Journal of Cardiology Cases 6 (2012) e32–e33

Contents lists available at www.sciencedirect.com

Journal of Cardiology Cases

journal homepage: www.elsevier.com/locate/jccase

Editorial

# Pulmonary arterial hypertension in adults with atrial septal defect

*Keywords:*
Atrial septal defect
Pulmonary arterial hypertension
Adult congenital heart disease

Atrial septal defect (ASD) is a congenital heart defect often encountered in the adult population, because many patients are free from overt symptoms for the first few decades and may show limited physical signs. Pulmonary arterial hypertension (PAH) complicating to left-to-right shunting at the atrial level is seen in 6–35% of untreated patients in later adulthood [1–3]. The presence of PAH is associated with older age, female sex, and defect size and causes progressive dyspnea, ascites, edema, presyncope or syncope, functional limitations, persistent right ventricular dilation and significant tricuspid regurgitation after closure of ASD, and increased mid-to-long-term morbidity and mortality [4–8]. Although the exact pathogenesis of PAH in patients with ASD is not clearly defined, it has been postulated that increased pulmonary flow leads to pulmonary endothelial damage with resultant leukocyte activation and release of mediators, ultimately causing vasoconstriction and eventual vascular hypertrophy [9]. The prevalence of Heath–Edwards grade 4 to 6 by histopathology of lung biopsy specimens was observed in 6% of adult patients who underwent surgical ASD closure. Histological changes in the intima and media of the pulmonary vessels can result in luminal narrowing and subsequent development of PAH. PAH can occur in adults with ASD as a result of chronic exposure of the pulmonary vessels to increased blood flow through the shunt.

## PAH after ASD closure in adults

Patients with moderate or severe PAH may benefit from substantial reductions in pulmonary artery pressures after ASD closure, although pulmonary artery pressures remain elevated in a sizable population. A reduction in pulmonary arterial systolic pressure >5 mmHg was noted in 34%, 74%, 79%, and 100% of patients with no, mild, moderate, and severe baseline PAH, respectively [7]. Balint et al. [2] showed that systolic pulmonary artery pressure decreased from 58 to 44 mmHg in ASD patients with PAH who have undergone percutaneous closure after a mean follow-up of 31 months. The proportion of patients with New York Heart Association functional class III or IV symptoms was reduced by 80% after transcatheter ASD closure [7].

Right ventricular enlargement, persistent PAH, and clinical heart failure development late after percutaneous ASD closure are seen more frequently in elderly patients. ASD closure for patients with PAH may induce further elevation of pulmonary arterial pressure and reduction in cardiac output.

As for arrhythmias, a significant relative risk reduction in the incidence of atrial tachyarrhythmia was noted after ASD closure. However, no reduction in the incidence of atrial tachyarrhythmia was noted after ASD closure in patients with severe PAH.

## Evaluation before ASD closure in patients with PAH

ASD closure is associated with an increased post-procedural mortality in elderly patients with PAH. Once severe PAH or Eisenmenger syndrome has developed, ASD closure is problematic due to the increased risk of right ventricular failure and pulmonary hypertensive crisis. For avoidance of such a serious situation, some criteria were used to determine the operability of ASD patients with PAH. Cyanosis from right-to-left shunting at the atrial level is indicative of severe PAH. A hemodynamic study during temporary balloon test occlusion of ASD can be a good indicator of the subsequent evolution of PAH. If a drop in cardiac output or an increase in right ventricular filling pressure occurs with test balloon occlusion, it is indicative of a low likelihood of benefit from ASD closure.

## Pulmonary vasodilators for patients with PAH before and after ASD closure

A recent large US-based registry suggested that PAH associated with congenital heart disease is more likely to be responsive to vasodilatory change than other forms of PAH [10]. For ASD patients with severe PAH, successful surgical ASD closure followed by postoperative reduction of pulmonary artery pressure using long-term prostacyclin treatment has been reported. Afterward, many reports indicated that ASD closure is possible in selected patients with severe PAH after advanced therapy with pulmonary vasodilators, i.e. oral bosentan, intravenous epoprostenol, and oral sildenafil [11–14].

## Atrial septostomy for patients with PAH after ASD closure

In the presence of severe PAH, ASD would function as a safety valve to unload the right ventricle preserving its function and

DOI of original article: http://dx.doi.org/10.1016/j.jccase.2012.02.002.


http://dx.doi.org/10.1016/j.jccase.2012.04.005

maintaining systemic output, despite the risk of hypoxia and cyanosis [15]. In addition, the natural history of idiopathic PAH may be better if a patent foramen ovale allows a reduction in right heart overextension by right-to-left shunting. For these reasons, percutaneous atrial septostomy is recommended for patients with severe PAH and intractable right heart failure despite maximal PAH-specific agents and inotropes as palliative treatment or bridge to transplantation [16,17]. Atrial septostomy creates a right-to-left interatrial shunt, decreasing right heart filling pressures and improving right heart function and left heart filling. While the created shunt decreases systemic arterial oxygen saturation, it is anticipated that the improved cardiac output will result in overall augmentation of systemic oxygen delivery. Improved cardiac output is considered to be the principal hemodynamic benefit. Kapoor et al. [18] reported hemodynamic and clinical improvement following the atrial septostomy of severe PAH using a unique technique. A major shortcoming of atrial septostomy is relatively high incidence of spontaneous closure or decrease in orifice size that requires repeat septostomy. Consequently, implantation of a fenestrated septostomy device in PAH proved successful in long-term follow-up [19].

## References


[1] Engelfriet P, Meijboom F, Boersma E, Tijssen J, Mulder B. Repaired and open atrial septal defects type II in adulthood: an epidemiological study of a large European cohort. Int J Cardiol 2008;126:379–85.

[2] Balint OH, Samman A, Haberer K, Tobe L, McLaughlin P, Siu SC, Horlick E, Granton J, Silversides CK. Outcomes in patients with pulmonary hypertension undergoing percutaneous atrial septal defect closure. Heart 2008;94:1189–93.

[3] Goetschmann S, Dibernardo S, Steinmann H, Pavlovic M, Sekarski N, Pfammatter JP. Frequency of severe pulmonary hypertension complicating “isolated” atrial septal defect in infancy. Am J Cardiol 2008;102:340–2.

[4] Sukmawan R, Watanabe N, Ogasawara Y, Yamaura Y, Yamamoto K, Wada N, Kume T, Okura H, Yoshida K. Geometric changes of tricuspid valve tenting in tricuspid regurgitation secondary to pulmonary hypertension quantified by novel system with transthoracic real-time 3-dimensional echocardiography. J Am Soc Echocardiogr 2007;20:470–6.

[5] Hörer J, Müller S, Schreiber C, Kostolny M, Cleuziou J, Prodan Z, Holper K, Lange R. Surgical closure of atrial septal defect in patients older than 30 years: risk factors for late death from arrhythmia or heart failure. Thorac Cardiovasc Surg 2007;55:79–83.

[6] Verheugt CL, Uiterwaal CS, van der Velde ET, Meijboom FJ, Pieper PG, Vliegen HW, van Dijk AP, Bouma BJ, Grobbee DE, Mulder BJ. Gender and outcome in adult congenital heart disease. Circulation 2008;118:26–32.

[7] Yong G, Khairy P, De Guise P, Dore A, Marcotte F, Mercier LA, Noble S, Ibrahim R. Pulmonary arterial hypertension in patients with transcatheter closure of secundum atrial septal defects: a longitudinal study. Circ Cardiovasc Interv 2009;2:455–62.

[8] Toyono M, Krasuski RA, Pettersson GB, Matsumura Y, Yamano T, Shiota T. Persistent tricuspid regurgitation and its predictor in adults after percutaneous and isolated surgical closure of secundum atrial septal defect. Am J Cardiol 2009;104:856–61.

[9] Diller GP, Gatzoulis MA. Pulmonary vascular disease in adults with congenital heart disease. Circulation 2007;115:1039–50.

[10] Thenappan T, Shah SJ, Rich S, Gomberg-Maitland M. A USA-based registry for pulmonary arterial hypertension: 1982–2006. Eur Respir J 2007;30:1103–10.

[11] Hirabayashi A, Miyaji K, Akagi T. Continuous epoprostenol therapy and septal defect closure in a patient with severe pulmonary hypertension. Catheter Cardiovasc Interv 2009;73:688–91.

[12] Hoetzenecker K, Ankersmit HJ, Bonderman D, Hoetzenecker W, Seitelberger R, Klepetko W, Lang IM. Atrial septal defect repair after a 10-month treatment with bosentan in a patient with severe pulmonary arterial hypertension: a case report. J Thorac Cardiovasc Surg 2009;137:760–1.

[13] Kim YH, Yu JJ, Yun TJ, Lee Y, Kim YB, Choi HS, Jhang WK, Shin HJ, Park JJ, Seo DM, Ko JK, Park IS. Repair of atrial septal defect with Eisenmenger syndrome after long-term sildenafil therapy. Ann Thorac Surg 2010;89:1629–30.

[14] Park YK, Park JH, Yu JH, Kim JH, Lee JH, Choi SW, Jeong JO, Seong IW. Transient use of oral bosentan can be an additional option to reduce pulmonary arterial hypertension in a patient with severe pulmonary arterial hypertension associated with atrial septal defect. J Cardiovasc Ultrasound 2011;19:159–62.

[15] Dimopoulos K, Peset A, Gatzoulis MA. Evaluating operability in adults with congenital heart disease and the role of pretreatment with targeted pulmonary arterial hypertension therapy. Int J Cardiol 2008;129:163–71.

[16] Kurzyna M, Dabrowski M, Bielecki D, Fijalkowska A, Pruszczyk P, Opolski G, Burakowski J, Florczyk M, Tomkowski WZ, Wawrzynska L, Szturmowicz M, Torbicki A. Atrial septostomy in treatment of end-stage right heart failure in patients with pulmonary hypertension. Chest 2007;131:977–83.

[17] McLaughlin VV, Archer SL, Badesch DB, Barst RJ, Farber HW, Lindner JR, Mathier MA, McGoon MD, Park MH, Rosenson RS, Rubin LJ, Tapson VF, Varga J, American College of Cardiology Foundation Task Force on Expert Consensus Documents, American Heart Association, et al. ACCF/AHA 2009 expert consensus document on pulmonary hypertension: a report of the American College of Cardiology Foundation Task Force on Expert Consensus Documents and the American Heart Association: developed in collaboration with the American College of Chest Physicians, American Thoracic Society, Inc., and the Pulmonary Hypertension Association. J Am Coll Cardiol 2009;53:1573–619.

[18] Kapoor A, Khanna R, Betra A, Kumar S. Inoue balloon atrial septostomy in severe persistent pulmonary hypertension following surgical ASD closure. J Cardiol Cases; http://dx.doi.org/10.1016/j.jccase.2012.02.002.

[19] Althoff TF, Knebel F, Panda A, McArdle J, Gliech V, Franke I, Witt C, Baumann G, Borges AC. Long-term follow-up of a fenestrated Amplatzer atrial septal occluder in pulmonary arterial hypertension. Chest 2008;133:283–5.



Manatomo Toyono (MD, PhD, FACC)*
*Pediatrics, Akita University Hospital, Akita 010-8543, Japan*

*Tel.: +81 18 884 6159; fax: +81 18 836 2620.
*E-mail address:* manatomo@doc.med.akita-u.ac.jp


3 April 2012