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Editorial

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In 1971, Mitchell et al. defined congenital heart disease (CHD) as a "gross structural abnormality of the heart or intrathoracic great vessels that is actually or potentially of functional significance" (1). One of the reasons why a special edition of the *Journal of the Cardiovascular Magnetic Resonance* is devoted to CHD is because it is fairly common. Hoffman and Kaplan (2) recently surveyed the literature and found the incidence of moderate to severe forms of CHD to be 6/1,000 live births, rising to 19/1,000 live births if potentially serious bicuspid aortic valves are included. All forms of CHD represent 75/1,000 live births including such lesions as tiny muscular ventricular septal defects. The New England Infant Cardiac Program (3) reported that 3/1,000 live births needed cardiac catheterization, surgery or died with CHD in early infancy (excluding premature infants with patent ductus arteriosus). This number rises to 5/1,000 live births when including those who will need some kind of specialized facilities during their lifetime.

This is not the province of only the pediatrician and cardiothoracic surgeon and anesthesiologist. With improvements in diagnosis and treatment of CHD along with a greater understanding of the anatomy and physiology, patients are living longer (4, 5). This growing population is being taken care of by an increasing number of adult cardiologists and internists. In 1980, there were an estimated 300,000 adults with CHD while in the year 2000, this rose to approximately 1 million. In 2020, the number is anticipated to be 1.4 million.

It is imperative, therefore, because of their complexity, that the imager performing cardiovascular magnetic resonance (CMR) understand the technical aspects of imaging the patient with CHD. The tradeoffs of spatial and temporal resolution cannot be used in small children because their smaller structures demand higher spatial resolution combined with their faster heart rates which demand a higher temporal resolution. Breathholding in children can also be problematic. "Work-arounds" have been developed for these issues, but more needs to be done. In addition, understanding both the anatomy, physiology, function and surgical corrections associated with pediatric cardiology is also a necessary component to successfully evaluating a patient with CHD by CMR. All these factors may have been why a recent survey of attendees at the scientific session of the Society for Cardiovascular Magnetic Resonance CMR of congenital heart disease ranked second in interest out of 7 broad topics.

With the ever increasing sophistication of technology, more can be done with CMR in a high quality manner in a short period of time without invasiveness than has been dreamt of 20 years ago. Figure 1 is an example of this. The patient is a 3-year-old with transposition of the great arteries after an arterial switch operation with a LeCompte maneuver and right ventricular outflow tract obstruction. Two- and 3-dimensional imaging, viability and functional imaging utilizing cine and velocity mapping took under 1 hour to perform with free breathing under conscience sedation.

It is appropriate that the first article in this special group of manuscripts by Dr. Geva is devoted to a historical perspective on magnetic resonance imaging and its development. We should all understand the giants on whose shoulders we are standing today. This is followed by Dr. Lon Simonetti's discussion of the technical aspects of generating CMR images in pediatric heart disease. The two articles that follow afterwards, by Dr. Woods, Weber and Higgins, concentrate on 2 broad topics in CMR imaging of CHD—anatomy and physiology/function.

The rest of the special edition is devoted to application of CMR to specific lesions. Drs. Wald and Powell tackle simple CHD, which is not always so simple. Dr. Weinberg summarizes CMR imaging of aortic arch abnormalities, and Dr. Geva does an extensive review of the treatment of conotruncal abnormalities. The final article is on the CMR application to single ventricles.

It is clear from the magnetic resonance (MR) historical perspective Dr. Geva presents that MR has come a long way over the past 81 years since the Gerlach and Stern article of 1924 (6). Much more still needs to be accomplished, but

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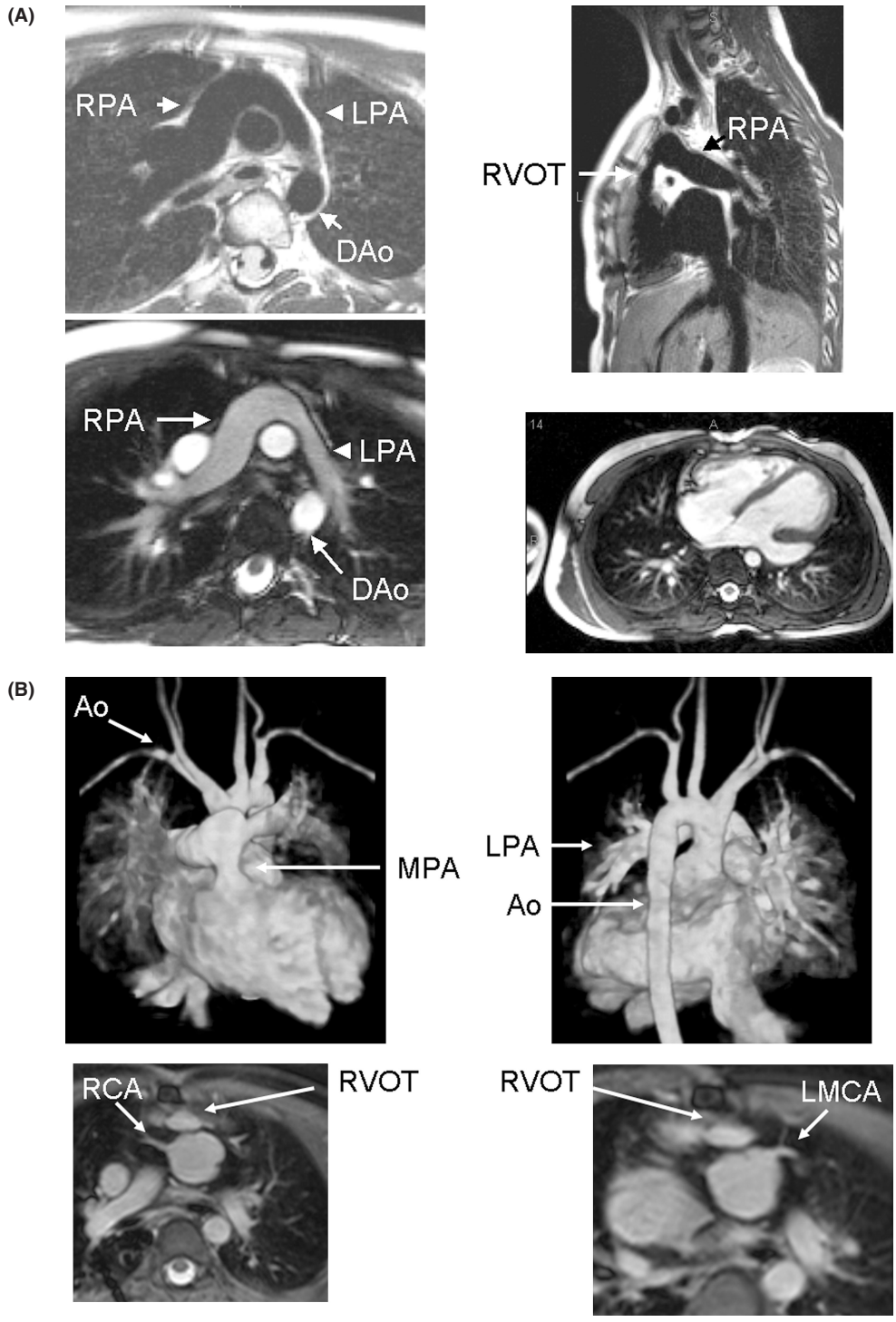

Figure 1. ***Examples of imaging:*** A 3-year-old patient with transposition of the great arteries after an arterial switch operation with a LeCompte maneuver. There is right ventricular outflow tract obstruction (RVOT). Two- and 3-dimensional imaging and viability along with functional imaging utilizing cine and velocity mapping took under 1 hour to perform with free breathing under conscience sedation. **(A):** The left 2 panels are dark blood (upper) and bright blood (lower) images of the pulmonary arteries – note how they "drape" over the aorta in a LeCompte maneuver. The upper right panel is a dark blood image of the RVOT and the right pulmonary artery (RPA) while the right lower panel is a 4 chamber bright blood image demonstrating a prominent, inferiorly displaced left atrial appendage. **(B):** *Three-dimensional gadolinium based imaging and coronary imaging.* Selected images of a 3-dimensional reconstruction of this patient, demonstrating the RVOT obstruction, the branch pulmonary arteries and the aorta. The upper left panel is an anterior view, and the upper right panel is a posterior view. The lower panels are coronary imaging after the arterial switch procedure to delineate the relationship between the right coronary artery (RCA) and the RVOT. The left and right lower panels demonstrate the takeoffs of the proximal RCA and left main coronary artery (LMCA) respectively and its relationship to the RVOT. Ao = aorta, LPA = left pulmonary artery.

if the past 81 years is any benchmark to gauge the accomplishments of the next 81 years, we are in for a meteoric ride.

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