Three-dimensional ultrasound STIC-HDlive rendering: new technique to assessing of fetal heart

Ultrassonografia tridimensional STIC-HDlive no modo de superfície: nova técnica para avaliação do coração fetal

Edward Araujo Júnior[1], MD, MSc, PhD; Luciano Marcondes Machado Nardozza[1], MD, MSc, PhD; Antonio Fernandes Moron[1], MD, MSc, PhD

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Congenital heart diseases (CHD) are the most common fetal congenital malformations, corresponding to an incidence six higher than chromosome anomalies and four higher than neural tube defects [1]. The prevalence of CHD in newborns ranges from 0.6% to 5% [2]. It's too known that the prenatal diagnosis can modify the outcome of some types of CHD [3,4]. The two-dimensional echocardiography is the "gold standard" exam to the diagnosis of CHD; however, it is operator-depending and only is realized in high risk pregnancies [5]. Although, the majority of CHD cases occurring in low risk pregnancies [6], being necessary appropriate screening in the second trimester ultrasound scan.

Due the high incidence of CDH in low risk pregnancies, several international associations tried to incorporate the "extended basic" cardiac scan in the second trimester ultrasound exam. In other words, the "extended basic" would be the inclusion of ventricles outflows in the four chamber view [7,8]. The incorporation of medical ultrasound obstetrics education has proved to be an effective method to improve the detection rate of CHD [9]. Despite of these improvements in the fetal cardiac screening, the second trimester ultrasound scan continues being operator-depending and time-consuming.

In the begging of 2000, a new software named spatio-temporal image correlation (STIC) has been available in several three-dimensional ultrasound machines. STIC enables acquisition of fetal heart volume and vascular connection data. The images generated by this software can be evaluated both in multiplanar and in rendering modes. They can also be evaluated both statically and in movement (4D) through a cineloop sequence that simulates an entire cardiac cycle [10,11]. The advantages of STIC for fetal heart evaluation are the following: lower dependency on the operator's experience, in obtaining diagnostic planes; shorter time taken to perform the examination, without the patient's presence during the volume analysis; possibility of evaluating structures through the render mode with assessment of their morphology and function [12]; and the capacity to send volumes for analysis at other fetal cardiology reference centers via an internet link [13]. Nowadays, the STIC has been utilized in the rendering mode to assess the atrioventricular valves [14,15] and interventricular septum [16]. STIC and virtual-organ computer-aided analysis (VOCAL) has been used to assess the fetal cardiac function by means heart stroke, cardiac output and ejection fraction [17,18]. In relation to screening of CHD, the isolated use of STIC still remains controversial. Some studies have shown advantages of two-echocardiography under STIC in the screening of CHD [19,20]; however, one study showed a great accuracy of STIC in the diagnosis of CHD in a high risk pregnancies [21]. Its necessary new multicenter studies with large samples both low and high risk obtaining definitive results [22].

Recently, a new software named HD*live* has been available in Voluson E8 (General Electric Medical System, Zipf, Austria) ultrasound machine. HD*live* is a new technique of surface designs, in which the operator performs light settings, creating depth effects by means of adequate lighting and shading of the images [23]. HD*live* has been used in the assessment of normal development of embryo/fetus [24,25] as well as in several cases of fetal malformations [26,27].

The STIC-HD*live* rendering is a new algorithm to assess the fetal heart structures similarly to other fetal structures. This new algorithm permits to assess the standard fetal echocardiography views as the four chamber and ventricles outflow views (Figure 1). Furthermore, this technique permits to reconstruction of all fetal heart and your connections (Figure 2). Recent study assessed four normal and three abnormal fetal hearts (Ebstein's anomaly, hypoplastic left heart syndrome and tetralogy of Fallot) [28]. The authors refer that STIC-HD*live* permitted realistic sensations of each leaflet of the atrioventricular valves. In the case of Ebstein's anomaly, natural and ana-

[1]Universidade Federal de São Paulo, Department of Obstetrics (UNIFESP), São Paulo, SP, Brazil.
E-mail: araujojred@terra.com.br

Abbreviations, acronyms & symbols	
CHD	Congenital heart diseases
STIC	Spatio-temporal image correlation
VOCAL	Virtual-organ computer-aided analysis

tomically realistic images of significantly low attachment of the tricuspid valve and the atrialized portion of the right ventricle obtained. In the case of hypoplastic left heart syndrome, thickened tricuspid and dysplastic pulmonary valves were clearly revealed. In the case of tetralogy of Fallot, the overriding aorta and ventricular septal defect were realistically depicted [28]. In other article, the authors have made the reconstruction of normal fetal heart showing the four chamber view and the left ventricle and descending aorta. The authors refer that the HD*live* differs from conventional rendering methods because it uses a fixed virtual light source that calculates the propagation of light through skin and tissue. Operators can freely select the light source at any angle relative to the ultrasound volume to enhance anatomical details [29].

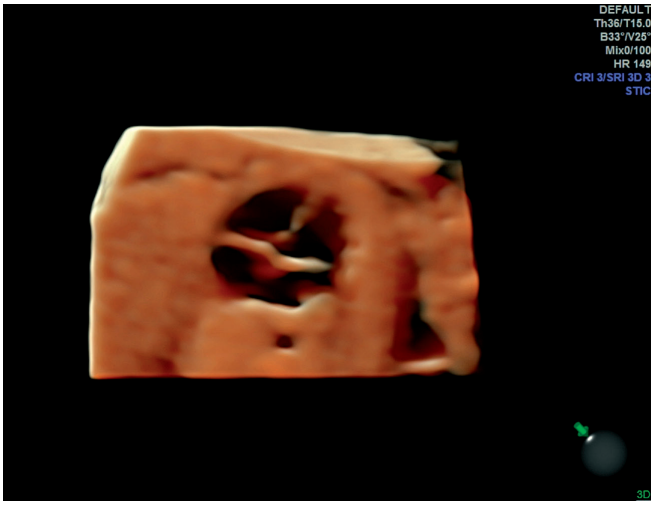

Fig. 1 - STIC-HDlive rendering showing the reconstruction of fetal heart in the four-chamber view

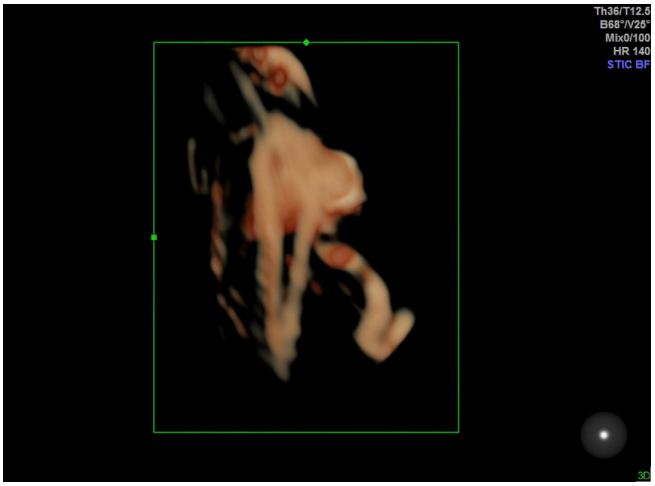

Fig. 2 - STIC-HDlive rendering showing the reconstruction of fetal heart and its vascular connections

In summary, we present a new technique named STIC-HD*live* to the assessing of fetal heart structures. The realistic images provided by this algorithm open new perspectives of non-invasive fetal cardiology, permitting to study in details valves, interventricular septum and venous/arterial connections. New studies comparing the HD*live* and conventional three-dimensional rendering modes are necessary to prove the real application of STIC-HD*live* in fetal echocardiography.

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