**Case Report**

**Anomalous Origin of the Left Internal Mammary Artery from the Aortic Arch: A Case Report and Review of the Literature**

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**Abstract**

The left internal mammary artery (LIMA) is commonly used during coronary artery bypass grafting to provide direct revascularization for arteries, typically left anterior descending artery, with significant coronary atherosclerosis. In the world medical literature, we identified only 3 cases of well-documented anomalous origin of the left internal mammary artery from the aortic arch identified following coronary artery bypass grafting surgery. Herein, we describe the case of a 63-year-old man who presented with chest pain.

**INTRODUCTION**

The left internal mammary artery (LIMA) has been used for indirect myocardial revascularization since the 1940s and as part of direct revascularization since the 1960s [1]. While IMA grafting lost some ground after the introduction of saphenous vein grafting (SVG), emerging data in the 1980s of the IMA’s superiority in terms of clinical and angiographic outcomes led to renewed interest in its utilization for direct revascularization in coronary artery bypass grafting (CABG) [2]. With frequent use of the LIMA in CABG surgery and the improved long-term survival of bypass patients, understanding the arterial anatomy is critical during follow up angiographic studies. Herein, we present a case of anomalous origin of left internal mammary artery in a patient with a prior CABG along with a review of previously reported cases.

**CASE PRESENTATION**

A 63 year-old male was transferred to our facility from outside hospital (OSH) to undergo cardiac computed tomographic angiography (cardiac CTA) after multiple unsuccessful attempts to engage his LIMA during coronary angiography. The patient had a history of paroxysmal supraventricular tachycardia, hypertension, hyperlipidemia, diabetes mellitus, obstructive sleep apnea, and coronary artery disease. He underwent four vessels CABG (LIMA to left anterior descending, sequential SVG to Diagonal 1 and obtuse marginal 1, and SVG to RCA) approximately 4 years prior to presenting to the OSH with chest pain that started after moving heavy equipment the previous night. His pain initially improved, but recurred later that evening and continued into the next morning. He subsequently presented to the emergency department at OSH and was found to have a normal troponin I and no acute electrocardiographic changes. Given his cardiac history, however, he was admitted for further evaluation and management.

The patient underwent coronary angiography to assess coronary artery bypass graft patency. Angiography showed aneurysmal dilation at the mid-segment of the SVG to right coronary artery with slow flow distally, but no significant obstruction. The sequential SVG to first diagonal and first obtuse marginal was also without significant disease. The LIMA, on the other hand, could not be identified by the operator despite multiple attempts to selectively engage the vessel from within the left subclavian artery. A non-selective aortogram was subsequently performed and hinted toward an anomalous origin of the LIMA directly from the aorta (Figure 1A). Cardiac catheterization was concluded and the patient was then referred to our facility for a non-invasive assessment of his vascular anatomy via CTA.

A prospectively gated cardiac CTA with submillimeter slice thickness was performed of the entire chest according to the bypass graft protocol. The CTA (Figure 1B) revealed an anomalous, origin of the LIMA directly from the aortic arch just...
distal to the takeoff of the left subclavian artery. The LIMA then coursed superiorly and slightly anteriorly before making a broad, anterior hair-pin loop at the level of the clavicle, assuming back its normal course posterior to the left chest wall. The LIMA and the two SVGs, all appeared patent as best assessed by cardiac CTA. The patient was sent back to his referring facility for further evaluation and management of his chest pain.

**DISCUSSION**

For decades, IMAs have had a positive impact on patient survival, mostly due to lower likelihood of early graft failure, and greater long-term patency rates compared to SVGs [3]. SVGs are also well known to be susceptible to accelerated atherosclerosis compared to their arterial counterparts which directly correlates with the presence of risk factors for typical atherosclerotic disease [3]. These findings make the IMAs and other arterial conduits, like the radial artery, the preferred grafts in CABG surgery.

The LIMA normally arises from the left subclavian artery. In 92% of those cases, the LIMA ostium can be found within the proximal one third of the subclavian artery4. The LIMA can also originate from a common trunk with other arteries, including the suprascapular, inferior thyroid, and thyrocervical arteries1. While these are the most common origins of the LIMA, we could only find four other published case reports of the LIMA originating independently and directly from the aortic arch distal to the left subclavian artery (Table 1) making it impossible to selectively engage during diagnostic cardiac catheterization or leading to false or conflicting conclusions between invasive and non-invasive testing regarding vessel patency.

![Figure 1](image1.png)

**Figure 1** Non-selective thoracic aortogram with pigtail catheter hinting (in retrospect) toward an anomalous origin of the LIMA from the aortic arch (A). Cardiac CTA (B) confirming direct and independent origin of the LIMA from the aortic arch distal to the left subclavian artery (arrow)

**Abbreviation:** LIMA: Left Internal Mammary Artery

<table>
<thead>
<tr>
<th>Author</th>
<th>Sex, Age (yr)</th>
<th>Time between CABG and diagnosis (yr)</th>
<th>Number of bypassed vessels</th>
<th>Method of diagnosis</th>
<th>Course</th>
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<td>19</td>
<td>3</td>
<td>Cardiac CTA</td>
<td>Tracked anteriorly, superiorly then looped down into anterior chest</td>
<td>Arch, distal to the left subclavian</td>
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<tr>
<td>Osherov A, et al. (2013)</td>
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<td>Hailan A, et al. (2014)</td>
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<tr>
<td>Current</td>
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<td>Cardiac CTA</td>
<td>Tracked superiorly and anteriorly then looped into anterior chest</td>
<td>Arch, distal to the left subclavian</td>
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**Abbreviations:** Yr: Year, CABG: Coronary Artery Bypass Grafting; M: Male; NA: Not Applicable; CTA: Computed Tomographic Angiography
All the reported cases have been in men between ages of 56-72 years [4-7]. The earliest reported follow up angiography post CABG was 3.5 years [5] while two of the cases diagnosed the anomalous LIMA 19 years following the initial bypass surgery [6,7]. Two of the cases were diagnosed using non-selective angiography of the aortic arch using a pigtail catheter [4,5]. As for the other three cases, including ours, the diagnosis was clinched by cardiac CTA after failed attempts to access the LIMA during conventional catheterization [6,7]. CTA was capable of accurately defining the course of the LIMA from its anomalous origin on all reported cases [6,7]. All LIMAs initially tracked superiorly from their origin in the distal aortic arch before looping back towards the chest wall to assume their normal course lateral to the sternum within the posterior chest wall [4-7].

These cases illustrate the importance of identifying the exact origin and patency of the LIMA with either non-selective aortography or cardiac CTA prior to its utilization as an arterial conduit in CABG surgery to help avoid any potential problems related to graft access in the post-operative setting. More specifically, state-of-the art cardiac CTA technology may help reduce procedure time, excessive contrast utilization, and radiation exposure related to performing multiple non-selective aortogram during post-operative angiography to identify IMAs and other venous grafts.

REFERENCES