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INPLASY

The Efficacy of Shear Wave Elastography in Measuring Placental Stiffness for Preeclampsia Screening and Diagnosis: A protocol for Systematic Review and Meta-Analysis

INPLASY202460037
doi: 10.37766/inplasy2024.6.0037
Received: 11 June 2024
Published: 11 June 2024

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ADMINISTRATIVE INFORMATION

Support - Nil.

Review Stage at time of this submission - Formal screening of search results against eligibility criteria.

Conflicts of interest - None declared.

INPLASY registration number: INPLASY202460037

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 11 June 2024 and was last updated on 11 June 2024.

INTRODUCTION

Review question / Objective How does shear wave elastography (SWE) perform in terms of accuracy for screening and diagnosing of preeclampsia in pregnancy?

Rationale Shear wave elastography (SWE) is a non-invasive imaging technique used to assess the mechanical properties of tissues by measuring their stiffness. SWE generates mechanical shear waves using an ultrasound transducer, which propagate through the tissue, and the speed at which these waves travel through the tissue, when measured provides an idea regarding its stiffness and the degree of fibrosis. Faster wave speeds typically indicate stiffer tissue. The data, thus generated is used to create a stiffness map of the tissue, providing visual and quantitative information about the tissue's mechanical properties. SWE is commonly used to evaluate liver stiffness as an indicator of fibrosis or cirrhosis (1), and to differentiate between benign and malignant breast lesions based on their stiffness (2). SWE can assess muscle and tendon integrity, helping diagnose conditions like tendinopathy or muscle stiffness (3). It also provides additional information about tissue characteristics in the prostate and thyroid glands, aiding in the detection of abnormalities (4, 5). Shear wave elastography (SWE) has several applications in obstetrics, providing valuable insights into maternal and fetal health like Assessment of Cervical Stiffness for prediction of Preterm Birth (6), to determine the readiness of the cervix for labor induction, improving the timing and success rate of induced labor (7), for prediction and diagnosis of adherent placenta, and also in some cases for the assessment of fetal conditions like neurological abnormalities (8) or liver disorders (9, 10). This

technology has gained attention in obstetrics, for evaluating the placenta, predominantly due to its non-invasive nature, real time and immediate results and also providing objective measurements that can be tracked over time. Abnormal stiffness measurements can indicate pathological conditions such as placental insufficiency, preeclampsia, or other complications.
In preeclampsia, the placenta often exhibits increased stiffness due to abnormal vascular development, inflammation, and fibrosis. These changes can be detected by elastography. Elastography can help in the early detection of preeclampsia, allowing for timely intervention and management, it can also be used to monitor changes in placental stiffness over time, providing insight into the progression of preeclampsia and also in stratifying the risk of adverse outcomes in pregnancies complicated by preeclampsia. Various studies have assessed the potential use of these parameters for screening and diagnosis of preeclampsia. These studies included diverse patient populations, small sample sizes, and different cut-off values. Therefore, we wish to perform this systematic review and meta-analysis to assess the ability of ultrasound-measured placental elasticity, by various representative values (shear wave velocity in m/s and shear wave elasticity in kilopascals) to accurately predict, and diagnose preeclampsia in different trimesters of pregnancy.

Condition being studied Preeclampsia in pregnancy.

METHODS

Search strategy A systematic electronic literature search of databases PubMed, Embase, Scopus, and Cochrane Library, Web of Science, and Google scholar, will be conducted for all studies using Shear wave elastography of the placenta for screening, diagnosis, or monitoring disease progression in patients with preeclampsia in any trimester of pregnancy.
The search will be done using a combination of keywords and Medical Subject Headings (MeSH) terms including placenta OR preeclampsia AND ((acoustic radiation force impulse) OR (ARFI) OR (shear wave elastography) OR elastography OR stiffness OR (Virtual touch IQ elastography) OR Elasticity OR kpa OR kilopascals), from inception till May 2024.

Participant or population Pregnant patients in any trimester of pregnancy, diagnosed with preeclampsia or at high risk of preeclampsia.

Intervention Shear wave Elastography to assess placental stiffness.

Comparator Normal pregnant females, without any co-morbidities.

Study designs to be included Original articles, case-control studies, prospective observational studies, including at least 8 patients with PE in the study group.

Eligibility criteria We will include all research (original articles, case-control studies, prospective observational studies, including at least 8 patients with PE in the study group), published in English, evaluating the accuracy of ultrasound elastography for measuring placental stiffness to screen or diagnose preeclampsia (PE). The studies will be included if they provide sufficient data to calculate true positive (TP), false positive (FP), false negative (FN), and true negative (TN) cases. Only the studies comparing Shear wave elastography of the placenta for screening, diagnosis, or monitoring disease progression in patients with preeclampsia with controls would be included. Studies with insufficient data, case reports, reviews, and non-English publications will be excluded. Studies on gestational hypertension will also be excluded.

Information sources PubMed, Embase, Scopus, and Cochrane Library, Web of Science, and Google scholar.

Main outcome(s) Our aim is to find out the pooled sensitivity, specificity, positive predictive value, and negative predictive value of SWE for the screening and diagnosis of PE.

Data management We will calculate the absolute value of the true positive (TP), false positive (FP), false negative (FN), and true negative (TN) values for each study regarding the index parameter. We paln to determine the pooled sensitivity, specificity, diagnostic odds ratios (DORs), and summary receiver operating characteristic (SROC) curves, assessing the effectiveness of ultrasound-measured shear wave elastography in diagnosing preeclampsia.

Quality assessment / Risk of bias analysis The methodological quality and risk of bias of included studies will be evaluated using the Quality Assessment of Diagnostic Accuracy Studies (QUADAS-2) tool (11).

Strategy of data synthesis All statistical analyses will be conducted using Meta-Disc® (version 1.4, XI Cochrane Colloquium, Spain) (12).

Subgroup analysis Patients with and without preeclampsia will be divided into subgroups, based on the trimester of pregnancy, and we plan to see the sensitivity of shear wave elastography separately for screening(first trimester) and for diagnosis (second and third trimester).

Sensitivity analysis All statistical analyses will be conducted using Meta-Disc® (version 1.4, XI Cochrane Colloquium, Spain) (12). We will calculate the absolute value of the true positive (TP), false positive (FP), false negative (FN), and true negative (TN) values for each study regarding the index parameter.

Language restriction English.

Country(ies) involved India.

Keywords preeclampsia, shear wave elastography, placental stiffness.

Contributions of each author

Author 1 - Mishu Mangla - conceptualisation, data search, data extraction, data analysis, writing the manuscript, approval of the final version of manuscript.
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