

Treatment of radial artery graft spasm after coronary artery bypass grafting

Arunas Valaika¹, Gintaras Kalinauskas¹, Loreta Ivaskeviciene¹, Robertas Samalavicius², Irena Butkuvieni¹, Gediminas Norkunas¹, Giedrius Uzdavinys¹

¹Heart Surgery Centre, Vilnius University, Lithuania

²Centre of Anesthesiology, Intensive Therapy and Pain Management, Vilnius University



Kardiologia i Torakochirurgia Polska 2011; 8 (3): 336–339

Abstract

Spasm of radial artery (RA) used as a conduit for CABG (coronary artery bypass graft) surgery is a rare phenomenon. Our experience with surgical treatment of RA spasm is reported. The patient with triple vessels disease was scheduled for elective CABG surgery. Both radial and mammary arteries were used to create four distal anastomoses. Seven hours after the patient was admitted to intensive care unit his condition started to deteriorate, severe ischemia and low cardiac output syndrome developed. Resternotomy was performed and intraortic balloon was inserted through the ascending aorta (patient had severe peripheral artery disease). During reexploration both RA's conduits were found spastic. Nitroglycerin and papaverin solutions were injected into the adjacent tissues of radial arteries. Following this treatment RA became dilated, ST segment on ECG came to normal. RA spasm can occur in rare cases despite prophylactic antispastic measures. However, early diagnosis and initiation of appropriate treatment might have an impact on outcome in this life-threatening situation.

Key words: radial artery, coronary artery bypass surgery.

Streszczenie

Skurcz tętnicy promieniowej (ang. *radial artery* – RA) użytej do wykonania pomostu w zabiegu pomostowania aortalno-wieńcowego (ang. *coronary artery bypass graft* – CABG) jest rzadkim zjawiskiem. W pracy autorzy przedstawiają własne doświadczenia w chirurgicznym leczeniu skurczu tętnicy promieniowej. Pacjent z trójnaczyniową chorobą wieńcową został zakwalifikowany do planowanego zabiegu CABG. Zarówno tętnica promieniowa, jak i piersiowa zostały wykorzystane do utworzenia czterech zespoleń dystalnych. Siedem godzin po przyjęciu pacjenta na oddział intensywnej terapii jego stan uległ pogorszeniu, wystąpiło ciężkie niedokrwienie oraz zespół małego rzutu serca. Wykonano resternotomię oraz wprowadzono balon wewnątrzaoortalny do aorty wstępującej (pacjent cierpił na ciężką chorobę tętnic obwodowych). W trakcie reeksploracji zaobserwowano skurcz obydwu pomostów tętnicy promieniowej. Do przyległych tkanek tętnic promieniowych wstrzyknięto roztwór nitrogliceryny i papaweryny, w następstwie czego tętnica promieniowa poszerzyła się, a odcinek ST w elektrokardiogramie się unormował. W rzadkich przypadkach skurcz tętnicy promieniowej może wystąpić pomimo zastosowania profilaktycznych środków antyastycznych. Jednakże wczesna diagnoza i rozpoczęcie właściwego leczenia mogą wpłynąć na wynik tej zagrażającej życiu sytuacji.

Słowa kluczowe: tętnica promieniowa, zabieg pomostowania aortalno-wieńcowego.

Introduction

A. Carpentier was the first to use radial artery (RA) as a conduit for myocardial revascularization for coronary artery bypass grafting procedures (CABG) in 1972. However, short and long term outcomes were unsatisfactory, and it's use in cardiac surgery was abandoned. A few decades later, in 1989, a new harvesting technique and antispastic treatment was introduced and use of radial artery as a conduit was indicated [1]. Clinical studies showed that

long term outcomes were worse comparing it's use with internal mammary artery [2], but superior comparing with the vein grafts [3]. Predisposition for spasm, which usually occurs in early postoperative period, is the main limitation for extensive use of RA in cardiac surgery. Various drugs have been used to prevent the spasm, unfortunately this treatment is not always successful. Our aim is to present the case of successful treatment of severe spasm of radial artery used as a conduit for myocardial revascularization.

Address for correspondence: Arunas Valaika, Centre of Cardiac Surgery, Vilnius University Hospital Santariskiu Clinics, Santariskiu str. 2, LT-08661 Vilnius, Lithuania, Tel. +370 523 652 40, Fax +370 523 652 38, E-mail: arunas.valaika@santa.lt

Case report

A 70-year-old male patient was admitted to our hospital with unstable angina. He had elevated blood pressure for many years and mild angina for one year. He underwent his first myocardial infarction (MI) (+Q, posterior-inferior) two months ago. Emergency percutaneous cardiac intervention was performed six hours after the onset of MI. Occlusion of right coronary artery and 75% stenosis of left anterior descendents and circumflex coronary arteries was found. Occluded right coronary artery (RCA) was reopened and dilated, with residual 30% stenosis (Fig. 1). Patient remained within class III of angina after the procedure (CCS angina classification). He had severe peripheral artery disease and thrombosis of deep veins in both legs. Echocardiographic evaluation: left ventricle end diastolic diameter (LVEDD) – 56 mm, left ventricle ejection fraction (LVEF) – 45%, hypokinesis of inferior wall of left ventricle, interventricular wall thickness – 13 mm, mild regurgitation through the mitral valve and diastolic dysfunction of left ventricle. Chest X-ray revealed no pathological changes. Laboratory data: cholesterol – 5.84 mmol/l, low density lipoprotein – 2.56 mmol/l, high density lipoprotein – 1.07 mmol/l, triglycerides – 3.6 mmol/l, serum creatinin – 106 μ mol/l, blood sugar – 5.2 mmol/l, potassium – 4.5 mmol/l. Patient was hemodynamically stable. Operative risk evaluation using Euroscore system – 7 points.

Patient was scheduled for elective CABG surgery. He had no saphenous veins which could be used as a conduit for myocardial revascularization because of deep vein thrombosis. Arterial revascularization using internal mammary artery and both radial arteries was planned. The clinical Allen test was normal in both hands. Arterial line for direct arterial pressure monitoring was placed in the left femoral artery. Surgery was performed in a standard way starting with right radial artery harvesting. Artery was good, 3.5-4 mm in diameter, without atherosclerotic lesions, however, during harvesting showed predisposition for spasm. Surgery continued with sternotomy and internal mammary artery harvesting. During the same time radial artery was withdrawn from the left hand. This artery was narrower than harvested from the right hand, about 3 mm. in diameter. After fasciotomy both arteries were placed in blood and papaverin solution. Revascularization was performed in a standard way, using cardiopulmonary bypass. Tepid blood cardioplegia was used for myocardial protection, delivered through aortic root and retrogradely through coronary sinus. Four grafts were performed during surgery. Left radial artery was used as a graft to right coronary artery, which was 1.5 mm in diameter. Right radial artery was sequentially sutured to marginal (2.5 mm in diameter) and diagonal (1.5 mm in diameter) branches. Internal mammary artery was used for revascularization of left anterior descendents (LAD) artery, which was 2 mm in diameter. Proximal ends of radial artery grafts were sutured to the aorta. Cardiopulmonary bypass time was 105 minutes, aortic cross clamp time – 68 minutes. Following surgery patient was transferred to intensive care unit. He had no pathological changes on the ECG. Infusion of

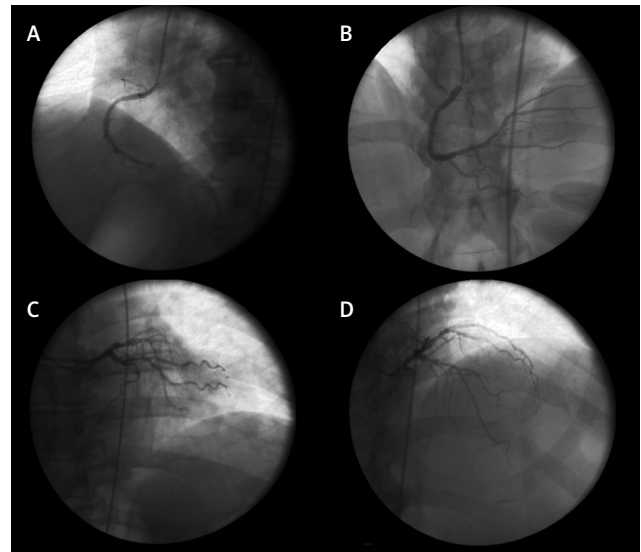


Fig. 1A–D. A – RCA occlusion, B – RCA after PCTA, C – OM stenosis, D – LAD stenosis

0.04 μ g/kg/min of epinephrine was needed for haemodynamic stability. After seven hours the patient condition began to deteriorate. Signs of ischemia appeared on the ECG, dose of epinephrine increased up to 0.2 μ g/kg/min, blood lactate – up to 16 mmol/l. Chest X-ray examination revealed no pathological findings. The decision was made to start treatment with intraaortic balloon counterpulsation. Resternotomy was performed for balloon insertion through the ascending aorta because femoral arteries could not be used due to severe vascular disease. During resternotomy both radial artery grafts were found very narrow without pulsatility. Papaverin was injected into the radial arteries and surrounding tissue. Gauze swabs irrigated with papaverin and nitroglycerine solution were applied to both arteries for 10-15 minutes, while IABP was inserted. After removal of gauze swabs both radial grafts were enlarged in diameter, pulsatile movements were noted. Patient's condition started to improve, changes in ECG returned to normal (Fig. 2), epinephrine dose decreased. Troponin I increased to 11 ng/ml 24 hours after surgery. At the same time cardiac echoscope evaluation showed left ventricle ejection fraction of 45% and akinesis of the inferior wall of the left ventricle. IABP was removed after 8 days of treatment. There were no episodes of angina. Twenty days following surgery patient was successfully discharged from the hospital with normal left ventricle function and no changes on the ECG. Plendil was prescribed for prophylaxis of the spasm and blood pressure control. The patient was in good condition at the 12 months follow up after surgery. His left ventricle ejection fraction was 50% and performed normally on the stress test examination.

Discussion

Six hundred fifty seven CABG procedures using radial artery as a conduit for myocardial revascularization were performed in our clinic from April 1997 to December 2009. It

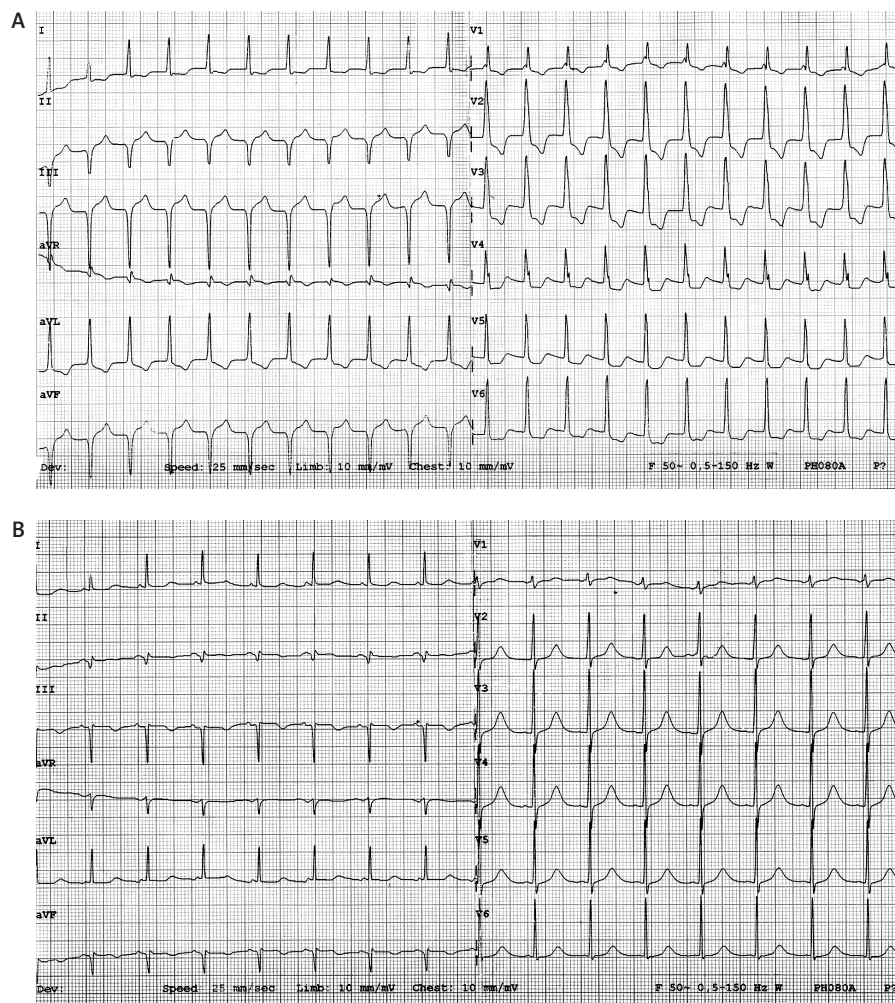


Fig. 2A–B. A – ischemia on ECG, 7 hours following surgery, B – ECG after treatment with papaverin-nitroglycerin solution

was the first case when we diagnosed low output syndrome due to RA graft spasm. Radial artery spasm may be stimulated by its anatomical peculiarity, harvesting technique, use of vasoactive substances, hypothermia or bioactive peptides found in circulation during surgery or shortly after it. Radial artery is usually withdrawn with surrounding tissue and concomitant veins. Sometimes diffuse narrowing of the radial artery graft and enlarged concomitant veins were seen in the beginning of our experience to use radial artery as a conduit for myocardial revascularization. The technique of radial artery harvesting was changed in our institution in the year 2000. Since then we started to divide neurovascular fascia from one side of harvested RA (semi-skeletonisation). We are of the opinion that after implementation of this procedure reactivity of radial artery significantly decreased. The similar phenomenon was described by Hirose [4] who used skeletonised radial artery grafts for revascularization. Systemic vasodilators, used for spasm prophylaxis were insufficiently efficient due to their adverse effect of higher doses trying to achieve this goal. The efficient concentration can be achieved while used locally. However, no one of drugs which are on the market can absolutely protect

radial artery from all the factors that can predispose artery spasm. Verapamil-nitroglycerin solution protects from the majority of potent vasoconstrictors, however, the effect does not last long [5]. Fenoxibenzamin is effective against spasm caused by adrenergic drugs, but is not protective from other vasoconstrictors [6]. Gaudino *et al.* [7] showed that prophylactic use of oral calcium channel blockers had no impact on rate of late spasm and patient outcomes. It was found that predisposition for spasm is increased in case of competitive flow through native coronary artery [8]. Because of that radial artery should be used for grafting of severely diseased (80-100% stenosis) coronary arteries. Early percutaneous coronary investigation is indicated of the postoperative CABG patient when radial arteries are used as a conduit for revascularization in cases of ischemia on ECG and hemodynamic instability. This would allow to diagnose radial graft dysfunction promptly and initiate appropriate treatment with intracoronary or systemic vasodilators. Radial artery spasm that do not respond to intraluminal vasodilators and cause haemodynamic instability must be treated surgically by additional graft [9]. In our case possibilities to perform angiography were limited

by peripheral artery disease and local medical treatment following re sternotomy was successful. Radial artery is a muscle type artery and has much bigger muscular layer than internal mammary artery. This determines it's faster and greater reaction to various stimulus. It was found that endothelium of internal mammary artery, as well as radial artery produce vazoreactive substances that adjust optimal blood flow through the artery [10]. We think that atraumatic radial artery harvesting technique, which allows leaving the endothelium intact and partial sceletonisation are the uppermost factors protecting against radial artery spasm.

References

1. Acar C, Jebara VA, Portoghese M, Beyssen B, Pagny JY, Grare P, Chachques JC, Fabiani JN, Deloche A, Guermonprez JL. Revival of the radial artery for coronary artery bypass grafting. *Ann Thorac Surg* 1992; 54: 652-659.
2. Possati G, Gaudino M, Prati F, Alessandrini F, Trani C, Glieca F, Mazzari MA, Luciani N, Schiavoni G. Long-term results of the radial artery used for myocardial revascularization. *Circulation* 2003; 108: 1350-1354.
3. Desai ND, Cohen EA, Naylor CD, Femes SE; Radial Artery Patency Study Investigators. A randomized comparison of radial-artery and saphenous-vein coronary bypass grafts. *N Engl J Med* 2004; 351: 2302-2309.
4. Hirose H, Amano A, Takahashi A, Takanashi S. Skeletonization of the radial artery with the ultrasonic scalpel: clinical and angiographic results. *Heart Surg Forum* 2003; 6: E42-E47.
5. He GW, Yang CQ. Use of verapamil and nitroglycerin solution in preparation of radial artery for coronary grafting. *Ann Thorac Surg* 1996; 61: 610-614.
6. Mussa S, Guzik TJ, Black E, Dipp MA, Channon KM, Taggart DP. Comparative efficacies and durations of action of phenoxybenzamine, verapamil/nitroglycerin solution, and papaverine as topical antispasmodics for radial artery coronary bypass grafting. *J Thorac Cardiovasc Surg* 2003; 126: 1798-1805.
7. Gaudino M, Glieca F, Luciani N, Alessandrini F, Possati G. Clinical and angiographic effects of chronic calcium channel blocker therapy continued beyond first postoperative year in patients with radial artery grafts: results of a prospective randomized investigation. *Circulation* 2001; 104 (12 Suppl 1): I64-I67.
8. Maniar HS, Sundt TM, Barner HB, Prasad SM, Peterson L, Absi T, Moustakidis P. Effect of target stenosis and location on radial artery graft patency. *J Thorac Cardiovasc Surg* 2002; 123: 45-52.
9. Mansuroglu D, Omeroglu SN, Daglar B, Ipek G. Surgical treatment for late postoperative radial artery graft spasm. *Interact Cardiovasc Thorac Surg* 2003; 2: 653-656.
10. He GW, Yang CQ. Radial artery has higher receptor-mediated contractility but similar endothelial function compared with mammary artery. *Ann Thorac Surg* 1997; 63: 1346-1352.