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Case Report

Anomalous origin of the middle colic artery from the ileocecal artery affecting laparoscopic ascending colon cancer resection ☆☆☆

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ABSTRACT

The anomalies of the middle colic artery have rarely been reported and reviewed in literature. However, in case such anomalies are observed in clinical practice, surgery must still be performed safely. This report presents the case of a 78-years-old female who underwent ileocecal resection and hepatectomy due to ascending colon cancer with liver metastasis. Preoperative abdominal contrast-enhanced computed tomography showed an anomaly of the middle colic artery. Since such anomaly is extremely rare, preoperative evaluation of vascular structure is important for safely performing the surgery.

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Introduction

Vascular abnormalities are very important and interesting not only in terms of embryology and surgical anatomy but also from a clinical and surgical standpoint. Laparoscopic surgery is widely performed in cases of colorectal cancer surgery, and the anatomical understanding of the abdominal cavity is

consequently extremely important [1–12]. In particular, in right-sided advanced stage colon cancer surgery, it is very important to be aware of the vascular structures around the surgical trunk in order to perform complete mesocolic excision [13–17] with D3 lymphadenectomy, as there are many variations around the surgical trunk that can cause massive bleeding when subjected to inappropriate surgical procedures [18].

Many patterns of venous structure around the surgical trunk have been reported, but arterial variation is rarely

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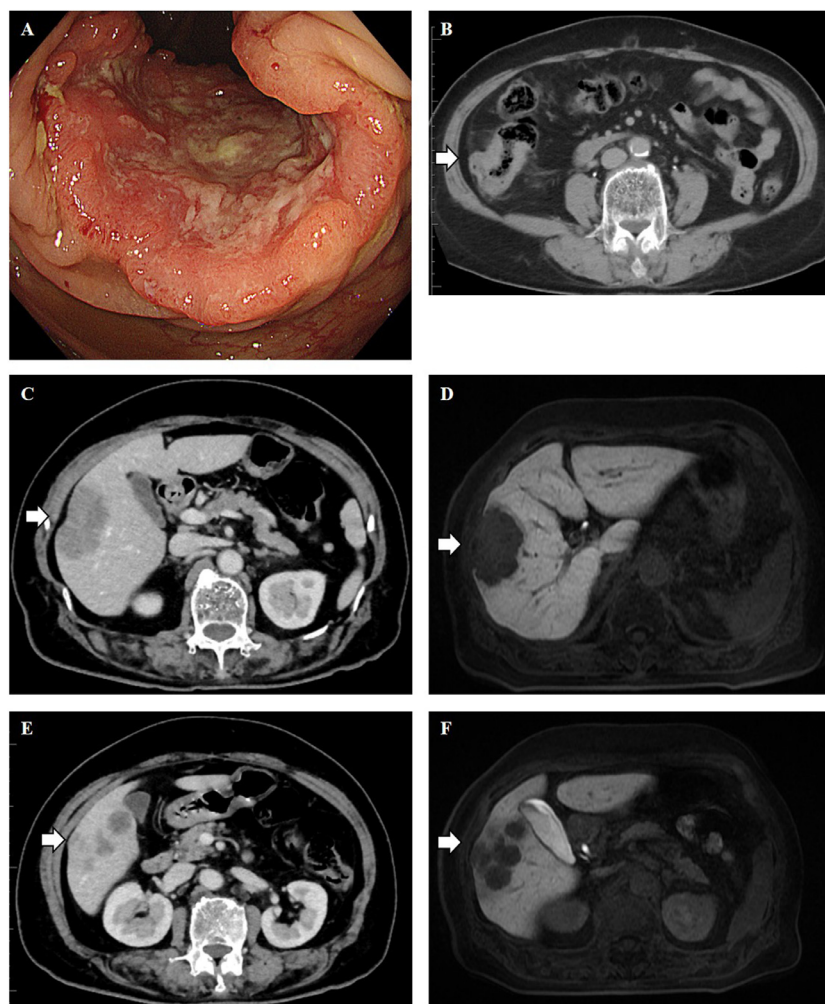


Fig. 1 – (A) A subcircumferential type II tumor in the ascending colon. **(B)** CT revealed a subcircumferential tumor, wall thickening and extraserosal invasion in the ascending colon (white arrow). **(C)** CT showed liver metastases measuring about 60 mm in segments 5/8 (white arrow). **(D)** MRI findings of segment 5/8 metastasis (white arrow). **(E)** CT showed liver metastasis measuring about 20 mm in segment 5 (white arrow). **(F)** MRI findings of segment 5 metastasis (white arrow).

reported [1–12]. We experienced a very rare case of abnormal branches of the superior mesenteric artery (SMA). In this case, three main branches of the SMA (ileocolic artery [ICA], right colic artery [RCA], and middle colic artery [MCA]) arose from a common trunk of the SMA. The present case had stenotic advanced stage ascending colon cancer with synchronous liver metastasis, and both the primary tumor and liver metastases were resectable, so we performed ileocecal resection with D3 lymphadenectomy and partial hepatectomy. There were no particular issues with the postoperative course, and the patient was discharged postoperative day 10.

We herein report a rare case of abnormal branches of the SMA. This work has been reported according to the SCARE criteria [19].

Case presentation

A 78-year-old woman was admitted to our hospital for a detailed examination of anemia (hemoglobin 8.4 g/dL). She had a medical history of diabetes and no surgical history.

The serum level of carcinoembryonic antigen was elevated to 76.4 ng/mL (reference value <5.0 ng/mL), and the carbohydrate antigen 19-9 (CA19-9) level was within the normal range. Colonoscopy showed a subcircumferential type II tumor in the ascending colon (Fig. 1A). The histopathologic diagnosis of the tumor biopsy specimen revealed moderately differentiated adenocarcinoma. Contrast-enhanced computed tomography (CT) revealed a subcircumferential tumor of 5.0 × 5.0 cm in the ascending colon with increasing density of the surrounding adipose tissue and enlarged regional lymph nodes (Fig. 1B). Therefore, we diagnosed this tumor as having extraserosal invasion (T4a) and regional lymph node (N1a).

CT and magnetic resonance imaging (MRI) revealed liver metastases of 60 mm in segments 5/8 and 20 mm in segment 5 of the liver (Fig. 1C-F). There were no distant metastases other than those in the liver. We classified the tumor as cT4aN1aM1a cStageIV A (the TNM Classification of Malignant Tumors, 8th Edition). We planned to perform simultaneous resection of the ascending colon cancer and liver metastases, and the operative procedures were ileocecal resection with lymphadenectomy, anterior segmentectomy and partial hepatectomy.

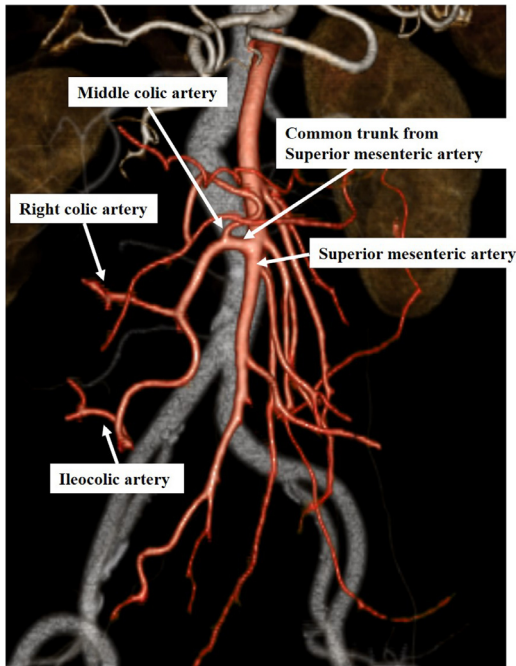


Fig. 2 – CT angiography showed that the middle colic artery (MCA), right colic artery (RCA) and ileocolic artery (ICA) had arisen from a common trunk of superior mesenteric artery (SMA).

In addition, CT revealed a vascular abnormality of the MCA, as the 3 colic arteries (ICA, RCA, and MCA) arose from a common trunk (Fig. 2). This vascular abnormality is extremely rare, and there are no similar reports in the literature. In order to perform complete mesocolic excision, we needed to ligate the root of the common trunk. We decided to preserve the MCA, as ligation of the common trunk would likely result in an inability to maintain the blood flow of the transverse colon. In this case, we had to preserve the MCA in order to maintain the intestinal blood flow.

The intraoperative findings revealed no peritoneal dissemination. First, we performed ileocecal resection with D3 lymphadenectomy before liver resection. Vascular bifurcation of the colic artery was performed as shown in Figure 3. As noted on preoperative CT, the MCA, RCA, and ICA all branched from a common trunk. The arterial common trunk was removed just after the MCA branched. The ileocolic vein (ICV) was removed at the bifurcation of the superior mesenteric vein (SMV). After the mesentery had been removed, anastomosis was performed in a layer-to-layer approach. Next, anterior segmentectomy was performed. Lesions suspected of having metastasized were observed at segments 2, 3, 4 and 6 on ultrasonography and also partially removed (Fig. 4).

The resected specimens showed a 70 × 35-mm mass in the ascending colon that was diagnosed as moderately differentiated adenocarcinoma. The tumor had invaded beyond the proper muscular layer (T3). A total of 23 lymph nodes were dissected, but no metastases were found (N0). The resected liver specimens revealed a well-defined 70 × 70-mm mass. The liver tumor was histologically diagnosed as metas-

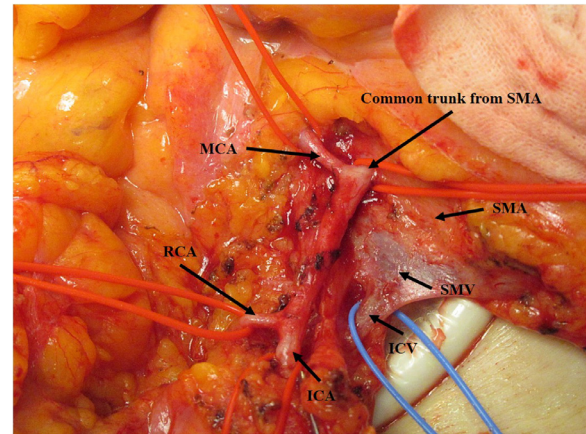


Fig. 3 – Intraoperative findings, middle colic artery (MCA), right colic artery (RCA), and ileocolic artery (ICA) bifurcated from a common trunk of the superior mesenteric artery (SMA). The ileocolic vein (ICV) was ligated just after it diverged from the Superior mesenteric vein (SMV). Lymph node dissection was performed with preservation of the MCA.

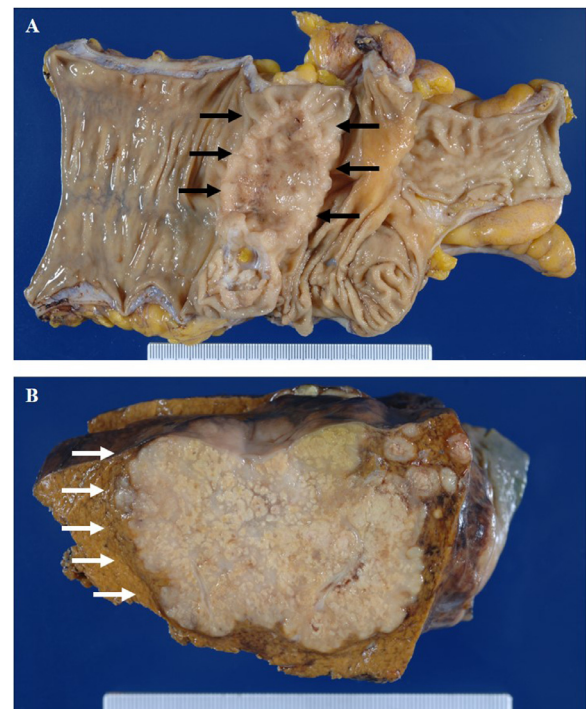


Fig. 4 – (A) The ascending colon tumor was 70 × 35 mm in size (black arrow). Histologically, the tumor was diagnosed as moderately differentiated adenocarcinoma. The depth of tumor invasion was beyond the proper muscle layer. No regional lymph node metastasis was detected. (B) The liver tumor was a well-defined 70 × 70-mm mass (white arrow). Histologically, the tumor was metastasis of the ascending colon cancer. The resected margins were tumor-negative.

tasis of ascending colon cancer. The hepatic resection margins were tumor-negative. We classified the ascending colon cancer as *T3N0M1a* *fStage:IVA* (TNM Classification of Malignant Tumors, 8th Edition).

The patient attends the outpatient department at our hospital for follow-up care, with no signs of recurrence at present (6 months after the operation).

Discussion

The anatomy of the right-sided colon vessels varies greatly from case to case. In surgery for right-sided colon cancer, vascular damage can lead to intraoperative bleeding and the emergence of other complications and should be performed with caution. Previous studies have reported variations in the vascular anatomy of the right colon, highlighting its importance and recognizing that failure to be aware of vascular variations preoperatively can sometimes lead to fatal bleeding [20]. However, most of these evaluations of vascular variants concerned the venous system, and few reports have evaluated arterial variants.

Most reports on variations in the right-sided colic artery dealt with the origin and defects of each branch. The ICA was seen in 99.8% of cases, running posterior to the SMA in 57.4% and anterior to the SMA in 42.6% of cases [21–23]. It is estimated that the RCA is present in 60%–80% of cases, with most deficiencies reported in RCAs [21–24]. Variations in the origin of the RCA are also common, with 40%–71% from the SMA, 12%–14% from the ICA, and 15%–30% from the MCA [21]. There are almost no cases of deficiency of the MCA, but variations in its origin have been reported [25]. Most MCAs diverge from the SMA (78.7%), followed the RCA (17.8%) and then the ICA, left colic artery, inferior pancreaticoduodenal artery, hepatic artery, splenic artery, and celiac trunk (all frequencies <1%) [21,22]. Furthermore, there is variation in the number of MCAs, with 89% of cases having a single MCA, 10% having 2 MCAs, and 1% having 3 MCAs [21].

Gamo et al. reported on the variations in the branches of the right-sided colonic artery, categorizing the branching patterns from SMA to I–IV along with their frequency [25]. The MCA, RCA, and ICA each diverge independently from the SMA in pattern I, while the RCA is absent in pattern III, and an accessory RCA is present in pattern IV [25]. Pattern II is subdivided into three subdivisions of IIa to IIc. The MCA and RCA diverge from the SMA as a common trunk in pattern IIa, and the ICA and RCA form a common trunk in pattern IIb. In pattern IIc, the MCA, RCA, and ICA diverge from the common trunk. The present case falls within this classification, which shows a frequency of 0%–0.35% [25].

In right-sided colon cancer surgery, understanding the vascular anatomy is very important for preventing bleeding complications. The venous anatomy is usually discussed in great detail, but the present case showed abnormal bifurcation of the colonic artery. When all of the colonic arteries bifurcate from the common trunk, as in the present case, vascular ligation associated with lymph node dissection must be carefully performed. In order to perform en bloc resection of the lymph nodes, the vessels are usually ligated just after the bi-

furcation from the SMA, but in cases with an abnormal bifurcation pattern, such as in our case, it is necessary to selectively treat the vessels in order to ensure an adequate blood flow to the remaining intestinal tract. In the present case, the MCA was preserved because we believed it was necessary in order to maintain the blood flow to the transverse colon region.

A detailed preoperative evaluation of the CT images in the present case allowed us to identify abnormalities in the colic arterial structure and perform the surgery safely. However, an intraoperative vascular evaluation is necessary in cases where preoperative multidetector-row CT cannot be performed, such as in patients with kidney dysfunction. In recent years, modalities such as indocyanine green (ICG) have been widely used for the intraoperative evaluation of the intestinal blood flow [26–30]. Although ICG was not used in the present case, it may have been useful for assessing the residual intestinal blood flow had we performed common trunk ligation, which would have allowed us to ligate the common trunk and perform en bloc dissection of the regional lymph nodes without damaging the mesentery. Thus, preoperative and intraoperative vascular assessments are necessary in order to perform surgery safely.

Conclusion

In the present study, we experienced a case of advanced stage ascending colon cancer with a unique vascular bifurcation pattern. A careful preoperative evaluation of the CT images allowed us to identify the unique vascular bifurcation and perform the operation safely. Preoperative imaging evaluations, including assessments of the vascular anatomy, are very important for preventing perioperative and postoperative complications, and the vascular anatomy should be ascertained on CT whenever possible. In the future, intraoperative evaluations using ICG and other techniques should be performed in addition to preoperative evaluations in order to perform surgery safely.

Ethical approval

A case report is exempt from ethical approval in our institution.

Patient consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author contribution

SM drafted the article. YS and TF had revised the manuscript critically. TB, TM, YN, SO, KO were assistants of operation. TN

revised the histopathological findings. EH and HO were supervision of this manuscript. All authors contributed to study concept or design at this submission and approved the final version.

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