

Great cardiac vein injury after circumflex artery intervention: a case report

Abdelrahman Elhakim ^{1*}, Mohamed Elhakim ², Ismail Ismail³, and Mohammed Saad ⁴

¹Cardiology Department, Interventional Cardiology, Schoen Hospital Neustadt, Am Kiebitzberg 10, 23730 Neustadt in Holstein, Germany; ²Intensive Care Unit, Critical Care and Anesthesia, Nepean Hospital, Derby Street, Kingswood, 2747 Sydney, NSW, Australia; ³Cardiology Department, Interventional Cardiology, University Clinic Oldenburg, Rafel-Strauss-Strasse 10, 26133 Oldenburg, Germany; and ⁴Cardiology Department, Interventional Cardiology, Schleswig-Holstein University Hospital-Kiel, Arnold-Heller-Street 3, 24105 Kiel, Germany

Received 6 April 2023; revised 5 July 2023; accepted 19 July 2023; online publish-ahead-of-print 21 July 2023

Background

Injury of the great cardiac vein (GCV) during circumflex coronary artery intervention is not discussed enough in the literature. In addition, relationship between the GCV and circumflex artery is highly variable and practically unpredictable in 30% of cases. This report describes a rare case of GCV injury during circumflex artery intervention.

Case summary

An 80-year-old man with known ischaemic heart disease was admitted with unstable anginal pain for urgent coronary angiography. Circumflex (Cx) percutaneous coronary intervention (PCI) of proximal-to-medial high-grade calcified stenosis was performed. Two hours later, the patient developed pericardial tamponade. Pericardiocentesis revealed a venous bloody effusion. Due to continuous bleeding, an urgent exploratory thoracotomy was performed. Intraoperatively, a large pericardial haematoma in the Cx region was evacuated. The perforation site was sought and identified as a tear at the GCV. Further hospitalization was uneventful, and the patient was discharged after one week. Clinical and echocardiographic outcomes were favourable at the 3-month follow-up.

Discussion

A GCV injury during PCI is a diagnosis of exclusion if there is a venous pericardial effusion directly after PCI and no injury of the right ventricle or surrounding structures, and thoracic computed tomography demonstrates a pericardial haematoma in the PCI region, especially the Cx region. A haematoma can deteriorate the haemodynamic status without effusion ‘dry tamponade’. Treatment should be addressed according to haemodynamics. A conservative therapy, pericardiocentesis, catheter-based bailout intervention or even an explorative pericardiotomy could be imperative to evacuate the haematoma and seal the injured vein.

Keywords

Great cardiac vein • Circumflex artery • Calcific lesion • Pericardial effusion • Case report

ESC curriculum

6.6 Pericardial disease • 2.4 Cardiac computed tomography • 7.5 Cardiac surgery • 3.2 Acute coronary syndrome • 3.4 Coronary angiography

Learning Points

- Injury of the great cardiac vein (GCV) is not a preventable complication but could be predicted by severely calcific circumflex artery intervention.
- The relations between the vein and circumflex artery are highly variable and practically unpredictable in 30% of the cases. The anterior interventricular vein is superficial to the artery in 60–70% of the population and passes under the artery in 30%.
- This is a peculiarity and uniqueness of the left circumflex coronary compared with other coronary arteries.
- A GCV injury during percutaneous coronary intervention (PCI) is a diagnosis of exclusion if there is a venous pericardial effusion
 - directly after PCI, particularly in the Cx region, and no injury on the right side of the heart or surrounding structures and
 - thoracic computed tomography demonstrates a haematoma in the PCI region.
- A haematoma can deteriorate the haemodynamic status without effusion ‘dry tamponade’.

* Corresponding author. Tel: +491638542698, Fax: +49 456154337300, Email: ayelhakim1985@yahoo.com

Handling Editor: Grigoris Karamasis

Peer-reviewer: Nidhi Madan

Compliance Editor: Hikmet Kadioglu

© The Author(s) 2023. Published by Oxford University Press on behalf of the European Society of Cardiology.

This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial License (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited. For commercial re-use, please contact journals.permissions@oup.com

- First, consider conservative therapy; if the patient is haemodynamically unstable or bleeds progressively, an explorative pericardiectomy could be imperative to evacuate the haematoma and seal the injured vein. Other interventional techniques could be helpful as a bailout technique in high-risk patients.

Introduction

Coronary artery perforation is a potentially life-threatening complication in 0.2–0.6% of all patients undergoing percutaneous coronary intervention (PCI).¹

However, injury of the great cardiac vein (GCV) after circumflex artery intervention is not discussed enough in the literature. It could be predicted by severely calcific circumflex artery intervention, as the relations between the vein and circumflex artery are highly variable and practically unpredictable in 30% of the cases.²

The GCV is the longest venous vessel of the heart. On reaching the area of the coronary sulcus, the GCV crosses the anterior interventricular branch and the circumflex branch of the left coronary artery, forming the triangle of Brocq.² The anterior interventricular vein (arrows) courses superficial to the arteries in 60–70% of the population (Figure 1A) and passes under both arteries in 30% of the population (Figure 1B). This is a peculiarity and uniqueness of the left circumflex coronary compared with other coronary arteries.³

If perforation leaks blood into the myocardium, causing large septal, intramural haematomas or into the pericardium causing pericardial haematoma ‘dry tamponade’, it could mask the situation with false impressions that there is no source of bleeding or obvious pathology and may require emergency explorative surgery or bailout intervention.

This report presents a rare case of GCV injury after percutaneous circumflex coronary artery intervention.

Summary figure

A great cardiac vein (GCV) injury during percutaneous coronary intervention (PCI)

is a diagnosis of exclusion if there is

- a venous pericardial effusion
- directly after PCI, particularly in the Cx region,
- and no injury on the right side of the heart or surrounding structures and
- thoracic computed tomography demonstrates a haematoma in the PCI region.

We present a case of great cardiac vein injury during Cx. percutaneous coronary intervention.

Pericardiocentesis revealed a venous bloody effusion. Due to continuous bleeding, an urgent exploratory thoracotomy was performed. Intraoperatively, a large pericardial haematoma in the Cx region was evacuated.

First, consider conservative therapy; if the patient is haemodynamically unstable or bleeds progressively, an explorative pericardiectomy could be imperative to evacuate the haematoma and seal the injured vein. Other interventional techniques could be helpful as a bailout technique in high-risk patients.

Case presentation

An 80-year-old man presented with known hyperlipoproteinaemia, arterial hypertension, and known ischaemic heart disease with Ramus

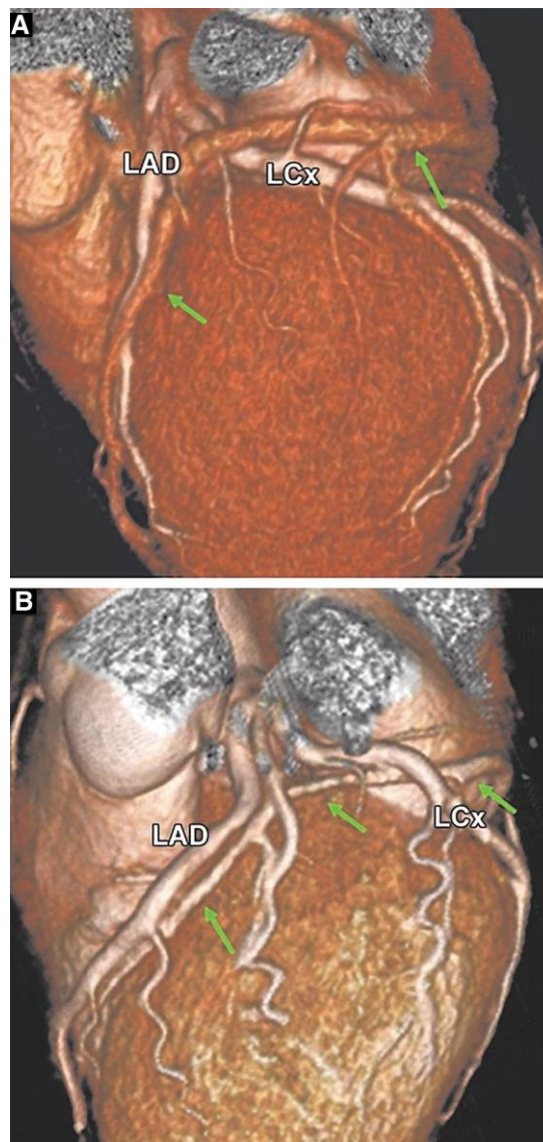


Figure 1 (A and B) Imaging of the cardiac venous system (CVS) by computed tomographic (CT) mapping of the coronary veins and its relations to coronary artery. Great cardiac vein crossing the left anterior descending (LAD) and left circumflex (LCx) arteries, forming a triangle. The relations of the vein and these arteries are highly variable. The anterior interventricular vein (arrows) courses *superficial* to the arteries in 60–70% of the population (A) and passes *under* both arteries in 20% of the population (B).³

intermedius coronary artery-drug-eluting stent due to ST elevation myocardial infarction of the lateral wall. He was admitted with unstable anginal pain (new, worsening chest tightness, get worse with little physical exertion and radiate to the left shoulder and arm) for urgent coronary angiography. Electrocardiogram revealed sinus rhythm with incomplete right bundle branch block. Transthoracic echocardiography (TTE) revealed low normal left ventricular function with an ejection fraction of 50%, and troponin value of 31 ng/L.

Diagnostic angiography using the right femoral artery approach showed that the proximal-to-medial circumflex artery had a high-

grade calcified stenosis (see [Supplementary material online, Figure S1](#)). With a 6 French extra backup guider, attempts were initially made using an Hi-Torque hydrophilic coating guide wire (Abbott BMW 0.014), followed by an Hi-Torque polymer-covered hydrophilic guide wire (Abbott Whisper MS 0.014) as a buddy wire. The lesion was successfully crossed with a wire tip placed in the distal left circumflex, and multiple balloon inflations at stenosis sites using a non-compliant 3.0 × 15 balloon (20 atmosphere) were undertaken. This was followed by proximal-to-medial placement of a 3.0 × 20 and 2.75 × 24 mm drug-eluting stent (Boston Scientific Promus Premier). Angiography post-stent deployment showed thrombolysis in myocardial infarction (TIMI)-Flow III (see [Supplementary material online, Figure S2](#)). Two hours later, the patient developed dyspnoea according to New York Heart Association grade IV and cardiogenic shock and became haemodynamically unstable with 15 mm pericardial effusion visualized on bedside TTE without any signs of compression on the right side of the heart. Pericardiocentesis was performed with an aspiration of 600 mL haemorrhagic venous effusion confirmed in blood gas analysis: Hb 11 g/dL, SO₂ 45%. This was the first clue that the source of bleeding had not been understood.

A second coronary angiography was performed, which showed no signs of coronary artery perforation with TIMI-Flow III in all of the coronary arteries. We further conducted aortography (see [Supplementary material online, Figure S3](#)) and left (see [Supplementary material online, Figure S4](#)) and right ventricular angiography (see [Supplementary material online, Figure S5](#)), which showed no signs of perforation or extravasation. As the patient's haemodynamic deteriorated again with a second pericardial drainage of 600 mL of haemorrhagic venous effusion, three units of packed red blood cells were given, and we performed thoracic computed tomography (CT). It revealed circumferential haemorrhagic pericardial effusion with delineation of the contrast medium in the area of the Cx that exceeds the myocardial contour ([Figure 2A, B](#)). After cardiothoracic consultation, we transferred the patient to a tertiary heart centre. As the patient's haemodynamic deteriorated for the third time with pericardial drainage of 600 mL of haemorrhagic venous effusion, the decision for emergency exploratory thoracotomy was made. Intraoperatively, a large myocardial haematoma in the circumflex region was evacuated. The perforation site was sought and identified as a tear at the GCV (see [Supplementary material online, Figure S6A, B](#)). The whole area was sealed with Tachosil.

The patient recovered post-surgery with no deficits and was discharged 7 days later. The discharge medications were acetylsalicylic acid, clopidogrel, statin, angiotensin-converting enzyme inhibitor, and B-blocker. Three months after the procedure, follow-up did not show quality of life limitations.

Discussion

We present a very rare complication of GCV injury after severe calcific Cx artery intervention. Retrospectively, we tried to understand the mechanism of bleeding in this rare case. As demonstrated in [Figures 3](#) and [4](#), the calcific lesion in the Cx artery protruded outside and injured the underlying neighbouring GCV.

A GCV injury during PCI is a diagnosis of exclusion if the patient has:

- (1) a venous pericardial effusion;
- (2) directly after PCI, particularly in the Cx region;
- (3) no injury of the right ventricle or other surrounding structures;
- (4) a haematoma in the PCI region confirmed by thoracic CT.

A haematoma can deteriorate the haemodynamic status without effusion 'dry tamponade'.

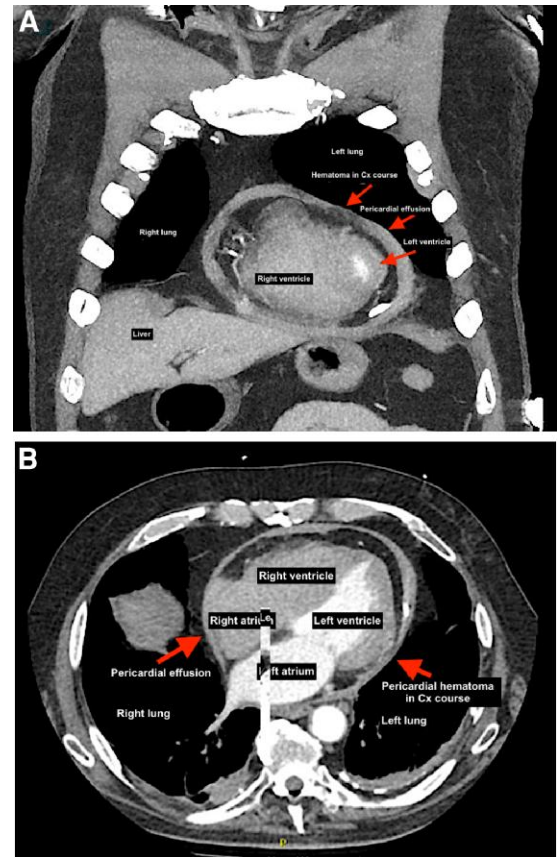


Figure 2 (A and B) Thoracic computed tomography revealed haemorrhagic pericardial effusion with delineation of a contrast medium in the area of the left circumflex (LCx) that exceeds the myocardial contour (haematoma).

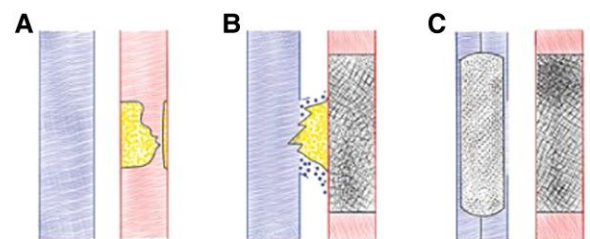


Figure 3 Mechanism of great cardiac vein injury after circumflex artery intervention. (A) Severely calcific Circumflex (Cx) lesion. (B) Cx percutaneous coronary intervention lead to protrusion of calcific plaque outside the Cx artery and injured the great cardiac vein. (C) Possible Cx stenting and prolonged balloon inflation as bailout interventional technique.

First, consider conservative therapy; if the patient is haemodynamically unstable or bleeds progressively, do a pericardial drainage and contact a heart surgeon as soon as possible for explorative pericardiectomy, to evacuate the haematoma, and to seal the injured vein.

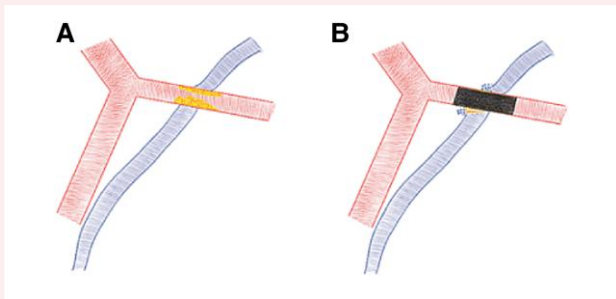


Figure 4 (A) Course and (B) mechanism of great cardiac vein injury after circumflex artery intervention.

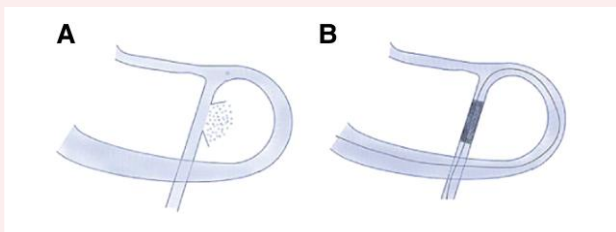


Figure 5 (A) Illustration of great cardiac vein drainage into coronary sinus and (B) possible bailout intervention technique of great cardiac vein injury through coronary sinus with prolonged balloon inflation.

Catheter-based intervention could be helpful as a bailout technique in high-risk patients as follows. First, intubate the coronary sinus and try to wire the GCV, then use a bailout prolonged balloon or covered stent implantation to stop the bleeding (Figure 5). However, it is difficult to say that it is reproducible for use in daily coronary intervention.

In this case, a successful explorative pericardiectomy to seal the injured vein and evacuate the haematoma was an attempt to save a difficult and rare complication.

Conclusion

A GCV injury during PCI is a rare complication. It is a diagnosis of exclusion if there is a venous pericardial effusion directly after PCI, particularly in the Cx region, and no injury on the right side of the heart or surrounding structures, and thoracic CT demonstrates a haematoma in the PCI region. A haematoma can deteriorate the haemodynamic status without effusion ‘dry tamponade’. First, consider conservative therapy. If the patient is haemodynamically unstable or bleeds progressively, perform a pericardial drainage. Explorative pericardiectomy could be imperative to evacuate the haematoma and seal the injured vein. Other catheter-based

interventions could be helpful bailout techniques in high-risk patients.

Lead author biography



Abdelrahman Elhakim is an interventional cardiologist and head of the catheter laboratory at Schoen Hospital Neustadt in Holstein, Germany. He completed his cardiovascular medicine residency and interventional cardiology fellowship in several hospitals in Germany. He also sub-specialized in coronary artery intervention, intensive care, and emergency medicine in Germany. He has led pulmonary embolism workshops and completed a medical doctoral study on pulmonary embolism

at Schleswig-Holstein University Hospital in Luebeck. He also holds a Master’s degree in cardiovascular medicine from Al-Azhar University, Egypt, and a second Master’s degree in business and health administration from Nuernberg University, Germany.

Supplementary material

Supplementary material is available at *European Heart Journal – Case Reports* online.

Acknowledgements

This work was supported by my wife Aline Wenner and my son Yousef. Great thanks to Emmanouil Chourdakis for his opinion and idea of possible bailout intervention of this complication. The paper is not under consideration elsewhere. None of the paper’s contents have been previously published. All authors have read and approved the manuscript.

Consent: Written informed consent was obtained from the patient in line with COPE for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Conflict of interest: None declared.

Funding: This case report was not supported by any funding.

Data availability

The data underlying this article are available in the article and in its online [supplementary material](#).

References

1. Stankovic G, Orlic D, Corvaja N. Incidence, predictors, in-hospital, and late outcomes of coronary artery perforations. *Am J Cardiol* 2004;**93**:213–216.
2. Pejkoic B, Bogdanovic D. The great cardiac vein. *Surg Radiol Anat* 1992;**14**:23–28. PMID: 1589843.
3. Saremi F, Muresian H, Sánchez-Quintana D. Coronary veins: comprehensive CT-anatomic classification and review of variants and clinical implications. *Radiographics* 2012;**32**:E1–32. PMID: 22236907.