Bedside Detection and Follow-up of Pulmonary Artery Stenosis After Lung Transplantation

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DECLARATIONS:

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A 57-year old man developed severe acute respiratory failure early after bilateral lung transplantation (LT) for idiopathic pulmonary fibrosis. Electrical impedance tomography (EIT) assessment of lung ventilation and perfusion, obtained through Pulmovista500 (Dräger, Germany) [1, 2], showed ventilation-perfusion mismatch due to reduced and delayed perfusion to the left graft (Figure1A, Video). Bedside transesophageal echocardiography (TEE) showed dilated right ventricle, without abnormal contractility or pulmonary hypertension. Left pulmonary artery could only be partially explored, showing turbulent flow. Computed tomography pulmonary angiography (CTPA) confirmed severe left anastomotic pulmonary artery stenosis (APAS) (Figure1B). Five days later, EIT showed slight improvement of ventilation-perfusion matching despite left lung perfusion delay (Figure1C, Video), associated with partial resolution of the anastomotic stricture at CTPA (Figure1D).

This is the first report of EIT use for evaluation of lung perfusion after LT. Early APAS identification after LT is crucial, as this complication is associated with increased mortality [3]. Since lung perfusion analysis through EIT is still experimental and EIT quantification of pulmonary stenosis has not been validated yet, no studies on humans are available comparing EIT with more established techniques, such as TEE. While TEE reliably assesses vascular dimension and pressure, it only partially visualizes main pulmonary vessels and is not free of complications [4]. This case suggests a potential role for EIT after LT in recognizing ventilation-perfusion mismatch consequent to alterations of regional perfusion caused by postoperative vascular complications, also allowing repeated noninvasive bedside assessments.

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FIGURE LEGENDS

Figure 1. A) Postoperative day 2. Pulmonary ventilation-perfusion analysis by electrical impedance tomography (EIT) showing ventilation-perfusion mismatch in the left graft. The distributions of tidal ventilation and lung perfusion are represented by the blue-white gradient area and the red-yellow gradient area, respectively. Among the quadrants, the proportions of tidal ventilation and lung perfusion are indicated by the blue and red percentage, respectively. The perfusion image depicts the relative perfusion at a given pixel, compared to the overall perfusion throughout the complete bolus passage. Dead space to tidal volume ratio, calculated by the Enghoff equation, was 0.49, while dead space, calculated through EIT analysis, was 0.48. The arterial partial pressure of oxygen to fraction of inspired oxygen ratio (PaO_2/FiO_2) was 70 mmHg, while arterial partial pressure of carbon dioxide ($PaCO_2$) was 69 mmHg. **B)** Postoperative day 2. Axial computed tomography pulmonary angiography (CTPA) image showing severe left pulmonary artery stenosis (4-mm luminal diameter) (arrow). **C)** Postoperative day 7. Pulmonary ventilation-perfusion analysis by EIT showing a slightly increased matching in the left graft. The distributions of tidal ventilation and lung perfusion are represented by the blue-white gradient area and the red-yellow gradient area, respectively. Among the quadrants, the proportions of tidal ventilation and lung perfusion are indicated by the blue and red percentage, respectively. The perfusion image depicts the relative perfusion at a given pixel, compared to the overall perfusion throughout the complete bolus passage. Dead space to tidal volume ratio, calculated by the Enghoff equation, was 0.39, while dead space, calculated through EIT analysis, was 0.36. PaO_2/FiO_2 and $PaCO_2$ were 198 mmHg and 60 mmHg, respectively.

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D) Postoperative day 7. Axial CTPA image demonstrating partial resolution of the left pulmonary artery stenosis (7-mm luminal diameter) (arrow).

Because of the unique characteristics of the studied patient (recent thoracic surgery with bilateral pleural drains), EIT perfusion images are presented without software removal of the heart region in order to prevent erroneous masking of perfusion data by the algorithm.

VIDEO LEGEND

Lung ventilation and perfusion dynamically assessed with electrical impedance tomography, on postoperative day 2 and day 7, are shown.

The distribution of tidal ventilation and lung perfusion is represented by the blue-white gradient area and the red-yellow gradient area, respectively. The video is frozen at the time point corresponding to the maximal perfusion area of the left lung.

Abbreviations: L, left; R, right.

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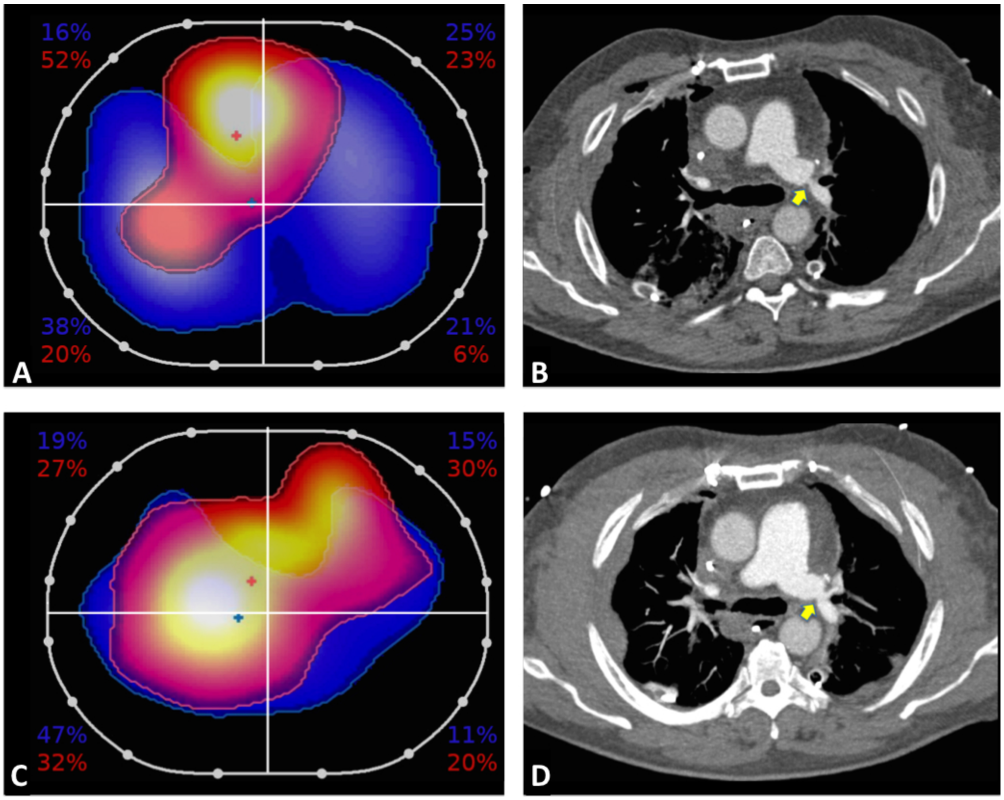

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366x289mm (72 x 72 DPI)

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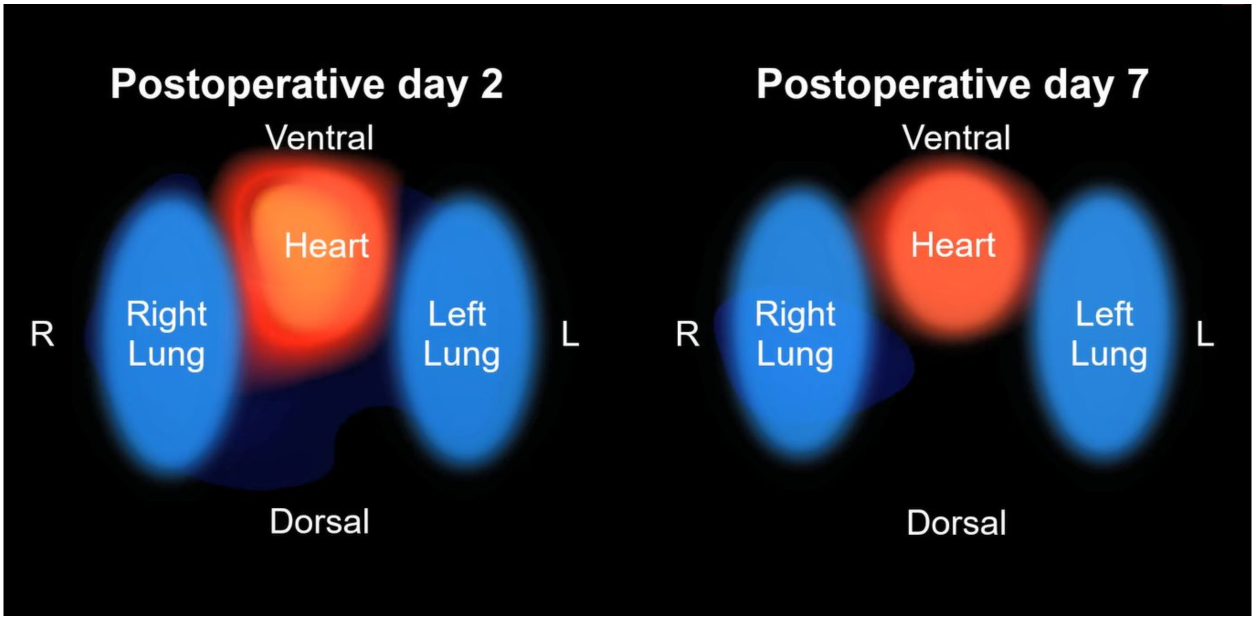

Still of Video

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