

Right-to-Left Shunting due to a Patent Foramen Ovale during Right Ventricular Infarction

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Most of the life-threatening hemodynamic changes that occur after a myocardial infarction are due to mechanical complications involving the infarcted tissue. The typical mechanical complications accompanying an acute myocardial infarction are ruptured papillary muscles that result in severe mitral insufficiency, ventricular septal defects, or rupture of the free left ventricular wall leading to acute tamponade.

Echocardiogram examination, sub-xyphoid view, demonstrating severe right ventricular dilatation with bulging of both the interventricular and inter-atrial septum into the cavity of the left ventricle and atrium, respectively. Agitated saline injection demonstrates bubble passage through a patent foramen ovale into the left atrium and, subsequently, the left ventricle (arrow).



We describe the rare case of an opening of a patent foramen ovale, which although not a true mechanical complication but a hemodynamic one, led to the severe complication of acute right ventricular myocardial infarction.

PATIENT DESCRIPTION

A 52 year old man was hospitalized in the intensive cardiac care unit due to an inferior and right ventricular myocardial infarction complicated by ventricular fibrillation and complete atrioventricular block. During coronary angiography a complete occlusion of both the left anterior descending artery and the right coronary artery was observed, the latter suspected to be the infarct-related artery. Initially, an intraaortic balloon pump was inserted, followed by thrombus aspiration, balloon inflation and a coronary stent placement, after which a grade 3 TIMI flow was achieved and sinus rhythm was regained.

Despite this seemingly successful intervention, the patient's hemodynamic condition deteriorated after he returned to the intensive cardiac care unit. He became hypoxic with very low blood pressure, but there was no objective evidence of further myocardial ischemia. Mechanical ventilation accompanied by treatment with noradrenaline was initiated. While mechanically ventilated with 100% oxygen, the saturation ranged between 75% and 85% with PO₂ levels of 45–55 mmHg. An echocardiographic examination demonstrated akinesis of the basal part of the interventricular septum and of the left ventricular inferior wall. In addition, the right ventricle

was severely dilated with moderately decreased function and bulging of the interventricular septum and inter-atrial septum into the cavities of the left compartments. An agitated saline injection study demonstrated passage of bubbles from the right to the left atrium through a patent foramen ovale [Figure].

Aggressive treatment with positive inotropic agents and inhaled nitric oxide did not improve the patient's condition, which continued to deteriorate rapidly, leading within a few hours to refractory shock and his demise.

COMMENT

During right ventricular infarction the right heart filling pressures (central, venous, right atrial and right ventricular end-diastolic pressures) are elevated, whereas left ventricular filling pressure is normal or only slightly raised. This disproportionate right-side filling pressure elevation may cause right-to-left shunting through a patent foramen ovale or atrial septal defects.

Despite the relatively high incidence of a patent foramen ovale in the general population (25–30%) [1], the incidence of right-to-left shunting through a patent foramen ovale in acute right ventricular infarction has never been reported. The morbidity and mortality rates of this rare complication were high in a study of eight cases [2]. Treatment strategies must focus on measures to support the failing right ventricle.

Many treatment options have been suggested. Currently, prompt reperfusion in order to improve right ventricular performance is considered the

most effective therapy. Other acceptable treatment options include volume loading to maintain adequate systemic preload, positive inotropic support to increase the afterload of the left ventricle in an attempt to reverse the shunt [3], temporary cardiac pacing to maintain atrioventricular synchrony in patients with heart block [4], and inhaled nitric oxide, which was reported to improve hypoxemia [5]. It should be noted that while afterload reduction may prove somewhat beneficial initially, its use may eventually lead to an increase in the right-to-left shunt and further deterioration with detrimental consequences. The closure of inter-atrial defects (either surgically or percutaneously) is generally not indicated because the right-to-left shunt tends to decrease as right ventricular function improves. This option, however, may be considered should the above treatment options fail and patients remain hemodynamically unstable

and hypoxemic. In the case presented, the patient's very rapid deterioration accompanied by severe and refractory hemodynamic instability prevented us from attempting this additional, more complicated, invasive procedure.

In summary, during acute inferior myocardial infarction complicated by cyanosis and hypoxia (particularly when the condition does not improve with increasing oxygen supplementation), patency of the foramen ovale (or a previously not diagnosed atrial septal defect) causing intracardiac shunting should be considered and echocardiographic evaluations (transesophageal echocardiogram or contrast-TTE) performed in order to make the diagnosis. Appropriate management should be directed to improve right ventricular performance, primarily by early revascularization.

TEE = transesophageal echocardiogram

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References

1. Hagen PT, Scholz DG, Edwards WD. Incidence and size of patent foramen ovale during the first 10 decades of life: an autopsy study of 965 normal hearts. *Mayo Clin Proc* 1984; 59: 17-20.
2. Amsel BJ, Rodrigus I, De Paep R, et al. Right-to-left flow through a patent foramen ovale in acute right ventricular infarction. Two case reports and a proposal for management. *Chest* 1995; 108(5): 1468-71.
3. Dell'Italia LJ, Starling MR, Blumhardt R, et al. Comparative effects of volume loading, dobutamine and nitroprusside in patients with predominant right ventricular infarction. *Circulation* 1985; 72: 1327-35.
4. Love JC, Haffajee CI, Gore JM, et al. Reversibility of hypotension and shock by atrial or atrioventricular sequential pacing in patients with right ventricular infarction. *Am Heart J* 1984; 108: 5-13.
5. Fessler MB, Lepore JJ, Thompson BT, Semigran MJ. Right-to-left shunting through a patent foramen ovale in right ventricular infarction: improvement of hypoxemia and hemodynamics with inhaled nitric oxide. *J Clin Anesth* 2003; 15(5): 371-4.