8: Vocabulary / Yale Fisher, MD

Transcript

Our next subject involves the vocabulary of ultrasound. This is rather extensive because there are a lot of words both used in physics and ultrasound in general that I basically don't understand.

So what I have tried to do is put together clinically useful words that you may hear in descriptions of ultrasonic information. And they are listed for you on the screen.

Basically a bell is a measurement of sound intensity and a decibel, obviously, is one tenth of that bell.

Hertz has to do with the frequency of your transducer and we are working in the ten megahertz range for most commercially available B-scan devices. You can certainly use higher ones but the penetration into the tissue is less, so while you will improve the ability to see things in the front of the eye, you will lose the ability to penetrate much further back. And the thirty-five to fifty to eighty megahertz instruments are basically for the cornea and the anterior segment. We are using the ten megahertz units because we are looking at the back but there are units available with twenty-two megahertz as well that will give you some compromise for both anterior and posterior segment work.

The rest of the words are all descriptions of acoustic impedance mismatch, at least the next two are: homogeneous and heterogeneous. Once sound gets into a tissue it will either pass freely through it if it has all the same acoustic impedance or there will be levels of differences in acoustic impedance, If it passes through it with no signal coming back, it is considered to be homogeneous. For the most part, the vitreous is like that and that is the reason that the vitreous appears to be darkened except for a few reflections from collagen that are present.

And I often ask students: "Well if the vitreous is basically water, it has no reflectivity, why is the optic never apparently also relatively homogeneous or black, since it is obviously much thicker in it's texture than water?" And this gets into the whole idea of that you have to stop thinking about soft or hard with tissue but rather what is the acoustic impedance mismatch?

In the optic nerve there is a strong reflection when you first get into the cribriform plate area but once the sound is in the tissue itself it regresses rapidly without any reflection and therefore the optic nerve appears to be dark, especially against the highly reflective and heterogeneous material of the orbital fat.

The [] in the fat send back sound from the fat every time the sound interfaces with them and you will see basically a white background in orbital fat with high reflectivity.

Homogeneous means the sound is passing through without sending back much echo. And heterogeneous means there are different levels of acoustic impedance mismatch within that tissue.

The next word is anachoic. That simply means no echo. It took me a long time to understand that one.

Attenuation means that the sound has been absorbed, classically seen in tumors because the sound wave can either be reflected, attenuated, meaning being absorbed so that you see less of a reflection behind it, or it can be deflected in some other direction. Usually behind tumors which are fairly heterogeneous and occasionally homogeneous you will see attenuation of the signal directly behind it. If it is bone, you will see nothing behind it, like in a choroidal osteoma. If it is tissue which absorbs a lot of sound, that absorption will be seen as less reflectivity behind it. Usually, the orbital fat will be a shade of gray less than the area of orbital fat not shadowed by the tumor itself.

Shadowing is a similar type of word. It means that the sound has been so strongly reflected that nothing, basically, passes through it and a chorodial osteoma is classic. Drusen on the head of the optic nerve are another. A small air bubble inside the eye is another, such as might occur in a double penetrating injury, the air bubble would remain in the vitreous cavity - it's much different than water and when the sound waves pass over it the strong reflection from the anterior portion of the bubble will come back and anything behind that small bubble will be obscured. It will be shadowed.

Reverberation is a term that is used predominantly in foreign body work. I would state here, although it is not a part of this particular website, that you're better off to get radiographic information prior to your ultrasound when you are trying to determine if a foreign body is present. Ultrasound can be done to rule out a foreign body, but it is not as diagnostic as radiographic information -except in one case, usually wood which is harder to see in CAT scanning and obviously you can't use MRI if there is any fear of the possibility of a magnetic foreign body inside the globe. So CAT scanning for wood can be seen but it's difficult, easier to see with ultrasound. But for the most part, I prefer to have a radiographic CAT scan with one to two millimeter slices prior to my ultrasound if I am going to be ruling out foreign body. I use the ultrasound for collateral damage to the eye: retinal detachment, vitreous hemorrhage, what else might be wrong, the site of exit on the back wall of the globe, a lot of different things but not only for foreign body localization or its' presence.

Reverberation, the word refers to the reverberation of sound within a foreign body, usually metallic, where the sound goes back and forth from one side of the foreign body to the other, releasing a little bit of returning echo each time. And this will look like a comet formation behind the foreign body, usually strung out all the way to the right of the screen behind the foreign body and into the orbital fat.

And we have one or two examples in the library setting.