Medicine

Breathe Here, Please

If doctors can analyze blood and urine to determine the cause of a patient's suffering, why shouldn't illness leave traces on our breath as well? Many researchers are firm believers in breath tests, hoping to diagnose even cancer with the method.

Though now said at most by highway patrol officers looking for drunk drivers, »let me smell your breath« was once a common request of physicians. As early as ancient Greece, Hippocrates was interested in trace odors on his patients' breath, as these smells frequently revealed important information. An acetone note similar to nail polish remover is a sign of diabetes; a fishy amine smell indicates liver or kidney problems; the odor of rotten eggs is potentially a symptom of a pulmonary inflammation. These types of medical skills are now at risk of atrophying. After all, why trouble your nose when modern, high-tech equipment can provide a definite diagnosis? Just take urine or blood samples to the lab or send the patients themselves off for a CAT scan or an x-ray.

Our breath, however, might still make a comeback, albeit via a chemical analyzer rather than our physicians' noses. For patients it would be the easiest sample they'd ever given – no needles, no unnecessary x-rays.

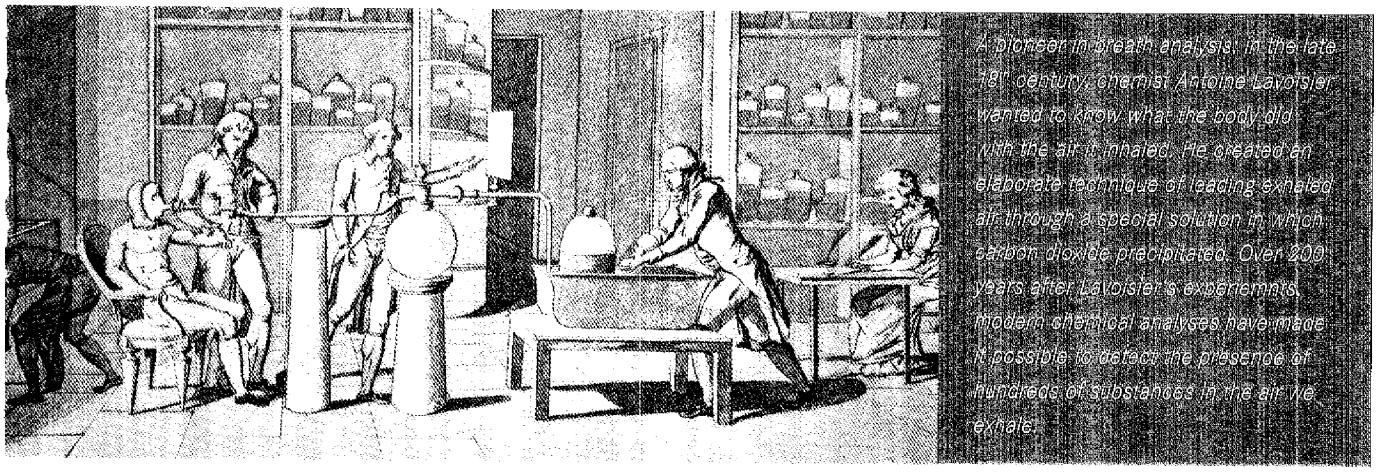
The underlying concept certainly seems plausible: when we exhale, our breath carries with it byproducts of human metabolism. Carbon dioxide is the most obvious example, the presence of which was proven over 200 years ago in a complex series of experiments conducted by Antoine Lavoisier.

Carbon dioxide is not the only component of our breath, however. Any volatile substances contained in the blood can enter our breath via our lungs; alcohol after drinking is the most common example. As early as 1971, chemist and Nobel Prize winner Linus Pauling detected some 200 substances in human breath, and more refined analytical methods have since raised that number to several thousand. Which begs the question of whether the type and amount of a given substance can convey medical information. Can individual substances perhaps indicate a specific physical ailment?

We now know, for instance, that nitric oxide (NO) is symptomatic of inflammations of the respiratory tract. Indeed, doctors now use NO analyzers to diagnose asthma and to monitor the condition of asthmatics.

But the story doesn't end there. Dr. Michael Phillips has been working for years to find out what human breath can tell us. The work of Linus Pauling first attracted his attention in the 1970s and has not let him go since. Today this native-born Australian is the head of Menssana Research, the company he founded in the US. The FDA has already approved the first Menssana test: an instrument known as Heartsbreath, which analyzes the breath to determine whether a patient's body has accepted or is rejecting a transplanted heart.

For patients, the method is far less invasive than the traditional biopsy taken of heart tissue. With Heartsbreath, patients need only to breathe for two minutes into a tube containing an adsorption material that traps the volatile organic compounds in the breath. After accumulating these compounds, the sorbent is sent to the lab where it is heated in order to separate out the VOCs, which can then be analyzed.



A pioneer in breath analysis, in the late 18th century, chemist Antoine Lavoisier wanted to know what the body did with the air it inhaled. He created an elaborate technique of leading exhaled air through a special solution in which carbon dioxide precipitated. Over 200 years after Lavoisier's experiments, modern chemical analyses have made it possible to detect the presence of hundreds of substances in the air we exhale.

Phillips believes that the distribution of specific hydrocarbons is particularly significant. In a 2004 interview published in »Analytical Chemistry,« Phillips says, »Because we're looking at more than 100 compounds, we see very distinctive fingerprints in different diseases.«

Phillips points to the oxidative stress response typical of many diseases, in which highly reactive radicals trigger undesirable and harmful oxidation reactions in human tissue. These reactions, he says, leave characteristic markers in the hydrocarbon profile of the breath.

This industrious Australian now believes that breath tests can be used to detect certain types of cancer at an early stage and has begun studying the breath of breast and lung cancer patients. At the 2005 meeting of the American Society of Clinical Oncology, the world's largest annual oncology conference, he presented a study in which tests performed on more than 400 test subjects detected lung cancer with over 80 percent certainty simply by analyzing the breath.

European researchers are also working to diagnose cancer by means of the breath – they express themselves somewhat more cautiously, however, than does Michael Phillips. »This area of research has a great deal of potential,« says Dr. Jochen Schubert, an adjunct faculty member of the Department of Anesthesiology and Critical Care at the University of Rostock Hospital, »but it will be a few years yet before we're really ready to apply the method.« Schubert is participating in the EU's BAMOD Project (Breath Analysis for Molecular Oriented Detection of Minimal Diseases) to be launched in January of 2006. Lung cancer will be the first target of BAMOD, and initially this will mean conducting systematic studies to find substances that show promise as indicators of malignant changes in lung tissue. »We'll be studying the air above tumor cell cultures in petri dishes as well as the breath of lung cancer patients,« says Schubert. He goes on to explain that, should any specific markers be discovered as a result of these studies, the next step would be to develop corresponding breath analysis methods.

The advantages are clear: tumors in the lungs are the most common form of cancer and the most frequent cause of death. Lung cancer can progress painlessly for a long period, and by the time symptoms appear it is often already too late for successful treatment. »If a simple test were available that could be used to detect the disease in its early stages,« says Schubert, »that would be a huge step forward. That would mean that anyone falling into one of the known high-risk groups could simply undergo this quick test on a regular basis.« The technology is not yet that advanced, however. Schubert anticipates that the next five years will bring progress.

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