

# Right ventricular injury and pulmonary embolism: The perils of deep intramyocardial left anterior descending artery dissection in off-pump coronary artery bypass grafting

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## ABSTRACT

An inadvertent vent in the right ventricle (RV) resulted during dissection of a deep intramyocardial left anterior descending coronary artery (LAD), during off-pump coronary artery bypass grafting (OPCAB), led to pulmonary artery air embolism and hemodynamic instability, requiring conversion to cardiopulmonary bypass (CPB) prior to repair. This required a special maneuver in positioning the patient to identify the RV injury and prevent the pulmonary air embolism.

**Keywords:** Deep intramyocardial left anterior descending coronary artery, exploring left anterior descending coronary artery, pulmonary embolism, right ventricle injury, trendelenburg position

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## CASE REPORT

A 68-year-old hypertensive male, with impaired renal function (creatinine of 1.69 and eGFR of 42 ml/min) and NYHA Class III (shortness of breath and angina on exertion) was diagnosed with triple-vessel coronary artery disease on the angiogram, which also showed a tortuous left anterior descending coronary artery (LAD). He was taken up for off-pump coronary artery bypass grafting (OPCAB). The left internal mammary artery and reversed saphenous veins were used as conduits to graft his coronaries.

Anesthetic induction and maintenance were as per our institutional protocol (induction with 5 µg/kg of fentanyl, 0.1 mg/kg of vecuronium, and 8% sevoflurane blended with 5 L/min of oxygen and maintenance with sevoflurane

as the inhalational agent of choice and intermittent bolus of fentanyl and relaxants). Surgical access was through a midline sternotomy with dissection of the left internal mammary and simultaneous harvesting of the saphenous vein. Heparin was given to achieve a target ACT of >400 s (as per our institutional protocol). Normally, we revascularize the LAD first and then proceed with the other grafts. The heart was stabilized with a continuous suction stabilizer device (Octopus<sup>®</sup> III evolution) [Medtronic Inc., USA] and the LAD was exposed to grafting. The artery itself was found to be deep intramyocardial. Blunt dissection with a cold tip of cautery and sharp dissection with cautery and scissors were carried out to locate and prepare the LAD. A 3–4 mm injury occurred, accidentally, parallel to the LAD in the right ventricular free wall.

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Spurting of dark blood prompted us to prepare for a repair, often easily achieved with a few carefully placed 6–0 polypropylene stitches. While exposing the area, there was a sudden drop in the mean arterial pressure (MAP) to less than 60 mmHg with a surge in mean pulmonary artery pressure (MPAP) from normal to more than 40 mmHg and a concomitant steep decline in end-tidal carbon dioxide (ETCO<sub>2</sub>) levels from 35 to less than 5. The ECG, however, was unchanged. ETCO<sub>2</sub> on ventilation raised suspicions of a pulmonary air embolism. Transesophageal echocardiography (TEE) probe was introduced to confirm the diagnosis and it revealed under filled left heart and dilated RV with poor contractility. This TEE picture further raised the suspicion of pulmonary air embolism, source being the vent injury in the RV during exploration of the LAD, and also the blower-mister that was being used by the first assistant to aid during dissection of the coronary artery. A decision was taken to go for emergency CPB with routine aortic and two-stage venous cannulation, without any vent in this case. Another 15000 units of heparin was given and a target ACT of >480 s was achieved. On pump, the 4–5 mm right ventricular free wall injury was identified and repaired using three 6–0 prolene sutures on the beating heart. After this, left internal mammary artery to LAD and reversed saphenous vein graft to obtuse marginal artery and posterior descending artery anastomosis were done using the on-pump beating heart technique. The patient was weaned off CPB uneventfully and postoperative TEE did not show any air in the pulmonary artery. The patient's systemic and pulmonary pressure were normal and he was shifted in a stable condition. Subsequent course was uneventful without any renal or cerebrovascular sequelae. The predischarge echocardiography and chest X-rays were normal.

## DISCUSSION

Off-pump CABG has been popular in the Indian subcontinent with, multiple studies to prove its efficacy. Three small trials from Europe and the United States of America have, in their 5-year results of 768 patients, showed no difference between the on-pump and off-pump group.<sup>[1-3]</sup> Larger studies like the CORONARY trial have also shown similar outcomes in both groups.

During CABG, very often the LAD is found to be intramyocardial, sometimes overlying a thin layer of RV endocardium, and many techniques have been described to expose the LAD.<sup>[4,5]</sup> One of the complications of intramyocardial LAD is RV injury during dissection, which can be repaired by a variety of techniques, using under running Teflon or direct suture technique. The repair

depends on the size of the vent and maybe extremely demanding.

Our case had an RV injury in a mild volume-depleted patient. We postulate that a simultaneous, combination of suction and blowing, in this situation led to froth generation resulting in pulmonary embolism (augmented by the suction effect of RV).<sup>[6]</sup> This was supported by sudden drop in ETCO<sub>2</sub>, dilatation of the RV, and drop in LV filling pressures with no change in ECG. Though the repair was technically easy, the hemodynamic instability prompted conversion to on-pump CABG. There was an uneventful recovery after the on-pump CABG without any sequelae, ECG changes, or hemodynamic instability (monitored using an invasive arterial line in the right radial artery and Swan-Ganz catheter in the pulmonary artery). This confirmed our strong suspicion of pulmonary air embolism which was resolved after initiation of CPB and routine CABG.

We report this case to bring to the attention of OPCAB surgeons, the possibility of such complication during dissection of the intramyocardial LAD. Being aware of this potential problem, it may be better to ensure that, whenever there is an RV injury during OPCAB, the patient should be put in the Trendelenburg position to ensure a filled RV, preventing air embolism. On the other hand, the normal tendency would be to put the patient in a reverse Trendelenburg position to reduce the venous return and thus the bleeding from the rent. There are reports suggesting a reverse Trendelenburg position preventing vascular air embolism. Hence, the practical experience from this case suggests that putting the head down and the heart at a level higher than the head will, in fact, reduce the chance of an air embolism to the pulmonary artery or the arch vessels.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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