Coronary Steal Syndrome — Definition and Symptoms

An incongruous alteration in the flow of blood in the form of steal syndromes is a well-known complication of coronary artery bypass grafting (CABG). It might be discovered incidentally, that is during an ultrasonographic or angiographic examination performed for any other indications, or during the clinical examination, finding of reduced blood pressure or unilateral upper-limb pulse. Treatment mostly comprises of open subclavian artery revascularization, normally via carotid-subclavian bypass or subclavian artery transposition, and new less invasive options which are endovascular intervention with recanalization, angioplasty with stenting if needed.

Definition of Coronary Steal Syndrome

Coronary Subclavian Steal syndrome is a rare complication of coronary artery
**bypass graft.** It mostly occurs due to the **stenosis of the left sub-clavian artery** which is proximal to the left internal mammary artery, compromising of the myocardial blood flow.

It is mostly the result of a long-standing subclavian stenosis occurring due to the progression of the stenosis following Coronary artery bypass graft.

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**Epidemiology of Coronary Steal Syndrome**

Coronary artery disease (CAD) and peripheral artery disease (PAD) exhibit a very high prevalence rate and there is an increased morbidity and mortality of these diseases in the western world.

Patients having a history of coronary artery disease (CAD) and an earlier coronary **revascularization**, in this case, angina pectoris, are usually attributed to the progression of atherosclerotic lesions.

**Etiology of Coronary Steal Syndrome**

Etiologic factors which can lead to steal syndrome include **proximal subclavian artery occlusion or severe stenosis**. In the majority of cases, it is the result of atherosclerotic arterial disease, which mostly has dominance for the left side. On the right side, disease or occlusion of innominate artery can result in occlusion of the origin of subclavian artery.

**Risk Factors of Coronary Steal Syndrome**

Coronary steal syndrome mostly occurs when a patient is on certain types of **vasodilator drugs** like:

- Dipyridamole
- Adenosine
- Isoflurane
- Hydralazine
- Nitroprusside

**Risk factors** for developing atherosclerotic plaques are categorized as:

- Non-modifiable
- Modifiable

**Non-modifiable** risk factors include:

- Age
- Sex: Predominant in males
- Having a family history

**Modifiable** risk factors include:

- Habit of cigarette smoking
- Diabetes Mellitus
- Hypertension
- Hyperhomocysteinemia
- Hypercholesterolemia

**Less common causes** include:
- Inflammatory arteriopathies like Takayasu arteritis or giant cell arteritis
- Congenital anomalies
- Thoracic outlet compression syndrome

Pathophysiology of Coronary Steal Syndrome

It occurs by the **shunting of the well-oxygenated blood from a critical area of low perfusion to an area of low perfusion**. It is unique as it may be iatrogenic and can occur in the pharmacologic stress imaging, by using dipyridamole to induce vasoconstriction. This will lead to a fall in the blood flow to the subendocardium distal to the site of the stenosed coronary artery.

In severe proximal subclavian artery stenosis or occlusion, **insufficient blood flow may be present to withstand the ipsilateral arm** and may result in low pressure in the distal subclavian artery. In this case, branches of the subclavian artery may get engaged to provide collateral reverse flow to the upper limb. Reverse flow of blood in the vertebral artery assists as a collateral artery for the arm in this condition.

Through exercise, **distinctive and metabolite-induced vasodilation leads to a drop in peripheral resistance in the upper-limb vessels**. The gap between arterial inflow and the metabolic demand may result in arm claudication. Additionally, when there is an increase in the retrograde flow through the ipsilateral vertebral artery, it may “steal” blood away from the cerebral circulation.

Symptoms of Coronary Steal Syndrome

This syndrome is mostly **characterized by a retrograde flow of blood** from the Left Internal Mammary Artery (LIMA) to the left subclavian artery (SA) when a proximal left SA stenosis is present. Coronary Subclavian steal syndrome is mostly **asymptomatic**.

When it becomes symptomatic, the patients mostly experience:

- Upper extremity symptoms like pain in the arm or discomfort or paraesthesia
- Neurological symptoms, which include dizziness, blurry vision, syncope
- Relapse after initial improvement following CABG; it can be associated with the exercise of the left arm
- Recurrent feeling of angina after CABG
- Examination may reveal a difference in the radial pulse volume and subclavian bruits
- Vertigo — this is the most common presentation
Diagnosis of Coronary Steal Syndrome

Coronary Sub-clavian Steal syndrome is **always suspected in patients who have complain of recurrent angina pains** after having undergone coronary artery bypass graft with an ITA. All these patients should have a **bilateral pre-operative blood pressure measurement** done.

**Coronary steal syndrome can be diagnosed:**

- Detailed patient history
- Physical examination
- An intra-arm pressure difference
- Electrocardiogram
- Computed tomography angiogram (CTA)
- Coronary Angiography
- Stress testing with Myocardial perfusion Imaging (MPI)

Treatment of Coronary Steal Syndrome

Percutaneous intervention is considered the **first line of treatment** in case of Coronary Subclavian steal syndrome. These include:

- Endovascular approach along with percutaneous transluminal angiography (PTA)
- Peripheral stenting

These treatment approaches has **many advantages**, which include:

- A minimally invasive approach
- Shorter duration of stay in the hospital
- Less chances of morbidity
- Avoidance of general anaesthesia
- Speedy recovery
Surgical Treatment

Surgical intervention is considered to a very less degree. It consists of:

**Placement of a clip on the anastomotic channel or on the bypass of the channel** with a vein graft in order to induce occlusion.

**ECA endarterectomy or angioplasty/stenting** is performed in reputed to external carotid artery stenosis/occlusion. Indication for this include:

- **Ipsilateral transient ischemic attacks** (either hemispheric or ocular) in patients with ipsilateral internal carotid artery occlusion and severe stenosis of the external carotid artery.
- **Ipsilateral internal carotid artery occlusion** and moderate stenosis of the external carotid artery along with ulceration.
- **Ipsilateral transient ischemic attacks with a non-stenotic ipsilateral external carotid artery** and thrombus within the cul-de-sac of the occluded ipsilateral internal carotid artery.
- **Monocular amaurosis fugax** in patients with ipsilateral internal carotid artery occlusion and a micro embolic source in the external carotid artery origin or the occluded carotid sinus.

With the lack of any of these criteria, it is unambiguous for the patient to avoid undergoing a major surgical procedure.

**Revision using distal flow (RUDI)**: This procedure is performed in case of high flow cardiac failure, occurring due to brachial AV access. This method includes the closure of the anastomosis in the antecubital fossa and then interposing a graft between the forearm ulnar or radial artery. It has been seen that it can effectively reduce the flow by 50%.

**Proximalization of the Arterial Inflow (PAI)**: This method will help in enhancing the access flow.

**Distal revascularisation -interval ligation (DRIL)**: This is a complex and time-consuming procedure. It is mostly possible when a suitable vein can be harvested.

**Prognosis of Coronary Steal Syndrome**

Long-term patency is tremendous, with nearly 90% of patients being free of **restenosis** at 4 years' time. Long-term patency is approximately 94–97% at 20 months.

Endovascular approach with Percutaneous Transluminal Angioplasty (PTA) and stent placement in the subclavian artery has a very high success rate (80–100%) with close to 0% mortality rate. Most of the complications are attributed to the distal embolization and they mostly occur in 3–6% of cases.

**References**


L. Raposo, H. M. Gabriel, P. A. Gonçalves et al., "Coronary-subclavian steal syndrome;"


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