REFERENCES

- 1 Choussat A, Fontan F, Besse P, et al. Selection criteria for Fontan's procedure. In: Anderson RH, Shinebourne ED, eds. *Pediatric cardiology*. Edinburgh: Churchill-Livingstone, 1978:559-66.
- 2 Fontan F, Fernandez G, Costa F, et al. The size of the pulmonary arteries and the results of the Fontan operation. *J Thorac Cardiovasc Surg* 1989;98:711-24.
- 3 Senzaki H, Isoda T, Ishizawa A, et al. Reconsideration of criteria for the Fontan operation: influence of pulmonary artery size on postoperative hemodynamics of the Fontan operation. *Circulation* 1994;89:1196-202.
- 4 Nakata S, Imai Y, Takanashi Y, et al. A new method for the quantitative standardization of cross-sectional areas of the pulmonary arteries in congenital heart disease with decreased pulmonary flow. *J Thorac Cardiovasc Surg* 1984;88:610-9.
- 5 Girod D, Rice M, Mair D, et al. Relationship of pulmonary artery size to mortality in patients undergoing the Fontan operation. *Circulation* 1985;72(suppl):II93-6.
- 6 Bridges ND, Farrell PE Jr, Pigott JD, et al. Pulmonary artery index: a nonpredictor of operative survival in patients undergoing modified Fontan repair. *Circulation* 1989;80(suppl):I216-21.
- 7 Reddy VM, McElhinney DB, Moore P, et al. Pulmonary artery growth after bidirectional cavopulmonary shunt: is there a cause for concern? *J Thorac Cardiovasc Surg* 1996;112:1180-92.
- 8 Slavik Z, Webber SA, Lamb RK, et al. Influence of bidirectional superior cavopulmonary anastomosis on pulmonary artery growth. *Am J Cardiol* 1995;76:1085-7.
- 9 Mendelsohn AM, Bove EL, Lupinetti FM, et al. Central pulmonary artery growth pattern after the bidirectional Glenn procedure. *J Thorac Cardiovasc Surg* 1994;107:1284-90.
- 10 Penny DJ, Pawade A, Wilkinson JL, et al. Pulmonary artery size after bidirectional cavopulmonary connection. *J Card Surg* 1995;10:21-6.
- 11 Buheiteel G, Hofbeck M, Tenbrink U, et al. Changes in pulmonary artery size before and after total cavopulmonary connection. *Heart* 1997;78:488-92.
- 12 Kirklin JW, Baratt-Boyes BG. Anatomy, dimensions and terminology. In: *Cardiac surgery*. 2nd edn. New York: Churchill Livingstone, 1993:3-60.
- 13 Borowski A, Reinhardt H, Schickendantz S, et al. Pulmonary artery growth after systemic-to-pulmonary shunt in children with a univentricular heart and a hypoplastic pulmonary artery bed: implications for Fontan surgery. *Jpn Heart J* 1998;39:671-80.
- 14 Jarmakani JMM, Graham TP, Benson DW, et al. In vivo pressure-radius relationships of the pulmonary artery in children with congenital heart disease. *Circulation* 1971;43:585-92.
- 15 Ishikawa S, Takahashi T, Sato Y, et al. Growth of the pulmonary arteries after systemic-pulmonary shunt. *Ann Thorac Cardiovasc Surg* 2001;7:337-40.
- 16 McElhinney DB, Marianeschi SM, Reddy M. Additional pulmonary blood flow with the bidirectional Glenn anastomosis: does it make a difference? *Ann Thorac Surg* 1998;66:668-72.
- 17 Frommelt MA, Frommelt PC, Berger S, et al. Does an additional source of pulmonary blood flow alter outcome after a bidirectional cavopulmonary shunt? *Circulation* 1995;92(suppl):II240-4.
- 18 Webber SA, Horvath P, LeBlanc JG, et al. Influence of competitive pulmonary blood flow on the bidirectional superior cavopulmonary shunt: a multi-institutional study. *Circulation* 1995;92(suppl):II279-86.
- 19 Mainwaring RD, Lamberti JJ, Uzark K, et al. Bidirectional Glenn: is accessory pulmonary blood flow good or bad? *Circulation* 1995;92(suppl):II294-7.
- 20 Uemura H, Yagihara T, Kawashima Y, et al. Use of the bidirectional Glenn procedure in the presence of forward flow from the ventricles to the pulmonary arteries. *Circulation* 1995;92(suppl):II228-32.
- 21 Mainwaring RD, Lamberti JJ, Uzark K, et al. Effect of accessory pulmonary blood flow on survival after the bidirectional Glenn procedure. *Circulation* 1999;100(suppl):II151-6.
- 22 Bartmus DA, Driscoll DJ, Offord KP, et al. The modified Fontan operation for children less than four years old. *J Am Coll Cardiol* 1990;15:429-35.
- 23 Kirklin JK, Blackstone EH, Kirklin JW, et al. The Fontan operation: ventricular hypertrophy, age and date of operation as risk factors. *J Thorac Cardiovasc Surg* 1986;92:1021-8.
- 24 Weber HS, Gleason MM, Myers JL, et al. The Fontan operation in infants less than two years of age. *J Am Coll Cardiol* 1992;19:828-33.
- 25 Pearl JM, Laks H, Drinkwater DC, et al. Modified Fontan procedure in patients less than four years of age. *Circulation* 1992;86(suppl):II100-5.
- 26 DeGroff CG, Carlton JD, Weinberg CE, et al. Effect of vessel size on the flow efficiency of the total cavopulmonary connection: in vitro studies. *Pediatr Cardiol* 2002;23:171-7.
- 27 Lardo AC, Webber SA, Friehs I, et al. Fluid dynamic comparison of intra-atrial and extracardiac total cavopulmonary connections. *J Thorac Cardiovasc Surg* 1999;117:697-704.

IMAGES IN CARDIOLOGY

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Profound coronary spasm caused by a mediastinal draining tube

A 49 year old female patient with exertional angina pectoris and one vessel disease (ostial and mid left anterior descending artery and diagonal branch stenoses) underwent elective coronary bypass grafting. The left internal mammary artery was anastomosed off-pump to the diagonal branch and LAD. After an uneventful operation the patient was transferred to the intensive care unit. Four hours later, however, she developed severe hypotension and bradycardia. The ECG showed ST elevation in the inferior leads and complete AV block. This episode lasted for 10 minutes and did repeat one more time. The patient was brought to the catheterisation laboratory. Coronary angiogram revealed a well functioning left internal mammary artery (LIMA). In contrast to the preoperative images (panel A), the right coronary artery was found diffusely narrowed. In its proximal part, the lumen was nearly completely obliterated; at this point, a mediastinal draining tube was observed (panel B). The tube was removed and the subsequent clinical course was uneventful; no rise in creatine phosphokinase was observed and the ECG on discharge was normal.

To our knowledge, this is the first report showing spasm of a native coronary artery caused by a mediastinal drain.

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(A) Normal appearance of the right coronary artery (RCA) at preoperative angiogram. (B) Nearly complete obliteration of proximal RCA lumen. The borders of the mediastinal draining tube are indicated with arrows.