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Elastography Applications

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Abstract: ***Elastography is a non-invasive medical imaging technique that detects tumors based on their stiffness (elasticity) compared to normal tissue. The most common type of elastography uses ultrasonic imaging to compare the shapes of the tissue under examination before and after it is compressed slightly. Cancerous tumors tend to be many times stiffer than normal tissue which gives under compression. Breast cancer is the leading cause of women mortality and cancer-related morbidity across the world. This disease alone is accountable for about a third of all the cancers in females. An image in which different degrees of stiffness show as different shades of light and dark is called an elastogram. Many tumors, including breast tumors, show up better in an elastogram than in conventional ultrasonic images. Elastography has been studied in the laboratory since the mid-1990s. It is now being considered as a possible substitute for a breast biopsy, which is an invasive surgical procedure that removes a sample of tissue for pathological examination. The most common type of elastography uses ultrasonic imaging to compare the shapes of the tissue under examination before and after it is compressed slightly. It has been applied to various organs and tissues, e.g as an adjunct tool to conventional US and X-ray mammography in the detection and characterization of the breast masses. Many clinicians use finger palpation to detect abnormally hard tissues by taking advantage of the fact that tissue stiffness is correlated with pathological changes, e.g malignant nodules are stiffer than benign nodules and normal tissues. Ultrasound (US) elastography tries to replace finger palpation .The researcher recommend that procedure should be used in King Khalid hospital and Najran university hospital in near future because it provide estimation of tissue stiffness and provide an effective comprehensive , affordable screening and early diagnosis of breast cancer to allow patients the best chance for a cure and life.***

Keywords: Elastography tumors Breast cancer ultrasound Elasticity

1. Introduction

Elastography is an ultrasonic imaging technique that displays the elasticity of soft tissues. It has been found useful in demonstrating abnormalities of both muscle and breast tissue. Magnetic resonance elastography (MRE) is a medical imaging technique that images propagating mechanical waves using MRI. It non-invasively measures the stiffness of biological tissues. Pathological tissues are often harder than the surrounding normal tissue. This has also been utilized in ablative treatments done with Focused Ultrasound where the treated necrosis tissue can be distinguished with MRE even in real time. Magnetic resonance elastography was first introduced by Muthupillaiin 1995(1). Elastography is an ultrasonic imaging technique that displays the elasticity of soft tissues. It has been found useful in demonstrating abnormalities of both muscle and breast tissue. Relative stiffness imaging is of great interest since the pathological state of soft tissues is often correlated with changes in their stiff nesses. Palpation which is a standard medical practice, relies on qualitative estimation of the low frequency (LF) stiffness of tissue.(2)

During breast, prostate or thyroid examinations, many clinicians use finger palpation to detect abnormally hard tissues by taking advantage of the fact that tissue stiffness is correlated with pathological changes, e.g malignant nodules are stiffer than benign nodules and normal tissues. Ultrasound (US) elastography tries to replace finger palpation while achieving higher sensitivity and specificity. It measures the deformation of tissue in response to applied force and derives and displays its stiffness.(3)

US elastography has demonstrated potential for noninvasively differentiating benign and malignant tumors. However, real-time US elastography is computationally demanding, which was one of the reasons for its late commercial introduction. The computational burden of US elastography is mainly attributed to several modules in strain estimation and post processing. The most compute-intensive task in strain estimation is cross correlation-based search, which estimates tissue displacements between returned ultrasound echo signals before and after compression. In previous study, Bae (4). Changes in tissue elasticity are generally correlated with pathological phenomena. Many cancers appear as extremely hard nodules. Magnetic resonance elastography (MRE) is a recently developed technique that can directly visualize and quantitatively measure the displacement's field in tissues subject to harmonic mechanical excitation at low-frequencies (10 to 1000Hz). A phase-contrast MRI technique is used to spatially map and measure the complete three-dimensional displacement patterns. From this data, local quantitative values of shear modulus can be calculated and images that depict tissue elasticity or stiffness can be generated. (5, 6, 7)

2. Clinical Application Elastography

In patients with chronic liver diseases, determination of the severity of liver fibrosis isimportant for prognostic reasons and for identifying patients who will benefit from treatment. For those patients already receiving treatment, assessment of liver fibrosis can determine their response to treatment. In addition, hepatocellular carcinoma and variceal screening can also be implemented for patients identified with underlying cirrhosis. At present, liver biopsy remains the current gold standard for assessing liver fibrosis, even though the diagnostic accuracy is limited by the specimen size and fragmentation, sampling error and inter-observer variability. The accuracy of liver biopsy can be reduced to 80% because of these limitations (8).

3. Previous Elastography Studies

Breast cancer is the leading cause of women mortalityand cancer-related morbidity across the world. Pakistani women are no exception. This disease alone is accountable for about a third of all the cancers in females. Approximately one in every 9 Pakistani women is likely to suffer from breast cancer, which is one of the highest incidence rates in Asia.(9)

Because mortality from this disease is stage-dependent, early detection is the key to survival. The value of screening mammography has been well-established, yet this technique has well-known limitations. For instance, the sensitivity and specificity of mammography are decreased substantially in women with radiographically dense breasts. Some women will avoid getting a mammogram just because they are so uncomfortable with its procedure. These limitations have prompted investigators to examine the value of other imaging modalities such as sonography.(10)

The Breast Imaging Reporting and Data System for Ultrasound, (BI-RADS) has been instituted to standardize the criteria for interpretation and reporting. These developments, along with advances in instrumentation, have made the role for breast ultrasound more important and necessary in the breast imaging evaluation. Its use allows more thorough and immediate evaluation of suspected breast abnormalities, which can speed diagnosis.(11)

Elastography uses ultrasonic imaging to compare the shapes of the tissue under examination before and after it is compressed. The extent of compression is very small, usually only 0.2–0.6 mm. An image in which different degrees of stiffness show as different shades of light and dark is called an elastogram. A malignant tumour produces a blue image while a benign tumour produces green image depending on degree of elasticity (12).

4. Conclusion

Elastography is a newly developed dynamic technique that uses ultrasound to provide an estimation of tissue stiffness. Elastography has been studied in the laboratory since the mid-1990s. It is now being considered as a possible substitute for a breast biopsy, which is an invasive surgical procedure that removes a sample of tissue for pathological examination. Elastography provides an effective, comprehensive and affordable treatment and the researcher recommend that procedure should be used in King Khalid hospital and Najran university hospital in near future because it provide estimation of tissue stiffness and provide an effective comprehensive and affordable screening and early diagnosis of breast cancer to allow patients the best chance for a cure and life.

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