Clinical Utility of Three-dimensional Computed Tomography for Esophageal Reconstruction using Colon Interposition after Gastrectomy

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Reconstruction after esophagectomy may represent a serious problem when a previous gastric resection has been performed. The colon is frequently used, but the marginal artery is of insufficient caliber to maintain the viability of a transposed colon. Three-dimensional computed tomography (3D-CT) provides abundant information about a patient’s anatomy without requiring an arterial puncture. We present a case in which 3D-CT was used. A 68-year-old man who had previously undergone a gastrectomy was diagnosed with esophageal cancer. 3D-CT showed that the left colic artery was straight and long and had a solitary branch from the inferior mesenteric artery. The vascular pedicle of the left colon was found during the operation to be in accord with the 3D-CT evaluation. The patient underwent a transthoracic esophagectomy, followed by reconstruction using left colon interposition. No anastomotic leakage or necrosis of the reconstructive colon occurred. (Kitakanto Med J 2012; 62: 143~146)

Key words: esophagectomy, three-dimensional computed tomography (3D-CT), gastrectomy, colon

Introduction

The first choice of material for reconstructive esophageal replacement after subtotal esophagectomy is the gastric tube. However, the stomach cannot be used in patients with a previous gastrectomy or a coincident gastric disorder, including gastric cancer and the invasion of esophageal cancer into the stomach.1 Many surgeons consider the colon to be appropriate for esophageal replacement following esophagectomy in patients with a history of gastrectomy. Preoperative angiography is used to evaluate arterial variations or abnormalities that may influence the choice of the colon or a vascular pedicle as the graft.2 Three-dimensional (3D) imaging with volume-rendering methods provides abundant information about a patient’s anatomy without requiring an arterial puncture. Three-dimensional computed tomography (3D-CT) angiography is performed by processing thin-slice CT scans using volume-rendering methods. Multidetector-row helical CT (MDCT) offers the latest advantages in CT technology by combining multiple rows of detectors and faster gantry rotation speeds.3 Previously, 3D-CT imaging was used most commonly in the preoperative planning of brain, maxillofacial, and orthopedic operations because it minimized motion artifacts during imaging.4 With recent advances in CT technology, 3D–CT imaging of the hepatic vein, portal vein, and intrahepatic bile duct has been used for the determination of surgical methods and the preoperative simulation of liver surgery.5–7 However, no published English-language studies to
date have examined the use of 3D–CT imaging to gain an understanding of the blood-vessel anatomy of a colon used for reconstruction in esophageal cancer patients.

We used MDCT and 3D–CT to investigate the vascular anatomy of the colon. Here, we present a case in which 3D–CT was used.

**Patient and Methods**

A 68-year-old man was diagnosed with esophageal cancer by upper gastrointestinal endoscopy (Fig. 1) during a routine medical examination. He had undergone a gastrectomy 42 years previously due to a gastric ulcer. We thus attempted to use colon interposition for esophageal reconstruction. We performed MDCT to evaluate arterial variations or abnormalities that would influence the choice of the colon or a vascular pedicle as the graft.

CT was performed using a 64-MDCT scanner (Aquilion; Toshiba Medical Systems, Tokyo, Japan) after colonoscopy; 0.5-mm slices were obtained in the arterial and portal venous phases using nonionic contrast medium (370mgI/ml; Iopamiron; Bayer Schering Pharma, Osaka, Japan). The contrast medium was infused into the medial cubital vein at a rate of 4 ml/s (40mgI/kg for 25s) using an automated injector. The arterial phase was scanned using a bolus tracking method and began when 200 Hounsfield units were detected in the abdominal aorta. The portal venous phase started 25s after the initiation of the arterial phase. Recorded volume data were transferred to ZioStation (Zio Software, Tokyo, Japan). The arterial and portal venous phase scans were merged, and 3D–CT images were then created by merging the arterial and venous angiography with the colonography (Fig. 2).

3D–CT images showed that the left colic artery was relatively straight and long and had a solitary branch from the inferior mesenteric artery, and the left colic artery had an ascending branch and show good

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**Fig. 1** Upper gastrointestinal endoscopy showed a type I tumor located 34–36cm from the incisors. 
A. Endoscopic findings of the tumor. 
B. Findings after Lugol staining.

**Fig. 2**
A. Three-dimensional computed tomography images were made by merging the arterial and venous angiography with the colonography.
B. Arterial angiography. SMA, superior mesenteric artery; IMA, inferior mesenteric artery; ICA, ileocolic artery; RCA, right colic artery; MCA-I, left branch of the median colic artery; LCA, left colic artery.
anastomosis with the middle colic artery. The Riolan bow existed, and the superior and inferior mesenteric artery systems connected. We thus decided to use the left colic artery as a vascular pedicle for the graft.

During surgery, we first opened the abdominal cavity to evaluate arterial variations or abnormalities that would influence our graft choice. The appearance of the vascular pedicle of the left colon was in accord with the 3D-CT evaluation. We then performed a transthoracic esophagectomy with a three-region lymphadenectomy, followed by reconstruction using left colon interposition with the left colic artery as the vascular pedicle. Pathological examination revealed a basaloid-squamous cell carcinoma (pT1b, pN0, M0, R0, pStage I) measuring 14×10mm (Fig. 3). No coexisting neoplastic lesion was found in the resected esophagus. No anastomotic leakage or necrosis of the reconstructive colon occurred. The patient was still alive and no recurrence had occurred after 21 months.

**Discussion**

The relationship between previous gastrectomy and the subsequent occurrence of a primary malignant esophageal tumor remains controversial. Maeda et al.\(^8\) reported that 12/129 (9%) patients surgically treated for esophageal cancer had previously undergone partial gastrectomies. Reconstruction after esophagectomy may represent a serious problem when a previous gastric resection has been performed. The colon or jejunum are most frequently used. However, the marginal artery is often of insufficient caliber to maintain the viability of a transposed colon.\(^9\) In such reconstructions, the rates of necrosis (0-7.6%) and anastomotic leakage (4-10.4%) in the colon are higher than those in the stomach.\(^10\) It is important to understand the anatomy of the colonic blood vessel and the resected parts of the colon and blood vessel before operation. Adequate blood flow in the colon must also be confirmed during the operation.

The use of a supercharging technique in colon interposition prevents the most serious complication of necrosis of the pedicled colon due to insufficient blood supply.\(^9\) However, this technique requires microvascular anastomosis, which is a complicated procedure that many surgeons find difficult to perform.

In left-sided colic reconstruction, the following three factors are important: 1) the inferior mesenteric artery must exhibit probe patency; 2) the left colic artery must have an ascending branch and show good anastomosis with the middle colic artery; and 3) the Riolan bow must exist, and the superior and inferior mesenteric artery systems must connect.\(^10\)

Our esophageal cancer patient had previously undergone a partial gastrectomy. Previous gastrectomy often causes strict adhesions between the mesocolon and adjacent organs, making it difficult to use the colon for reconstruction. However, reconstruction has been achieved using the left colon without microvascular anastomosis. At the end of the procedure, the interposed colon appeared macroscopically to have an adequate blood supply. 3D-CT angiography was sufficient for the anatomical evaluation of the colonic arteries and the communication between the marginal colonic arteries. This information is useful in the preoperative planning of vascular dissection and additional microvascular anastomosis. Thus, 3D-CT angiography is an easy, less invasive alternative to conventional angiography for the evaluation of esophageal reconstruction using the colon.
References


