Syllabus for ISMRM 2015

Pediatric Cardiovascular MR: Make it fast, safe, and accurate

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Highlights

- Team approach: Anesthesia, MR technologists/nurses, MR radiologists/cardiologists
- Type of anesthesia vs MR technique: breath-holding vs free breathing
- Need for robust rapid high resolution real time techniques for the future

This 15-minute discussion on the topic of performing cardiovascular MR (CMR) in the very young will be a review of current clinical practice of CMR in the neonates and infants and young children. Clinical approach/practice and reason for the CMR examination will vary depending on the local expertise, experience, and availability of imaging equipment (MR scanners vs CT scanners). This discussion will emphasize on current available MR techniques with clinical examples. Latest animal studies seems to suggest adverse effects of anesthetic and sedative drugs on the developing brain. More robust rapid MR imaging techniques would be helpful to decrease need for sedation and to shorten CMR examination times.

To successfully perform clinically indicated CMR examinations in neonates, infants, and young children can be challenging at many levels. The clinical necessity and the goals of the examination has to be clearly defined prior to the examination such that the imager can create the shortest protocol to acquire the needed information. The type of sedation, deep sedation vs general anesthesia with muscle paralysis, depends in part on the experience of the anesthesiology team working in the MR environment. Communication between anesthesiologist and the CMR imager is crucial. Free-breathing techniques and breath-holding techniques are both used depending on the experience of the CMR imagers, the type of sedation used, and the goals of the CMR. Non-sedation CMR on neonates and infants have been clinically successful in some pediatric institutions with “wrap-and-go” technique using an immobilizer after patient have been fed. This requires not only robust free-breathing MR techniques but also dedicated nursing staff and MR technologists with attention to many details during the set up of the examination.

The very young patients typically will have rapid heart rate and respiratory rates. Although this may seem challenging initially, a sedated patient tend to have very steady heart rate and respiratory rates. Vectocardiogram (VCG) triggering which is widely available in many MR scanner systems are extremely robust and can easily provide highly accurate synchronization even in very high heart rates. Respiratory bellows and respiratory navigator are routinely used to compensate for the respiratory motion. Given that the respiratory motion in a sedated infant is also very periodic and the tidal volume is not high, simple technique such as multiple signal averages can yield diagnostic results. Examples of both breathing-holding and free-breathing techniques will be shown. Many clinical reasons for the CMR examination relates to physiologic data and not just morphologic information. In congenital heart disease evaluation, there are many instances for the need of quantification of flow. The concept of internal validation of flow quantification as a measure of accuracy within a CMR examination will be emphasized.

Finally, perhaps most importantly, in the anesthesia literature in the recent years, there are animal studies suggesting long-term, possibly permanent adverse effects of anesthetic and sedative drugs on the developing brain. While there is not definitive clinical studies proving causality in humans due to presence of many confounding factors, the most recent draft of the consensus statement on the use of

anesthetic and sedative drugs in infants, toddlers, and preschool children contains much stronger language than in the 2012 FDA consensus statement. Robust rapid CMR techniques that are designed for the very young patients should be the goal of the scientific MR community and the MR manufacturers. These techniques can significantly decrease the need and duration of sedation.

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