Case Series

Postmortem Angiographic Findings in Four Cases with Absence of Left Circumflex Coronary Artery and Review of The Literature

Christos E. Nerantzis1*, Hector Anninos2, Soultana K Marianou1, Sokratis Pastromas3, Stamatios E. Theocharis4, and Emmanouil B. Agapitos4

1Forensic Medical Service of Athens, Athens, Greece
2Department of Clinical Therapeutics, "Alexandra" General Hospital, School of Medicine, National and Kapodistrian University of Athens, Athens, Greece
3Henry Dunant Hospital Center, Athens, Greece
4Department of Pathology, Medical School, National and Kapodistrian University of Athens, Athens, Greece

*Corresponding author: Christos E. Nerantzis, Forensic Medical Service of Athens, Athens, Greece, Tel: +30-210-228-3386, Fax: +30-210-778-808; E-mail: theano9@otenet.gr

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Abstract

Objectives: The purpose of this study is to describe the findings of the postmortem coronary artery angiographic visualization in cases with absence of left circumflex (LCx) coronary artery and to compare them with those of the diagnostic coronary artery imaging.

Background: Studies regarding the congenital absence of the LCx coronary artery, after diagnostic coronary imaging, report about the very rare occurrence of it, the presence of ischemic disorders in its territory and the superdominant right coronary (RC) artery supplying with blood the territory normally corresponding to the LCx.

Methods: Six hundred hearts derived from victims of various accidents were examined postmortem grossly, microscopically and angiographically. We describe for the first time the angiographic findings in cases with congenital absence of LCx. We attempt furthermore an accurate postmortem angiographic description about the behavior of the RC and anterior descending (AD) coronary arteries.

Results: We report four healthy people with absence of LCx between six hundred victims of accidents. In each case the territory normally supplied by the LCx had been perfused with blood by branches of the AD and the large extension of the superdominant RC coronary artery. We have not observed histological changes of the myocardium.

Conclusions: The absence of LCx is not so rare, does not provoke ischemic changes and its territories is supplied by branches of both AD and RC arteries.

Keywords: Postmortem coronary angiography, branches of Coronary arteries, Coronary anomalies.

Introduction

The origin and course of the coronary arteries in normal hearts have been well investigated and described [1-3]. Coronary anomalies have intrigued clinicians, anatomists and physiologists for years. Most coronary anomalies did not result in signs, symptoms, or complications, and were usually discovered as incidental findings at the time of
Catheterization or at autopsy [4-14]. Coronary artery anomalies have been divided into benign and malignant types depending upon the potential clinical outcome [6,7,15]. Congenital absence of the left circumflex (LCx) coronary artery is a very rare benign congenital anomaly of the coronary circulation, and few cases have been described in the literature almost exclusively after diagnostic coronary imaging, except for one, which was discovered at autopsy. Barresi et al. [4] first described two cases of this anomaly after angiography, and Bastetti et al. [5] described the anomaly after autopsy for the first time. Subsequently, other researches have reported the existence of this anomaly alone [6,7,11,13-19], or in combination with other congenital anomalies or with atherosclerotic disease [8-11,13,20-23]. Based in the above studies we believe that the total number of the cases with absence of the LCx alone or combined with another anomaly or disease amount including our four cases equals 31 cases in the literature.

Materials and Methods

We report the postmortem angiographic visualization in four cases with absent LCx coronary artery, a female aged 32 and three males aged 19, 22 and 38 years old. All subjects were healthy (they were not responsible for the accidents and the relatives did not mention any clinical symptoms). These four cases derived from a series of 600 postmortem angiographies of human hearts, victims of accidents, 422 males and 178 females, ranging in age from 15 to 89 years old. The heart weight varied between 135 and 530 g. All angiographies were performed at the Forensic Medicine of Athens, within the last forty years. Gross anatomical examination was followed by postmortem coronary angiographic evaluation within the first 24 hr following death. In these hearts, radiopaque medium (Ba-Sulfate of different colors) was injected in both coronary arteries at a pressure of 100-160 mmHg depending on the size of the heart. Low pressure was used in order to avoid deformation of the vessel’s lumen and/or changes to their architecture. This led to the identification by naked eye of the course of the coronary arteries and their epicardial branches. In addition, X-ray films were taken at different aspects of the whole heart. In the reported cases, the posteroanterior projection was the most useful for the identification of the origin, course and distribution of the coronary arteries. After X-ray filming, samples were taken for histological examination from different parts of the anterior and posterior ventricular wall as well as from the interventricular septum, to be examined for ischemic changes.

Results

We found four cases with absence of the LCx coronary artery among six hundred postmortem coronary angiographies, corresponding to 0.67%. In our four cases the postmortem examination showed the origins of the main stem, which continued as anterior descending (AD), and the right coronary (RC) arteries at their expected sites with no evidence of an anomalous origin of the LCx artery. The postmortem coronary angiography demonstrated the existence of two arteries, the AD and the RC. The AD artery coursed in the anterior interventricular groove downwards to the apex and wrapped around towards the posterior surface for about 3 cm in one case (Figure 1), supplying with blood all the apex and the lower posterior segment of the left ventricle (LV). In the other three cases the apex was supplied with blood by both the AD and posterior descending (PD) arteries (Figures 2-4). The AD artery during its course to the apex gave origin apart form the usual branches, to more diagonal (D) branches and the obtuse marginal (Figures 1-4) perfusing some areas which would normally be supplied by the LCx artery, such as all the lateral and the upper posterior wall of the left ventricle (LV). In one heart (Figure 4) the AD after its origin turned slightly to the left and 18 mm distally returned to the inter-ventricular groove providing a large diagonal artery which divided in three branches. The first two entered the inter-ventricular septum giving blood to it. The lower (third) entered slightly under the myocardium for 24 mm and returned to the anterior surface of the LV. Distally, the AD supplied with blood the anterior part of the inter-ventricular septum, and the whole anterior and lateral wall of the LV.
Figure 1. Posteroanterior X-ray view of a postmortem coronary angiography, demonstrating absence of left circumflex (LCx) artery, with the left main coronary artery continuing as anterior descending (AD) artery. The arteriogram demonstrates also the large extension (LE) of the superdominant-right coronary (RC) artery to the left atrioventricular groove, marked with four double arrows. It also shows the acute marginal (AM) branch, the posterior descending (PD) artery, the obtuse marginal (OM) artery and a number of diagonal (D) arteries originating from the AD artery.

Figure 2. Posteroanterior X-ray view of a postmortem coronary angiography, demonstrating absence of LCx artery, the left main coronary artery continuing as AD artery, the LE marked with three double arrows. The AM, PD, OM, D, the conal artery (CA), and the sinus node artery (SNA) originating from the posterior wall of the main stem are also visualized.

The dominant RC artery [24] after the origin of the posterior descending (PD) artery, proceeded with a large extension (LE) artery [25] to the left atrioventricular groove between the LV and left atrium (LA), giving blood to the corresponding areas, ending in various distances from the PD artery’s origin in each case (Figures 2-4). The entire length of the RC in three cases measured from the origin to the end of the large extension ranged from 220-250 mm. (Figures 2-4). In the fourth case (Figure 1) the extension of the posterior part of the RC artery ended on the lateral wall of the LA with a total length of 290 mm. In these four cases the RC artery supplied with blood more than half of the cardiac mass. It is noteworthy that in the heart (Figure 4) the RC artery in the area of the acute margin (AM) divided in two. The main part followed the atrio-ventricular groove supplying the upper part of the inter-ventricular
septum, the atrio-ventricular node area and parts of the posterior upper LV wall and lower parts of the LA. The other larger part traversed downwards the posterior right wall diagonally, as posterior right diagonal (PRD) artery [26] to reach the posterior inter-ventricular groove, ending in the apex, supplying with blood the lower posterior part of the LV and the interventricular septum.

**Figure 3.** Posteroanterior X-ray view of a postmortem coronary angiography, demonstrating absence of LCx artery, the left main coronary artery continuing as AD artery, the LE marked with three double arrows. The AM, PD, OM, D are also shown. The picture also displays the SNA originating from the posterior wall of the main stem. The small ball shows the atrioventricular node area.

**Figure 4.** Posteroanterior X-ray view of a postmortem coronary angiography, demonstrating absence of LCx artery. The left main coronary artery is continuing as AD artery and the LE is pointed with three double arrows. The AM, PD, OM, D are shown as well. The picture also demonstrates a very large diagonal, the CA and the posterior right diagonal (PRD) artery.
In the present four cases, there were no evidence either macroscopically or microscopically to suggest any ischemic changes. Moreover, in two cases we found an accessory artery, the third or conus artery (CA) arising by a separate ostium (Figures 2 and 4) from the right aortic sinus, and coursing over the right ventricle (RV). Furthermore, in two cases the sinus node (SN) arteries arised from the posterior surface of the main stem (Figures 2 and 3). Except for the described four cases with LCx absence we found seven more cases with anomalous origin, course and ending of the coronary arteries [27-33] and another three cases with anomalies of origin, course and ending of the SN arteries [34-36].

**Discussion**

We describe for the first time the postmortem angiographic findings in four human hearts, showing absence of LCx coronary artery, and the compensatory changes of the RC and AD coronary arteries in this anomaly. Congenital absence of the LCX coronary artery is an anomaly in which the artery fails to develop in the AV groove [8,19]. Absence of the LCx is thought to be an extremely rare anomaly occurring between 0.003% 6 and 0.005% [21], a frequency derived by studies of diagnostic coronary imaging. The same percentage is further supported by a number of other authors [6-9,12-16,20]. It is also noteworthy that large series of diagnostic coronary imaging [37-44] and smaller series of postmortem coronary examination [45-47] do not report on this anomaly. In contrast to the common perception, that this variation is very rare, our findings of a very high percentage of 0.67% in postmortem coronary angiographic examination prove otherwise. This high incidence could be observed merely by chance or it could be attributed to the fact that in the aforementioned, mostly angiographic, studies the subjects examined were relatively older since the majority were referred due to symptoms suggestive of coronary heart disease. Hence, most of them would display atheromatous lesions rather than congenital coronary artery anomalies. On the contrary, our study’s material consisted of accident victims, which were symptom-free. Moreover, it included a large number of postmortem coronary angiographies and thus it could be more representative of the general population. Newer imaging techniques, such as Computed Tomography (CT) angiography, which can be performed more readily as a screening method in selected populations, may reveal non-invasively and possibly at higher incidence than traditional coronary angiography, aberrant types of coronary circulation in the living patient.

The absence of ischemic changes in the myocardium of the hearts of our four cases as well as the fact that these patients did not complain about cardiac symptoms before their accident, support the concept that the territories corresponding to the absent LCx were well supplied by branches of both coronary arteries (AD and RC), and not only from the large extension (super-dominant) RC artery, as some authors suggest [6,12,14-19]. It is interesting to note that the large extension of the RC artery is not only observed in cases with the absence of LCx but is also described in 11% of cases with functional dominance of the right coronary artery [25]. These patients were also asymptomatic without any history of heart disease. These information will benefit medical examiners and anatomists as well as help interventional cardiologists and cardiac surgeons recognize the absence of the LCx and the compensatory adaptation of the AD and RC arteries, a knowledge which will be useful with regard to their interventional or surgical procedures, (valve replacement or myocardial revascularization). Interventional electrophysiologists may also find this useful since various left atrial ablation sites are in vicinity to certain coronary branches [48,49].

**Conclusion**

Absence of left circumflex coronary artery is not a rare congenital anomaly. The absence of heart disease in our cases suggests that the territories which would be supplied by the absent left circumflex artery, received adequate perfusion from branches of the other two coronary arteries (AD, RC), in a different way for each case and not only by the large extension of the RC artery.
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Conflict of Interest

The authors declare no potential conflict of interests.

References


