



Cervical Elastography in the Diagnosis and Evaluation of Cervical Insufficiency and the Risk of Preterm Birth

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Abstract

Introduction: Elastography is a non-invasive medical imaging technique that helps determine the stiffness of organs and other structures in the body by sending painless, low-frequency vibrations that move through the organ and are collected by a computer that uses this information to create a visual map that shows the stiffness (or elasticity) of the organ being examined. In ultrasonography, together with the morphological information of the B mode and the vascular information of the Doppler mode, it provides key data for diagnosis and has multiple uses in the field of gynecology since it has been shown to predict the risk of cervical insufficiency and preterm birth, and to differentiate malignant tissue from normal tissue.

Material and methods: A descriptive study and bibliographic review was carried out, taking the publications from different databases and medical search engines that refer to the use of elastography in the diagnosis and evaluation of cervical incontinence and preterm delivery, to later offer a research outlet to verify the effectiveness of the study.

Conclusions: Cervical elastography is a procedure without side effects, with a low cost of performance and a high diagnostic value, which is demonstrated by our experience, and it is necessary to encourage its use in gynecologic-obstetric care institutions.

Keywords: Elastography; Cervical Inconsistency; Preterm Delivery

Introduction Elastography

Elastography is a non-invasive medical imaging technique that helps determine the stiffness of organs and other structures in the body. Elastography sends painless, low-frequency vibrations moving through the organ that are collected by a computer, which uses this information to create a visual map that shows the stiffness (or elasticity) of the organ being examined.

In ultrasonography, together with the morphological information of the B mode and the vascular information of the Doppler mode, it provides key data for diagnosis and has multiple uses in the field of gynecology since it has been shown to predict the risk of cervical insufficiency and preterm birth, and to differentiate malignant tissue from normal tissue.

Effective and reproducible methods for the quantitative evaluation of the biomechanical properties and microstructure of the

cervix can be used to predict the success of induction of labor in full-term pregnancies, as well as the risk of spontaneous preterm birth. Thus, the finding of a neck with a hard consistency may correlate with failures in labor induction. Conversely, a soft neck is associated with a high risk of preterm labor [1].

As mentioned above, the identification of patients at risk is an essential requirement for taking measures and interventions to prevent preterm birth and reduce its consequences [1].

Cervicometria, maternal factors (age, height and obstetric history) and biomarkers (fibronectin) allow the calculation of risk for preterm delivery.

Biomechanical evaluation of the cervix can also be used for this purpose. However, these techniques have not yet been established in the guidelines of the main obstetric societies worldwide due to the lack of studies that support these diagnostic methods [1].

Elastography is a diagnostic method based on the biomechanical properties of the cervix. It is an ultrasound or magnetic resonance imaging technique used to detect abnormal soft tissues through elasticity parameters during compression. This method is based on the identification of specific areas of the cervix [2]. The neck is scanned in the usual way, through minimal pressure with the trans-

ducer. By deforming cervical tissue (Figure). Specialized software is used to produce a color map that describes the deformation of the tissue with respect to the surrounding tissue. Initially used for the diagnosis of cancer and applied in different fields of medicine, such as cardiology, gynecology, urology, endocrinology [3].

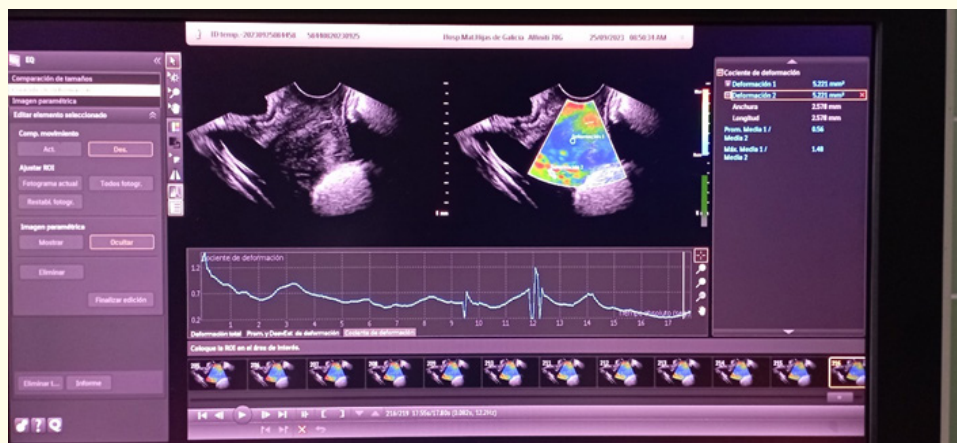


Figure 1: Elastography in a normal patient where a cervix with a deformity of 5.22cm² is observed, which induces a degree of hardness of the cervix.

This method uses a combination of sound waves with magnetic resonance imaging to evaluate the properties of soft tissues. Like ultrasonography, it studies the elastic characteristics of tissue [2].

When used at the level of the cervix, elastography provides a direct measure of cervical incompetence, used to calculate the risk factor that triggers preterm labor, because the characteristics of cervical stiffness are more closely related to cervical capacity than current measures (cervicometria) [4].

Preterm birth syndrome is defined as births that occur before 37 weeks of gestation. It includes births caused by preterm labor, premature rupture of membranes, and cervical insufficiency and excludes preterm deliveries indicated by maternal or fetal conditions [5].

It is responsible for 35% of infant deaths in the first year of life and severe short- and long-term morbidity in those who survive prematurity [6]. For this reason, it is vitally important to identify risk factors, make an adequate diagnosis, and apply strategies for the prevention and management of this syndrome [7].

Taking into account that preterm birth is a multifactorial syndrome, and in which multiple causal agents participate, including: infectious, inflammatory, genetic processes, premature rupture of membranes [5], it is necessary to focus and apply the different methods of prevention, diagnosis and treatment, long before the onset of symptoms and thus achieve an impact on the high rates of preterm birth that persist today [6].

The rate of preterm births (understood as births occurring before the completion of 37 weeks of gestation per 100 births) has

been growing exponentially in the last 16 years, reaching more than 20% between 1990 and 2006 [2,10,11]. In addition, it causes approximately 1 million deaths each year; The risk of neonatal death decreases as gestation approaches term, so the relationship is inversely proportional [8].

On the other hand, the younger the gestational age, the serious consequences for the preterm product occur, with short-term risks (death, interventricular hemorrhage, hyaline membrane disease, necrotizing enterocolitis, among others), and long-term sequelae such as: (deficit of psychomotor development, increased risk of chronic morbidities in adulthood [9].

Our institution is currently managing a high level of morbidity that includes a wide spectrum of pathological entities during pregnancy; among which vaginal sepsis, intrauterine growth restriction (IUGR) and consequently the increase in the index of cervical inconsistency and preterm delivery are observed. Therefore, it is necessary to incorporate new diagnostic modalities and functional studies to predict and evaluate the state of the cervix of pregnant women with risk factors.

Materials and Methods

We reviewed the literature available in English and Spanish from 2001 to June 2023 in the following databases: MEDLINE, EMBASE, PubMed, Elsevier, ClinicalKey, google, Ovid and Cochrane, and Infomed, using the keywords preterm birth, pessary, vaginal progesterone, cerclage, prevention, preterm birth, preterm birth screening. A total of 29,643 results were obtained, which were filtered to select articles available in full text, and 9925 results were obtained. Subsequently, a selection was made using as

a criterion the treatment of the topic of diagnosis and prevention of preterm birth, as a result 101 articles were chosen that included updated management guidelines, scientific and technological research, reviews.

A longitudinal, descriptive and prospective study is proposed, taking as a universe the patients with risk factors for cervical incontinence and premature birth who are treated at the 10 de Octubre Maternal Obstetric and Gynecology Hospital

The variables to be measured would be: age, race, number of pregnancies, history of previous preterm births, history of vaginal or urinary sepsis and presence of genetic malformations. A previously structured data collection sheet was used and then analyzed with the statistical program Excel.

Inclusion criteria were patients referred for obstetric assessment to the imaging service of the 10 de Octubre Maternal Obstetric and Gynecology Hospital with risk criteria for cervical incontinence or preterm delivery. These patients were referred both from the consultation of pathologies associated with pregnancy of our institution, as well as from the different areas of Primary Health Care. The exclusion criteria would include patients who could not undergo cervicometry and cervical elastography either because they had active vaginal sepsis, the presence of a cervical pessary or cerclage or because of an inability to tolerate the procedure.

The procedure was performed after obtaining the patient's informed consent. A transabdominal baseline examination was performed. The cervical transducer was inserted into the patient to visualize the length and morphological characteristics of the cervix and then comparative longitudinal scans (Dual) were performed, the thickness and length of the neck were measured separately and the findings found in the color mapping were described, taking 4 points of interest (ROI), which allow assessing the level of deformation of the consistency of the neck. The procedure took an average of 15 to 20 minutes.

The equipment used was a Phillips ultrasound machine reference Affiniti 70G, all procedures were performed by the same observer with certified experience in ultrasound.

Ethical considerations

In all cases, informed consent was given, which is included in the invasive research procedures or the biosciences profile of the Ministry of Public Health; This includes the risks, benefits and ethical principles to be complied with by health personnel during the processing of personal data.

Development

At present, there is no evidence that the assessment of elastography of the cervix for the prediction of cervical incontinence and, consequently, preterm delivery is included in the Cuban obstetrics and gynecology protocol; Therefore, it is necessary to establish the procedure that allows us to provide our specialists with another

tool which contributes to raising the quality of the medical services provided and the satisfactory result of the pregnancy.

Procedure for performing cervical elastography

Requirements for its realization

Since there is no evidence of this type of procedure being carried out in our institution or within the national health system, it is necessary to establish the rules and procedures for its performance and interpretation by medical personnel.

The fundamental premise or inclusion criteria for the performance of this diagnostic modality are:

- A history of cervical incontinence.
- History of previous preterm births
- History of recurrent vaginal or urinary sepsis.
- Evidence of cervical modifications in the second trimester of pregnancy.
- Patients with labor induction criteria.

Exclusion criteria include:

- The presence of active vaginal sepsis
- Active vaginal bleeding
- Large cervical modifications with or without membrane protection.
- The presence of uterine pessaries or the previous performance of cerclage.
- Other conditions that prevent the patient's cooperation during the conduct of the study.

Technical requirements

To carry out this study, it is necessary to have an ultrasound scanner that has a transvaginal probe and that has the Elastography software to map the area under study, for subsequent interpretation. The above is one of the advantages of performing this ultrasonographic assessment, as it reduces the cost of diagnosis per patient.

Technical procedure

To carry out this procedure, it is necessary to have the patient's approval, for which he must accept the informed consent issued by the medical institution; which includes all the ethical and medical aspects to be complied with by staff, patients and relatives; thus ensuring the realization and compliance with good scientific and medical practices.

Subsequently, the patient is placed in the dorsal decubitus position, with the legs slightly bent (gynecological examination position), to allow the entry of the transvaginal catheter.

Once introduced, a simple examination of the cervix is performed to visualize and evaluate its size, consistency of the internal cervical orifice (OCI) and determine the Cervical Consistency Index (CHF) according to Parra's method. Next, the examination will be

carried out in a longitudinal section of the neck with the use of elastography following the following technical parameters:

- Protocol: Pelvic TV
- Ultrasound map: 2 or 4
- Ultrasound mixer: 2
- Persistence: Maximum
- Anti-aliasing: Medium

Once the aforementioned parameters have been established, the operator will proceed to establish at least 4 points of interest (ROI), taking as a reference the External Cervical Orifice (OCE), Internal Cervical Orifice (OCI), 2 intermediate points at the level of the uterine myometrium; which will allow the degree of deformation of the cervix to be assessed.

Degree of deformation

- Deformation between 1-10mm² is classified as hard and therefore as unlikely to cervical modification.
- Deformation between 10-12mm² is classified as medium or soft and therefore with a 50% probability of cervical modification.
- Deformation above 12mm² is classified as soft and therefore with more than a 70% chance of cervical modification.

Conclusions and Recommendations

- The rate of preterm birth worldwide has not changed in the last decade, despite the different screening and prevention strategies discussed in this monograph.
- It is vitally important to encourage government entities in our country to conduct research on preterm birth, and thereby have a positive impact on the reduction of current rates.
- It is recommended to apply new strategies for the prevention of preterm birth in order to reduce mortality and morbidity rates in the long term, and consequently reduce costs in our health system.
- Studies are recommended to support the use of screening techniques based on the biomechanical evaluation of the cervix (cervical consistency index and cervical elastography). Taking into account that it allows quantifying the risk for preterm birth, and thus allowing timely and effective interventions.

Socio-economic impact

The author considers that the implementation of this study within the protocols of gynecology and obstetrics will have a high socioeconomic impact, by offering our specialists a viable and reliable tool that will allow them to assess early the state of the cervix of patients at risk of cervical incontinence or preterm delivery; as well as establishing a predictive method of the evolution and effectiveness of the labor induction process.

Internationally, the cost of performing a cervicometry has a cost that ranges between 65 and 67 Usd, but taking into account that this study only uses a small amount of medical supplies, we consider that the cost of performing it should be calculated only by establishing the cost of the energy carriers, use of equipment and medical supplies but without neglecting to observe its economic impact in a comprehensive way. This leads to even greater savings by saving on costs per patient for procedures, treatments and hospitalization time.

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