

New Method for Staging of Rhinosinusitis Using Doppler Ultrasound

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Bacteria growing resistant to antibiotics is a major issue in medicine. It is therefore important not to prescribe antibiotics when it is not needed. One case where this is common today is rhinosinusitis. Acute rhinosinusitis (ARS) is the fifth most common diagnosis for which antibiotics are prescribed, according to the US National Ambulatory Medical Care Survey. A new non-invasive diagnosis method using ultrasound has been developed at SUS and LTH, which could potentially prevent these unnecessary prescriptions.

Normally, the maxillary paranasal sinuses are air filled pockets in the skull approximately 4 to 6 cm deep. Rhinosinusitis is an infection caused by either a virus or bacteria, during which these cavities are filled with fluid.

There are two non-invasive methods a doctor can use to help him/her diagnose rhinosinusitis. The first method is Computer Tomography (CT), which enables the doctor to look at the patients head in a 2- or 3-Dimensional image. The doctor can then see if there is

fluid in the sinuses. The second way is to use ultrasound. Ultrasound are sounds with higher frequency than 20 000 Hz, meaning above the normal range of human hearing. By sending ultrasound waves into the maxillary sinus cavity, the returning echoes can be used to create an image of the insides of the sinuses. Since air and bone have very different acoustic properties, it is not possible to see the back of the sinus cavity when it is filled with air. However, if the cavity is filled with a fluid, the echo from the back wall of the sinuses can be seen in the image. This means that the presence of fluid can be easily detected using ultrasound and hence, rhinosinusitis is easily diagnosed. There is however no non-invasive procedure that can determine whether the infection is caused a virus or bacteria.

The current way to distinguish between the two types of rhinosinusitis is to look at the viscosity, or thickness, or the fluid. Studies indicate that ARS with low viscosity, or more runny fluid, is caused by viruses, while fluid with high viscosity (thicker), is caused by bacteria. Since antibiotics are only needed

when the infection is caused by bacteria, determining the viscosity of the fluid inside the cavity could possibly decrease the amount of unnecessary prescriptions of antibiotics for patients with rhinosinusitis.

The viscosity of the fluid in the sinus is usually determined by drawing a sample. This is done by puncturing the sinus with a needle, and since the sinus is located behind a thin wall of bone, this is an uncomfortable procedure for the patient.

In a master's thesis at LTH (which is based on earlier work by Jansson and Sahlström at LTH and Skåne Universitetssjukhus), the ultrasound procedure has been improved and expanded to also determine the viscosity of the fluid. The method is based on what is called acoustic streaming. When sound waves travel through a fluid, some energy is absorbed- sometimes to the point where the fluid starts moving in the direction of the sound. Depending on the viscosity of the fluid, more or less energy is required in order for this to occur. Thereby, it should be possible to determine the cause of the infection using this non-invasive procedure. A program has been developed on a clinical ultrasound scanner, and an initial patient study is pending. Hopefully, less antibiotics will need to be prescribed due to this master's thesis.