Anomalous great cardiac vein draining directly into the boundary between the superior vena cava and right atrium

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Anomalous great cardiac vein draining directly into the boundary between the superior vena cava and right atrium

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Abstract

The great cardiac vein usually ascends to the anterior interventricular sulcus and turns leftward in the coronary sulcus to transition into the coronary sinus. We present a rare case in which the great cardiac vein drained directly into the boundary between the superior vena cava and the right atrium. The great cardiac vein originated from the apex cordis at the distal 1/3 of the interventricular sulcus, ascended along the anterior interventricular sulcus and drained directly into the boundary between the superior vena cava and the right atrium. In this case, the coronary sinus existed and the oblique vein of the left atrium was absent. In addition, there was no communicating branch between the great cardiac vein and the middle cardiac vein. These findings suggest a possible relationship between the course and drainage of the great cardiac vein and the absence of the oblique vein of the left atrium. Moreover, we speculate that the drainage of the great cardiac vein and the existence of a communicating branch between the great cardiac vein and the middle cardiac vein is a related form of the coronary sinus.

Key words: Coronary sinus, Coronary veins, Great cardiac vein, Oblique vein of the left atrium, Superior vena cava

Introduction

There are widespread anastomoses at all levels venous circulation, on a scale exceeding that of the arteries and amounting to a veritable venous plexus by ordinary standards. The innominate vein is one of three abnormalities of the superior vena cava (SVC) among anomalies of systemic venous connections, as follows: persistent left SVC, a right SVC draining to the left atrium (LA), and abnormal position of the innominate vein[1)]. As for variations of the great cardiac vein (GV), Lüdinghausen has reported that the GV goes through the ventral side of the arterial conus and anastomoses with the small cardiac vein[2)]. And not only are adjacent veins often connected, but connections also exist between tributaries of the coronary sinus (CS) and those of the anterior cardiac veins.

The GV is the longest of the cardiac veins. It usually ascends to the anterior interventricular sulcus and turns leftward in the coronary sulcus to transition into the CS. Many anatomical variations of the GV have been described in cadavers[3-5)], aberrant courses and openings are uncommon[6-8)]. However, to our knowledge, few cases have been reported a GV draining into the SVC.

In this paper we describe an extremely rare case in which a GV drained directly into the boundary between the SVC and the right atrium (RA) in an embalmed cadaver. Their functional and developmental significance are discussed.

Materials and methods

In a 2010 anatomical dissection practice, a rare case of the GV draining into the boundary between the SVC and the RA was observed in a 77-year-old Japanese woman. No history of cadavers was available because they are sourced with

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little documentation. Cadaver was preserved in preservative fluid consisting of 10% formalin, glycerol and phenol and acetic acid.

The protocol for the research project was approved by the Act Concerning Dissection and Preservation of Dead Body, the related laws and regulations, and it conforms to the provisions of the Declaration of Helsinki in 1995 (as revised in Edinburgh 2000).

Results

The GV originated from the apex cordis and ascended along the anterior interventricular sulcus. The outer diameter was 3.4 mm at the beginning of the left coronary sulcus. Thereafter, it passed across the circumflex branch of the left coronary artery superficiality and drained directly into the boundary between the SVC and the RA (Figs. 1 and 2). A valve-like structure was seen at the inner drainage portion. The posterior vein of the left ventricle (PLV) ran cephalad on the posterior wall of the left ventricle and turned leftward in the coronary sulcus to transition into the CS. There was no communication between the PLV and the GV. The middle cardiac vein (MV) ascended on the posterior interventricular sulcus and drained into the CS. The oblique vein of the left atrium (OV) was absent.

Discussion

Relationship between GV and OV

As for the coronary venous circulation, the blood in the GV drains into the CS (Fig.3). Aberrant courses of the GV are rarely encountered during the coronary angiography, or anatomical dissection. Lüdinghausen[2] reported a case in which the GV passed through the anterior aspect of the RA, and opened directly into the RA. Yener et al.[9] reported a case in which the GV drainaged into the left internal thoracic vein. Similar to our case, Bergman et al.[3] described the GV passed between the aorta and the left atrium with absence of the CS that drained directly into the left SVC. Kawashima et al.[5] reported a GV that drained directly into the SVC, with the OV absence (Fig.4). The OV absent with all cases which the GV drainage into the SVC or the RA. These results suggest that the OV absent in the case of the GV drainage into the SVC or the RA has certain relationship with the OV absence.

Relationship between GV and CS

The GV and the MV are two main tributaries to form the CS. Regarding the drainage course to the RA, the MV is more stable than the GV[10]. In three cadaveric cases of the GV

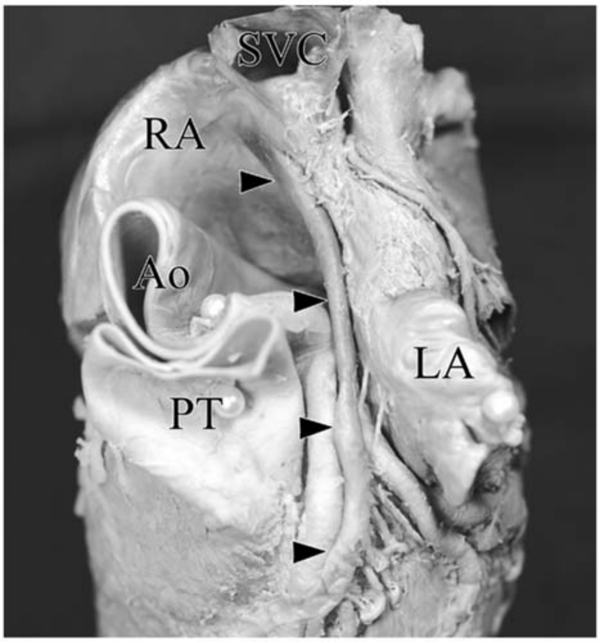

Fig.1 Photograph of the heart viewed from the left upper side. The great cardiac vein drains into the boundary between the superior vena cava and the right atrium (arrowheads).

Abbreviations for Figs.1-4:
Ao=aorta; GV=great cardiac vein; LA=left atrium; LPV=left pulmonary vein; OV=oblique vein of the left atrium; PLV=posterior vein of the left ventricle; PRV=right pulmonary vein; PT=pulmonary trunk; RA=right atrium; RPV=right pulmonary vein; SANB=sinuatrial nodal branch; SVC=superior vena cava.

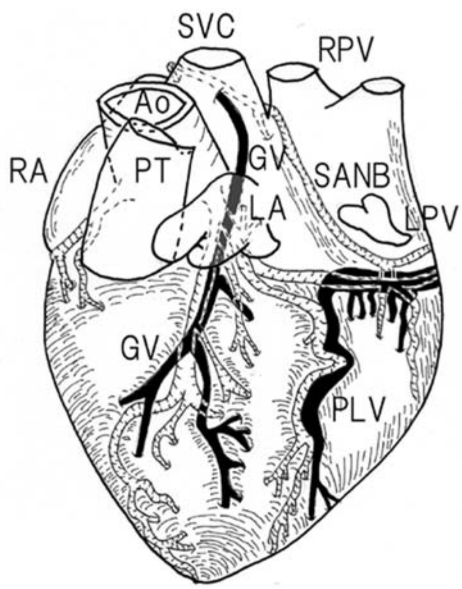

Fig.2 Schematic representation of the heart viewed from the left side. The great cardiac vein drains into the boundary between the superior vena cava and the right atrium, there is no communicating branch between the great cardiac vein and the posterior vein of the left ventricle.

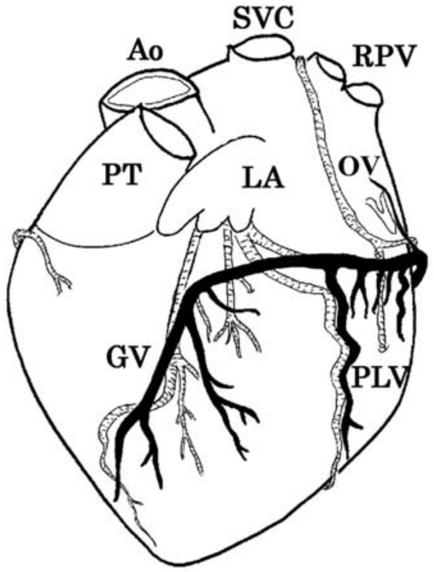

Fig.3 Schematic of the normal course of the GV.

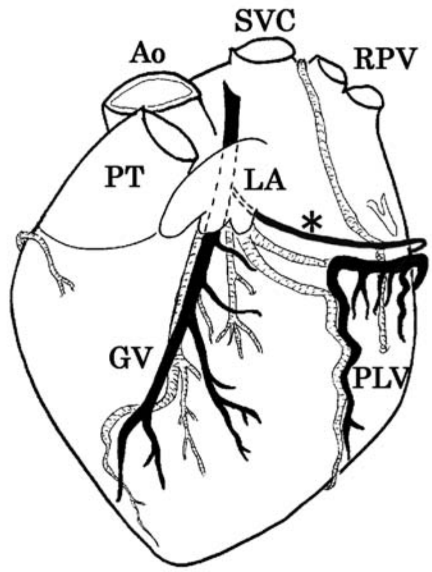

Fig.4 Schematic of the aberrant course of the GV. The GV drained directly into the SVC. The asterisk (*) shows the communicating branch between the GV and the coronary sinus.

draining into the SVC, the communication between the GV and the MV was not found or only thin communicating branch existed. In normal case the GV, which is the remnant of the left SVC, merged with the GV on the posterior wall of the left atrium. Thus, the absence of the GV and the nonexistence of the communicating branch between the GV and the MV occurred in the vicinity. At this region during early embryonic stage, the CS and the GV develops from the regressing left horn of the venous sinus and the left common cardinal vein. We speculate that the certain aplasia of the venous system in this region caused the aberrant course of the GV in our case. The GV had many variations due to its long course and various obstacles to overcome before draining into the RA.

Morphogenesis of the GV

The GV develops from an endothelial sprout that extends from the cardiac apex, passes upwards in the anterior interventricular sulcus to join the left horn of sinus venousus at 4-8 weeks [10]. Kawashima et al.[5] showed their cases regarding the origin, course and drainage of the cardiac veins, described that the three drainage routes to the right atrium and drainage boundary between the GV and MV relate to morphology of the cardiac veins. And they reported the case which the GV drained into the SVC, it is very similar with our case. Nevertheless there is a difference during these two cases. As for Kawashima's[5] case, there was a communicating branch with between the GV and CS. On the other hand, our case didn't have the communicating branch between the GV and the CS.

We conjectured as to the course of the GV as follows. In the case of Kawashima et al.[5], first, the communicating branch was formed between the normal GV and the RA. And most of the blood of the GV flowed into this communicating branch. As a result, the blood flowing toward the CS decreased, and the normal branch atrophied. About our case, we assume that the branch of the drainage into the SVC was formed initially. This means the GV of our case was aplasia.

Clinical remarks

Variation of the cardiac veins has received limited attention until recently, and the true prevalence of such variation is as yet unclear. Regarding our case, we inference that there is no functional obstacle according to a run of the GV. However, the cardiac surgeons need to be aware of the case which GV run the retro-aortic course to avoid damage of the GV during the aortic valvuloplasty or aortic valve replacement. Moreover, it is important to make a diagnosis of abnormality of the cardiac vein during the Glenn operation or the Mustard operation. Further, the recognition of coronary vein anomalies that disconnect large segments of the left ventricular myocardium from the main CS is critical for cardiothoracic surgeons who perform interventions involving retrograde cardioplegia and other forms of coronary venous retroperfusion[11].

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