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Ultrasonic Tissue Strain Imaging

ULTRASONIC STRAIN IMAGING

**You are listening to ReachMD XM 157, the channel for medical professionals. Welcome to advances in medical imaging, a program discussing the latest innovations and clinical radiology and imaging technologies. This edition of advances in medical imaging is sponsored by Siemens Ultrasound, the industry leader in tissue strain analytic applications. Siemens answers for life. Your host is Dr. Jason Birnholz, Director of Diagnostic Ultrasound Consultants, Oak Brook, Illinois. Quantifying the art of palpation. With me today Dr. Brian Garra, John and Kathryn Tampas Green and Gold Professor of Radiology at the University of Vermont and Vice Chairman for Research and Section Chief of Ultrasound in the Radiology Department of the Fletcher Allen Hospitals in Burlington, Vermont. Today were are discussing ultrasonic strain imaging.**

**Dr. BIRNHOLZ:**

Hello Brian.

**Dr. GARRA:**

Hi! How are you?

**Dr. BIRNHOLZ:**

Thanks a lot for joining us.

**Dr. GARRA:**

It's my pleasure.

**Dr. BIRNHOLZ:**

Is it appropriate to think of ultrasonic strain imaging as a form of palpation"

**Dr. GARRA:**

I really think so. Yeah. I think its an extension of an old technique and it would also provide quantification and more precise localization, then you can perform with your own hand often times.

**Dr. BIRNHOLZ:**

Okay. So, its better than palpation?

**Dr. GARRA:**

Its palpation in steroids. Its importation form of palpation that gives you an image which you can correlate with other imaging modalities.

**Dr. BIRNHOLZ:**

And I guess you are palpating anywhere you want deep inside the body, not just the surface.

**Dr. GARRA:**

So far, most of the applications had been superficial, however, the amount of pressure you need to apply, the amount of squeezing you need to apply to produce elastogram is very, very small. Its almost imperceptible to the eye and it is, it is possible to achieve that level of compression anywhere in the body, except may be inside the spinal canal from externally, however, you can use vessel pulsations as well as your means of obtaining motion.

**Dr. BIRNHOLZ:**

Well, we are going to be talking mainly about ultrasonic strain imaging, but can you also apply the same kind of computer processing to CT and MRI.

**Dr. GARRA:**

Yes. There has been only very little work done on CT. Most of the work had been done on ultrasound and also on MRI. MRI works very well with the use of somewhat different method where they measure the sheer modulus of tissues by transmitting a vibration through the tissues, but it ends up giving you a sort of the same result, except that its semi-quantitative instead of qualitative.

**Dr. BIRNHOLZ:**

Ultrasound is available now, isn't it?

**Dr. GARRA:**

Yes. There are at least 4 companies that produce commercial machines where you can get an add-on that includes elastography.

**Dr. BIRNHOLZ:**

Now, when you make a map of elastic features, is this an absolute measurement or is just relative, does it depend on what your target is embedded in or is it just through anywhere in the body whatever you are looking at?

**Dr. GARRA:**

It is a relative image, just like an MR is also a relative image, so it doesn't necessarily lessen its utility, but you do have to keep in mind that the stiffness is from the serial, is not only, will be image be affected and its relative image, but also the actual stiffness as the material changes depending on what it is surrounded by. So, for instance, the inside of an egg, if you already image it from the outside, you would say its very hard because you are actually seeing the shell, but if you remove the shell, then it becomes very soft. So, materials don't have a single stiffness. Their stiffness is probably controlled by the surrounding tissues.

**Dr. BIRNHOLZ:**

Okay, well. Let's take kind of a classic example of palpation. We are trying to feel a firm nodule within soft tissue, which would be breast, what have you found about strain imaging for evaluating breast nodules?

**Dr. GARRA:**

Well, breast imaging is a very competitive area. There is got to be 50 modalities that all claimed to be able to be the panacea for detection of breast cancer. Elasticity imaging or elastography is a potent add-on, which you find in the elastogram as said, breast cancers are harder than normal tissue and also harder than benign tissue such as a fibroadenoma or fibrocystic nodule. In addition, the nodules often appears larger on the elastogram than it does on the sonogram and that's because the surrounding desmoplastic reaction and invasiveness of a cancer causes stiffening of the surrounding tissue, which shows up on the elastogram, but doesn't show up on the sonogram, so you can use that size difference as a means of differentiating one from the other, but also the hardness is very important.

**Dr. BIRNHOLZ:**

Well, you mentioned that desmoplastic reaction part. Is that mean to have the potential for picking up nodules that are may otherwise be invisible and you may not even be able to palpate them?

**Dr. GARRA:**

Definitely, nodules that you can palpate are detectable using elastography. Nodules that are not visible is a little bit different kettle of fish because there are lot of areas in the breast that are somewhat hard, that are cancer, and they are obviously not cancer when you look at other imaging modalities. So, I wouldn't attempt to use elastography alone by itself, but it should be used in conjunction. Luckily, you

can get the elastogram at the same time as you do the sonogram, so you are getting the extra information almost for free, you don't have to do another imaging test.

**Dr. BIRNHOLZ:**

Now, let's say, somebody has identified the nodule, either they can feel it or let's say an x-ray or mammogram raises a question and you do an ultrasound, would you automatically do elastography at the same time?

**Dr. GARRA:**

I think eventually everybody will often times, will display the sonogram on one screen and the elastogram on another or split the screen and do it that way, but first, if you are doing a quick survey just to check nodules or probably just use the ultrasound and then if you find something that's slightly suspicious, you just press a little harder with the probe, you get your elastogram and you are on your way and that can help you distinguish what's going on. The elastogram is created in realtime <_____> instrument.

**Dr. BIRNHOLZ:**

Let's see, somebody palpates the nodule and you do your stuff in the elastogram, says this is not firm, there is no desmoplastic reaction, this looks perfectly innocuous, is that enough, would you avoid doing a biopsy then and just follow the person?

**Dr. GARRA:**

Actually, that is where it's, where it's most powerful. There are many modalities that can detect breast cancer. Where elastography is helpful is in increasing your confidence that a lesion you think might well be benign, falls into the probably benign category and can go into a watchful waiting mode. So, actually, elastography is useful in that regard or that may be where it's most useful. In preliminary work, we have shown that you can eliminate 15%, you can move 15% or so of lesions from a higher BIRADS category to a lower BIRADS category and 15% may not sound like a lot, but given the number of benign biopsies and ends up to a lot of cost savings and a lot of discomfort avoided.

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**Dr. BIRNHOLZ:**

Well, Brian, let's take a fictitious patient, let's say somebody who has been a heavy drinker for many years and now, he comes in with fatigue and weight loss and loss of appetite, referring physician thinks that the liver edges are little firm and he says well, why don't we get an ultrasound and he sends the patient to you. Now, let's just say that there is early cirrhosis. We don't know this yet, but that's going to be our end thing . What might you see, what you think about when the patient is first presenting and you doing the conventional ultrasound part of the exam?

**Dr. GARRA:**

Well, the first of thing you are of course, when you get a patient with a history of like that, is you are going to look for some of the signs of cirrhosis, but typically you might see some heterogenadian liver parenchyma, which is partly due to the cirrhosis, but partly also due to concomitant fatty change, which often occurs in conjunction with cirrhosis. In addition, you will see in advanced stages, shrinkage of the liver, but if this is an early patient, you won't see that, but you may see nodularity of the surface of the liver. Other findings would be much later on like fluid in the abdomen and of course the most important thing you are going to be looking for, is a tumor in the liver, hepatocellular carcinoma, which occurs with increased frequency in patients with chronic hepatitis and cirrhosis.

**Dr. BIRNHOLZ:**

Okay, well, then let's say, you say this liver doesn't, it's architecture is not quite right and then is that the point you would say, all right, let's turn on our elastography?

**Dr. GARRA:**

Well, if you have a lesion in the liver, elastography may be helpful, but at it's current state, elastography only gives you a relative image, so if you have diffuse cirrhosis of the liver, you are not going to be able to pick up that increased stiffness because the whole liver will look slightly darker than prior, but you probably won't be able to perceive if you have nothing to compare to. Now, some investigators have shown that you can compare to adjacent muscle and take a ratio, most of the current instrumentation out there, does not make it easy for you to get a ratio image, but there are some advances on the rise and that are going to change that dramatically. There is also a non-imaging device called the FibroScan that comes from France that uses elasticity imaging and measurement. It sends a vibration into the liver and tracks the progress of the sheer wave that travels to the liver and that it calculates for stiffness of the liver and that is shown to be very accurate in detecting more advanced stages of cirrhosis. Eventually, I think, we will get to that stage within imaging modalities too and may be sooner rather than later, actually.

**Dr. BIRNHOLZ:**

Okay, that would be fairly advanced stage, so as opposed to picking up early disease.

**Dr. GARRA:**

Well, the FibroScan, yes, but because that's non-imaging device, you have problems with the overlying ribs and how thick the overlying tissue is. With an imaging device, it may be much more sensitive because you can focus in on areas of where you have a good picture of the liver and you can see what you are doing. This has already been done fairly extensively and an MRI where they can quantitatively estimate the stiffness of the liver and some early results are coming out with some ultrasound devices that can have the same capability.

**Dr. BIRNHOLZ:**

Okay, so this is not exactly quantitating the fibrosis in an area, so much as looking at its how it is relative to the tissue around it?

**Dr. GARRA:**

Right now, it is, but later on, within a few years, you will see upgrades to the current level of instrumentation that will allow you to quantify the level of stiffness. That is important not only in the liver, say for instance, but also in, let's say you are looking in a renal transplant, we know that transplant becomes stiffer when they start to reject and now would be another good application for this type of modality.

**Dr. BIRNHOLZ:**

My thanks to Dr. Brian Garra who has been our guest. We have been discussing ultrasonic strain imaging.

Brian, thank you very much for sharing your work with us.

**Dr. GARRA:**

Thank you.

**I am Dr. Jason Birnholz. Please visit our web site at reachmd.com, which features our entire library through on-demand podcasts or call us toll free with your comments and suggestions at 888 MD XM 157. Thanks for listening.**

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