

# How to Deal with Graft Ischemia While Performing Colon Interposition for Esophageal Reconstruction

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## Abstract

The colon has become an effective and reliable graft for esophageal reconstruction. The in-depth knowledge of colon vascular anatomy is very essential to select an optimal graft. However, the colon interposition remains a surgical procedure associated with a high risk of graft ischemia. The graft ischemia is a dreaded complication which can impact the graft viability and the surgical outcomes. Various investigations have been used to assess graft blood supply and confirm the diagnosis of ischemia during colon interposition. Several strategies have been described to deal with this complication when it occurs intraoperatively. According to the patient conditions, the surgeon should be able to define the appropriate treatment strategy to deal with this complication. As colon interposition is a high-risk procedure, the preoperative identification of the risk factors, optimization of patient condition, and meticulous operative technique are required to reduce the risk of graft ischemia while selecting a colon graft for esophageal reconstruction.

**Keywords:** Esophageal reconstruction; Colon interposition; Ischemia; Management

## Introduction

Over time, the colon interposition has become a reliable therapeutic option after esophagectomy [1,2]. The selection of the optimal graft is conditioned by the blood supply adequacy and the reconstruction length. Based on vascular anatomic conditions of the colon; the selection of colon segment to be used as future graft is made intraoperatively. Therefore, when selecting a colon graft, the in-depth knowledge of colon vascular anatomy is very essential and helpful to select a graft with an optimal blood supply. However, colon interposition for esophageal reconstruction has been recognized to be a surgical procedure associated with a high risk of graft ischemia

[3,4]. The incidence of ischemia varied from 2 to 9, 6% [4-7]. Ischemia is a feared complication which can greatly affect the graft viability and surgical outcomes in absence of adequate treatment strategy. Several strategies have been described to deal with graft ischemia when it occurs during colon interposition procedure following esophagectomy. This brief report aims to address how to deal with graft ischemia and to reduce the risk of its occurrence during colon interposition.

## Causes and Risk factors

Compared to left colon interposition, the right colon interposition is associated with a high risk of graft ischemia [8,4]. The causes of graft ischemia includes the arterial or the venous drainage insufficiency, and the injury to the graft pedicle feeding while mobilizing or handling the selected colon segment [9]. Technical errors such as mismanagement of graft feeding pedicle by exerting an excessive traction, kinking of the pedicle when pulling up the graft to the neck or graft twisting can impair the graft blood supply [10]. The length of graft has been identified to be a risk factor [11] and ischemia was more frequent in long-segment grafting [11,12]. The persistent intraoperative hypotension can induce an arterial spasm with reduced tissue oxygenation and graft ischemia. Comorbid patients with diabetes, hypertension, low cardiac output, obstructive pulmonary disease, and atherosclerotic vascular disease have been found to be a high risk surgical patient to develop graft ischemia during colon interposition [13]. These comorbid factors are associated with an increased risk of graft ischemia by impairing tissue perfusion and oxygenation [13].

## Management Strategies

The blood supply and venous drainage of the graft should be assessed in the presence of the clinical signs of tissue hypoperfusion such as coloration changes, absence of palpable pulsation, or important venous congestion. Handled Doppler ultrasound and Fluorescence Imaging System (SPY) are the most used techniques in operative room to evaluate graft perfusion [5,9,13-15]. Once confirmed, the ischemia should be

managed adequately. So, several treatment approaches are available to deal with this complication intraoperatively. The first approach is to augment the arterial flow and venous drainage by adding microvessel anastomosis. Therefore optimizing arterial and venous blood flow by performing graft supercharging becomes necessary to salvage the graft if feasible. The graft supercharge was principally performed by anastomizing the graft mesenteric vessels to the left internal mammary artery. However, transverse cervical artery, branches of internal carotid, and internal or external jugular veins can be used as recipients in some cases. If graft perfusion was improved as ascertained by reappearance of adequate blood flow pulsation in the mesenteric arcade, presence of a vigorous peristaltic activity, and immediate clearance of congestion and cyanosis [16]. This vascular blood improvement can be confirmed by blood flow investigation techniques previously described. In such circumstances, the surgical procedure of colon interposition can be achieved.

On other hand, if graft supercharge is not technically possible, other approaches can be discussed with taking in consideration the risk factors, patient hemodynamic and operative time. In hemodynamically stable patient with less risk factors, if the operative time is relatively short, the surgical procedure of reconstruction can be completed by using another conduit after remove of the ischemic graft. However, if the operative time is too long with the presence of more risk factors, delaying reconstruction procedure is the more beneficial attitude. A diverting cervical esophagostomy and a feeding jejunostomy are performed after removing the ischemic graft. A further reconstruction should be considered by using another conduit. In case of hemodynamic instability of the patient, a damage-control strategy is highly recommended and it consists of excising of the ischemic graft, performing cervical esophagostomy and feeding jejunostomy and transferring patient to intensive care for optimization. In patient with delayed reconstruction, the further reconstruction can be considered once patient conditions have been improved. The stomach, colon (right or left) and jejunum graft can be used to establish the gut continuity. The substernal route is preferred for delayed reconstruction and opening the thoracic inlet is highly recommended when this approach is considered [4,8,11].

## Prevention+++

Colon interposition for esophageal reconstruction is associated with a high risk of graft ischemia. This type of surgery is technically demanding and being familiar with it is highly recommended to complete a successful surgical procedure and reduce the risk of ischemia. The prevention is the best way to prevent this feared surgical complication. There are three principal parameters to take in consideration while performing a colon interposition. Firstly, the preoperative identification of high-risk patient (comorbidities), and optimization of patient conditions are required before time of surgery. Secondly, meticulous surgical technique in selecting the colon segment is required to optimize graft blood supply and reduce the risk of ischemia. The good knowledge of

colon vascular anatomy and its variations is essential and helpful to select an optimal graft. The vascular anatomy of the colon is perfectly studied and weakness points are well defined such the terminal portion of the ileum and the Griffith point which corresponds to the anastomosis between branches of the middle and left colic arteries [17]. Therefore inspecting carefully the mesenteric blood vessels and selecting the colon segment which has less variation and less weak points of blood vessels are essential to prepare an optimal colon graft. Thirdly, when handling and pulling up the graft through mediastinal or substernal route, precaution is required to avoid twist, kicking and mechanical compression of graft feeding pedicle. As suggested by authors, When the substernal approach is used, opening the thoracic inlet is highly recommended by surgeons to avoid cervical compression of graft [4,11,18,19].

## Conclusion

The colon interposition for esophageal reconstruction remains a surgical procedure with high risk of graft ischemia. This surgical procedure is more demanding and being familiar with it is essential to decrease risk of ischemia. Several strategies have been described to deal with the graft ischemia occurred intraoperatively. The surgeon should choose the appropriate approach to deal with this complication. However, prevention is the best strategy, identification and optimization of the risk factors and meticulous operative technique are highly required to prevent graft ischemia.

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