Coronary-pulmonary steal caused by internal thoracic artery–pulmonary artery fistula after coronary artery bypass operations

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Internal thoracic artery (ITA)–pulmonary artery (PA) fistula is a rare complication of coronary artery bypass grafting (CABG). We describe such a case and review the literature with the aim of evaluating the clinical presentation, diagnosis, and outcome.

Clinical Summary

A 57-year-old woman underwent off-pump single-vessel CABG with a left ITA (LITA)–left anterior descending coronary artery graft through a median sternotomy in June 2000. The LITA pedicle on the basis of its origin from the left subclavian artery was dissected with electrocautery, and intercostal branches were divided with metallic clips. The left pleura was drained with a 32F chest tube that was removed 24 hours later. Two weeks postoperatively, she presented with atypical chest pain and underwent cardiac catheterization that showed a patent graft and no communication with the pulmonary vasculature. Her symptoms were attributed to postoperative pericarditis and were relieved with nonsteroidal anti-inflammatory agents.

In August 2004, she presented with angina. Her examination, electrocardiogram, and chest radiograph showed no abnormalities. A coronary angiogram showed a patent LITA with a fistulous communication to left PA branches (Figure 1). Her angina was explained on the basis of a coronary-pulmonary steal through the patent LITA. Because she refused surgical intervention, her medications were adjusted to include long-acting oral nitrates. She reported improvement in her symptoms and continues to do well 5 months later.

Discussion

The pathogenesis of ITA-PA fistula after CABG is not well understood, and several theories have been postulated. Electrocoagulation without clipping of the ITA branches might allow recanalization of the vessels and increase the risk of fistula formation. Disruption of the visceral pleura during surgical intervention might facilitate contact between the ITA and the pulmonary vasculature.

Figure 1. A coronary angiogram with a LITA injection showing a patent ITA with evidence of a communication to the pulmonary vasculature through a plexus of small pulmonary arterial tributaries consistent with a thoracic–pulmonary artery fistula.

The resulting raw surface might enhance neovascularization and promote fistula formation. Apical blebs might predispose to spontaneous visceral pleural disruption or bleb rupture, thereby setting the stage for this process. In hopes of reducing these risk factors, meticulous clipping of the ITA branches and avoiding entry into the pleura have been advocated.

We have identified 15 reported cases, and to this group, we add this case (Table 1).¹⁻¹¹ The first patient was reported in 1990. All except one (94%) were men. Their mean age was 56 years (range, 45-65 years). Three (19%) occurred in patients who had off-pump CABG, and the remaining 13 occurred in patients who had CABG with cardiopulmonary bypass. Thirteen (81%) patients presented with recurrent angina, and 3 (19%) were asymptomatic at rest but had abnormal stress test results. The mean time from CABG to diagnosis of the fistula was 4 years (range, 5 months to 13 years). All fistulas were identified by angiography, with a selective injection of the ITA showing communication with PA tributaries or plexus. In most cases there was a 2- to 5-year lag time between CABG and development of symptoms.

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TABLE 1. Literature review of 15 published cases of internal thoracic–pulmonary artery fistula reported between 1996 and 2004 (including the present case)

Case (reference)	Date	Age (y)	Sex	Operation	Symptoms
Garrean (present case)	2004	57	F	LITA	Recurrent angina
Ferreira et al ¹	2002	50	M	LITA + 3 veins	Recurrent angina
Maiello et al ²	2002	59	M	LITA (MIDCABG)	Recurrent angina
Madu et al ³	2001	57	M	LITA + 2 veins	No symptoms, positive nuclear imaging study
	2001	60	M	LITA	Progressive angina
	2001	55	M	LITA + 2 veins	Dyspnea with exertion, chest pain
	2001	64	M	LITA	Crescendo angina
Musleh et al ⁴	2001	42	M	LITA + 2 veins	Recurrent angina
Liu et al ⁵	2000	56	M	LITA (MIDCABG)	No symptoms, positive nuclear imaging study
Najm et al ⁶	1996	65	M	LITA + 1 vein	Recurrent angina
Groh et al ⁷	1994	57	M	RITA + LITA	Recurrent angina
Kimmelstiel et al ⁸	1993	53	M	LITA + 2 veins	Recurrent angina
Birnbaum et al ⁹	1992	55	M	LITA + 2 veins	Recurrent angina
Blanche et al ¹⁰	1991	57	M	LITA	Angina
	1991	45	M	LITA, RITA + 1 vein	Asymptomatic with positive stress test result
Johnson et al ¹¹	1990	59	M	LITA + 1 vein	Recurrent angina

LITA, Left internal thoracic artery; *PA*, Pulmonary artery; *CAD*, coronary artery disease; *MIDCABG*, minimally invasive coronary artery bypass grafting; *LAD*, left anterior descending coronary artery; *NA*, not available; *CABG*, coronary artery bypass grafting; *RITA*, right internal thoracic artery; *LPA*, left pulmonary artery; *RPA*, right pulmonary artery.

Treatment of ITA-PA fistulas included (1) conservative management, (2) surgical separation of the ITA from the lung parenchyma, or (3) percutaneous embolization. Depending on the patient's operative candidacy, conservative management with antiangina medications might be the best or only option. Surgical ligation is definitive in those who can tolerate surgical intervention. The recommended approach is a left thoracotomy with dissection of the ITA from the adjacent lung parenchyma. Percutaneous intervention can be performed, although it might be associated with the risk of distal coronary embolization. Of the 16 reviewed cases, 12 had information available regarding manage-

ment of the fistulous communication. Of those 12, 7 (58%) received medical therapy alone, 4 (33%) underwent dissection of the ITA from the lung parenchyma through a left thoracotomy or redo sternotomy (2 patients each), and 1 had embolization of the fistulous tract. Symptomatic improvement was reported in all but one patient, who was treated medically, with persistence of his symptoms.

Recurrent angina after CABG in the presence of angiographic evidence of LITA-PA communication should raise the suspicion of a coronary-pulmonary steal. The incidence of this complication seems to be on the increase as more patients receive ITA conduits during CABG operations.

Time to diagnosis	Angiographic findings	Treatment	Outcome
4 y	LITA-PA fistula	Medical	Improved
1 y	No progression CAD, LITA-PA fistula	Medical	Improved
1 y	No progression CAD, LITA-PA fistula	Sternotomy, surgical division	Improved
8 y	Progression of disease, LITA-PA fistula	NA	NA
10 y	Native vessel disease, patent LITA-LAD with LITA-PA fistula	NA	NA
3 y	Patent grafts, LITA-PA fistula	NA	NA
13 y	LITA-PA fistula	NA	NA
9 y	LITA-PA fistula	Sternotomy, surgical division and CABG for new native disease	Improved at 6 y f/u
2 mo	LITA-PA fistula, complete occlusion LAD	Medical	Unchanged
3 y	No progression CAD, LITA-PA fistula	Medical	Improved
4 y	No progression CAD, LITA-LPA, RITA-RPA fistula	Medical	Improved
4 y	No progression CAD, LITA-PA fistula	Medical	Improved
2 y	No progression CAD, LITA-PA fistula	Left thoracotomy with dissection ITA from lung parenchyma	Improved
NA	LITA-PA fistula	CABG, embolization	Improved
5 mo	RITA-PA	None	NA
3 y	No progression CAD, LITA-PA fistula	Left thoracotomy, staple division of lung	Improved

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