Scientists use exhaled breath to detect hypoxia

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Researchers working in the United States have demonstrated a technique that may enable real-time, in-flight detection of hypoxia in pilots.

The study, led by researchers at the Air Force Research Laboratory, 711th Human Performance Wing, Wright-Patterson AFB, Ohio, replicated a fairly standard 'hypoxic' event. Volunteers were exposed to 5 minutes of reduced oxygen levels to simulate higher altitudes, followed by 5 minutes at 100% oxygen 'recovery' – a typical response protocol to in-flight hypoxia.

The results, published today, 28th October 2015, in the *Journal of Breath Research*, indicate that volatile organic compound (VOC) analysis could identify biomarkers of hypoxia.

"Despite the myriad of advances in aerospace technology, many modern high performance aircraft still rely on the pilot to recognize the symptoms of hypoxia in order to initiate appropriate procedures in the event of a malfunction," said Dr. Claude C. Grigsby, Technical Advisor, Human Signatures Branch, 711th Human Performance Wing "This research provides the basis for both the utility of exhaled breath monitoring to monitor for hypoxia as well as targets for future solid state senor development."

He added, "This is one of many, on-going efforts at AFRL to develop real-time, non-invasive sensing technologies to enhance Airmen performance and safety."

Whilst pilots are typically trained to recognize hypoxic symptoms and react accordingly, sudden loss of cabin pressure could prevent the pilot from noticing the detrimental conditions prior to losing consciousness. Biomarkers such as the VOCs in exhaled breath could be used to detect hypoxia or trigger automated systems.

The researchers used two methods to monitor the exhaled breath of the volunteers, firstly collecting a sample prior to and following the simulated hypoxia and recovery, and by collecting samples every minute through the course of the simulation.

The results show that VOCs diminish following a hypoxic event; however the mechanism to explain this remains unclear.

"We have several hypotheses regarding the underlying mechanisms resulting in the changes observed in the exhaled breath VOC profiles. However, due to obvious limitations in human subject testing, these hypotheses will be challenging to prove." Adds Dr. Sean W. Harshman, Research Scientist, UES Inc. 711th Human Performance Wing, Air Force Research Laboratory, Wright-Patterson AFB, Oh.

"In spite of this fact, we are working to better understand hypoxic episodes mechanistically to validate our findings and to improve our non-invasive chemical sensing platforms. Our future and ongoing studies seek to confirm the data presented in this manuscript, develop a flight worthy chemical sensor, and begin further mechanistic studies of respiratory hypoxia. These data will allow us to gain a better understanding of hypoxic episodes and to better protect our flight crews."

More information: The identification of hypoxia biomarkers from exhaled breath under normobaric conditions *Journal of Breath Research*, Volume 9, Number 4

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