Research of New Uses for Sound in Allopathic Medicine

Three examples of research to improve diagnosis and tracking of diseases, particularly cancer are described below. None of the articles speculated on how these conditions once diagnosed could be treated using sound. Allopathic medicine, even at the research stage, is still a ways from making that leap.

Gil Alterovitz, a bioinformatician at Harvard Medical School, is developing a computer program that translates protein and gene expression into music. In his model harmony represents good health and discord indicates disease.

"At any given time in each of our cells, thousands of genes are churning out their molecular products while thousands more lie senescent. The profile of which genes are on versus off is constantly changing--with specific diseases such as cancer, for example." In searching for a more simplifies way to represent this complexity of information, Alterovitz decided to use music. By condensing gene expression from multiple factors to a few fundamental signals each one represented by a different note and instrument, genetic music became possible. He used mathematical modeling to identify physiological relationships. If one physiological signal changes, there is a correlation to certain others that will change as well. By using the same note for those variables, it simplifies the redundancy of information. The team carefully chose the notes so that normal activity would have a harmonious sound, while abnormal activity would have a discordant sound. Hearing the discordant sound would immediately catch the attention of the listener indicating a physiological problem.

Alterovitz got the idea for this when he was in graduate school working on a project. He had joined surgeons in the operating room and felt distracted by numerous monitors sending information relating to over two dozen physiological signals. Sometimes alarms would go off and be ignored because they were not relevant. He thought that if all those signals could be integrated and presented in a holistic way, they would be more meaningful to the physicians.

The team studied colon cancer and reduced thousands of genes to four components using genetic databases. Genes moving together or opposite in a predictable way could be lumped together as one variable without much loss of detail about the system. They assigned notes to each component and compared the music from normal healthy data sets to those of colon cancer and found that in this model the music from the colon cancer was discordant.

Since then, some other diseases have also been translated into music. If the beeps from monitors are changed to musical notes, the heart rate monitor could be violins, the blood pressure monitor cellos and so on and doctors would immediately hear when the music became discordant and know that a patient was in distress.

Music could also be used to track the disease. Changes in the music could show that the patient was getting better or worse. It gives the user the ability to discern many pieces of information at once.

The sounds can be heard on the sites below:

http://www.the-scientist.com/blog/display/55998/

http://www.technologyreview.com/video/index.aspx?id=21094&brightcove=1672070565&iframe=biotech&autoplay=true

Another team at the University of Missouri can detect the spread of skin cancer cells in the body by listening to their sound. The method is called photacoustic detection. It combines laser and ultra sound techniques by using laser to make the cells vibrate then picking up the sound and picking up the sound characteristic of melanoma cells. They take a blood sample from a patient and expose it to brief intense rapid fire sequences of blue-laser pulses lasting only billionths of a second. They were able to identify as few as 10 melanoma cells.

“The dark, microscopic granules of melanin contained in the cancer cells absorb the energy bursts from the blue-laser light, going through rapid cycles of expanding as they heat up and shrinking as they cool down. These sudden changes generate loud cracks -- relative to the granules' size -- which propagate in the solution like tiny tsunamis. The sound waves produced by melanin are high-frequency ultrasounds, meaning that they cannot be heard by the human ear, even if amplified.” Researchers can pick them up with special microphones and analyze them with a computer. Other human cells do not contain pigments with the same color as melanin, so the melanin signature is easy to tell apart from other noises. The presence of melanin granules in the blood is an unmistakable sign. This test will allow for an earlier diagnosis and treatment of one of the most aggressive forms of cancer.

Melanoma is the only type of cancer whose cells will strongly absorb all wavelengths of light, emitting ultrasounds that stand out from those of other cells. Artificial materials could be introduced, to act as light absorbers with their own photoacoustic signature, the particles would then signal the presence of cancer cells.

In another study, scientists at UCLA studied baker's yeast cells and discovered that the cell wall vibrates at 1,000 times/second. When the vibrations were converted to sound, they made a high pitched scream about the same sound as two octaves above middle C. The scientist said that if one continued to listen to the sound one could go mad. For mammalian cells, to vibrate in order to be converted to sound, they must be blasted with light. Biologists at the University of Manchester in England, blast human prostate cells with infrared light, their microphones pick up thousands of simultaneous notes generated by the cells. Through statistical analysis of these sounds—which are created as the cells rapidly heat up and cool down, causing vibrations in the air molecules directly above them—biologists can differentiate between normal and cancerous cells. "The difference between a healthy cell and a cancer cell is like listening to two very large orchestras playing their instruments all at the same time," Gardner says. "But in the cancerous orchestra, the tuba is horribly out of tune."

Bibliography

http://futurismic.com/2008/07/20/translating-genetic-information-into-music-to-diagnose-disease/

http://www.technologyreview.com/Biotech/21094/?a=f

http://bcl.med.harvard.edu/proteomics/proj/csf/menu.php

http://www.wbur.org/2010/03/04/surgical-symphony

http://www.thecrimson.com/article/2007/4/26/tf-translates-dna-into-music-sequence/

https://lifeboat.com/ex/bios.gil.alterovitz

http://www.childrenshospital.org/vector/vector_fall08/sounding_out_disease.html

http://www.broadinstitute.org/cancer/software/genepattern/desc/expression.html

http://www.youtube.com/watch?v=ozA_xORcZ_s

http://www.eurekalert.org/pub_releases/2006-10/osoa-ltt101606.php

http://www.popsci.com/scitech/article/2008-01/do-cells-make-noise