Exhaled breath profiling and eosinophilic airway inflammation in asthma – results of a pilot study


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**Rationale**

- Eosinophilic inflammation in asthma is predictive for responses to inhaled steroids
- Sputum analysis is limited by requirements of lab facilities and not directly available results
- Breath volatile organic compounds (VOCs) may be useful for asthma phenotyping
- Exhaled air metabolomics measured by GC-MS is associated with eosinophilic inflammation in asthma

**Hypothesis:** Breathprint profiles analysed by electronic noses (eNoses) can be surrogate markers for eosinophilic airway inflammation

**Aim**

To test whether breathprints analysed by a composite eNose platform can discriminate eosinophilic asthma from non-eosinophilic asthma.

**Methods**

**Inclusion:** Patients with mild / severe asthma included in U-BIOPRED

**Asthma:** 1. history of wheeze
2. reversibility / PC20 / diurnal PEF variation / tapering med

**Mild asthma:** inhaled ICS (<500mcg FP) & non-smokers (<Spy)

**Severe asthma:** IMI-criteria2 (history of wheeze & high dose ICS >1000mcg FP & uncontrolled OR OCS OR frequent exacerbations)

**Cross-sectional design:**

- Spirometry, FeNO
- Sputum induction: (selected plug) count sputum eosinophils
- Local exhaled air collection → centralised analysis by eNose platform (see Figure 1)

**Statistical analysis:**

- Diagnosis: 1. Eosinophilic asthma; >3% sputum eosinophils
2. Non-eosinophilic asthma; <3% sputum eosinophils
- Stepwise discriminant analysis + cross-validation on all significantly associated exhaled markers (sensors+FeNO) analysed by t-test
- Bootstrap based ROC-curve

**Table 1: Patient characteristics**

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<thead>
<tr>
<th></th>
<th>Non-eosinophilic</th>
<th>Eosinophilic</th>
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<tbody>
<tr>
<td>Age*</td>
<td>51.2 (15.4)</td>
<td>58.1 (9.6)</td>
</tr>
<tr>
<td>Gender (M/F)</td>
<td>7/8</td>
<td>8/16</td>
</tr>
<tr>
<td>Post-FEV1 % predicted*</td>
<td>80.9 (24.4)</td>
<td>76.3 (16.2)</td>
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<tr>
<td>Tiffenau % predicted*</td>
<td>80.2 (16.1)</td>
<td>76.6 (11.7)</td>
</tr>
<tr>
<td>FeNO†</td>
<td>20.0 (11-33)</td>
<td>37.5 (27-73.3)</td>
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<tr>
<td>Oral CS (yes/no)</td>
<td>3/12</td>
<td>13/11</td>
</tr>
<tr>
<td>Sputum eosinophils %†</td>
<td>0.97 (0.2-1.9)</td>
<td>13.7 (9.9-27.9)</td>
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<tr>
<td>Sputum neutrophils %†</td>
<td>55.1 (30.3-88.7)</td>
<td>47.7 (35.5-60.5)</td>
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* Mean (Standard Deviation); † Median (interquartile range)

**Conclusions**

- eNose breathprints analysed by a composite eNose platform can distinguish between eosinophilic and non-eosinophilic asthma
- eNose sensors provide a stronger signal than FeNO, though the combination provides the best model

**Implications**

- eNoses may have a potential for subphenotyping of asthma
- eNose is an easily applied method, even less invasive than a sputum induction, to be used for patient selection in drug trials
- The inclusion has finished; Q3 2013 validation/confirmation in a larger sample-size

**Figure 1:** Flowchart of exhaled breath analyses by an eNose platform, through local sample collection and central analyses

**Figure 2:** Discriminant results (3 sensors + FeNO)

**Figure 3:** ROC-curve

**References**

1 Ibrahim et al. Thorax 2011; 66(9):804-9
3 Sensors + FeNO
4 Sensors + FeNO