 2.5	66.7 ± 22.1*	90.8 ± 7.7	72.3 ± 25.1*
S3v (mmHg/ml)	2.45 ± 0.07	3.32 ± 0.46	2.49 ± 0.15	4.33 ± 0.44*#

*: $p<0.05$ vs. baseline, within a group; #: $p<0.05$ vs. Air-OVA, within a condition, by by Kruskal-Wallis Analysis of Variance on Ranks.

CONCLUSIONS: The increase in S3v during bronchoconstriction was significantly larger in rats exposed to NO_2 suggesting that this atmospheric pollutant can alter peripheral airway function in OVA-sensitized Brown-Norway rat, a model of allergic asthma. This is the first comparison of the phase III slope of the expiratory capnogram with direct measurements of regional ventilation heterogeneity. Our data suggest that regional ventilation heterogeneity contributes to the increase in S3v during acute bronchoconstriction. Further study is needed to characterize the relation between regional ventilation and perfusion distributions and the expiratory CO2 waveforms, in order to assess whether S3v can be used as a metric of regional ventilation heterogeneity in patients.
NB: These results were submitted to the Euroean Repiratory Society International Congress as an abstract, which has received an “Excellence Grant in Clinical Physiology and Exercise”.

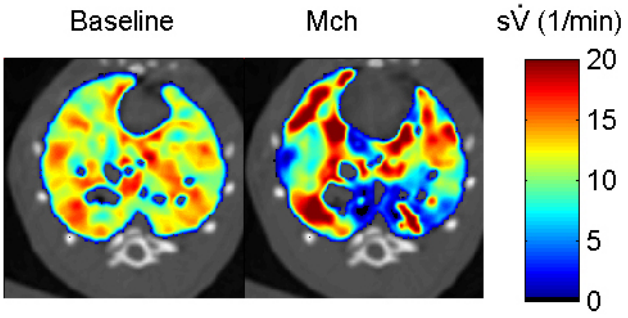

Figure 1: Specific ventilation ($s\dot{V}$) distributions at baseline and during Methacholine (Mch) infusion in a representative rat. Image voxel : 350 × 350 × 700 µm. Acquisition time: 2 sec/image. The $s\dot{V}$ images were computed from 10 serial images of stable Xe gas washin [1].

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References

1. Bayat S. et al. Phys Med Biol. 2001;46(12):3287-99