Fetal Cardiac Screening

What Are We (and Our Guidelines) Doing Wrong?

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Abbreviations
CHD, congenital heart disease

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How can we improve at prenatal detection of congenital heart disease (CHD)? Despite worldwide efforts to teach and to train, despite all of technology's newest bells and whistles and promises, and despite raising the bar with the most recent sets of guidelines for fetal cardiac imaging,[1–6] prenatal screening for CHD remains flawed, still commonly missing major forms of CHD.

During the last 30 years, important weaknesses of prenatal screening programs have been recognized and addressed; guidelines for fetal cardiac imaging have been revised; and detection rates have improved. Increasing recognition of the importance of evaluating the beating heart (rather than still-frame images)[7–9] and of the importance of evaluating the outflow tracts along with the 4-chamber view[10–12] has resulted in improved rates of detection and revisions of guidelines.[1,2,4,5] Expansion of fetal cardiac screening to include the 3-vessel and trachea view has been suggested as a means to facilitate detection of outflow tract and aortic arch abnormalities, and many have recommended that clips should include sweeps to demonstrate the relationship of one cardiac segment to the next.[1] As color flow fetal cardiac imaging has been found to facilitate detection and evaluation of CHD,[13–14] guidelines now generally include the routine use of color when performing fetal echocardiography[1,3,5] but disagree on the role of color during the fetal cardiac screening examination.[1,2,4] Guidelines from the International Society of Ultrasound in Obstetrics and Gynecology, for example, recommend clips and encourage color flow imaging,[2] whereas guidelines from the American Institute of Ultrasound in Medicine recommend neither clips nor color flow imaging in low-risk pregnancies.[4] Finally, although 3-and 4-dimensional fetal cardiac imaging may ultimately facilitate prenatal detection of CHD,[15,16] this technology remains unavailable in many settings and requires further study.

Unfortunately, despite these insights, and despite raising the bar with recent sets of guidelines, fetal cardiac screening programs continue to miss major forms of CHD. In our opinion, the reason (and solution) is 2-fold and applies as much to those who perform detailed fetal echocardiography as to those who perform fetal cardiac screening.

The first reason, although simple and intuitive, has received little formal attention, even in recent guidelines for fetal cardiac screening and fetal echocardiography.[1,2,4,5] Effective fetal cardiac imaging requires not only the proper views of the beating heart but also something else that commonly goes overlooked—good image quality. Even the most recent guidelines for fetal cardiac imaging, although detailing laundry lists of structures and views to be obtained, do not emphasize the need to obtain these views with any specific level of image quality.[1–5] Although guidelines commonly acknowledge "acoustic limitations" and review technical considerations (such as transducer frequency, field of view, and focal zones), practical scanning approaches toward overcoming such limitations are rarely mentioned as options, let alone formally recommended. Instead, guidelines from the American Institute of Ultrasound in Medicine and the American Heart Association merely suggest that some patients may need a return visit if imaging is suboptimal.[1,4] Guidelines from the International Society of Ultrasound in Obstetrics and Gynecology go a bit further, mentioning the importance of imaging perpendicular to the ventricular septum.[2]

Scanning needs to optimize image quality not only by optimizing the technical settings on the machine but also, perhaps more importantly, by optimizing fetal/maternal positions and probe placement and by applying sufficient transducer pressure. Furthermore, scanning must be performed with the proper angles of acquisition. Evaluation of ventricular inflows, for example, can be optimized with the angle of acquisition relatively parallel to the ventricular septum,[17] while evaluation of the inlet and outlet portions of the ventricular septum, as well as the left and right ventricular outflow tracts, may be optimized with the angle of acquisition relatively perpendicular to the ventricular septum.[2,5,17] In general, imaging with the apex oriented toward the probe tends to provide higher-quality imaging than imaging with the cardiac apex directed away from the probe.[17] With proper scanning technique (including having the patient walk around the room or use the restroom, when necessary), imaging limitations such as fetal lie and maternal habitus can be dramatically reduced. Virtually every large, busy academic institution has missed cases of tetralogy of Fallot because of inadequate angles of acquisition, and cases of hypoplastic left heart syndrome because of poor image quality. For those who evaluate the beating 4-chamber and outflow tract/3-vessel and trachea views, inadequate attention to these imaging considerations, in our view, accounts for most missed cases of CHD.

Secondly, effective detection of CHD from even pristine clips, however, requires prior knowledge of the appearance of CHD. Someone who encounters a case of transposition of the great arteries without ever before seeing such a case is far less likely to recognize the defect as abnormal than someone who has previously detected a case of transposition. Those interpreting fetal cardiac examinations should be experienced not only with views and sweeps of normal hearts but also with the sonographic appearance of major forms of CHD. Although textbooks and articles can be useful, cardiac abnormalities must be viewed in real time or from cine clips, not from a series of still-frame images. Such experience can be obtained in clinical settings seeing high volumes of fetal cardiac abnormalities, or through a variety of symposia or educational multimedia presentations.

To facilitate recognition of cardiac abnormalities, some clinicians (including Dr DeVore) may flip the real-time image vertically/horizontally while scanning to conform to standard views, whereas others (including Dr Sklansky) maintain the display to correspond to the position of the fetus within the maternal abdomen. Either approach can be used to optimize effective interpretation, but the importance of image quality remains, regardless of the orientation of the display.

We have written this commentary because we believe we understand why fetal cardiac screening continues to falter. Like so many others, we want to see detection rates improve substantially, aiming for greater than 90% detection rates for all pregnancies screened by 2025. Much of the solution, in our opinion, is for those involved with fetal cardiac imaging to strive as much to optimize image quality and the angle of acquisition as to obtain the requisite views, and for future sets of guidelines to emphasize explicitly that requisite views should not only be acquired but also be acquired above a certain minimum standard of image quality, including appropriate angles of acquisition. Furthermore, training needs to include greater exposure to cardiac pathology.

Fetal cardiac imaging and congenital heart surgery have both evolved dramatically over the past 30 years. Surgery for CHD, having achieved dramatically improved survival for affected infants, now has shifted its focus beyond survival to improving neurodevelopmental outcomes.[18] Likewise, fetal cardiac imaging, now having expanded to include additional views and modalities, needs to take the next step, raise the bar still further, and focus on image quality.

In summary, the time has come for a paradigm shift beyond requisite views and modalities. Fetal cardiac imaging should no longer be considered as a laundry list of views and imaging modalities; moving forward, it is also the quality of the clips, and the angles at which they are acquired, that may make all the difference.

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