

Recognising the remnants of the left venous valve

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Abstract

This is an invited commentary. I did not think abstracts were required for commentaries.

Recognising the remnants of the left venous valve

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In an interesting brief report in this issue of the Journal, Feng and his colleagues describe their experience with a valve related to the orifice of the superior caval vein. They point out that, although remnants of the valves of the embryonic venous sinus are well recognised to persist in postnatal life as the valves of the inferior caval vein and the coronary sinus, it is rare to find such valvar remnants related to the orifice of the superior caval vein.¹ As they correctly explain, the remnants related to the inferior caval vein and the coronary sinus are parts of a complete valvar complex. When first formed, they mark the boundary, during embryonic development, between the systemic venous sinus and the right atrium. In support of this statement, they make reference to a recent study conducted by Hikspoors and colleagues.² This work provides a pictorial account of the anatomical changes taking place during embryonic development of the human heart. The beauty of this report, in which one of us (RHA) was privileged to take part, is that the three-dimensional datasets used by the investigators have now been made available as interactive portable document format files.² These files can be interrogated and reconstructed by the interested reader. By selecting the appropriate segmented components of the developing heart, it is possible to appreciate how, at the early stages of development, the systemic venous tributaries are bilaterally symmetrical, with tributaries from the umbilical, vitelline, and cardinal systems draining into the right and left sinus horns (Figure 1A).

At this initial stage, furthermore, each of the sinus horns is in direct continuity with the atrial component of the developing primary heart tube. This process of development is described as stage 12 within the system initially proposed by the Carnegie Institute, where the serial sectioned human embryos from which the reconstructions were made are still archived. These processes take place during the fifth week of development. By the next stage of development, or Carnegie stage 13, a remarkable change has occurred. The systemic venous tributaries have remodelled in such a way that the left sinus horn has become incorporated within the left atrioventricular junction. As a result, the overall systemic venous sinus then drains exclusively to the right side of the developing atrial chambers (Figure 1B). It is this rightward shift of the systemic venous tributaries that sets the scene for subsequent atrial septation. The remodelling uses as a fulcrum the so-called dorsal mesocardium. This is the stalk, which anchors the developing heart to the pharyngeal mesenchyme. It is the connection provided through the dorsal mesocardium that is used by the pulmonary vein as it canalises within the pharyngeal mesenchyme, gaining its entry to the developing left atrium.² It is only subsequent to the rightward shift of the systemic venous sinus that it becomes possible to recognise the valves that guard its entrance to the remainder of the developing morphologically right atrium. After this initial transfer, the left sinus horn remains a significant channel, with the venous valves themselves forming an obvious landmark when viewed from the cavity of the right atrium (Figure 2).

This arrangement continues to term in animal species such as the mouse, in which the left sinus horn persists as the left superior caval vein (Figure 3). In normal human development, however, the left sinus horn diminishes markedly in size. It persists only as the coronary sinus, which then serves as the conduit for drainage of the larger part of the venous return from the heart itself. In keeping with the diminution in size of the left sinus horn, in the human heart there is comparable diminution in prominence of the left venous valve. The right venous valve also diminishes markedly in size, usually persisting as the Eustachian and Thebesian valves, which guard the orifices of the inferior caval vein and the coronary sinus. On occasion, nonetheless, the right venous valve can persist to provide the substrate for division of the morphologically right atrium, usually known as “cor triatriatum dexter”. This terminology is very confusing, since the lesion does not produce a triatrial heart. The arrangement does no more than produce more obvious division of the right atrial chamber.³ In some instances, the persistent valve can become aneurysmal, and can extend as a windsock through the tricuspid valve (Figure 4B). On other instances, the valve can persist in intermediate form. It can then produce the arrangement as described by the Chinese authors, and can guard not only the orifice of the inferior caval vein and the coronary sinus, but also the orifice of the superior caval vein (Figure 4A). As can be seen in the example shown in Figure 4A, the valvar remnant is continuous with a myocardial strip, which then extends into the cavity of the pectinated right atrial appendage. This is the spurious septum, or “septum spurium”. It is the cranial commissure of the initially complete venous valves. The caudal commissure becomes fibrous, and persists as the tendon of Todaro.²

But what of the left venous valve? As suggested by Feng and colleagues, it, too, can persist as a discrete entity. It is questionable, however, as to whether the valve, when not obvious, has been incorporated within the atrial septum. The origin and components of the atrial septum itself remain controversial. It is described as having primary and secondary components. This much is true. The second component, however is not the superior margin of the oval fossa, as is still frequently shown in textbooks of embryology, anatomy, and cardiology. The superior rim of the fossa is no more than an infolding of the walls of the right and left atrial chambers.⁴ The true second atrial septum is the inferior buttress of the oval fossa. This is formed by muscularisation of the mesenchymal cap carried on the leading edge of the primary septum itself, along with the vestibular spine. The latter structure grows into the heart through the rightward boundary of the dorsal mesocardium.^{2,4} When the left venous valve persists, as it does in the murine heart (Figure 3B), then a space exists between the valve and the floor of the oval fossa. This intersepto-valvar space can still be recognised when the left venous valve does persist in the human heart (Figure 5A). In fact, when searched for carefully, the left venous valve is to be found more frequently than currently believed. It can form a filigreed network adherent to the margins of the oval fossa (Figure 5B), or as a fold, which can co-exist with a similar fold directly beneath the orifice of the superior caval vein (Figure 5C). As Feng and colleagues discuss, these remnants of the venous valves related to either the superior caval vein or the oval fossa, thus far, have rarely

been encountered by clinical cardiologists. As with so many things, however, when one is aware of their potential existence, they are much more likely to be recognised. Now that the structures have been brought to attention, it is likely we will learn much more of their potential significance. Feng and colleagues are to be congratulated on recognising the entities in their patient for what they really are.¹

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Legends to Figures

Figure 1. The images are made by reconstructing the developing systemic venous tributaries in developing human embryos, using the interactive pdf files available from Reference #2. The developing heart is shown as viewed from behind. At Carnegie stage 12 (panel A), both sinus horns are in direct continuity with the atrial component of the developing heart tube (white arrows with red borders). One stage later, as shown in panel B, the left sinus horn has become incorporated into the developing left atrioventricular junction, losing its connection with the left side of the developing atrial component (white star with red borders). The systemic venous sinus then connects only with the cavity of the developing right atrium. Note the location of the dorsal mesocardium, which has served as the fulcrum for the remodelling.

Figure 2. The images are from a three-dimensional episcopic dataset prepared from a human embryo at Carnegie stage 14. The venous valves now mark the boundary between the systemic venous sinus and the developing right atrium, as seen in the four chamber section shown in Panel A. Panel B is a section showing how the systemic venous tributaries now open within the confines of the venous valves. With further development, the left sinus horn will become the coronary sinus.

Figure 3. The images are four-chamber sections through three-dimensional episcopic datasets prepared from developing mouse embryos. Panel A shows the arrangement at embryonic day 14, when septation is complete, while panel B shows the situation at term. Both venous valves persist.

Figure 4. The images show persistence of the right venous valve in two human hearts. Panel A shows an example where the valve has persisted as the Eustachian valve, guarding the mouth of the inferior caval vein, as a prominent Thebesian valve guarding the mouth of the coronary sinus, but also as a valve guarding the mouth of the superior caval vein. The valve at the orifice of the superior caval vein is reinforced by a muscular strap, which is the spurious septum. The arrow shows how the strap passes in front of the entrance of the superior caval vein to the right atrium. Panel B shows an example where the valve has become aneurysmal, producing a windsock that has prolapsed through the tricuspid valve.

Figure 5. The images show various human hearts with persistence of the left venous valve (white arrow with red borders). Panel A shows a four chamber cut across the oval fossa. In panel C, there is also persistence of the venous valve guarding the mouth of the superior caval vein (red arrow with white borders).





