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Intensive Care Med (2005) 31:602–603
DOI 10.1007/s00134-004-2466-3

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Percutaneous closure of patent foramen ovale in a patient presenting arterial hypoxaemia and supported with bi-ventricular assist device

Accepted: 7 September 2004
Published online: 14 January 2005
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Sir: Due to a shortage of donors, ventricular assist devices (VADs)—left, right or bi-ventricular—have been developed as a bridge to cardiac transplantation for patients with severe congestive heart failure (CHF) [1]. The Berlin Heart VAD is an external implantable device utilising an extracorporeal pump (or "ventricle") with a compressed air system, which aspirates blood from the atria or ventricles and pumps it through the aorta and/or the pulmonary trunk [1]. In the presence of an inter-atrial communication, i.e. patent foramen ovale (PFO) or atrial septum defect (ASD), a significant right-to-left shunt (RLS) may develop, leading to systemic arterial desaturation [2]. We report the case of a patient with a Berlin Heart bi-ventricular assist device (BiVAD), implanted as a bridge to cardiac transplantation for decompensated CHF, complicated by a severe refractory arterial hypoxemia caused by a RLS via a PFO.

A 46-year-old male presented in cardiogenic shock with radiological evidence of pulmonary oedema. The coronary angiography revealed severe three-vessel coronary artery disease (CAD) with 10% left ventricular ejection fraction at echocardiography. Immediate revascularisation was not considered feasible and because of the rapid clinical deterioration of the patient a Bi-VAD, Berlin Heart Excor, was inserted as a bridge to possible cardiac transplantation.

Due to the ameliorated haemodynamics, a more aggressive vasodilatatory therapy was instituted, however, on the following day unexplained recurrent arterial desaturation was observed, with arterial oxygen saturations as low as 75%. A trans-oesophageal echocardiography (TEE) was performed to investigate a suspected RLS, through an inter-atrial communication.

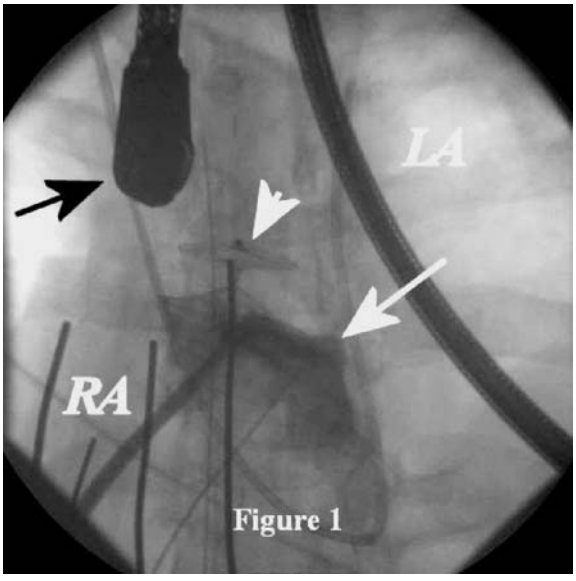

Fig. 1 Fluoroscopy image showing contrast medium (c.m. *white arrow*) injection in the right atrium (*RA*) without passage of c.m. through the Amplatzer PFO occluder (*arrowhead*). *LA* left atrium, *black arrow* TEE transductor

This was confirmed after contrast injection, with massive passage of micro-bubbles through a PFO.

Despite measures designed to reduce especially the right heart pressure, the shunt continued to be clinically significant, therefore we decided to close the PFO, under fluoroscopy and TEE guidance using an Amplatzer PFO occluder via a percutaneous approach [3]. At the end of the procedure the shunt was virtually absent on both fluoroscopy and TEE (Fig. 1). This was further corroborated by a marked improvement in arterial oxygenation during the subsequent days. On day 16, the patient underwent successful cardiac transplantation with a favourable clinical course.

Due to a combination of VAD-induced left atrial and ventricular unloading a RLS is generally observed in the presence of an inter-atrial communication [2]. Conservative measures to reduce the degree of RLS by lowering right-sided heart pressures, such as reducing PEEP, reduction of the pressure support ventilation and careful volume management, are often insufficient. In such cases the closure of the intra-atrial communication is necessary, by either a surgical or percutaneous approach [3]. Because PFOs are present in up to 30% of the general population, peri-operative screening with a TEE should be considered prior to implantation of a VAD [4]. Furthermore, the TEE should be preferably performed immediately after the VAD is activated, because almost 20% of PFOs can be detected only in the presence of this artificial, device-generated, right-left atrial gradient [5].

In conclusion, we suggest that when a VAD (left, right or bi-ventricular) has to be implanted, patients should be screened for an inter-atrial communication by TEE [4, 5]. If this is present, surgical closure should be considered during the VAD-implantation [2]. However, if a clinically apparent shunt is documented after VAD implantation, percutaneous closure can be performed safely with a high success rate [3], and should probably be considered first-line treatment.

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