Knowledge of the embryology of the normal heart is essential for understanding the development of congenital cardiopathies. However, learning embryology is not an easy matter because it requires understanding the intricacy and evolution of many complex structures and functions. Classically, this evolution is usually described in textbooks by means of drawings and sketches. With these techniques, however, it is difficult to imagine the spatial and temporal links. Recent advances in computer graphics have brought about ways to illustrate these dimensions. We developed a 3D animation of the full embryogenetic process of the normal heart. A group of cardiac embryology experts composed of cardiologists, paediatrician-cardiologists, and embryologists synthesized the data contained in the main textbooks of embryology. On the basis of the resultant consensus, computer graphics were used to model 3D anatomical structures corresponding to each stage of heart development: fertilization, development of trilaminar germ disc, formation and folding of the primitive heart tube (Figure, A), morphogenesis of the heart chambers (Figure, B and C) and valves, and development of the aorta and the pulmonary artery (Figure, C). These illustrations demonstrate that virtual imaging can significantly improve the understanding of complex systems. It is now possible to understand normal heart development in 15 minutes.

Embryogenesis from days 21 to 28. A, The cardiac loop is formed. The heart tube is folded into an S-shaped dextro-ventral convexity. B, The atria are partitioned. The septum primum (in brown) grows from the inferior part of the atria to the top, leaving a foramen called the ostium primum. The septum secundum (in orange) comes from the top. The ostium primum will be closed at the end of the fifth week by an expansion of tissue coming from the endocardial cushions (in yellow). C, The conus and the truncus are partitioned. The dextrodorsal and sinistroventral conus ridges, which are isolated in the first picture, partition the conus by a helical outgrowth into 2 cavities: the subpulmonary and the subaortic coni. The truncus is partitioned from the bottom upward from aortopulmonary swellings, leading to the formation of the aorta and pulmonary arteries.
Virtual Imaging for Teaching Cardiac Embryology
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