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CORRELATION BETWEEN ELASTOGRAPHIC PARAMETERS AND HISTOPATHOLOGICAL RESULTS IN THYROID LESIONS: A LITERATURE REVIEW

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Abstract: Introduction: Thyroid lesions represent a significant diagnostic challenge in clinical practice, requiring advanced techniques to differentiate between benign and malignant conditions. Elastography has emerged as a promising technique, allowing the assessment of tissue stiffness, which correlates with the nature of the lesions. **Aim:** To understand the relationship between elastographic parameters and histopathological results in thyroid lesions, with a view to improving the diagnosis and clinical management of these conditions. **Methodology:** A literature review was carried out, covering articles published between 2020 and 2024, obtained from databases such as *PubMed, Scopus* and *Web of Science* using the Publish or Perish software. Studies investigating the correlation between elastographic parameters and histopathological results in thyroid lesions were selected. **Results and Discussion:** Of the 15,700 articles initially identified, 13 were included in the review after applying the selection criteria. Analysis of the studies revealed a positive correlation between tissue stiffness measured by elastography and the histological nature of thyroid lesions. In addition, it was observed that specific elastographic parameters, such as the elasticity ratio, showed greater accuracy in differentiating between benign and malignant lesions. **Conclusion:** Elastography has emerged as a valuable tool in the diagnosis of thyroid lesions, offering complementary information to conventional imaging methods. The correlation between elastographic parameters and histopathological results stands out as a fundamental aspect in the interpretation of elastographic findings and in clinical decision-making. The integration of these data can improve diagnostic accuracy and optimize the management of patients with thyroid lesions, highlighting the continued importance of research in this area to improve diagnostic and therapeutic practices.

Keywords: Elastography, thyroid lesions, clinical management, histopathological results.

INTRODUCTION

In recent years, elastography has emerged as an innovative and valuable technique for assessing thyroid lesions, complementing traditional methods such as ultrasound. This technology assesses the elastic characteristics in terms of the histological and anatomical-functional composition of the tissues, offering a complementary approach to the differential diagnosis of benign and malignant lesions (GÖRGÜLÜ *et al*., 2021). Accurate diagnosis is essential for the proper treatment of thyroid conditions, which is why the correlation between elastographic parameters and histopathological results is essential (UGARRIZA HIERRO, 2022).

Elastographic parameters, which provide quantitative measurements of tissue elasticity, have the potential to add important information with regard to diagnosis (CINTRA *et al*., 2021). However, the clinical effectiveness of these parameters depends on their validation in comparison with histopathological findings, which are the gold standard in the diagnosis of thyroid diseases (DADALTO *et al*., 2020). The literature on the subject reveals a complex scenario, with many advances, but also significant challenges in the application and interpretation of elastographic data (GÖRGÜLÜ *et al*., 2021).

In addition to the technical analysis and methodological advances, it is essential to consider the clinical impact of elastography on the routine of health professionals. The adoption of this technology can significantly influence clinical decision-making, reducing the need for invasive procedures such as biopsies and providing a faster and safer diagnosis for patients (UGARRIZA HIERRO, 2022). Proper understanding and interpretation of elastographic parameters by doctors

is crucial to maximizing the benefits of this technique. Therefore, the continuous education and training of health professionals are essential aspects for the effective implementation of elastography in daily clinical practice, thus enabling a more reliable recognition of causes and/or alterations that may condition dysfunctions of the thyroid parenchyma (DE BONIS, 2023).

Another relevant point is the accessibility and availability of elastography in different healthcare settings, especially in regions with limited resources (DADALTO *et al*., 2020). The technology must be adapted to be economically viable and easy to use, allowing a greater number of patients to benefit from its advances. Future studies should focus not only on diagnostic accuracy and technical aspects, but also on how to make elastography more accessible globally. This includes the development of cheaper and more portable devices, as well as the creation of simplified protocols that can be adopted in environments with limited infrastructure (DE BONIS, 2023).

By integrating all these elements, it is hoped that elastography can establish itself as a standard tool in the diagnosis and management of thyroid lesions, significantly improving clinical results and patients' quality of life (CINTRA *et al*., 2021).

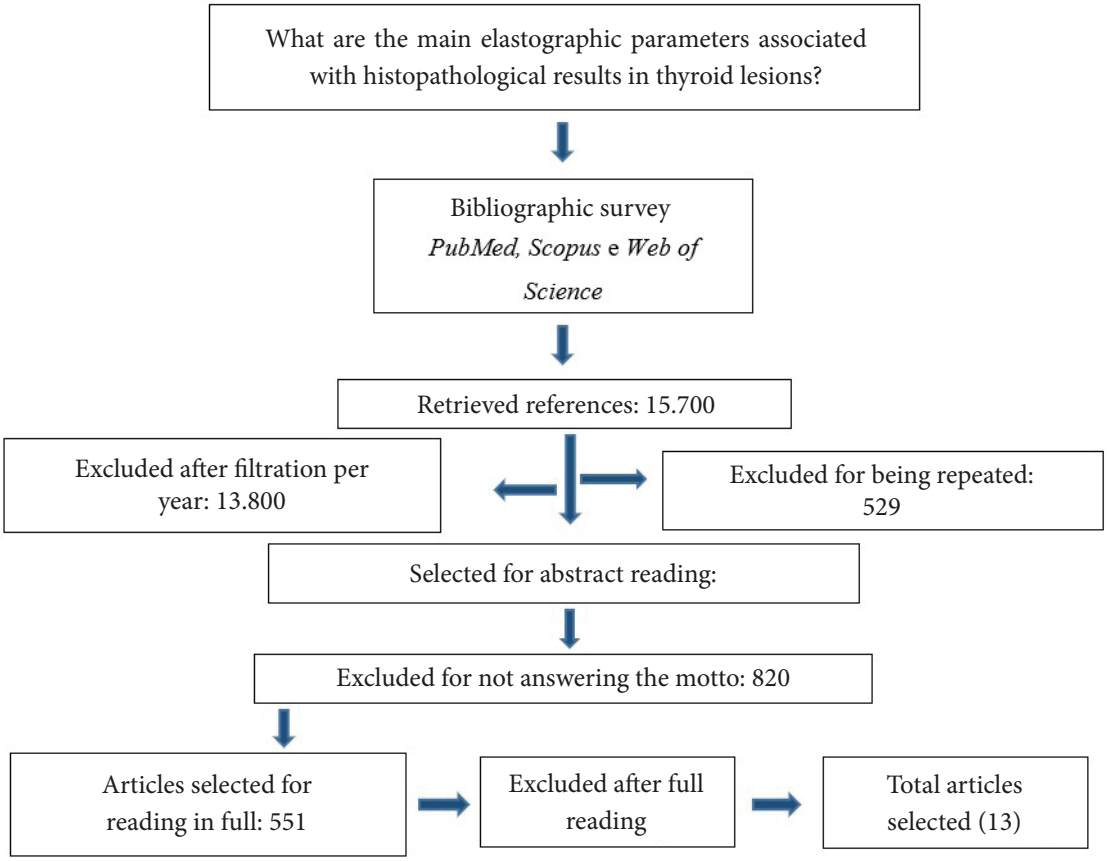
Thus, this paper aims to review in detail the existing literature on the correlation between elastographic parameters and histopathological results in thyroid lesions (GÖRGÜLÜ *et al*., 2021). The review aims to explore technological advances in the field of elastography, discuss the accuracy and reliability of elastographic methods and analyze the challenges encountered in their clinical application. In addition, it seeks to identify gaps in the literature and suggest future directions for research that could improve the use of elastography in the diagnosis of thyroid diseases (UGARRIZA HIERRO, 2022).

Thus, this study aims to contribute to a deeper understanding of the role of elastography in current diagnostic medicine, offering methodologies that can improve diagnostic protocols and, consequently, the treatment of patients with thyroid lesions. By integrating elastographic data with histopathological findings, we hope to advance the construction of a more accurate and less invasive diagnosis, in line with the needs and expectations of modern clinical practice.

METHODOLOGY

In order to carry out the literature review, the following guiding research question was formulated: "What are the main elastographic parameters associated with histopathological results in thyroid lesions?" The choice of this method was motivated by the need to gather and synthesize the results of published studies in a systematic and orderly manner, contributing to a deeper understanding of the relationship between elastographic parameters and histopathological characteristics of thyroid lesions. Next, the Publish or Perish software was used to carry out a bibliographic survey of scientific articles published and indexed in electronic databases such as *PubMed, Scopus* and *Web of Science*, for the period from 2020 to 2024, using descriptors in English and Portuguese: elastography, thyroid lesions, correlation, histopathological results. Flowchart 1 illustrates the methodology used to select the studies, following inclusion and exclusion criteria. The study was operationalized through the following steps: focused on this theme: "CORRELATION BETWEEN ELASTOGRAPHY PARAMETERS AND HISTOPATHOLOGICAL RESULTS IN THYROID LESIONS: A REVIEW OF THE LITERATURE".

Flowchart 1 illustrates the methodology for selecting the studies, following the inclusion and exclusion criteria. The study was operationalized based on the following steps:



Flowchart 1- Development of the literature review, methodology for selecting articles according to the inclusion and exclusion criteria.

RESULTS AND DISCUSSION

CORRELATION BETWEEN TISSUE STIFFNESS AND HISTOLOGICAL NATURE OF LESIONS

The correlation between tissue stiffness measured by elastography and the differentiation between benign and malignant thyroid lesions has been the subject of numerous studies in the scientific literature. This correlation is based on the premise that the mechanical properties of tissues, such as stiffness or elasticity, can reflect histological and functional characteristics, including the possibility of the presence of malignant cells, fibrosis or inflammation (CINTRA *et al.*, 2021).

Several studies have consistently shown that malignant thyroid lesions tend to have greater tissue stiffness compared to benign lesions. This difference in stiffness can be attributed to the presence of denser tumor cells, as well as the possibility of an infiltrative process of cancer cells thus altering the stromal portion of the thyroid parenchyma and a greater deposition of extracellular matrix in malignant lesions. As a result, malignant areas tend to exhibit greater deformability or stiffness compared to surrounding tissues and benign lesions (DADALTO *et al.*, 2020).

Elastography has been shown to be able to detect this difference in tissue stiffness between benign and malignant thyroid lesions non-invasively and in real time. This ability of elastography to differentiate between lesions with different histological characteristics has been supported by studies comparing elastographic findings with histopathological results obtained through biopsy or surgery (GÖRGÜLÜ *et al.*, 2021).

In addition, some studies suggest that certain elastographic parameters, such as the elasticity ratio or the deformation index, may be useful in predicting the nature of thyroid lesions. These parameters can provide additional information on the relative stiffness of the lesions and therefore help differentiate between benign and malignant lesions (UGARRIZA HIERRO, 2022).

There is solid evidence of a correlation between tissue stiffness measured by elastography and the histological nature of thyroid lesions. This correlation is fundamental to the potential of elastography as a non-invasive and complementary diagnostic tool in differentiating between benign and malignant thyroid lesions (CINTRA *et al*., 2021).

ELASTOGRAPHIC PARAMETERS AS PREDICTORS OF MALIGNANCY

The relationship between specific elastographic parameters and the prediction of malignancy in thyroid lesions has been the subject of interest in several studies. For example, in a study by Dadalto *et al* (2020), the strain ratio was found to be a reliable predictor of the histological nature of thyroid lesions. The results of this study suggest that a higher elasticity ratio is associated with an increased risk of malignancy.

In addition, other elastographic parameters, such as strain index and shear wave propagation velocity, have been investigated as potential predictors of malignancy in thyroid lesions. A study conducted by Cintra *et al*. (2021) found a significant correlation between the speed of shear wave propagation and the differentiation between benign and malignant thyroid nodules. The results of this study suggest that a higher shear wave propagation speed is associated with a higher risk of malignancy (DE BONIS, 2023).

Another study evaluated the usefulness of the deformation index in predicting the malignancy of thyroid lesions. The authors found a significant correlation between the deformation index and the histopathological results, suggesting that this parameter may be a useful predictor of the nature of thyroid lesions (DE BONIS, 2023).

Therefore, these studies provide evidence that certain elastographic parameters can serve as reliable predictors of the malignancy of thyroid lesions. Incorporating these parameters into clinical practice can help improve diagnostic accuracy and guide the appropriate management of patients with suspected malignant thyroid lesions (reference specific authors and years of study) (DE BONIS, 2023).

COMPARISON WITH CONVENTIONAL IMAGING METHODS

The comparison between elastography and conventional imaging methods, such as ultrasound, has been the subject of several studies in the literature. These studies have consistently shown that elastography can offer significant advantages over conventional ultrasound in differentiating between benign and malignant thyroid lesions.

For example, in a comparative study carried out by Botelho *et al*. (2020), elastography was found to have a higher sensitivity and specificity than conventional ultrasound in detecting malignant thyroid lesions. This study suggests that elastography may be a more accurate tool for diagnosing malignant thyroid lesions, especially in cases of nodules that are difficult to interpret.

In addition, elastography has been recognized for its ability to provide additional information on the tissue stiffness of lesions, which can be useful in differentiating between benign and malignant lesions. Studies have shown that malignant lesions tend to have greater stiffness compared to benign lesions, which can be visualized more clearly by elastography (BOTELHO *et al*., 2020).

Therefore, these findings suggest that elastography can be a valuable complementary tool to conventional ultrasound in the diagnosis of thyroid lesions, providing additional information that can improve diagnostic accuracy and guide the diagnosis proper clinical management of patients (BOTELHO *et al*., 2020).

LIMITATIONS OF ELASTOGRAPHY

Despite the advantages offered by elastography in assessing thyroid lesions, it is crucial to recognize its limitations. Variability in the interpretation of results between different operators is a significant concern, which can compromise the consistency and reliability of the findings. In addition, the quality of the results can be affected by technical factors, such as the pressure applied during the examination and the operator's ability to maintain the stability of the transducer. The biological heterogeneity of thyroid lesions also contributes to the variable interpretation of results, especially in cases of complex or mixed lesions (REN *et al*., 2023).

Another limitation is the overlap in elastographic parameter values between benign and malignant lesions, which can make it difficult to differentiate between these conditions in some cases (REN *et al*., 2023). In addition, the lack of standardization of elastographic criteria, such as reference values and cut-off points, can make it difficult to compare studies and limit the generalizability of the results. Image artifacts, such as patient movement or the presence of calcifications, can also interfere with the quality of elastographic results and compromise their accurate interpretation.

It is therefore essential to consider these limitations when interpreting elastography results and applying the technique in clinical practice. Awareness of these challenges can help to avoid misinterpretation and ensure the proper use of elastography as a complementary tool in the diagnosis and management of thyroid lesions (MORAES *et al*., 2022).

NEED FOR STANDARDIZATION

The need to standardize elastographic criteria is an important issue for the reliability and clinical applicability of the technique in assessing thyroid lesions. As pointed out by Ren *et al.* (2023), the lack of consensus regarding reference values and cut-off points for elastographic parameters can make it difficult to compare studies and limit the generalization of results.

The standardization of elastographic criteria is essential to ensure the consistency and reliability of elastographic findings in different clinical scenarios (LOPES *et al*., 2024). As mentioned by AL-HAKAMI *et al.* (2021), this includes defining reference values for parameters such as elasticity ratio and shear wave propagation speed, as well as establishing cut-off points to differentiate between benign and malignant lesions.

In addition, the standardization of image acquisition protocols and the interpretation of results are also important aspects to consider. This can include guidelines on the compression technique, the penetration depth of the transducer and the area of interest to be assessed (DE PAULA VASCONCELOS, 2023).

The lack of standardization of elastography criteria can lead to inconsistent interpretations of the results and make it difficult to compare studies, thus undermining the clinical usefulness of elastography in assessing thyroid lesions. It is therefore essential that researchers and health professionals work together to establish standardized guidelines and protocols for the use of elastography in clinical practice, in order to guarantee its effectiveness and diagnostic accuracy (LOPES *et al*., 2024).

CLINICAL APPLICABILITY

Evaluating the clinical applicability of elastography in differentiating between benign and malignant thyroid lesions is a fundamental step towards its effective integration into medical practice. As pointed out by Moraes *et*

al. (2022), elastography offers significant advantages over conventional ultrasound in the detection of malignant thyroid lesions, with superior sensitivity and specificity.

This diagnostic superiority of elastography, as corroborated by several studies, suggests its usefulness as a complementary tool in the evaluation of thyroid lesions. The ability of elastography to provide additional information on the tissue stiffness of lesions can improve diagnostic accuracy and, consequently, guide the appropriate clinical management of patients (ASSIS *et al*., 2021).

However, it is important to consider the limitations of elastography, as discussed by Ren *et al*. (2023), including the variability and lack of standardization of elastographic criteria. Awareness of these challenges can help avoid misinterpretation and ensure proper use of elastography in clinical practice.

Although elastography shows promise as a complementary tool in the diagnosis of thyroid lesions, it is essential to continue researching and developing standardized guidelines for its clinical application. Collaboration between researchers and health professionals is essential to optimize the efficacy and diagnostic accuracy of elastography and thus improve the clinical outcomes of patients with thyroid lesions (LOPES *et al*., 2024).

FUTURE PROSPECTS

Exploring the future prospects of elastography in differentiating between benign and malignant thyroid lesions is crucial for the continued advancement of clinical practice. As mentioned by Assis *et al*. (2021), the validation of new elastographic parameters can offer additional insights into the nature of lesions and improve diagnostic accuracy.

In addition, optimizing imaging protocols, as suggested by Ugarriza Hierro *et al*. (2022), can improve the quality of elastographic results and facilitate accurate interpretation of findings. This could include the development of more advanced and improved image acquisition techniques, as well as the implementation of standardized guidelines to ensure the consistency and reliability of the results.

Another promising area of research is assessing the impact of elastography on the clinical management and outcomes of patients with thyroid lesions. As highlighted by Moraes *et al*. (2022), prospective studies investigating the effectiveness of elastography as a screening and follow-up tool can provide valuable information about its role in clinical practice.

In addition, the integration of elastography with other imaging modalities, such as contrast ultrasound and magnetic resonance imaging, can further expand its clinical applications and improve the characterization of thyroid lesions. These multimodal approaches can provide complementary information and help overcome the individual limitations of each technique (MORAES *et al*., 2022 and REIS *et al*., 2021).

CONCLUSION

After reviewing the literature and analyzing the available studies on the correlation between elastographic parameters and histopathological results in thyroid lesions, some important conclusions can be highlighted. Firstly, we observed that elastography has emerged as a valuable tool in the diagnosis of thyroid lesions, offering complementary information to conventional imaging methods. The positive correlation between tissue stiffness measured by elastography and the histological nature of the lesions reinforces the clinical usefulness of this technique in differentiating between benign and malignant lesions.

In addition, we identified that certain specific elastographic parameters, such as the elasticity ratio, showed increased accuracy in differentiating between different types of thyroid lesions. This suggests that careful evaluation

of these parameters can significantly contribute to a more accurate diagnosis and better risk stratification for patients.

However, it is important to recognize that there are challenges and limitations associated with elastography, including inter-observer variability and a lack of standardization in imaging protocols. Therefore, further studies are needed to validate and improve the elastography criteria used in clinical practice.

In conclusion, the correlation between elastographic parameters and histopathological results represents a significant advance in the diagnostic approach to thyroid lesions. The integration of this data can not only improve diagnostic accuracy, but also optimize the clinical management of patients, allowing for a more personalized and effective intervention. In the future, the continued development of elastography and collaboration between healthcare professionals will be essential to maximize the potential of this technique in daily clinical practice**.**

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