

# Near-fatal kinking of mammary graft due to emphysematous lung disease

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## Abstract

Left internal mammary artery grafting is commonly used in elective coronary artery bypass graft surgery. We report a near-fatal case with graft kinking upon sternal closure due to distended, emphysematous lungs impinging on the mammary graft. After the sternum was closed, the patient suffered a severe hemodynamic deterioration. Surgical examination revealed kinking of his left internal mammary artery upon sternal closure due to distended, emphysematous lungs impinging on the mammary graft. Using an off-bypass technique, the kink in the mammary graft to the left anterior descending artery was removed by moving the origin of the left internal mammary artery to a hooded graft of a saphenous vein graft instead. In this position, the graft no longer was impinged upon by the distended emphysematous lungs. Subsequently, the patient's sternum was closed without hemodynamic impingement. Although chronic obstructive pulmonary disease is well described to increase complications in coronary artery bypass graft surgery, it has not been previously associated with the kinking of a left internal mammary artery. This report highlights another contribution that chronic obstructive pulmonary disease can make to increased morbidity following coronary artery bypass graft surgery and alerts readers to watch for this complication in susceptible patients.

## Keywords

Cardiovascular, anesthesia/pain, surgery, CABG complications, coronary graft problems

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## Introduction

Internal mammary artery grafting is commonly used in elective coronary artery bypass grafting surgery (CABG). In recent decades, most surgeons in the Society of Thoracic Surgeons (STS) do a single arterial bypass of the left internal mammary artery (LIMA) or thoracic artery to the left anterior descending (LAD) and also saphenous vein grafts (SVG) to remaining targets.<sup>1</sup>

The LIMA is the gold standard conduit in CABG and has repeatedly been shown to be associated with improved survival, graft patency, and freedom from cardiac events compared with SVG conduits.<sup>1</sup> The LIMA is used routinely to bypass the LAD artery in the event that considerable disease is present, provided that contraindications to its use are not present (such as poor LIMA blood flow or extreme risk of sternal infection/malunion). The improved survival in LIMA over SVG is thought to be because of the unique vascular biology of the internal mammary artery

and the large territorial run-off when the LIMA is used to bypass the LAD.<sup>1</sup>

## Case report

We report a case of a 75-year-old man who had a near-fatal kinking of his mammary artery graft upon sternal closure

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due to distended, emphysematous lungs impinging on the mammary graft.

### Past medical history

The patient had a past medical history of severe chronic obstructive pulmonary disease (COPD) with bullous emphysema. He was dependent on home nasal cannula oxygen. Pre-operative Pulmonary Function Tests revealed an FEV<sub>1</sub>/FVC of 50%. Patient had a 60 pack-year history of smoking and had quit smoking 3 months previously. He also had coronary artery disease (CAD), previous percutaneous transluminal coronary angioplasty (PCTA), hyperlipidemia, atrial fibrillation, and peripheral vascular disease. Body mass index (BMI) was 20.95. Pre-op labs showed hematocrit of 34.6, normal coagulation parameters, a blood urea nitrogen (BUN) of 14, a creatinine of 0.9, and a serum bicarbonate of 22.9.

Patient arrived for elective CABG, but transesophageal echocardiography (TEE) also revealed the unanticipated finding of severe mitral regurgitation.

During the surgical exposure of the mammary artery, the surgeon noted that the emphysematous lung bullae were interfering with his surgical exposure. Thus, he requested that the tidal volume be decreased to facilitate his surgical exposure. This was done in a step-wise fashion down to a 300 mL tidal volume, with a compensatory increase in respiratory rate up to 22.

The patient underwent an elective CABG times three and a mitral ring placement.

The patient was able to be weaned from cardiopulmonary bypass utilizing norepinephrine infusion at 7 µg/min, epinephrine 5 µg/min, and milrinone 5 µg/min.

Subsequently, after the sternum was wired closed, the patient suffered a severe hemodynamic deterioration requiring emergent re-opening of the chest. No surgical bleeding was found in the chest, nor was pericardial fluid observed. Careful surgical examination revealed kinking of the mammary artery to LAD graft upon sternal closure due to distended, emphysematous lungs impinging on the mammary graft.

The patient was re-heparinized. The mammary artery was transected close to its origin at the subclavian artery and clipped. To verify that the artery and graft were otherwise patent, the mammary artery was back-bled, indeed verifying sufficient flow. The combination of regional wall abnormality on transesophageal echocardiography, visible tension on the mammary artery, and otherwise free flow in the grafted vessel confirmed the etiology of emphysematous lung kinking of the artery. With an off-bypass technique, the surgeon then fashioned a proximal anastomosis of the free LIMA onto the vein graft of another vessel. Flow was confirmed with Doppler ultrasonography, and perfusion was confirmed by verifying regional wall motion on transesophageal echocardiography.

In this position, the graft no longer was impinged upon by the distended emphysematous lungs. Subsequently, the

patient's sternum was able to be closed without hemodynamic impingement. The patient was transferred uneventfully to the post-op cardiac care intensive care unit.

### Discussion

Complications associated with LIMA use are varied and may include sternal infection and sternal dehiscence. Even fistulae between the LIMA and the pulmonary vasculature have been described.<sup>2</sup> Pseudoaneurysms at the anastomotic site of the LIMA to the LAD have been described.<sup>3</sup>

It is routine technique in cardiac surgery to carefully size the graft length so that it is neither too short to comfortably reach the target anastomosis nor excessively long so that it may fold over or kink, thus leading to a potentially catastrophic mechanical blockage of blood flow.

Problems with internal mammary grafts have been described previously: There are limited ways to address a kinked mammary artery causing obstruction to flow. As would be expected, the best treatment is prevention. More than three decades ago, Jones et al.<sup>4</sup> advised to avoid "angulation at secondary or tertiary limbs of the mammary artery" and foretold that the "mammary pedicle may be jeopardized by lungs of excessive volume, which may sweep the pedicle medially."

Another option to lengthen the mammary graft would be to skeletonize the graft by trimming the fascia around the arterial graft. This would make the graft longer and possibly prevent kinking.

If the vessel remains kinked despite adequate initial technique, re-operation may be necessary. The mammary artery may be shortened if excessive length is to blame; otherwise the pedicle may be fixed to the anterior surface of the right ventricle, ensuring a gentle curve.<sup>5</sup> If this is insufficient, the mammary may be transformed into a free graft as in this case. Should all of these fail or if the kinking is discovered far postoperatively, intracardiac stenting is a possibility.<sup>6</sup>

Brenot et al.<sup>5</sup> described two cases in 1988 diagnosed postoperatively and in which re-operation was needed. Sachdeva et al.<sup>7</sup> reported a case where the mammary graft only kinked during expiration. The use of stents to correct kinking postoperatively has been reported.<sup>6</sup> However, Cetindag et al.<sup>8</sup> describe a thoracotomy was necessary to correct a kink in a right internal mammary artery graft. Delayed kinking was managed in one report also with stenting.<sup>9</sup>

### Conclusion

To our knowledge, this is the first report of mammary artery conduit kinking due to impingement by an emphysematous lung during chest closure. Although COPD is well described to increase complications in CABG surgery,<sup>1</sup> it has not been previously associated with the kinking of an LIMA. Although the Pulmonary Function Tests in our patient suggested severe lung disease (an FEV<sub>1</sub>/FVC of 50%), this has not been reported to be associated with LIMA kinkage.

This report highlights another contribution that COPD can make to increased morbidity following CABG surgery and alerts readers to watch for this complication in susceptible patients.

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### Informed consent

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