Study finds low-frequency ultrasound can improve oxygen saturation in blood

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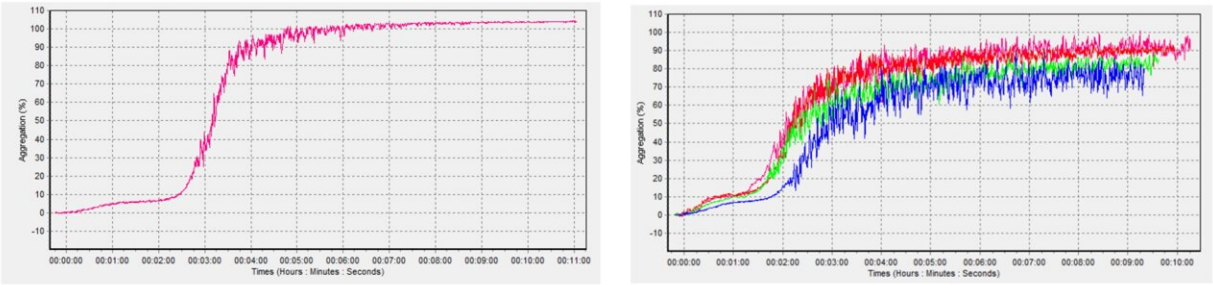

Blood platelet aggregation with epinephrine (a) and low-frequency ultrasound (b) in vitro. In (b), two samples are sonicated with ultrasound at 60 W electric power (pink, red) and two samples are sonicated with ultrasound at 35 W electric power (green, blue). Credit: *Applied System Innovation* (2023). DOI: 10.3390/asi6060099

Research conducted by a team of scientists from Kaunas universities, Lithuania, revealed that low-frequency ultrasound influences blood parameters. The findings suggest that ultrasound's effect on hemoglobin can improve oxygen's transfer from the lungs to bodily tissues.

The research was undertaken on 300 blood samples collected from 42 pulmonary patients. The samples were exposed to six different low-frequency ultrasound modes at the Institute of Mechatronics of Kaunas University of Technology (KTU).

The results were published in the article, "Prediction of Changes in Blood Parameters Induced by Low-Frequency Ultrasound," in *Applied System Innovation*.

The changes in 20 blood parameters were registered using the blood analyzing equipment at the Lithuanian University of Health Sciences (LSMU) laboratories. For the prediction of ultrasound exposure, artificial intelligence, i.e., analysis of variance (ANOVA), non-parametric Kruskal-Wallis method and machine learning algorithms were applied. The calculations were made at the KTU Artificial Intelligence Center.

The use of non-pharmaceutical treatment improves oxygen circulation and reduces blood pressure

KTU professors Vytautas Ostaševičius and Vytautas Jūrėnas say the ongoing research papers are related to blood platelet aggregation. The research of the KTU team revealed that the ultrasound's impact on blood parameters is not limited to the platelet count—it also affects red blood cells (RBC), which can result in better oxygen circulation and lowered blood pressure.

"During exposure to low-frequency ultrasound, aggregated RBCs are dissociated into single RBCs, whose hemoglobin molecules interact with oxygen over the entire surface area of RBCs, which is larger than that of aggregated RBCs and improves oxygen saturation in blood. The number of dissociated single RBCs per unit volume of blood decreases due to the spaces between them, compared to aggregates, which reduces blood viscosity and affects blood pressure," explains Ostaševičius, the Head of KTU Institute of Mechatronics.

The scientists claim that the effect of ultrasound on the hemoglobin in

RBCs was higher than its impact on platelet aggregation, which is responsible for blood clotting. Their findings have been supported by an additional analysis made at the LSMU Laboratory of Molecular Cardiology.

"This means that low-frequency ultrasound can be potentially used for improving oxygen saturation in the lungs for pulmonary hypertension patients. Keeping in mind the recent COVID-19 pandemic, we see a huge potential in exploring the possibilities of our technology further," says Ostasevicius.

In medicine, high-frequency ultrasound from 2 to 12 MHz is used for both diagnostic and therapeutic purposes.

"Acoustic waves emitted by high-frequency ultrasound have a limited penetration depth into the body, so external tissues are more affected by high-frequency ultrasound than internal organs. Low-frequency ultrasound acoustic waves, penetrate deeper into the internal organs with a more uniform sound pressure distribution," explains Jurenas.

There are numerous applications for ultrasound in medical settings.

"For example, focused ultrasonic waves are used to break kidney stones, and to kill cancer cells. Maybe ultrasound can be used to activate certain medications, or to alleviate the delivery of antibiotics to the inflamed areas," says Jūrėnas.

More information: Vytautas Ostasevicius et al, Prediction of Changes in Blood Parameters Induced by Low-Frequency Ultrasound, *Applied System Innovation* (2023). DOI: 10.3390/asi6060099