Website address:
https://www.gesundheitsindustrie-bw.de/en/article/press-release/forschungsteam-entwickelt-neuartige-biomimetische-sprechventil-technologie

Research team develops novel biomimetic speaking valve technology

A research team from the University of Freiburg and the Medical Center- University of Freiburg has developed a novel biomimetic speaking valve technology that could significantly increase the safety of tracheostomised patients. The challenge: if conventional speaking valves are used improperly, dangerous overpressure can occur, which can cause serious complications and even death. In a collaboration between the Freiburg Botanical Garden, the Medical Center – University of Freiburg and the Cluster of Excellence livMatS of the University of Freiburg, researchers developed a speaking valve with an integrated pressure release valve and an acoustic warning signal, inspired by the trapping mechanism of the carnivorous bladderwort plant Utricularia vulgaris.

Utricularia vulgaris, also known as a bladderwort, is a carnivorous plant that traps its prey using specialized hollow, water filled trap bladders. It has been the subject of intensive research in the working group of Prof. Dr. Thomas Speck for many years. These bladders create an internal vacuum and are closed by a special 'trap door'. When small creatures touch the fine trigger hairs on the outside of the door, it opens inwards within 0.5 ms. This fast and reliable opening mechanism of the trap allows water to flow in, dragging the prey with it. The trap door then closes again by means of an elastic resetting mechanism.

The research team applied this principle to the new pressure release valve: a flexible membrane mimics the opening movement of the plant trap and reacts to critical pressure increases in the speaking valve. Upon reaching a specific pressure threshold, which can be adjusted based on the thickness and composition of the membrane, the membrane opens, enabling the regulated release of excess air. The air flows through a pipe module situated behind the "trap door," generating an acoustic signal. This signal serves as an alert for medical personnel, immediately drawing attention to potentially hazardous circumstances. "This innovative pressure release valve opens automatically when critical pressure is reached, emitting a clearly audible warning signal," explains Dr Falk Tauber, co-author and project manager. The design thus ensures timely pressure release and alerts medical personnel to ensure quick assistance.

"Bionic solution for a tangible clinical problem"

The direct inspiration for this innovative concept came from so-called CIRS reports. In this reporting and learning system at the Medical Center- University of Freiburg, critical situations in patient care can be reported without sanctions and their learning potential translated into concrete solutions for improving patient safety. "It was a stroke of luck for us to become aware of the creative potential of our partners in the Botanical Garden and Cluster of Excellence and to be able to develop this elegant bionic solution for a tangible clinical problem with them," says Dr. Claudius Stahl, co-author and specialist in anaesthesiology at the Medical Center – University of Freiburg.

The biomimetic approach enables the opening pressure to be flexibly adjusted so that the valve can be adapted to the individual needs of the patient. The University of Freiburg has applied for a patent for this development.

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Further information

- University of Freiburg