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ABSTRACT

INTRODUCTION: Postoperative coronary artery spasm is an infrequent life-threatening event after cardiac surgery which can occur without an underlying coronary disease

PRESENTATION OF CASE: We report a documented case of a 67-year-old man with normal coronary arteries submitted to mitral valve replacement. Immediately after surgery he had a ST elevation in the inferior leads, and an inferior wall hypokinesia at the trans-oesophageal echo. A coronary angiography demonstrated a focal spasm in the right coronary artery which was successfully treated by intracoronary injection of nitrates. The following postoperative course was uneventful and the left ventricular function returned to normal.

DISCUSSION: A coronary artery spasm should be suspected whenever a postoperative infarction occurs after valvular surgery especially in absence of associated coronary artery disease. In this cases postoperative coronary angiography allows both the diagnosis and the treatment.

CONCLUSION: This case-report summarizes the findings of this rare and potentially life-threatening cause of early postoperative ischemia and highlights the role of early coronary angiography in the cases of suspected myocardial infarction after cardiac surgery

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1. Background

Coronary artery spasm (POCAS) is a rare cause of postoperative ischemia [1]. The underlying mechanisms of spasm remain unclear, although an endothelial dysfunction seems to play a major role [2]. All cardiac surgical procedures are associated with an imbalance of the homeostasis that may promote POCAS, especially in association with coronary artery disease. Occasionally the spasm occurs in patients with valve disease as in our patient who was submitted to a mitral valve replacement and had apparently normal coronary arteries.

2. Case description

A 67-year-old man was admitted to hospital for the surgical treatment of a severe rheumatic mitral regurgitation. Preoperative coronary angiogram was unremarkable (Fig. 1A) The right coronary

artery was dominant giving origin to large posterior descending and posterolateral arteries. In the left coronary system a single obtuse marginal originated from the circumflex artery which was of small caliber and exited the atrioventricular groove thereafter. The operation was carried through full median sternotomy and aortobicaaval cardiopulmonary bypass. The mitral valve was exposed through a vertical transeptal bilateral atriotomy and replaced with a bileaflets mechanical prosthesis. The operative course was uneventful and the patient was transferred to the intensive care unit (ICU) on normal sinus rhythm and good cardiac function without inotropic support. Upon arrival in the ICU, a marked ST elevation became evident in inferior leads, while hemodynamic conditions remained stable. A transthoracic echocardiogram revealed hypokinetic inferior wall. A coronary angiogram was performed: a focal, subocclusive spasm was evident in the middle to distal segment of the right coronary artery (Fig. 1B Video 1). An intracoronary injection of nitrates resulted in a prompt resolution of the spasm (Fig. 1C Video 2) and of the electrocardiographic changes. Continuous intravenous infusion of nitroglycerin (4 mg/h) and oral administration of diltiazem 60 mg twice a day were started. On postoperative day 2, intravenous nitroglycerin was changed to transdermal patch (10 mg/day). Subsequent postoperative course was uneventful and the patient was discharged in good clinical conditions on postoperative day 7. Transthoracic echocardiogram on discharge showed no abnormalities of regional kinesis.

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Table 1
Review of articles reporting coronary artery spasm following cardiac surgery. (References in the additional on-line material).

Author	Ref.	No. of patients	Type of operation	Time of onset	Clinical manifestation	ECG changes	Angiographic localization of spasm	Treatment	Outcome
Patients operated for coronary artery disease									
Buxton et al., 1981	[12]	6	CABG	<2 h	Collapse	STE, inferior	RCA	ICN, IVN	3 survived, 3 died
Zeff et al., 1982	[13]	1	CABG	periop	Haemodynamic instability	Na	RCA	ICN	Survived
Zingone et al., 1983	[14]	1	CABG	5 h	Angina	STD, V2-V6	Diffuse	ICN	Survived
Donatelli et al., 1993 ^a	[15]	1	CABG	6 h	Haemodynamic instability	Na	RCA	ICN, IVN, IVCCB	Survived
Caputo et al., 1999	[16]	1	CABG	2 h	Collapse	STD, V1-V6	LAD	ICN	Survived
Trimboli et al., 2003	[17]	1	OPCAB	1 h	Collapse, VF	STE, diffuse	RCA	ICN	Survived
Inokuchi et al., 2004	[18]	3	CABG	Na	Haemodynamic instability	Na	diverse	IVN, IVCCB, fasudil	Survived
Fukui et al., 2005	[19]	1	OPCAB	Na	Haemodynamic instability	Na	Diffuse	ICN, IABP	Survived
Döpfmer et al., 2005	[20]	1	CABG	2 h	VF	STE, lateral	Diffuse, Graft	IVN, LVAD	Survived
Kaku et al., 2007	[21]	1	CABG	20'	Collapse, VT	STE, inferior; AVB	RCA	ICN, CAS	Survived
Guo et al., 2008	[22]	2	CABG	4 h	Angina	ST modifications	LAD, RCA diffuse	ICN, ICCCB	Survived
Carneiro et al., 2010	[23]	1	OPCAB	24 h	Collapse, VF	STE, V2-V5	Diffuse	ICN, IABP	Survived
Ju et al., 2011	[24]	1	OPCAB	<1 h	Collapse	STE, diffuse	Diffuse	ECMO	Survived
Hosoba et al., 2012	[25]	1	CABG	15 h	Collapse	STE, inferior	Diffuse	ICN, IVCCB, IABP	Survived
Patients operated for other cardiac conditions									
Tsuchida et al., 1993	[26]	1	AVR	4 h	Collapse	STE, V4-V6	Diffuse	ICN	Survived
Kanno et al., 1994 ^b	[27]	1	MVR	2 h	Collapse	STE, inferior	RCA	IVCCB	Survived
Kimura et al., 2006 ^b	[28]	7	Diverse	Intraop to 24 h	Collapse	NA	Diffuse, Grafts	IVN + MCS	6 survived, 1 died
Pinho et al., 2007	[29]	1	AVR	1 h	Collapse, VF	STE, inferior	RCA	ICN	Survived
Pragliola et al., 2007	[30]	1	AVR	1 h	Collapse, VF	STD, inferior	Diffuse	ICN	Survived
Sekine et al., 2007 ^b	[31]	1	Bentall	5 h	Collapse	STE, diffuse	Diffuse left coronary	IABP, ECMO	Died
Guo et al., 2008	[28]	1	Bentall	3 h	Silent	STE, V2-V6	Diffuse spasm of LAD	IVN, IVCCB	Survived
Casquero et al., 2009	[32]	1	MVR, TVR		Haemodynamic instability	Na	Diffuse	ICN	Survived
Antevil et al., 2010	[10]	1	MVR	28 h	Collapse, angina	Na	LAD, RCA	ICN	Survived
Anselmi et al., 2013 ^c	[33]	1	TVR	intraop	CPB unweanable	STE, diffuse	Diffuse	ICN, ECMO	Dead
Cases without angiographic confirmation of spasm (spasm suspected by combination of ECG alterations, clinical scenario, ex-adiuvantibus criteria)									
Ginsburg et al., 1981	[34]	1	CABG	intraop	CPB unweanable	STE, inferior	Na	Support therapy	Survived
Shafei and Bennett, 1990	[35]	1	MVR	Intraop	CPB unweanable	Na	Na	IVN	Survived
Yokoyama et al., 1990 ^b	[36]	2	ASDC, SM	<24 h	Refractory VF	Na	Na	IVN, IABP	Survived
Seki et al., 1991 ^b	[37]	1	AVR	Periop to 7 day	Haemodynamic instability	STE	Na	IVN, IVCCB	Survived
Kinoshita et al., 1991	[38]	5	diverse	Periop	Collapse, VT	STE	Na	IVN, IVCCB	Survived
Urrea Ramos et al., 1994	[39]	1	CABG	Intraop	CPB unweanable	Na	Na	IVCCB	Survived
Minato et al., 1995 ^b	[40]	1	Bentall	Periop	VT, acute MR	Na	Na	IVN, IVCCB	Survived
Lin et al., 2007 ^b	[41]	3	OPCAB	Na	Collapse	Na	Na	ICN, IABP, ECMO	Survived
Sawaki et al., 2010 ^b	[42]	1	AVR	Periop	Collapse, VT	Na	Na	IVN, IVCCB, MCS	Survived

ASDC, atrial septal defect closure; AVB, atrioventricular block; AVR, aortic valve replacement; CAS, coronary artery stenting; CABG, coronary artery bypass grafting; CPB, cardiopulmonary bypass; ECMO, extracorporeal membrane oxygenation; IABP, intraaortic balloon counterpulsation; ICCCB, intracoronary calcium channel blockers; ICN, intracoronary nitrates; IVCCB, intravenous calcium channel blockers; IVN, intravenous nitrates; LAD, left anterior descending; MR, mitral regurgitation; MVR, mitral valve replacement; Na, not available; OPCAB, off-pump coronary artery bypass; RCA, right coronary artery; SM, septal myectomy; STD, ST depression; STE, ST elevation; TVR, tricuspid valve repair; VF, ventricular fibrillation; VT, ventricular tachycardia.

^a Article in Italian.

^b Article in Japanese.

^c Patient affected by carcinoid syndrome.

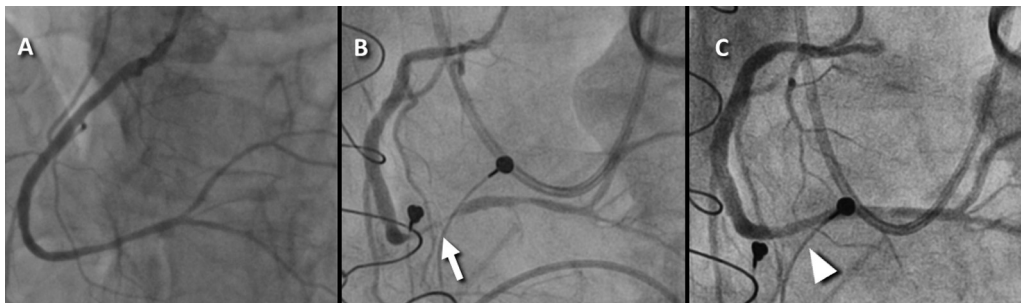


Fig. 1. Preoperative and postoperative angiographic evaluation. (A) Preoperative angiogram of the right coronary artery; (B) postoperative angiogram showing the focal spasm in the mid-distal portion (arrow); (C) complete resolution of the spasm following intracoronary nitroglycerin infusion (arrowhead).

3. Discussion

Perioperative myocardial infarction is the first cause of early and long-term mortality after cardiac surgery [3]. Although the most common cause of postoperative ischemia after mitral valve surgery is a iatrogenic lesion to the circumflex artery [4], a coronary spasm [5] should always be considered among the possible causes of postoperative ischemia. It can be spontaneous or induced by surgical manipulation or pharmacological agents. It may also occur with or without an underlying atheromatous coronary disease: intense oxidative stress, inflammation and changes in vascular reactivity all lead to an increased propensity to spasm [6]. There are also diseases that predispose to coronary spasm, like the carcinoid syndrome [7].

Since 2006 [8] we have adopted a policy of immediate postoperative coronary angiography in cases of hemodynamic instability or dubious ECG interpretation. This allows a prompt diagnosis as well as in most cases the treatment of any possible spontaneous or iatrogenic condition [9]. However, in the last five years we could not observe any case of POCAS. The present one prompted us to accurately search the literature (Table 1).

The most common presentation of POCAS is upon arrival in the ICU up to 6 h after surgery. Usually it causes hemodynamic instability associated with ventricular arrhythmias and fibrillation. In some cases an extracorporeal membrane oxygenation (ECMO) support may be required to sustain the circulation and gain time to establish the diagnosis. When the spasm is limited to right coronary artery the electrocardiographic alterations are those of an inferior infarction, but ST changes can be subtle and difficult to interpret when the spasm is diffuse. The true incidence of POCAS is largely unknown. In the English literature, we could find 32 reports, including 7 small series, for a total number of 54 patients. In 9 of the reports a coronary angiography was not performed and the spasm was suspected as a result of the clinical presentation.

Some cases were considered intra-operative spasms, a condition that it is extremely difficult to ascertain. A recent case of intra-operative spasm occurred after the repair of a functional mitral regurgitation and was successfully detected and treated in a hybrid operating room by Antevil et al. [10].

POCAS is not a benign event. The mortality in the 54 cases collected from the literature was 11% and its incidence can be underestimated by its apparent rarity and difficult diagnosis. On the other hand, once angiographically documented, the treatment of POCAS is usually rapidly effective. The direct intracoronary injection of nitrates or calcium channel blockers promptly resolves the spasm. Devices to mechanically support the circulation (Intraortic balloon pump; the ECMO or even a ventricular assist device) were used in 10 cases.

Despite the high early mortality the long-term prognosis of the patients successfully treated for POCAS is good. Buxton et al. performed an angiographic control at 3 and 12 months [11] in five of the six patients who developed a POCAS in his series. Direct

intracoronary injection of ergonovine provoked a focal spasm in the right coronary artery in only in one case. It was concluded that the spasm does not recur after surgery, although some patients may have a predisposition to its development.

In conclusion, coronary artery spasm is an infrequent cause of ischemia after surgery. Postoperative ischemia should prompt a coronary angiography to rule out the spasm and allow immediate therapy.

References

- [1] A. Maseri, S. Chierchia, Coronary artery spasm: demonstration, definition, diagnosis, and consequences, *Prog. Cardiovasc. Dis.* 25 (1982) 169–192.
- [2] J. Brouzet, T. Mainar, V. Bordes, P. Ruiz-Nodar, J.M. Pineda, Severe spontaneous three-vessel coronary artery spasm, *Valencia J. Int. J. Cardiol.* 112 (2006) e53–e55.
- [3] K.D. Larsen, I.S. Rubinfeld, Changing risk of perioperative myocardial infarction, *Perm J.* 16 (Fall) (2012) 4–9.
- [4] E. Kilian, A. Beiras, A. Fernandez, B. Reichart, P. Lamm, Intraoperative assessment of circumflex occlusion during mitral valve operation, *Ann. Thorac. Surg.* (2011) 2271.
- [5] K. Thygesen, J.S. Alpert, A.S. Jaffe, M.L. Simoons, B.R. Chaitman, H.D. White, Joint ESC/ACCF/AHA/WHF task force for universal definition of myocardial infarction, *J. Am. Coll. Cardiol.* 60 (October (16)) (2012) 1581–1598.
- [6] M.M. Ruel, T.A. Khan, P. Voisine, C. Bianchi, F.W. Sellke, Vasomotor dysfunction after cardiac surgery, *Eur. J. Cardiothorac. Surg.* 26 (2004) 1002–1014.
- [7] S. Bhattacharyya, S. Raja, C. Toumpakis, M.E. Caplin, G.D. Dreyfus, J. Davar, Outcomes, risks and complication of cardiac surgery for carcinoid heart disease, *Eur. J. Cardiothorac. Surg.* 40 (2011) 168–172.
- [8] D. Gilmanov, T. Gasbarri, M. Ravani, M. Glauber, Circumflex artery percutaneous revascularization after minimally invasive double annuloplasty and left atrium ablation, *J. Heart Valve Dis.* 70 (6) (2012) 646–647.
- [9] C. Pragliola, L. Altamura, G. Niccoli, M. Siviglia, S. DePaulis, G.F. Possati, Postoperative coronary artery spasm complicating aortic valve replacement: implications for identification and treatment, *Ann. Thorac. Surg.* 83 (2007) 670–672.
- [10] J.L. Antevil, A.L. Karavas, J.H. Selby, J.G. Byrne, Use of a hybrid operating room to diagnose and treat delayed coronary spasm after mitral valve repair, *J. Thorac. Cardiovasc. Surg.* 140 (2010) e25–e27.
- [11] A.E. Buxton, J.W. Hirshfeld Jr, W.J. Untereker, S. Goldberg, A.H. Harken, L.W. Stephenson, R.N. Edie, Perioperative coronary arterial spasm: long-term follow-up, *Am. J. Cardiol.* 50 (September) (1982) 444–451.
- [12] A.E. Buxton, S. Goldberg, A. Harken, J. Hirshfeld Jr, J.A. Kastor, Coronary-artery spasm immediately after myocardial revascularization: recognition and management, *N. Engl. J. Med.* 304 (21) (1981) 1249–1253.
- [13] R.H. Zeff, L.A. Iannone, C. Kongtahnorn, T.M. Brown, D.F. Gordon, M. Benson, S.J. Phillips, R.E. Alley, Coronary artery spasm following coronary artery revascularization, *Ann. Thorac. Surg.* 34 (1982) 196–200.
- [14] B. Zingone, A. Salvi, B. Branchini, Perioperative coronary artery spasm leading to myocardial ischaemia after vein graft surgery, *Br. Heart J.* 49 (March) (1983) 280–283.
- [15] F. Donatelli, M.A. Mariani, M. Pocar, M. Triggiani, S. Pelenghi, A. Grossi, Intraoperative coronary artery spasm successfully treated with nitroglycerin and nifedipine, *Ann. Thorac. Surg.* 36 (1983) 97–100.
- [16] M. Caputo, F. Nicolini, G. Franciosi, R. Gallotti, Coronary artery spasm after coronary artery bypass grafting, *Eur. J. Cardiothorac. Surg.* 15 (4) (1999) 545–548.
- [17] S. Trimboli, G. Oppido, F. Santini, A. Mazzucco, Coronary artery spasm after off-pump coronary artery by-pass grafting, *Eur. J. Cardiothorac. Surg.* 24 (5) (2003) 830–833.
- [18] K. Inokuchi, A. Ito, Y. Fukumoto, T. Matoba, A. Shiose, T. Nishida, M. Masuda, S. Morita, H. Shimokawa, Usefulness of fasudil, a Rho-kinase inhibitor, to treat

- intractable severe coronary spasm after coronary artery bypass surgery, *Cardiovasc. Pharmacol.* 44 (3) (2004) 275–277.
- [19] T. Fukui, S. Takanashi, Y. Hosoda, Coronary artery and graft spasm after off-pump coronary artery bypass grafting, *Jpn. J. Thorac. Cardiovasc. Surg.* 53 (2005) 109–113.
- [20] U.R. Döpfmer, J.P. Braun, J. Grosse, W. Konertz, Temporary left ventricular assist and levosimendan for coronary artery spasm, *Interact. Cardiovasc. Thorac. Surg.* 4 (2005) 316–318.
- [21] B. Kaku, M. Ikeda, H. Kato, S. Takabatake, T. Hayashi, T. Taguchi, Y. Niita, Y. Hiraiwa, S. Aoki, Coronary artery multistenting in the treatment of life-threatening refractory coronary spasm after coronary artery bypass grafting, *Int. Heart J.* 48 (2007) 379–385.
- [22] L.R. Guo, M.L. Myers, E.L. Kuntz, Coronary artery spasm: a rare but important cause of postoperative myocardial infarction, *Ann. Thorac. Surg.* 86 (2008) 994–995.
- [23] J.D. Carneiro Neto, J.A. Lima Neto, R.M. Simões, N.A. Stolf, Coronary-artery spasm after coronary artery bypass graft surgery without extracorporeal circulation: diagnostic and management, *Rev. Bras. Cir. Cardiovasc.* 25 (2010) 410–414.
- [24] M.H. Ju, J.B. Kim, H.J. Kim, S.J. Choo, Refractory coronary artery spasm after minimally invasive direct coronary artery bypass grafting, *Korean J. Thorac. Cardiovasc. Surg.* 44 (2011) 288–291.
- [25] S. Hosoba, T. Suzuki, N. Takashima, T. Kinoshita, S. Kuryanagi, H. Nota, T. Asai, Successful management of refractory lethal coronary spasm after off-pump coronary bypass grafting, *Ann. Thorac. Cardiovasc. Surg.* 20 (18) (2012) 359–362.
- [26] K. Tsuchida, T. Takemura, M. Kijima, S. Matsumoto, Coronary artery spasm after aortic valve replacement, *Ann. Thorac. Surg.* 56 (1993) 170–173.
- [27] M. Kanno, H. Kurihara, H. Satoh, M. Hamawaki, M. Honda, Coronary artery spasm after mitral valve replacement: a case report, *Kyobu Geka* 47 (1994) 315–318.
- [28] N. Kimura, K. Kawahito, K. Adachi, H. Murata, A. Yamaguchi, H. Adachi, T. Ino, Effects of intra-coronary and intra-graft administration of nicorandil for coronary spasm after coronary artery bypass grafting, *Kyobu Geka* 59 (2006) 71–77.
- [29] T. Pinho, J. Almeida, M. Garcia, P. Pinho, Coronary artery spasm following aortic valve replacement, *Interact. Cardiovasc. Thorac. Surg.* 6 (2007) 387–388.
- [30] C. Pragliola, L. Altamura, G. Niccoli, M. Siviglia, S. De Paulis, G.F. Possati, Postoperative coronary artery spasm complicating aortic valve replacement: implications for identification and treatment, *Ann. Thorac. Surg.* 83 (2007) 670–672.
- [31] Y. Sekine, M. Kitano, T. Akimoto, K. Matsuda, Perioperative coronary spasm in the modified Bentall's operation for localized dissecting aneurysm of aortic sinuses, *Kyobu Geka* 60 (2007) 794–799.
- [32] E. Casquero, D. Durán, V. Asorey, R. Casais, Coronary artery spasm after mitral and tricuspid annuloplasty, *Eur. J. Cardiothorac. Surg.* 36 (2009) 191.
- [33] A. Anselmi, H. Corbineau, D. Boulmier, V.G. Ruggieri, Early diffuse coronary artery spasm after heart valve surgery in the carcinoid syndrome, *J. Card. Surg.* 28 (2013) 402–403.
- [34] R. Ginsburg, E.B. Stinson, M.R. Bristow, J.S. Schroeder, Coronary-artery spasm after revascularization, *N. Engl. J. Med.* 305 (1981) 699.
- [35] H. Shafei, J.G. Bennett, Coronary artery spasm during mitral valve replacement, *Eur. J. Cardiothorac. Surg.* 4 (1990) 398–400.
- [36] M. Yokoyama, T. Yamada, H. Nakahara, N. Oshima, S. Tanabe, Y. Irie, H. Sano, Two cases of perioperative coronary vasospasm following ASD closure and OMC, *Kyobu Geka* 43 (1990) 891–894.
- [37] K. Seki, R. Kuribayashi, T. Sakurada, S. Sekine, H. Aida, T. Abe, T. Syu, K. Tsuchida, Coronary artery spasm after aortic valve replacement: a case report, *Kyobu Geka* 44 (1991) 176–179.
- [38] K. Kinoshita, K. Matsuzaki, H. Mayumi, T. Asou, M. Masuda, Y. Kawachi, K. Tokunaga, A new aspect of coronary artery spasm induced by cardiac surgery, *Jpn. J. Surg.* 21 (1991) 395–401.
- [39] M.S. Urrea Ramos, S. Celaya Lara, J.A. Santibáñez Salgado, V. Lozano Torres, V. Herrera Alarcón, S. Estrada Dávalos, F. Rucínque Acevedo, V. Araya Gómez, Intraoperative circulatory collapse due to a coronary spasm following successful coronary revascularization, *Arch. Inst. Cardiol. Mex.* 64 (1994) 67–72.
- [40] N. Minato, T. Itoh, M. Natsuaki, K. Furukawa, K. Rikitake, H. Yamamoto, Perioperative coronary artery spasm in modified Bentall's operation for annulo-aortic ectasia in Marfan's syndrome. A case report of perioperative chordal rupture of the mitral valve, *J. Cardiovasc. Surg. (Torino)* 36 (1995) 153–157.
- [41] C.Y. Lin, Z.C. Weng, S.H. Loh, G.J. Hong, C.S. Tsai, Coronary artery spasm after off-pump coronary artery bypass grafting, *ANZ J. Surg.* 77 (2007) 126–129.
- [42] S. Sawaki, A. Matsuura, H. Ito, S. Saito, H. Takemura, K. Miyahara, S. Ashida, S. Mori, A. Takanohashi, K. Yagami, M. Usui, Y. Hirate, Severe coronary artery spasm immediately after aortic valve replacement, *Kyobu Geka* 63 (2010) 102–105.

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