

# Assessment of the course of the great cardiac vein in a selected number of human hearts

M. Kaczmarek, F. Czerwiński

Department of Human Anatomy, Pomeranian Medical University of Szczecin, Poland

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*The aim of this work is to determine morphological and topographical aspects of the great cardiac vein, especially its relation to the branches of the left coronary artery. The examination of the cardiac veins was carried out on 36 specimens of hearts of both sexes aged between 12 and 70 and without any known history of change in cardiac pathology. The techniques applied by us were anatomical dissection and retrograde injection of the coronary vessels with Polimal 100, Polimal 150 and Durakryl resin. We examined the topography and morphology of the great cardiac vein and the mutual correlation between the great cardiac vein and the branches of the left coronary artery.*

**Key words:** human heart, cardiac veins

## INTRODUCTION

The great cardiac vein (GCV) is the longest vein of the heart and supplies the greatest inflow of the coronary sinus. Normally GCV originates in the stern-rib surface near the apex of the heart, from where it runs through the interventricular sulcus to the base of the heart [3]. This first part, which is situated in the interventricular sulcus and which accompanies the anterior interventricular branch of the left coronary artery, is called the anterosuperior interventricular vein [4] or the anterior interventricular vein [13]. Circling the pulmonary surface of the heart, GCV runs in the coronary sulcus, passing into the left end of the coronary sinus on the phrenic surface of the heart. Given the present development of the diagnostic methods in cardiology, it is essential to carry out a detailed analysis of the course of GCV as well as of the correlation between its course and branches of the left coronary artery, as this may be helpful in the surgical treatment of these vessels. The arteriovenous connections in the human heart should, moreover, not be underestimated, especially in the light of research strongly reaffirming the

importance of the diagnosis and therapy of ischaemic myocardial lesions [7, 16].

The aim of this work is to examine the variability of the course and the morphology of GCV as well as correlations between the great cardiac vein and the anterior interventricular and circumflex branches of the left coronary artery. These relationships result from the arteriovenous Brocq and Mouchet triangle, which has been classified by PejkoVIC and Bogdanovic [15] as open or closed.

Various works on the different courses of single veins in the human heart can be found in the literature [2, 5, 9, 10]. It has been observed that variability in the course of GCV occurs more often than is the case with the middle cardiac vein [8]. In the research carried out by von Luedinghausen [9] it was reported that the great cardiac vein can also empty into the right atrium, whereas Yener et al. [17] reported a case in which GCV drained directly into the internal thoracic vein.

## MATERIAL AND METHODS

Examination was made of 36 preparations of human hearts from cadavers of both sexes aged

Address for correspondence: M. Kaczmarek, Department of Human Anatomy, Pomeranian Medical University of Szczecin, Powstańców Wielkopolskich 72, 70–111 Szczecin, Poland, tel: +48 91 466 14 80, e-mail: majulka@poczta.fm

between 12 and 70 years and without any known history of change in cardiac pathology. The material originated from the Department of Human Anatomy of the Pomeranian Medical University of Szczecin.

Both the veins and the coronary arteries of the examined hearts were filled with the epoxy resin Polimal 100 and Polimal 150 and with the resin Durakryl. The application of the resin allowed the veins as well as the arteries to be visualised exactly.

The epoxy resin was dissolved in the solvent and the hardening substance and the dye were added. Once the required level of consistency had been achieved, the resin was administered to the examined hearts. A blue pigment was added to the resin in order to distinguish the veins from arteries. Next, the preparation was left dipped in glycerine for 24 hours, which allowed it to retain the natural shape of the human hearts. During fixation the hearts were hung with their great vessels on the stands in such a manner that they could not touch any surface or become deformed. As a result, casts showing the exact course of the arterial and the venous vessels could be obtained. Once the resin had become hard, the heart preparations were etched into 40% hydrochloric acid, which allowed further precise casts of the hearts and all their vessels to be obtained.

The veins were measured with an electronic vernier calliper gauge, the lengths of the veins with a planimeter and the angles of departure with a goniometer.

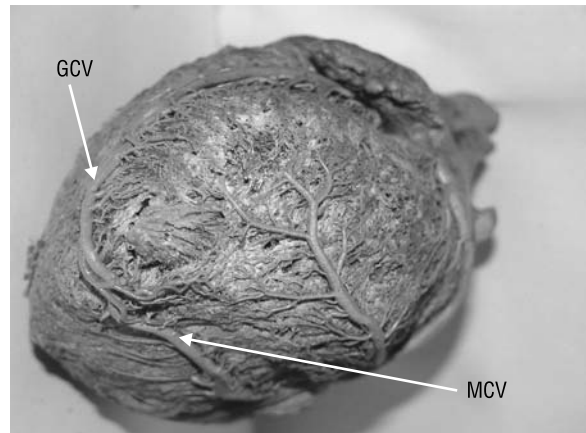
## RESULTS

From the cases examined it was found that 41% of GCV originated in the lower third of the anterior interventricular sulcus, while 80% came into being as a result of a connection between two veins and 20% as a connection between three veins.

A total of 17% of veins came both into middle third and the superior third of the anterior interventricular sulcus. In 67% of these cases it arose from two veins and in 33% from three veins. When all the examined hearts were taken into account, GCV arose from the connection of two veins in 74% cases and from three veins in 26%.

In 9 cases (25%) GCV united in the apex of the heart with the middle cardiac vein, forming a large venous arc (Fig. 1). These veins, emptying to the coronary sulcus, formed a venous ring round the left ventricle.

The maximum length of GCV, measuring from the beginning of its longest branch and finishing in the lower left part of the coronary sulcus, amounted



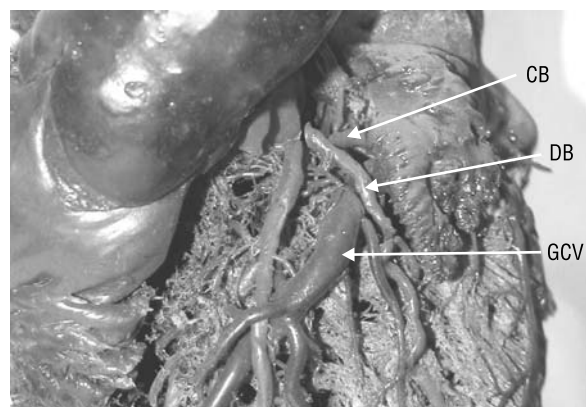
**Figure 1.** The apex of the heart. The large venous arc is formed by the great cardiac vein (GCV) and the middle cardiac vein (MCV).

to 25.3 cm, the minimum length to 12.4 cm and the average length to 17.7 cm.

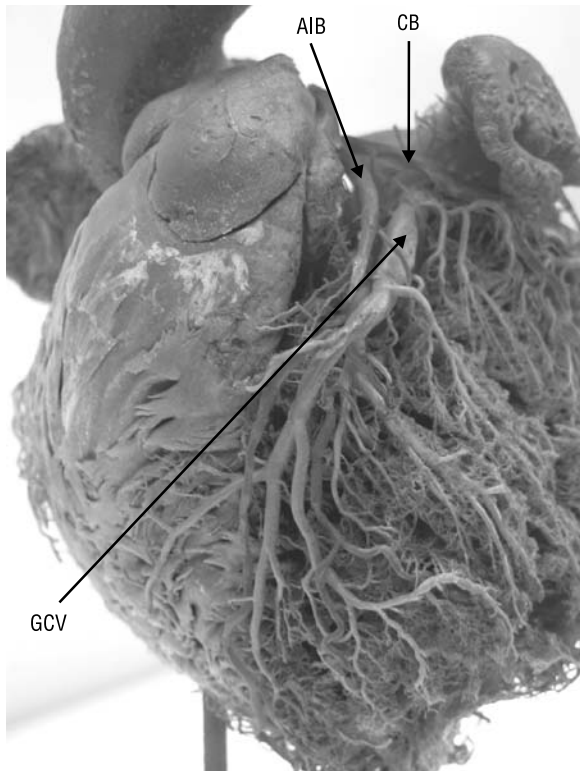
The GCV in all the given cases emptied to the coronary sulcus at an angle of 180°. The diameter of the outlet of GCV to the coronary sulcus fluctuated between 3 and 8.5 mms (average amounting 5.8 mms).

In 39% of cases GCV ran near the coronary sulcus over the diagonal and circumflex branches of the left coronary artery. Similarly, in 39% GCV passed over the circumflex and simultaneously under the diagonal branches. In 8% cases it ran over the diagonal branch and under the circumflex. In 14% cases GCV ran under the diagonal and circumflex branches (Fig. 2).

The great cardiac vein, along with the circumflex and the anterior interventricular branches of the left coronary artery, form the arteriovenous triangle described as the Brocq and Mouchet triangle, the base of which is created by GCV (81%). Despite the fact



**Figure 2.** The great cardiac vein (GCV) runs under the diagonal (DB) and circumflex branches (CB) of the left coronary artery.



**Figure 3.** The Brocq and Mouchet triangle is open in the right lower end. The great cardiac vein (GCV) runs at the left side from the anterior interventricular branch (AIB) of the left coronary artery crossing the circumflex branch (CB) of the left coronary artery.

that it is formed by the three vessels mentioned above, it is sometimes divided into smaller triangles by the branches of the left coronary artery, the largest of which is the diagonal [6]. According to Pejko $\acute{v}$ ic and Bogdanovic [15], the triangle can be closed, open completely or open at its right or left end, depending on the position of the vessels which form it. Its topography and morphology proved to have significant variability. In 73% of the cases examined the triangle was open at the right lower end, that is to say GCV ran in the anterior interventricular sulcus on the left of the anterior interventricular branch, crossing the circumflex branch (Fig. 3). In 7% of the cases examined the triangle was open completely, GCV not crossing any of the branches of the left coronary artery. In 3% of the cases GCV only crossed the anterior interventricular branch, creating an open triangle at the left end. In 5 of the cases examined (17%) GCV was situated to the right of the anterior interventricular branch, crossing both branches of the left coronary artery and forming in this way a closed triangle.

In 7 cases (19%) the anterior interventricular vein, running in the interventricular sulcus upward to the

place of division of the left coronary artery, created an acute venous angle and became the great cardiac vein.

In the examined cases we did not observe the presence of GCV in the myocardial bridges. The intramuscular course of this vein could indicate dysrhythmia [9, 14, 15].

In all 36 cases examined the anterior interventricular vein, following its own course, accompanied the anterior interventricular branch of the left coronary artery, situated in most cases (83%) on the left side parallel to the artery. The maximum distance between the vein and the artery amounted to 9.5 mm, at a minimum distance of 2 mm and with an average distance of 5.3 mm.

## DISCUSSION

The correlation between GCV and the branches of the left coronary artery show a very high degree of variability in the research carried out [9, 11, 12, 15]. Where the anterior interventricular vein was in the lower two thirds of the interventricular sulcus, it was, in the majority of cases, situated parallel to and on the left side of the anterior interventricular branch of the left coronary artery. This result is in accordance with the research carried out by McAlpine [11]. According to Pejko $\acute{v}$ ic and Bogdanovic [15], it is situated more often on the right of the anterior interventricular branch.

In our cases the maximum distance between the anterior interventricular vein and the anterior interventricular branch of the left coronary artery amounted to 9.5 mm, with a minimum of 2 mm (average 5.3 mm), which corresponds to the data of other authors [14].

Where the anterior interventricular vein runs in the anterior interventricular sulcus and arrives at the area of division of the left coronary artery variations in its position are revealed. In the material examined by us GCV was situated superficially to the diagonal and the circumflex branches in 39%. In the same percentage of cases it ran superficially to the circumflex branch and deeply to the diagonal branch. The superficial position to the circumflex and diagonal branches is consistent with the data of other authors [9, 15]. However, a course of GCV deeper than the diagonal branch and superficial to the circumflex branch was found, according to von Luedinghausen [9], in 9% of cases. In 8%, a lower percentage than found by von Luedinghausen (21%), it was ascertained that the position of GCV was superficial to the diagonal branch and deep in the relation to the circumflex branch. Otherwise, the superficial position of both branches

of the left coronary artery in relation to GCV (14%) is close to the results given by other authors [9].

The arteriovenous triangle formed by branches of the left coronary artery and GCV may, in accordance with the criteria given by Pejkoć and Bogdanović [15], be closed, or open completely, or open only on one side. We were able to establish the presence of the triangle in 29 out of 36 of the examined hearts (81%). In the research by Pejkoć and Bogdanović [15] GCV ran most often on the right side of the anterior interventricular branch of the left coronary artery, forming a closed triangle, whereas in our research the triangle most often (73%) appeared open in the right end, which is supported by the research carried out by Ortale (64%). Regarding the closed triangle, we were able to observe this in only 5 cases (17%). In only 1 case (3%) did we ascertain that GCV following its own course covered the anterior interventricular branch without crossing the circumflex branch at the same time, as confirmed also by Ortale et al. [14].

The anterior interventricular vein, when running on the left of the anterior interventricular branch of the left coronary artery, as it did in 7 cases (19%), arriving at the area of partition of the left coronary artery, bends and forms the acute venous angle and continues to run in the coronary sulcus. When the position of GCV is deeper than the arteries this can result in pressure [15]. In the research by Pejkoć and Bogdanović [15] the Brocq and Mouchet triangle was present in 98% of cases and the venous angle only in 2% cases, which may be supported by the work of other researchers [11, 12]. The results reported by Ortale et al. [14] are similar to ours, with the presence of the Brocq and Mouchet triangle detected in 89% of cases and the venous angle in 17% of 37 examined human hearts.

In all the cases examined GCV emptied to the coronary sulcus. The maximum diameter of the outlet GCV amounted to 8.5 mm and the minimum to 3 mm, with an average of 5.8 mm. This is consistent with the results obtained by other authors [1, 6, 15].

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