

CASE REPORT

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Anomalous circumflex artery encircling the aortic annulus: implications for mitral valve repair

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Abstract

Injury to coronary arteries during mitral surgery is a rare but life-threatening procedural complication, an anomalous origin and course of the left circumflex artery (LCx) increase this risk. Recognizing the anomaly by the characteristic angiographic pattern and identifying its relationship with the surrounding anatomical structure using imaging techniques, mainly transesophageal echocardiography (TOE) or coronary computed tomography angiography (CCTA), is of crucial importance in setting up the best surgical strategy. We report a case of anomalous origin of a circumflex artery (LCx) from the proximal portion of the right coronary artery (RCA) with a pathway running retroaortically through the mitro-aortic space. An integrated diagnostic approach using a multidisciplinary team with a cardiologist and an imaging radiologist allowed us to decide the surgical strategy. We successfully performed a mitral valvular repair using a minimally invasive minithoracotomic approach and implanting a complete semirigid ring.

Keywords Mitral valve surgery, Intraoperative complication, Coronary injury, Anomalous circumflex coronary course

Background

An abnormal LCx vessels origin, steaming from the right coronary artery and following a retroaortic course, is a very uncommon anomaly (0.15% incidence) [1] that, if undiagnosed, considerably increases the risk of coronary damage with subsequent life-threatening complications during valve surgery [2]. Therefore, it is crucially important to recognize such a anomaly during the preoperative screening. We report our diagnostic and therapeutic strategy in a case of a patient candidate to mitral valve repair showing an unusual preoperative coronary angiogram which alerted us to the presence of an anomalous coronary branch encircling the aortic annulus.

Case presentation

A 50 year old man was referred to our attention with the diagnosis of symptomatic (NYHA II/III) primitive severe mitral insufficiency. In his medical history there was no other significant events. The ECG showed sinus rhythm. Preoperative TOE echocardiography reported a huge mitral insufficiency (grade 4/4) without excess of tissue (fibroelastic degeneration), a prolapse of the anterior leaflet due to primary chordae elongation and a flail prolapse of the middle portion of the posterior leaflet (P2) due to primary chordae rupture, the annulus was dilated with a spherical shape. Indication for surgical mitral valve repair was given and preoperative routine exams were performed. The coronary angiogram showed an anomalous branch of the right coronary artery detaching earlier from the main stem and following an anomalous pathway upwards and posteriorly in the fibrous heart body along the mitro-aortic continuity (Fig. 1A, B, C).

The bi-dimensional (2D) TOE (Fig. 2A) confirmed the presence of the anomalous artery and the

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three-dimensional (3D) views (Fig. 2B) were instrumental in exactly identifying the course of the vessel which lies 65 mm upwards to the level of the hinge point between the anterior leaflet and the mitral valve annulus.

The CCTA study further confirmed the anomalous position of the vessel and its relations with the adjacent anatomical structure (Fig. 2C, D).

The operation was performed using a minimally invasive video assisted approach: right minithoracotomy (fourth intercostal space) without mechanical spreading (soft tissue retractor, Edwards Lifescience, Irvine, CA), internal aortic cross clamp (Endo-Clamp catheter, Edwards Lifescience, Irvine, CA) and cold cardioplegic arrest (Custodiol). The repair was realized according to the Carpentier technique: a triangular resection of P2, a double secondary chordae transposition on P1 and P2, implantation of two artificial chordae (GoreTex) from the medial head of the anterior and posterior papillary muscles to A1 and A3, and a valvuloplasty with a semi-rigid complete ring (Physio II Edwards). Particular care was taken to precisely stitch on the anterior mitral annulus (A1, 2 and 3) exactly at the level of the mitro-annular hinge point. The immediate and post operative course went smoothly without any ECG modification or hemodynamic impairment. The patient was discharged at day 5. After 3 years of follow-up the patient is going perfectly well with normal valvular end ventricular function.

Discussion

Reparative surgery of the mitral valve for primitive mitral insufficiency is nowadays the gold standard therapy even for asymptomatic very low surgical risk patients [3]. In the last few years the use of minimally invasive techniques has been more commonly requested by patients and evidence of its feasibility and safety are increasingly reported [4]. In this setting it is crucially important to prevent any potential iatrogenic complication. The abnormal origin and retroaortic course of the LCx has a such a distinctive pattern that must act as a red flag for surgeons (Fig. 1A, B, C). That's why, in our opinion, a preoperative coronary imaging screening for all patients candidate for mitral surgery is mandatory. Mitral valve repair with a complete ring is reported to be the treatment of choice providing a better long term durability [3, 4]. Conversely, the use of an open ring has been proposed as a safer in this condition [5], but in our opinion a correct effective implant of an open ring implies its attachment to both right and left fibrous bodies. Consequently, considered the particular course of the anomalous coronary (Fig. 2A, B), the risk of injury is not really avoided. In our opinion the most important factor to address in order to predict the safety and feasibility of a complete annuloplasty is

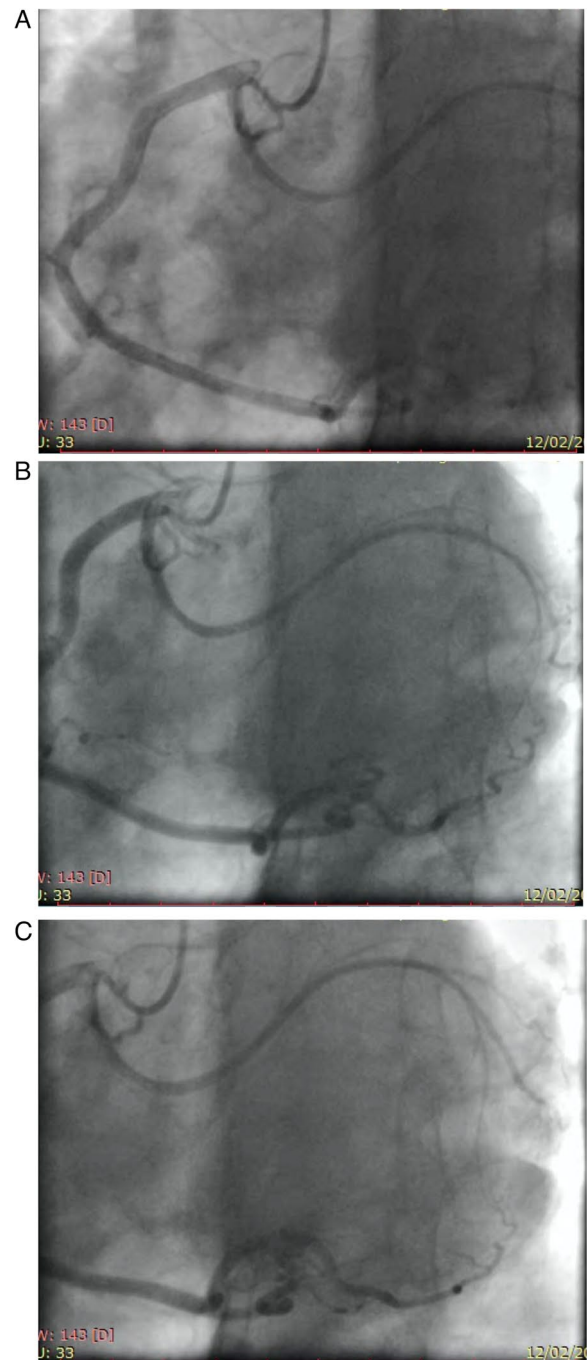


Fig. 1 Coronary angiogram (LAO with Cranial 30°) shows the origin (1A), the middle (2A) and the distal portion (3°) of the anomalous circumflex artery

the distance between the LCx (Left circumflex artery) and the anterior plan of the ring attachment which was about 65 mm in our case (Fig. 2A, B). The plan of the ring attachment was defined as the hinge point of the anterior leaflet which was about two millimeters more

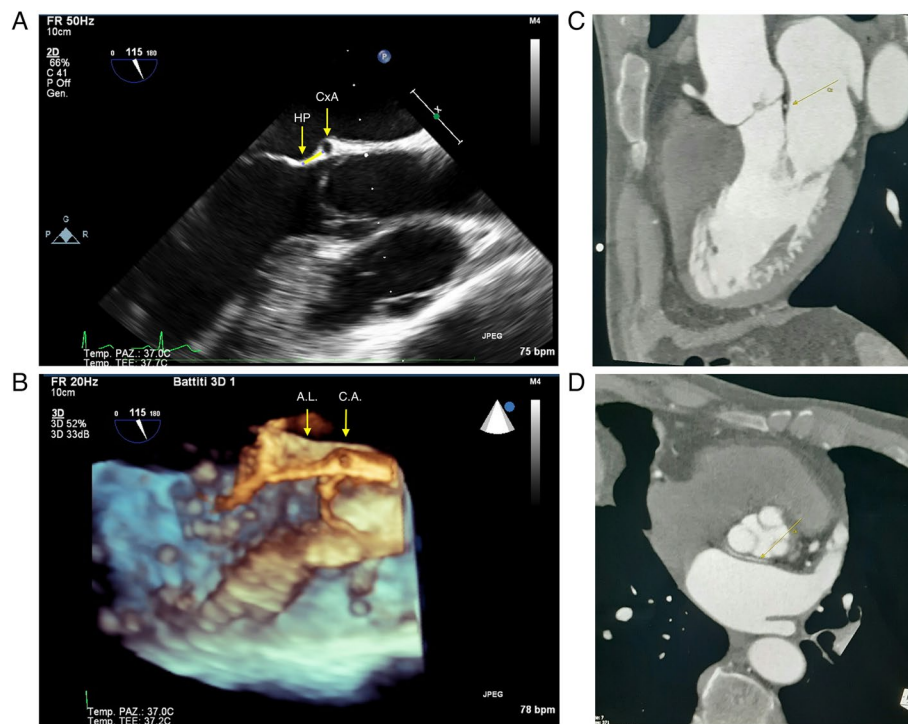


Fig. 2 TOE long axis shows the hinge point of the anterior mitral leaflet (H.P) and the anomalous circumflex artery (C.A.) (2A) and the distance between this two points. 2B shows the same projection in 3D. CxA (anomalous circumflex artery); HP (hinge point of the anterior mitral leaflet); AL (Anterior leaflet). IMG 2 C- 2 D The CCTA study confirmed the anomalous origin of a circumflex artery (LCx) from the proximal portion of the right coronary artery (RCA) with a pathway running retroaortically through the mitro-aortic space

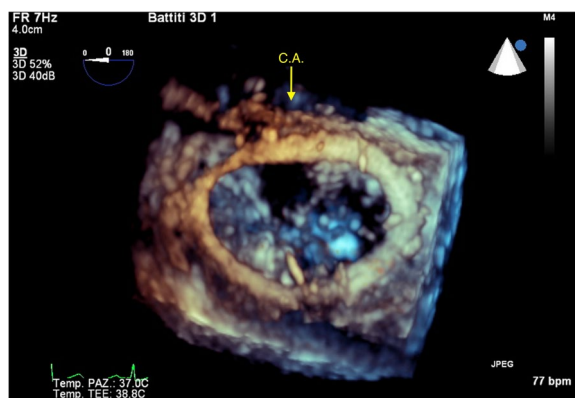


Fig. 3 3D TOE shows the postoperative 3D view

proximal to the usual stitching level (the so called “mitral annulus”). The use of the TEE echocardiography and particularly of the 3D view was crucially important in identifying the vessel before the operation and to verify its patency at the end of the procedure (Fig. 3).

Conclusion

We wish to emphasize the vital importance of recognizing the presence of an anomalous LCx from the pre-operative coronary angiogram: the image we present in Fig. 1 should be noted by every surgeon involved in valvular surgery. We strongly suggest using a multidisciplinary integrated approach to establish the best surgical technique for every specific patient.

Authors' contribution

All authors read and approved the final manuscript. MP performed the surgical procedure and was responsible for patient care AB performed the anesthetic procedure and was responsible for the postoperative care CC participated in coordination of the work, in the drafting and in the design of the manuscript SM was responsible for patient care and participated in the design of the manuscript GC was responsible for patient care and participated in the design of the manuscript.

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Availability of data and materials

The data used to support the findings of this case report are restricted to protect patient privacy.

Declarations

Ethics approval and consent to participate

Ethics approval and consent to participate was obtained from the patient.

Consent for publication

Written informed consent was obtained from the patient for publication of this case report and any accompanying images.

Competing interests

The authors declare no competing interests.

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References

1. Bakker RC, Bouma W, Wijdh-den Hamer IJ, Natour E, Mariani MA. Mitral valve repair in a patient with an anomalous left coronary artery. *J Card Surg.* 2014;29:782–4.
2. Lopez-Marco A, Syed A, Combella T, Mehta D. Iatrogenic lesion of an anomalous circumflex coronary artery during mitral surgery. *Ann Thorac Surg.* 2016;102:e525–7.
3. Falk V, Baumgartner H, Bax JJ, De Bonis M, Hamm C, Holm PJ, Iung B, Lancellotti P, Lansac E, Muñoz DR, Rosenhek R, Sjögren J, Tornos Mas P, Vahanian A, Walther T, Wendler O, Windecker S, Zamorano JL; ESC Scientific Document Group. 2017 ESC/EACTS Guidelines for the management of valvular heart disease. *Eur J Cardiothorac Surg.* 2017;52(4):616–64. <https://doi.org/10.1093/ejcts/ezx324>.
4. Modi P, Hassan A, Chitwood WR Jr. Minimally invasive valve surgery: a systematic review and meta-analysis. *Eu J Cardiothorac.* 2008;34:943–52.
5. Pettinari M, Gutermann H, Van Kerrebroek C, Dion R. Anomalous origin of the circumflex artery: an underestimated threat during mitral valve surgery. *Ann Thorac Surg.* 2015;100:1437–9.

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