

## A benign patent foramen ovale in off-pump coronary artery bypass can suddenly take a right turn, but can it be tolerated?

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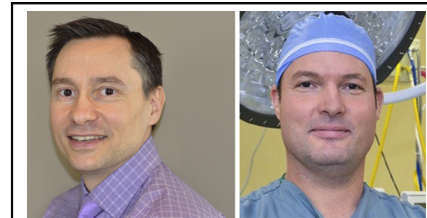
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### Central Message

Desaturation due to right-to-left shunt through a patent foramen ovale during off-pump coronary surgery is uncommon but may be encountered more frequently when addressing the posterior circulation.

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Morita and colleagues<sup>1</sup> describe a case of desaturation due to right-to-left shunting through a patent foramen ovale (PFO) when manipulating the heart during off-pump coronary artery bypass (OPCAB). They describe a clinical scenario that, although rare, should be considered when encountering hypoxemia during OPCAB. Neither the prevalence of a PFO nor the incidence of OPCAB is rare, so certainly OPCAB is performed in many patients with a PFO. Presumably in many of these patients the existence of the PFO goes unnoticed, especially when no shunting occurs. Even when shunt exists, if it does not result in desaturation, it is likely to remain unnoticed. The authors point out there is a paucity of reports of hypoxemia due to shunting through a PFO during OPCAB, suggesting it is a rare event; however, it may be that many cases are undetected because initial corrective measures improve the oxygenation sufficiently to permit the completion of the procedure. When desaturation does occur this report highlights the importance of considering a PFO as the cause. They also suggest desaturation may be more common when turning the heart to address the right coronary artery's distal branches, along the diaphragmatic surface of the heart, compared with maneuvers to expose the left side of the heart.

Performing OPCAB requires manipulating the heart differently depending on the location of the target vessel, the tools used to position the heart, and the ventricular shape and mass. Most of these positions are not optimal for the forward flow of blood through the heart, resulting in increases in pressure and decreases to compliance of the cardiac chambers. If the PFO is large enough and the right ventricular compliance falls sufficiently to increase right atrial pressure, the shunting of deoxygenated blood can result in desaturation, as described by Morita and colleagues.<sup>1</sup> Because there are other causes of deoxygenation during heart surgery, among the initial attempted remedies is to recruit underventilated lung and increase inspired oxygen fraction (F<sub>IO<sub>2</sub></sub>). In pure intracardiac shunting, because none of the shunted blood has the benefit of another pass through the lungs before going to systemic capillaries,

increasing F<sub>IO<sub>2</sub></sub> will not increase the oxygen saturation of this shunted blood. Nevertheless, recruitment measures and increasing F<sub>IO<sub>2</sub></sub> will contribute to an increase in oxygen saturation to a point. Blood still passing through the pulmonary circulation, but initially not optimally saturated due to ventilation-perfusion mismatch, will become more saturated with these maneuvers, as was seen when the authors made their initial change. A weakness of the article is that the authors were unable to estimate the shunt fraction in their report because all of the variables to calculate this were unavailable.

When described in the literature, PFO in OPCAB appears to have variability in clinical consequence.<sup>2-5</sup> The reports vary from that of 1 case<sup>2,4,5</sup> to 11 cases.<sup>3</sup> Most did not result in desaturation<sup>3,5</sup> and only 1 report required the conversion to cardiopulmonary bypass.<sup>2</sup> Shunts have been reported with use of heart stabilizers and with use of surgical sponges<sup>2,3</sup> to position the heart. Unfortunately, not all reports described which target vessel was being addressed when the shunt occurred. Of the reports that did, including the report by Morita and colleagues,<sup>1,2,4</sup> it was during positioning for the right coronary artery or its branches. Therefore, their report suggests greater vigilance for a shunt due to PFO should accompany desaturation encountered during OPCAB of the posterior circulation.

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