

## CASE REPORT

# VIEUSSENS' ARTERIAL RING: A HEART'S LIFESAVING JEWELLERY

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### ABSTRACT

**Introduction.** In 1706, Raymond de Vieussens described a proximal inter-coronary pathway connecting the conus branch of the right coronary artery (RCA) with an infundibular branch of the left anterior descending artery (LAD) or directly with the proximal LAD. Later, in the 19<sup>th</sup> century, this anatomical structure would be named in his honour "Vieussens' arterial ring" (VAR). VAR serves as a collateral pathway in case of coronary artery disease.

**Case presentation.** We present the case of a 58-year-old male with a concurrent ostial chronic total occlusion of the LAD and an acute thrombotic occlusion of the proximal RCA, that survived via a Vieussens' arterial ring.

**Conclusions.** The existence of collateral circulation holds a crucial role in the manifested symptoms and the prognosis of patients with ischaemic heart disease. The connection between the conus branch and the LAD (VAR) may provide adequate circulation to either the left or right coronary arterial system, preserving the left ventricular ejection fraction and allowing patients to survive even the most severe myocardial infarctions.

### RÉSUMÉ

**Anneau artériel de Vieussens: le bijou qui sauve la vie d'un coeur**

**Introduction.** En 1706, Raymond de Vieussens décrit une voie inter-coronaire proximale reliant la branche conique de l'artère coronaire droite (RCA, FR: ACD) à une branche infundibulaire de l'artère antérieure descendante gauche (LAD, FR: ADG), ou directement avec l'ADG proximale. Pendant le XIX<sup>e</sup> siècle, cette structure anatomique sera nommée en son honneur "anneau artériel de Vieussens" (VAR, FR: AAV). AAV sert de voie collatérale en cas de maladie coronarienne.

**Présentation de cas.** Nous présentons le cas d'un homme de 58 ans avec une occlusion totale chronique ostiale concomitante de l'ADG et une occlusion thrombotique aiguë de l'ACD proximal, qui a survécu via un AAV.

**Conclusions.** L'existence d'une circulation collatérale joue un rôle crucial dans les symptômes manifestés et le pronostic des patients atteints de cardiopathie ischémique. La connexion entre la branche conique et le ADG (AAV) peut fournir une circulation adéquate vers le système artériel coronaire gauche, ou droit, préservant la fraction d'éjection ventriculaire gauche et

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**Keywords:** collateral circulation, conus artery, Vieussens' ring.

#### Abbreviations list

RCA = right coronary artery  
 LAD = left anterior descending artery  
 VAR = Vieussens' arterial ring  
 ECG = Electrocardiogram  
 NSTEMI = Non-ST-elevation myocardial infarction  
 IM = Intermediate  
 LCx = Circumflex  
 CTO = Chronic total occlusion  
 D1 = First diagonal branch  
 PDA = Posterior descending artery

#### INTRODUCTION

Raymond de Vieussens' "Nouvelles Découvertes sur le Coeur", published in 1706, provided an in-depth anatomical study of the heart's blood vessels and lymphatic system<sup>1</sup>. In his work, he encountered numerous new cardiac findings, including a proximal inter-coronary pathway connecting the conus branch of the right coronary artery (RCA) with an infundibular branch of the left anterior descending artery (LAD) or directly with the proximal LAD. In the second half of the 19<sup>th</sup> century, in his famous textbook "Anatomy: Descriptive and Surgical" Henry Gray named this arterial structure "Vieussens' arterial ring" (VAR) in his honour<sup>2</sup>.

Embryologically, the fetal conotruncal circle being the origin of the coronary ostia, gives rise to the epicardial coronary arteries, through its communication with the atrioventricular and inter-ampullar circles<sup>3</sup>. VAR coincides with the location of the circle; thus, it is considered a persistent, matured conotruncal circle. When present, it serves as a collateral pathway in case of coronary artery disease<sup>4</sup>. We report the case of a patient with severe coronary artery disease that Vieussens' arterial ring saved his life.

#### CASE PRESENTATION

A 58-year-old male, heavy smoker, with no prior medical history presented to the emergency department, complaining about breathing difficulty and chest pain of 5-hours duration. Physical examination revealed diaphoresis, hypotension, dyspnoea on exertion and angina. The pain was radiating to the jaw and the left arm, following the ulnar nerve's distribution. A twelve-lead electrocardiogram (ECG) demonstrated a normal sinus rhythm of 90 beats per minute, ST-segment depression in leads II, III and aVF, with inverted T-waves in leads V1-V4. Serum biochemistry

permettant aux patients de survivre même aux infarctus du myocarde les plus graves.

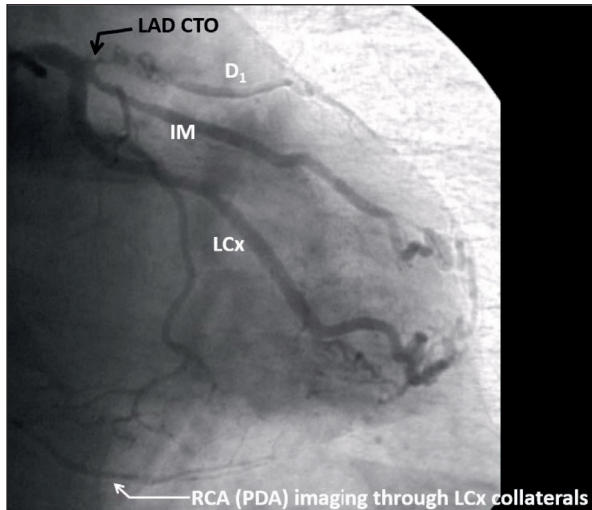
**Mots-clés:** circulation collatérale, artère conique, anneau de Vieussens.

results were normal apart from the elevated troponin and creatine kinase-MB. Based on the patient's symptoms, the ECG changes and the troponin elevation, the diagnosis of an acute, inferior non-ST-elevation myocardial infarction was made (NSTEMI).

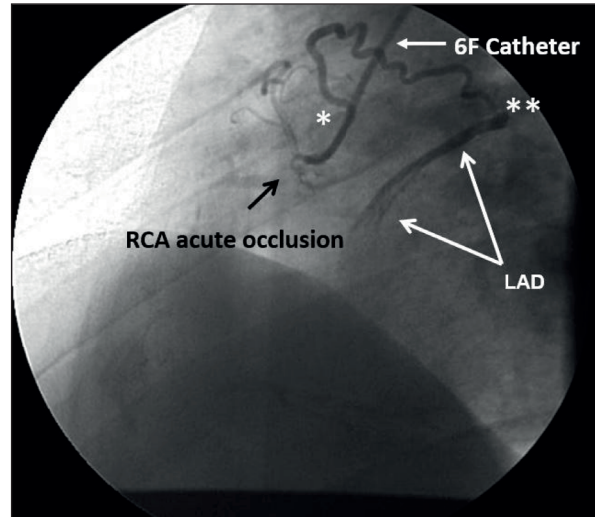
Subsequently, the patient underwent cardiac catheterization, via the left radial artery, using the Seldinger's technique. Coronary angiography revealed an ostial chronic total occlusion of the LAD, while intermediate (IM) and circumflex (LCx) arteries were free of critical stenoses (Figure 1). The culprit lesion, for the patient's symptoms, was an acute thrombotic occlusion of the proximal RCA. The LAD was filled by a large conus branch, which had a separate origin within the right sinus of Valsava, next to the ostium of the RCA. With a tortuous and anterior course to the right ventricular outflow, the conus artery terminated to LAD, just distal to the occlusion (Figure 2), forming a collateral circulation between the conus artery and the LAD, known as Vieussens' arterial ring. The patient underwent primary percutaneous revascularization to the RCA and was referred for coronary artery bypass surgery.

#### DISCUSSION

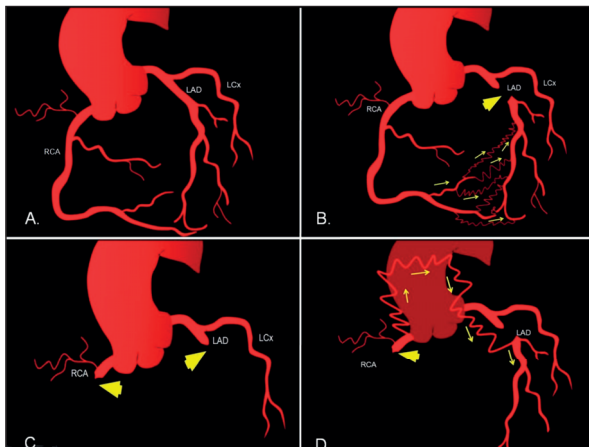
The existence of collateral circulation holds a crucial role in the manifested symptoms and the prognosis of patients with ischaemic heart disease<sup>5</sup>. In the presence of severe or total occlusion of either the RCA or LAD, the conus branch can be a rich source of collateral circulation between the two coronary arterial systems, preserving the left ventricular ejection fraction<sup>6</sup>. In about 40-50% of the general population, the conus branch instead of being the first branch of the RCA, originates directly from the right aortic sinus and is called the "isolated conus artery"<sup>7</sup>. When conventional right and left coronary angiography fail to visualise any collateral pattern



**Figure 1.** Left coronary angiography. Ostial chronic total occlusion of the LAD and retrograde imaging of the RCA through LCx collaterals. CTO: chronic total occlusion; D1: first diagonal branch; IM: intermediate branch; LAD: left anterior descending artery; LCx: circumflex artery; RCA: right coronary artery; PDA: Posterior descending artery.



**Figure 2.** Right coronary angiography. RCA proximal thrombotic occlusion and imaging of the LAD through the Vieussens' arterial ring (\*). \*\* denotes drainage of the Vieussens' arterial ring into the proximal LAD. LAD: left anterior descending artery; RCA: right coronary artery.



**Figure 3.** A. Schematic presentation of a normal coronary circulation. B. In case of total occlusion of the LAD (arrowhead), distal RCA provides retrograde blood to the LAD through collaterals connecting PDA to LAD septal branches (small arrows). C. Subsequent proximal RCA occlusion in the presence of occluded LAD (arrowheads) leads to severely compromised coronary perfusion, massive ischemia and death. D. The presence of a proximal connection (through the VAR, small arrows) between RCA and LAD ensures adequate blood supply in case of bilateral coronary occlusion. LAD: left anterior descending artery; LCx: circumflex artery; RCA: right coronary artery; PDA: Posterior descending artery; VAR: Vieussens' arterial ring.

towards an occluded LAD, a selective conus artery catheterization is highly recommended<sup>8</sup>. However, caution must be exerted since conus catheterization is extremely arrhythmogenic<sup>9</sup>.

Shahbaz and colleagues described the case of a 59-year-old male with total occlusions of both the left main coronary artery and the RCA, who was kept alive because of a VAR<sup>10</sup>. Our case was equally dramatic, since an acute occlusion of the RCA, superimposed in an already compromised coronary circulation, due to chronic total LAD occlusion, could have led to massive cardiac ischemia in the absence of this collateral pattern. The VAR provided blood to the proximal LAD and protected the patient from cardiogenic shock (Figure 3).

## CONCLUSIONS

Collateral circulation comprises a major prognostic factor when it comes to coronary artery disease. Vieussens' arterial ring (VAR) as a connection between the conus branch and the LAD may provide adequate blood supply to either the left or right coronary arterial system, in case of severe stenotic lesions, which otherwise would not have been compatible with life.

## Author Contributions:

K.C. wrote the manuscript, D.S. was responsible for the diagnostic procedures, clinical diagnosis and treatment decisions. A.F. was responsible for the supervision and final approval of the version to be published. All authors have read and agreed to the published version of the manuscript.

**Compliance with Ethics Requirements:**

„The authors declare no conflict of interest regarding this article“

„The authors declare that all the procedures and experiments of this study respect the ethical standards in the Helsinki Declaration of 1975, as revised in 2008(5), as well as the national law. Informed consent was obtained from the patient included in the study“

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