

## The conus artery as a lethee in coronary artery disease

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### ABSTRACT

Collaterals connecting coronary arteries may protect the heart from ischemic attacks, thus mediate in the preservation of myocardial functions. Symptoms and ventricular functions are closely related to the quality of coronary collaterals. In the presence of chronic total occlusion (CTO) in the left anterior descending artery (LAD), collateral circulation from the conus artery to the LAD is rare but may be life-saving. We report a 44-year-old patient with moderate left ventricular dysfunction and multi-vessel coronary disease in whom collateral flow was supplied by the conus artery, connecting to distal to the LAD CTO.

Keywords: collateral, conus artery, myocardial function.

## INTRODUCTION

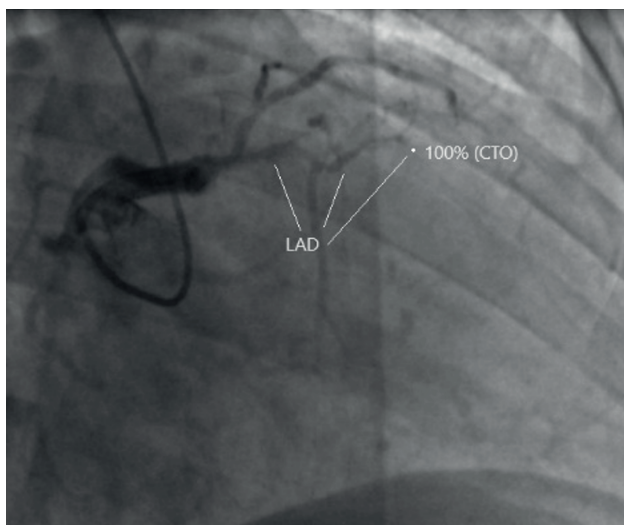
Coronary collaterals are blood vessels that provide connections between coronary arteries. It may protect the heart from ischemic attacks, thus resulting in preserved myocardial functions. The better developed the coronary collaterals, the better the myocardial protection [1-3]. The most commonly observed coronary collaterals are connections between the septals of the left anterior descending artery (LAD) and the posterior descending artery (PDA) of the right coronary artery (RCA). The collateral pattern formed by the conus artery has a low incidence and should not be overlooked [4]. Here, we present a young patient with moderate left ventricular dysfunction and multi-vessel coronary disease in whom collateral flow was supplied by the conus artery, connecting to distal to the lesion with complete occlusion of the LAD.

## CASE PRESENTATION

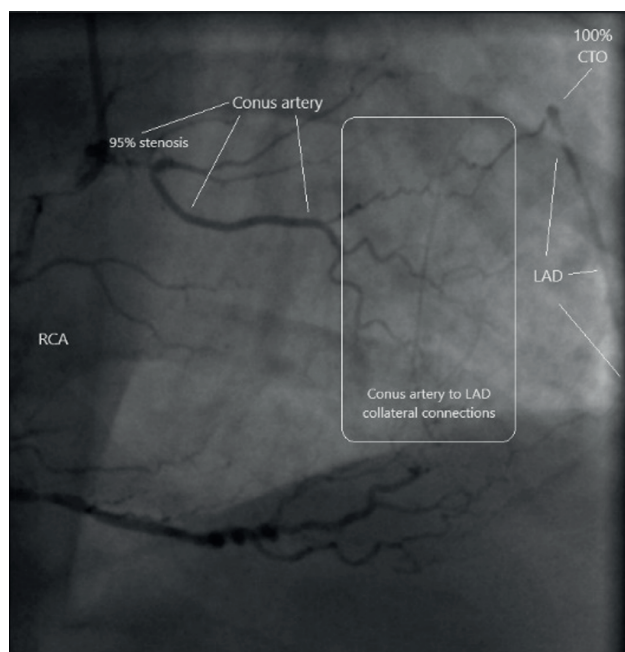
A 44-year-old man with shortness of breath and inability to lie flat (orthopnea) was admitted to the cardiology clinic with decompensated heart failure. The patient had risk factors of smoking, hypertension and hyperlipidemia and had a history

of hospitalization for decompensated heart failure in another hospital about 5 months ago. On physical examination, blood pressure was 140/90 mmHg, pulse rate: 110 beats/min and decreased respiratory sounds and rales were heard in the basal parts of the lungs. Other physical examination findings were within normal limits. Electrocardiography showed sinus tachycardia and echocardiography showed global hypokinesia with an ejection fraction (EF) of 40%. After stabilization with guideline-based treatment, coronary angiography was performed. Coronary angiography showed a 90% stenosis in the LAD proximally and a chronic total occlusion (CTO) lesion immediately afterwards (Figure 1). No major lesion was observed in the circumflex artery. Right coronary angiography showed 90% stenosis in the middle part of the RCA and 99% stenosis in the middle segment of the well-developed acute marginal branch of the RCA. The conus artery was seen to arise from the RCA ostium and to meander anterior to the pulmonary artery and to merge just distal to the LAD CTO lesion, supplying the middle and distal segments of the LAD. Additionally, there was a severe stenosis (95%) in the proximal part of the conus artery (Figure 2). After successful coronary by-pass surgery carried out due to both multi-vessel disease involving the LAD and low

EF, the patient was discharged uneventfully. On examination 3 months later, we observed that the general condition of the patient was good and his EF increased to 50%.



**Figure 1.** Coronary angiography shows a chronic total occlusion (CTO) lesion in the left anterior descending artery (LAD).



**Figure 2.** Right coronary angiography shows collateral circulation from the conus artery, branching from the ostium of the right coronary artery (RCA), to distal to the chronic total occlusion (CTO) in the left anterior descending artery (LAD).

## DISCUSSION

The present case is valuable as a reminder of the importance of defining the presence, origin and course of coronary collateral flow in a CTO lesion. Our case had a conus artery branch providing collateral connections between proximal RCA and distal to LAD CTO lesion.

The collaterals may play an active role in maintaining myocardial viability, and the well-developed collaterals are known to improve cellular function and global myocardial performance in CTOs [1-3]. Moreover, they may bridge over in protect the myocardium from ischemia during episodes of coronary ischemia and prolong the chance of intervention in the limited time from the onset of acute myocardial infarction to successful coronary reperfusion [1,2,4,5].

It should be determined from which vessel (from where) the collateral blood flow to the chronically occluded vessel is provided. McEntegart et al. [4] evaluated collateral circulation to chronically occluded coronary arteries, and they reported that collateral blood flow to the LAD originated from the PDA in 52.3%, from the RV in 26.8% and from the conus branch in 5.9% of 159 cases of LAD CTO. The conus artery supplies blood flow to the conus or outflow tract of the right ventricle. It may arise from the first segment of the RCA or from the superior and anterior to the ostium of RCA as a separate branch directly from the aorta [6-8]. In the present case, we identified the conus artery branch stemming from the RCA ostium as the collateral vessel providing blood supply to distal to the LAD CTO lesion.

Detailed identification of the coronary collateral is important not only for diagnosis but also for treatment. The detection of such a collateral vessel may influence the treatment decision in favour of PCI in CTO lesions for several reasons. First, the conus artery providing collateral blood flow to the true lumen distal to the CTO lesion allow clear

visualisation of the distal vascular bed. Therefore, this connection can be used for microcatheter tip selective injection facilitating antegrade approach and as a collateral channel for retrograde approach in all CTO PCI. Second, it can be used as a vessel for wire / balloon anchoring to fix and increase support for RCA guiding catheter in RCA CTO PCI. Coronary surgery should be considered for the treatment of patients who cannot be treated with PCI in LAD CTO [9]. Our case had a low left ventricular ejection fraction. He also had multivessel disease involving LAD, and a thin, tortuous and diseased conus artery providing connection between RCA and LAD, as shown in Figure 1 and 2. For these reasons, our patient underwent successful coronary artery bypass operation. In patients undergoing coronary surgery, the origin and course of the conus artery should be well known to avoid intraoperative injury. The conus artery may be damaged during surgical interventions involving right infundibulum manipulations, especially in the case of its intramyocardial course [7,8]. Levin et al. reported that the conus artery could not be demonstrated angiographically in almost 20% of cases [8]. When conventional angiographic methods are failed to demonstrate coronary collateral flow, especially in cases where surgical procedure or CTO PCI is planned, multidetector coronary computed tomography (MDCT) should be considered [6-8].

Coronary collateral circulation is an important factor in the pathophysiology of coronary disease. Symptoms and prognosis in patients with coronary artery disease depend on the quality of the collateral circulation. If the collateral vessel is weak and/or diseased, ventricular function may not be adequately preserved [1-4]. Shokry et al. [3] recently showed that the presence of well-developed coronary collateral could independently predict with high accuracy myocardial viability. In our case, the conus artery branching from the RCA had both a thin and tortuous structure and severe atherosclerotic stenosis. We think that the reason for the moderate decrease in ventricular function

observed in our case was both the underlying multi-vessel disease and the diseased conus artery supplying collateral flow to distal to the LAD CTO lesion.

In conclusion, coronary collateral flow is of paramount because it can reduce the severity of ischemic attacks and thus contribute to the preservation of myocardial functions. In CTO lesions, if present, the origin and course of the collateral vessel supplying blood flow to the distal part of the lesion should be described in detail. If uncertainty, MDCT should be performed, especially in patients in whom CTO PCI or surgical procedure is planned. Conus branch artery providing collateral connections between two different vascular zone presents a few technical opportunities, including selective contrast injection, anchoring, and vascular channel (collateral) for retrograde approach, to increase the success of and/or to simplify the PCI in CTO lesions. In patients undergoing coronary surgery, the conus artery providing collateral flow should not be damaged during the procedure.

#### **Author contribution**

Study conception and design: MY; data collection: MY and ZD; analysis and interpretation of results: MY and ZD; draft manuscript preparation: MY and ZD. All authors reviewed the results and approved the final version of the manuscript.

#### **Ethical approval**

Informed consent was obtained from the patient for participation and publication.

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#### **Conflict of interest**

The authors declare that there is no conflict of interest.

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