Altered neural activity in brain cough suppression networks in cigarette smokers

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ABSTRACT Cough is important for airway defence, and studies in healthy animals and humans have revealed multiple brain networks intimately involved in the perception of airway irritation, cough induction and cough suppression. Changes in cough sensitivity and/or the ability to suppress cough accompany pulmonary pathologies, suggesting a level of plasticity is possible in these central neural circuits. However, little is known about how persistent inputs from the lung might modify the brain processes regulating cough.

In the present study, we used human functional brain imaging to investigate the central neural responses that accompany an altered cough sensitivity in cigarette smokers.

In nonsmokers, inhalation of the airway irritant capsaicin induced a transient urge-to-cough associated with the activation of a distributed brain network that included sensory, prefrontal and motor cortical regions. Cigarette smokers demonstrated significantly higher thresholds for capsaicin-induced urge-to-cough, consistent with a reduced sensitivity to airway irritation. Intriguingly, this was accompanied by increased activation in brain regions known to be involved in both cough sensory processing (primary sensorimotor cortex) and cough suppression (dorsolateral prefrontal cortex and the midbrain nucleus cuneiformis). Activations in the prefrontal cortex were highest among participants with the least severe smoking behaviour, whereas those in the midbrain correlated with more severe smoking behaviour.

These outcomes suggest that smoking-induced sensitisation of central cough neural circuits is offset by concurrently enhanced central suppression. Furthermore, central suppression mechanisms may evolve with the severity of smoke exposure, changing from initial prefrontal inhibition to more primitive midbrain processes as exposure increases.