

Surgical Treatment of a Catheter-Induced Iatrogenic Dissection of the Right Coronary Artery following Cardiac Catheterization

Panagiotis Artemiou, MD, PhD¹, Stefan Lukacin, MD, PhD¹, Peter Kirsch, MD, PhD², Jan Ignac, MD², Boris Bily, MD^{1*}, Alzbeta Tohatyova, MD³, Miroslava Bilecova-Rabajdova, PhD⁴, Frantisek Sabol, MD, PhD¹

¹University of P. J. Safarik, Medical Faculty, Department of Cardiovascular Surgery, Kosice, Slovakia.

²University of P. J. Safarik, Medical Faculty, Department of Cardiology, Kosice, Slovakia.

³University of P. J. Safarik, Medical Faculty, Children's Hospital, Kosice, Slovakia.

⁴University of P. J. Safarik, Medical Faculty, Department of Clinical Biochemistry, Kosice, Slovakia.

Received 06 May 2015; Accepted 14 October 2015

Abstract

Iatrogenic dissections of the ascending aorta are an uncommon and severe complication during cardiac catheterization. A 68-year-old female patient underwent diagnostic cardiac catheterization due to non-ST-elevation myocardial infarction. During the procedure, a catheter-induced 360° Class I dissection of the right coronary artery occurred. The patient developed severe bradycardia, which was treated with a temporary pacemaker. She underwent an emergency operation with ligation and a saphenous vein graft in the right coronary artery. The postoperative course was uneventful; and on postoperative day 6, she was discharged home.

J Teh Univ Heart Ctr 2016;11(1):30-33

This paper should be cited as: Artemiou P, Lukacin S, Kirsch P, Ignac J, Bily B, Tohatyova A, Bilecova-Rabajdova M, Sabol F. Surgical Treatment of a Catheter-Induced Iatrogenic Dissection of the Right Coronary Artery following Cardiac Catheterization. *J Teh Univ Heart Ctr 2016;11(1):30-33.*

Keywords: Cardiac catheterization • Dissection • Iatrogenic disease

Introduction

Iatrogenic dissections of the ascending aorta are an uncommon and severe complication during heart catheterization. The incidence ranges between 0.02 and 0.08% in diagnostic procedures and between 0.07 and 0.6% during percutaneous coronary interventions (PCIs).¹⁻¹⁰ The main mechanism involved is the retrograde extension of a coronary artery dissection into the aortic root.¹¹ The clinical presentation and outcome of iatrogenic aortic dissections

seem to differ from those of spontaneous dissections.¹²

In this report, we present a catheter-induced iatrogenic dissection of the right coronary artery following cardiac catheterization.

Case Report

A 68-year-old woman with a history of arterial hypertension well controlled on medical treatment, hypercholesterolemia

*Corresponding Author: **Boris Bily**, UPJSLF and VUSCHAS, 8, Ondavska Street, 040 11 Kosice, Slovakia. Tel: +421 910487461. Fax: +421 557891213. E-mail: boris_bil@yahoo.co.uk.



treated with simvastatin, and paroxysmal atrial fibrillation treated with amiodarone was admitted with unstable angina, elevated troponin levels, and ischemic electrocardiographic changes on leads V4-V6. Moreover, she suffered from hepatopathy and subclinical hypothyroidism and had previously undergone mastectomy due to breast cancer.

The patient underwent diagnostic cardiac catheterization with normal coronary arteries. The left main coronary artery was selectively cannulated with a 6 F Judkins Left-4 guiding catheter and the right coronary artery was also selectively cannulated with a 6 F Judkins Right-4 guiding catheter (Medtronic, Inc., Minneapolis, Minnesota). The velocity of the contrast injection in both coronary arteries was 3 mL/s. In both arteries, the cannulation was uneventful without any complication. A second fluoroscopic injection into the right coronary artery demonstrated a 360° dissection of the right coronary artery extending to the coronary cusp with a subtotal occlusion of the artery (Figure 1).

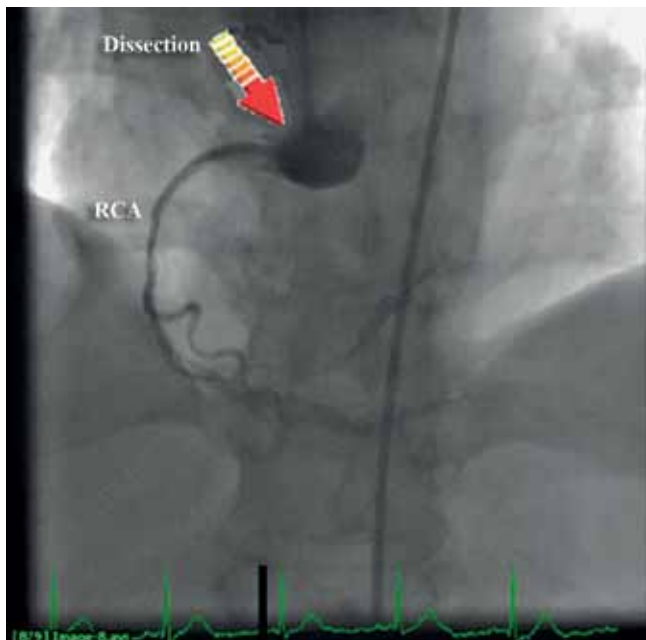


Figure 1. Coronary angiogram (left anterior oblique projection) – arrow showing the aortocoronary dissection of the right coronary artery (RCA)

The patient developed severe bradycardia, which was treated with a temporary pacemaker. Emergency transthoracic echocardiography in the catheterization laboratory and later perioperative transesophageal echocardiography confirmed the dissection and demonstrated acute akinesis of the diaphragmatic myocardial wall and the interventricular septum with moderate left ventricular dysfunction (Figure 2).



Figure 2. Transesophageal echocardiogram (long axis) – arrow showing the aortocoronary dissection

Ao, Aorta; AoV, Aortic valve

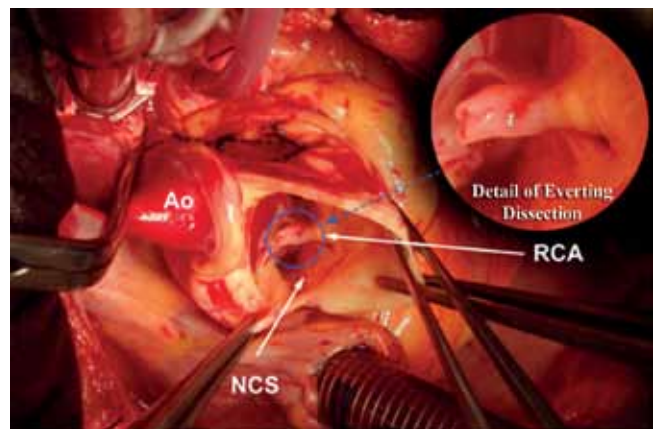


Figure 3. Intraoperative finding - arrow showing the evverting aortocoronary dissection

Ao, Aorta; RCA, Right coronary artery; NCS, Non-coronary sinus

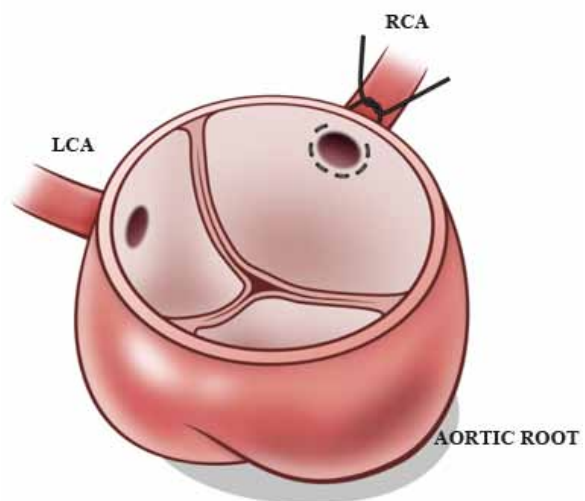


Figure 4. Intraoperative procedure – drawing showing ligation of the right coronary artery at its origin

LCA, Left coronary artery; RCA, Right coronary artery

The patient underwent an emergency operation through a median sternotomy with ligation of the right coronary artery at its origin with a saphenous bypass vein graft. The aorta was opened, and no aortic wall dissection was seen. The operative finding showed a 360° dissection of the right coronary artery with the dissecting flap everting into the aortic lumen (Figure 3). The dissection on the right coronary artery was extended distally to the bifurcation of the artery. The venous graft was placed distally before the bifurcation of the artery, and the lumen of the artery at the anastomotic site was dissected. The operative procedure is shown in Figure 4.

The postoperative course was uneventful; and on postoperative day 6, she was discharged home in stable condition.

Discussion

Catheter-induced dissection with retrograde extension to the aortic root, a feared complication of cardiac catheterization, is rare and has been estimated to occur in approximately 0.02 to 0.08% of diagnostic catheterization and 0.07 to 0.6% of PCIs, but the overall incidence of catheter-induced dissections remains unknown.^{10, 13}

In our patient, aortocoronary dissection was the complication of a catheter-induced dissection of the right coronary artery. This finding is consistent with those in the literature. Goldstein et al.¹⁴ reported that 89% of dissections involve the right side and 11% the left side. The media of the left coronary artery contains more circulatory and spiral smooth muscle cells than does the right coronary artery. These cells are arranged in concentric layers with abundant elastic fibers, which may explain the higher resistance of the left main coronary artery to retrograde dissections.¹⁵

A proposal was made by Dunning et al.¹¹ for a classification system based upon the extent of aortic involvement. Class I: The contrast staining involves the coronary cusp; Class II: The contrast extends up the aortic wall < 40 mm; and Class III: The contrast extends > 40 mm up the aortic wall. In their series, patients with Class III dissections had poor outcomes. This classification may be useful for risk stratification. According to this classification, our patient had a Class I dissection with a favorable outcome.

The risk factors for aortocoronary dissections include hypertension, older age, extensive atherosclerosis and underlying structural weakness of the media (cystic medial necrosis),¹⁶ use of Amplatz-shaped catheters, and catheterization for acute myocardial infarction.¹¹ Other possible risk factors include catheter manipulation and deep intubation of the catheter within the coronary artery,¹⁷ vigorous contrast injection and vigorous deep inspiration,^{18, 19} and finally a variant anatomy of the coronary ostia.²⁰

The management of the catheter-induced coronary artery dissection depends on the patency of the distal vessel and

the extent of the propagation of the dissection. If there is a compromise of the distal artery bed, such as the acute closure of the artery, urgent revascularization is mandated to prevent the infarction of that myocardial area. This may be achieved via PCI or coronary artery bypass graft surgery (CABG). Our patient presented with acute hemodynamic instability and a third-degree atrioventricular block, so the decision for urgent CABG was made. In the literature, there have also been reports of successful outcomes with CABG.^{18, 21} In contrast in some cases, the treatment of choice regarding aortocoronary dissections has involved immediate stenting limited to the coronary artery and its ostium to seal the entry point of the dissection without intervention in the aortic extension of the dissection.^{15, 17, 22-24} Also, localized aortocoronary dissections that appear stable throughout the procedure can probably be managed conservatively.¹³

Surgical intervention in the aorta via either aortic replacement or glue aortoplasty^{25, 26} along with coronary bypass can be considered depending on the finding of immediate coronary stenting,¹⁵ aortic extension,¹¹ or progression²⁷ of the dissection and the clinical condition of the patient such as hemodynamic instability.

Invasive and noninvasive imaging methods have been used to visualize and follow aortocoronary dissections induced in the catheterization laboratory. In our case report, catheter coronary angiography and aortography was utilized for an immediate diagnosis of the coronary artery dissection and its aortic extension. Also, transesophageal echocardiography was employed in the catheterization laboratory for an accurate definition of the dissection and evaluation of the aortic valve function. Intravascular ultrasound also has been used to identify the entry point of the dissection.²⁸ Moreover, computer tomography angiography has been drawn upon as a noninvasive modality for a precise diagnosis and follow-up of the aortic extension of a coronary artery dissection induced in the catheterization laboratory.²⁹ In some cases, however, magnetic resonance imaging has been used for the follow-up of the aortic extension of the dissection.³⁰

Conclusion

Although in Class I dissections the surgical approach is not the first choice, in our case report we used it for the following reasons. The patient presented with acute hemodynamic instability alongside arterial hypotension and third-degree atrioventricular block and - in addition - the echocardiographic picture was not clear enough to determine the class of the dissection. Indeed, the definite diagnosis of the dissection was determined intraoperatively. Given the intraoperative finding, CABG was a more appropriate treatment than was PCI. In conclusion, the seriousness of our patient's clinical condition and echocardiographic findings constituted the reasons for us to proceed with a surgical approach.



References

- Gómez-Moreno S, Sabaté M, Jiménez-Quevedo P, Vázquez P, Alfonso F, Angiolillo DJ, Hernández-Antolín R, Moreno R, Bañuelos C, Escaned J, Macaya C. Iatrogenic dissection of the ascending aorta following heart catheterisation: incidence, management and outcome. *EuroIntervention* 2006;2:197-202.
- Bredlau CE, Roubin GS, Leimgruber PP, Douglas JS, Jr, King SB, 3rd, Gruentzig AR. In-hospital morbidity and mortality in patients undergoing elective coronary angioplasty. *Circulation* 1985;72:1044-1052.
- Wyman RM, Safian RD, Portway V, Skillman JJ, McKay RG, Baim DS. Current complications of diagnostic and therapeutic cardiac catheterization. *J Am Coll Cardiol* 1988;12:1400-1406.
- Geraci AR, Krishnaswami V, Selman MW. Aorto-coronary dissection complicating coronary arteriography. *J Thorac Cardiovasc Surg* 1973;65:695-698.
- Moles VP, Chappuis F, Simonet F, Urban P, De La Serna F, Pande AK, Meier B. Aortic dissection as complication of percutaneous transluminal coronary angioplasty. *Cathet Cardiovasc Diagn* 1992;26:8-11.
- Alfonso F, Almería C, Fernández-Ortiz A, Segovia J, Ferreirós J, Goicolea J, Hernández R, Bañuelos C, Gil-Aguado M, Macaya C. Aortic dissection occurring during coronary angioplasty: angiographic and transesophageal echocardiographic findings. *Cathet Cardiovasc Diagn* 1997;42:412-415.
- Alfonso F, Hernandez R, Goicolea J, Segovia J, Perez-Vizcayno MJ, Bañuelos C, Silva JC, Zarco P, Macaya C. Coronary stenting for acute coronary dissection after coronary angioplasty: implications of residual dissection. *J Am Coll Cardiol* 1994;24:989-995.
- Alfonso F, Goicolea J, Aragoncillo P, Hernandez R, Macaya C. Diagnosis of aortic intramural hematoma by intravascular ultrasound imaging. *Am J Cardiol* 1995;76:735-738.
- Alfonso F, Alvarez L, Almería C. Iatrogenic subtle acute aortic dissection during coronary angioplasty for in-stent restenosis. Value of intravascular ultrasound for diagnosis and management. *J Invasive Cardiol* 2004;16:511-513.
- Carter AJ, Brinker JA. Dissection of the ascending aorta associated with coronary angiography. *Am J Cardiol* 1994;73:922-923.
- Dunning DW, Kahn JK, Hawkins ET, O'Neill WW. Iatrogenic coronary artery dissections extending into and involving the aortic root. *Catheter Cardiovasc Interv* 2000;51:387-393.
- Januzzi JL, Sabatine MS, Eagle KA, Evangelista A, Bruckman D, Fattori R, Oh JK, Moore AG, Sechtem U, Llovet A, Gilon D, Pape L, O'Gara PT, Mehta R, Cooper JV, Hagan PG, Armstrong WF, Deeb GM, Suzuki T, Nienaber CA, Isselbacher EM; International Registry of Aortic Dissection Investigators. Iatrogenic aortic dissection. *Am J Cardiol* 2002;89:623-626.
- Pérez-Castellano N, García-Fernández MA, García EJ, Delcán JL. Dissection of the aortic sinus of Valsalva complicating coronary catheterization: cause, mechanism, evolution, and management. *Cathet Cardiovasc Diagn* 1998;43:273-279.
- Goldstein JA, Casserly IP, Katsiyannis WT, Lasala JM, Taniuchi M. Aortocoronary dissections complicating a percutaneous coronary intervention. *J Invasive Cardiol* 2003;15:89-92.
- Yip HK, Wu CJ, Yeh KH, Hang CL, Fang CY, Hsieh KY, Fu M. Unusual complication of retrograde dissection to the coronary sinus of valsalva during percutaneous revascularization: a single-center experience and literature review. *Chest* 2001;119:493-501.
- Spittell PC, Spittell JA, Jr, Joyce JW, Tajik AJ, Edwards WD, Schaff HV, Stanson AW. Clinical features and differential diagnosis of aortic dissection: experience with 236 cases (1980 through 1990). *Mayo Clin Proc* 1993;68:642-651.
- Jain D, Kurowski V, Katus HA, Richardt G. Catheter-induced dissection of the left main coronary artery, the nemesis of an invasive cardiologist. A case report and review of the literature. *Z Kardiol* 2002;91:840-845.
- Awadalla H, Sabet S, El Sebaie A, Rosales O, Smalling R. Catheter-induced left main dissection incidence, predisposition and therapeutic strategies experience from two sides of the hemisphere. *J Invasive Cardiol* 2005;17:233-236.
- Biel SI, Krone RJ. Left coronary artery dissection with an amplatz-shaped catheter. The role of vigorous inspiration during contrast injection. *Chest* 1984;86:640-641.
- Curtis MJ, Traboulsi M, Knudtson ML, Lester WM. Left main coronary artery dissection during cardiac catheterization. *Can J Cardiol* 1992;8:725-728.
- Gur M, Yilmaz R, Demirbag R, Kunt AS. Large atherosclerotic plaque related severe right coronary artery dissection during coronary angiography. *Int J Cardiovasc Imaging* 2006;22:321-325.
- Carstensen S, Ward MR. Iatrogenic aortocoronary dissection: the case for immediate aortoostial stenting. *Heart Lung Circ* 2008;17:325-329.
- Al-Saif SM, Liu MW, Al-Mubarak N, Agrawal S, Dean LS. Percutaneous treatment of catheter-induced dissection of the left main coronary artery and adjacent aortic wall: a case report. *Catheter Cardiovasc Interv* 2000;49:86-89.
- Kim JY, Yoon J, Jung HS, Yoo BS, Lee SH. Percutaneous coronary stenting in guide-induced aortocoronary dissection: angiographic and CT findings. *Int J Cardiovasc Imaging* 2005;21:375-378.
- Ahmed AA, Mahadevan VS, Webb SW, MacGowan SW. Glue aortoplasty repair of aortic dissection after coronary angioplasty. *Ann Thorac Surg* 2001;72:922-924.
- Sarkis A, Maaliki S, Haddad A, Hatem J, Ghanem G. An unusual complication of coronary angiography: bidirectional dissection of the right coronary artery and the ascending aorta. *Int J Cardiol* 2009;132:e20-22.
- Hunt I, Faircloth ME, Sinha P, Marber MS, Venn GE, Young CP. Aortocoronary dissection complicating angioplasty of chronically occluded right coronary arteries: is a conservative approach the right approach? *J Thorac Cardiovasc Surg* 2006;131:230-231.
- Oda H, Hatada K, Sakai K, Takahasi K, Miida T, Higuma N. Aortocoronary dissection resolved by coronary stenting guided by intracoronary ultrasound. *Circ J* 2004;68:389-391.
- Tanasie C, Chandonnet M, Chin A, Kokis A, Ly H, Perrault LP, Chartrand-Lefebvre C. Catheter-induced aortic dissection after invasive coronary angiography: evaluation with MDCT. *AJR Am J Roentgenol* 2011;197:1335-1340.
- Porto I, Mitchell AR, Selvanayagam JB, Neubauer S, Banning AP. Percutaneous treatment of simultaneous aortic dissection and pericardial tamponate during coronary intervention. *Int J Cardiol* 2005;105:104-107.