

Transcatheter Embolization of a Coronary Fistula Originating from the Left Anterior Descending Artery by Using N-Butyl 2-Cyanoacrylate

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Abstract

In this report, we describe a successful percutaneous transcatheter n-butyl 2-cyanoacrylate embolization of a coronary fistula originating from the left anterior descending artery in an adolescent with unexpected recurrent attacks of myocardial ischemia.

Key words: Transcatheter—Coronary fistula—Embolization

Isolated coronary artery fistulas are rare congenital anomalies (1). They may represent a broad clinical picture from asymptomatic to hemodynamically significant clinical course. Elective closure has been recommended even in asymptomatic patients after reports that patients with coronary artery fistula may develop complications including myocardial ischemia, congestive heart failure, aneurysmal dilation and endocarditis during or after the second decade of life (1–4). In this report, we describe a successful percutaneous transcatheter n-butyl 2-cyanoacrylate embolization of a coronary fistula originating from the left anterior descending artery in an adolescent with unexpected and transient attacks of myocardial ischemia.

Case Report

A 17-year-old boy with a history of unexpected recurrent transient myocardial ischemia attacks was diagnosed as having a coronary fistula. He had been referred by another center for further evaluation and transcatheter closure of the coronary fistula. During these previous episodes, we had learned from the hospital records that the patient had been admitted to that same hospital twice during a 3-year period complaining of severe chest pain. Electrocardiographic evaluation and serum Troponin I analysis revealed evidence of myocardial ischemia. Echocardiographic study was found to be normal, and selective coronary angiography showed a coronary artery fistula originating from the left anterior descending artery, and draining into the main pulmonary artery. Possible viral etiologies were all negative.

On admission to our unit, clinical and laboratory reevaluation of the patient including physical examination, ECG, chest x-ray and echocardiography were all normal. The patient was taken to the operating room following i.v. antibiotic and 100 IU/kg heparin. Right and left heart catheterization and selective left and right coronary artery angiography were performed and a fistula originating from the left anterior descending coro-

nary artery was seen without any additional abnormalities in the right and left coronary vessels (Fig. 1-A). The fistula was small and slightly tortuous, communicating the coronary circulation with the main pulmonary artery. The shunt size was not measured because it was small, consequently, n-butyl 2-cyanoacrylate embolization of the fistula was planned. A 6 Fr guiding catheter was used to cannulate the left coronary system and a 0.012" micro-guide wire (200 cm long without distal curve, Sorcerer Neurological Nitinol Microguide-Wire, SOR012D, BALT, France) through the guiding catheter and left anterior descending coronary artery was advanced into the coronary artery fistula. Thereafter, a 2.7 Fr infusion microcatheter with 155 cm total length and 0.4 mm internal diameter (Vasco 14, Vasco Catheters, BALT, France) was advanced into the fistula over the wire.

Later on, the guide wire was removed, leaving the distal end of the microcatheter in the middle of the fistula. A test injection with contrast material was performed to gauge flow characteristics and the placement of catheter (Fig. 1-B). Then, using a single-column technique, 0.2–0.3 cc of the 50% diluted n-butyl 2-cyanoacrylate (Histoacryl Blue; Braun, Melsungen, Germany) and a nonionic contrast agent (iodized oil; Lipiodol ultra-fluide; Guerbet, Aulnay-sous-Bois, France) mixture were injected under direct fluoroscopic guidance. Fifty percent diluted n-butyl 2-cyanoacrylate and lipiodol was prepared to achieve faster polymerization of the material occluding the fistula point without further distal embolization. After occlusion of the fistula was confirmed with angiography via a guiding catheter, the microcatheter was removed. Complete occlusion of the fistula was achieved, on repeat selective left coronary artery angiography, through the guiding catheter after removing the microcatheter (Fig. 1-C,D). Low molecular weight heparine was given the patient immediately after the procedure and for a further 5 days to avoid thromboembolic event. On the following day, n-butyl 2-cyanoacrylate was visible and remaining in the same position on chest x-ray. Serial electrocardiograms and specific cardiac enzyme studies demonstrated no evidence of ischemia related to the procedure. The patient was discharged on the second day of the procedure. During a one-year follow-up, the patient experienced no new cardiac ischemia attacks.

Discussion

The incidence of isolated congenital coronary artery fistula occurs in 1/50,000 live births [1]. Since the first description of the disease in 1865 [5], documentation of 174 patients by Libertson et al. [6] from published cases and studies revealed that fistula-related symptoms (dyspnea on exertion, fatigue, angina or congestive heart failure) and complication incidence (myocardial infarction, endocarditis or death) increases by age in untreated patients. Therefore, the authors recommended closure of the coronary artery fistulas during childhood, even in asymptomatic patients. In this study,

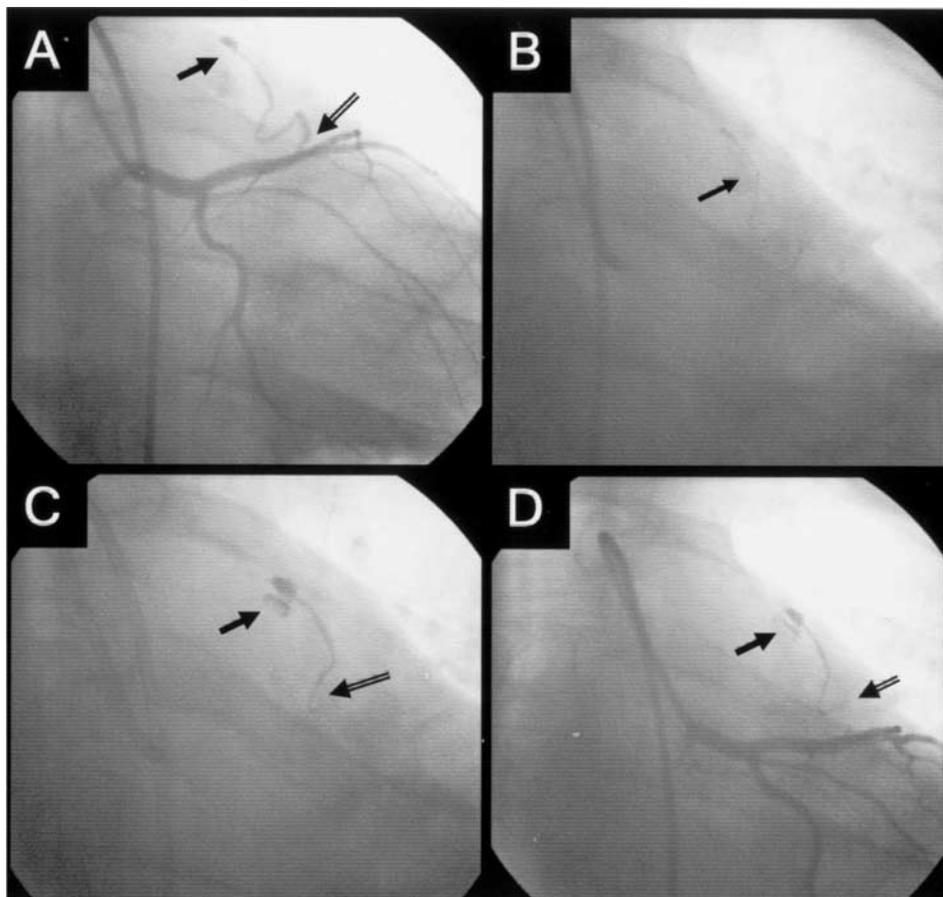


Fig. 1. **A** Selective left coronary artery angiography demonstrating a fistula originating from the left anterior descending coronary artery (double line arrow) and opening to the main pulmonary artery (single line arrow). **B** A test injection with contrast material through the microcatheter confirming the distal end of the microcatheter is in the middle of the fistula (arrow indicating distal marker of the microcatheter). **C** Fluoroscopic appearance of n-butyl 2-cyanoacrylate in embolized fistula; arrows indicate proximal and distal end of polymerized n-butyl 2-cyanoacrylate. **D** Selective left coronary artery angiography through a guiding catheter, after removing the microcatheter, showing complete occlusion of the fistula.

symptoms and complications occurred in 11% of untreated patients <20 years old and in 35% >20 years old. Our case had two transient myocardial ischemia attacks during his adolescence.

The preferred method of approach for any patient depends on the anatomy of the fistula, the presence or absence of associated defects and the experience of the interventional cardiologists and surgeons [7]. Since its introduction in 1983, transcatheter closure of coronary fistulas has been utilized as an alternative to surgical closure. Transcatheter occlusion of coronary artery fistula was found to be successful in 83% of 45 patients in studies excluding case reports, published since 1983 [7]. Given the available data, complete closure by transcatheter and surgical techniques are comparable, as are rates of early and late complications. Features such as extreme vessel tortuosity, multiple drainage sites and coronary artery branches at the site of optimal device positioning may render the coronary artery fistula unsuitable for transcatheter occlusion. Additionally, the ability to cannulate the distal fistula and avoid flow interference through nearby coronary branches is mandatory for transcatheter occlusion. In our case, due to unexpected recurrent angina-like symptoms accompanied by elevation of cardiac enzymes, we thought that the symptoms were most probably related to the coronary artery fistula since no other reason was apparent from the investigations. Therefore, transcatheter closure was performed because the anatomy was suitable.

Until now, many percutaneous interventional embolic occlusion techniques with various materials including Gianturco coils, polyester-covered stainless steel coils, detachable balloon, double umbrella devices, polyvinyl alcohol particles were used in the coronary

circulation [1–7]. The embolization of a coronary fistula with n-butyl 2-cyanoacrylate is a new technique that has been successfully used for years in patients with cerebral arteriovenous fistulas [8]. N-butyl 2-cyanoacrylate is a resin, which on contact with the blood immediately solidifies and causes complete luminal obliteration of the fistulas pathway. Recently, successful embolizations of coronary fistulas with n-butyl 2-cyanoacrylate were reported in two patients by Villavicencio et al. [9] and in one patient by Vajifdar et al. [10]. An important point in all these reported cases with coronary fistula is that the fistulas were all small-caliber, low-flow fistulas, and communicated with the pulmonary artery, as in our case.

In the present case, among all transcatheter occlusion techniques discussed above, only microcoil or n-butyl 2-cyanoacrylate may have been suitable since the fistula was very small. As our Radiology Department is experienced with the use of n-butyl 2-cyanoacrylate, and because of its low cost and ability to occlude a fistula like this by a single injection, we chose n-butyl 2-cyanoacrylate embolization in our patient.

Symptomatic pulmonary complications occur infrequently after cyanoacrylate glue injection to cerebral arteriovenous malformation. Pelz et al. [11] reported pulmonary complications in 3 of 182 patients who underwent embolization of brain arteriovenous malformations with cyanoacrylate glue, mainly related to high-flow vascular brain lesions. All were treated conservatively and resolved spontaneously; that is, no clinically significant pulmonary complication was observed in small size arteriovenous malformation. With this convenient finding, no pulmonary complication was observed

in previously reported cases and in our patient after n-butyl 2-cyanoacrylate embolization to small-caliber coronary artery fistula communicating to the pulmonary artery. Therefore, it seems to be safe and feasible in this type of fistula. However, n-butyl 2-cyanoacrylate embolization of the coronary artery fistula, particularly when communicating to the left atrium or pulmonary vein, may be dangerous because of the risk of inadvertent systemic arterial embolization.

Experiences with embolization of the coronary fistulas with n-butyl 2-cyanoacrylate are scarce. We think it can be used in selected patients, especially for embolization of small-caliber coronary fistulas with small shunt communicating with the pulmonary artery. However, it is not possible to guarantee the feasibility and safety of this technique until there is further experience with it.

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