Researchers uncover a mechanism linking inhaled diesel pollution and respiratory distress

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Researchers in the UK have, for the first time, shown how exhaust pollution from diesel engines is able to affect nerves within the lung. Air pollution is a significant threat to health, they say, and identifying potential mechanisms linking exposure to diesel exhaust and the exacerbation of respiratory diseases may lead to treatments for those affected.

Mr. Ryan Robinson, a PhD student at the National Heart and Lung Institute, Imperial College London, UK, will tell the 13th European Respiratory Society Lung Science Conference today (Saturday) about his work studying diesel exhaust particles and airway sensory nerves. The news comes as the Healthy Lungs for Life campaign, launched by the European Respiratory Society and European Lung Foundation, takes places this year aiming to raise awareness of the importance of breathing clean air.

Diesel exhaust is a significant component of urban air pollution, containing a complicated mixture of gases and airborne particles. "Studies have shown that exposure to these diesel particles is associated with harmful health effects," says Mr. Robinson. "These particles are very small - down to 20 nanometres in diameter - and are therefore not only invisible to the naked eye, but can penetrate deep into the lungs."

The lungs contain numerous sensory nerves that can detect potentially

harmful stimuli and thus allow the body to respond, for example by triggering a cough. "However, we know that these nerves can also be involved in exacerbating respiratory conditions, for example by causing the bronchi to constrict in diseases such as asthma," says Mr. Robinson

The researchers, who included Mr. Robinson's supervisors Professor Maria Belvisi, Professor Terry Tetley and Professor Alexandra Porter, found that the diesel particles from a forklift truck could activate airway sensory nerves in an in vivo anaesthestised guinea pig model. "It was interesting to see that the more chemically sensitive airway nerves were involved, rather than the mechanically sensitive ones," says Mr. Robinson.

The researchers then used an in vitro isolated nerve preparation that allowed them to probe the mechanisms involved more rapidly. "The first thing we noted was that the particles, when cleaned, were harmless. It was clear that the chemicals isolated from an organic extraction of the diesel particles were key to the activation of the nerve, which backed up the data we saw in vivo," he will tell the conference.

To understand how the diesel extract activated the airway nerves, the researchers used pharmacological and genetic knock out tools. "It is widely known that the environmental sensors known as transient receptor potential (TRP) ion channels are key to airway sensory nerve activation, so we decided to block a variety of different channels to discover whether an extract of diesel could activate any of them," he will say.

The researchers found that the responses to the diesel extract were driven by activation of the TRP ankryin-1 (TRPA1) channel. They also discovered that the application of an antioxidant abolished the responses to the extract. "Oxidative stress, an imbalance between disturbances in the normal oxidative state of cells and the system's ability to repair the resulting damage, is linked to many diseases and is a known TRPA1

activator," says Mr Robinson.

This research is, however, only a first step towards understanding how air pollution may be affecting airway sensory nerves and respiratory reflexes. Whether other types of fuel activate airway nerves remains to be seen, and it is even possible that they may have a far more potent effect in this area than diesel. It will also be crucial to determine whether increased activation of sensory nerves explains why some are more susceptible to the effects of air pollution than others, the researchers say.

"We hope that our work may lead to treatments or management strategies than can help those with respiratory diseases such as asthma that are particularly affected by air pollution," says Mr. Robinson. "Our results indicate that our reliance on fossil fuels, and particularly diesel, could have a detrimental effect on our health, supporting the idea that we should be looking towards alternative fuel sources. We believe that our data highlight an important alternative mechanism by which diesel contributes to respiratory illness and will further influence governments in the quest to initiate change," he will conclude.

More information: Poster title: Diesel exhaust particles (DEP) initiate sensory reflex events via activation of transient potential receptor ankrin-1 (TRPA1) ion channels, Saturday 14 March 2015, 11:40-14:30

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