

Superior mesenteric vessel anatomy features differ in Russian and Chinese patients with right colon cancer: computed tomography-based study

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To the Editor: The literature has registered a considerable interest among Western surgeons in the role of extended lymph node dissection in right hemicolectomy. There are a lot of voices of dissent regarding the harvest of nodes lying dorsally to the superior mesenteric vein (SMV) and superior mesenteric artery (SMA).^[1]

The colic branches of the SMA are usually represented by the ileocolic artery (ICA), middle colic artery (MCA), and right colic artery (RCA). The latter was present in 60.0% (95% confidence interval 0.454–0.741) patients.^[2] The position of SMA branches in relation to the SMV plays a key role in safe D3 lymph node dissection. Reaching the origin of SMA branches is technically more difficult if they lie dorsally to the SMV.

Computed tomography (CT) is a reliable method for evaluating the involvement of adjacent structures and detecting metastasis in the liver, lungs, or other organs. It is recommended as a part of the pre-operative assessment of colon cancer.^[3] CT scanning with intravenous contrast makes it possible to perform a thorough study of the anatomy of colon vessels.^[4]

Anatomical variations have been evaluated by researchers from Asia, Europe, and North America, and their findings suggest that some ethnic differences could exist among groups.^[5] Nevertheless, the literature lacks a direct comparative study regarding the vascular anatomy of the right colon in different ethnicities.

The purpose of this study was to compare the frequency of SMA branches and variants of relative position with respect to SMA and SMV in Russian and Chinese patients.

A retrospective analysis was carried out on prospectively collected data of all consecutive right colon cancer patients who underwent laparoscopic or robotic right hemicolectomy with D3 lymph node dissection at the Beijing Clinic, China and Moscow Clinic, Russia, between 2016 and 2018. All human studies have been reviewed by the appropriate ethics committee and have, therefore, been performed in accordance with the ethical standards laid down in an appropriate version of the 1965 *Declaration of Helsinki*. Right colon cancer was defined as cancer located in the appendix, cecum, ascending colon, or hepatic flexure. Patients who had previously undergone major abdominal resections by laparotomy or whose CT scans were unclear or incomplete were excluded.

MCA was defined as the most cranial artery arising from the SMA and supplying to the transverse colon. The ICA was considered the most caudal colic branch of the SMA that supplies to the cecum, ileum, and appendix.

RCA supplies to the ascending colon. For the purposes of this study, we defined the RCA as a vessel originating directly from the SMA between the ICA and MCA. However, this vessel reportedly has other types of origin, for example, a common trunk with either the MCA or the ICA; in this study, these types of vessel branching were not regarded as RCA. Cases where RCA as a separate trunk

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originating from the SMA could not be found were recorded as “RCA missing.” Cases where MCA as a separate trunk originating from the SMA could not be found were recorded as “MCA missing.”

Considering that the MCA always runs ventrally to the SMV, whereas RCA and ICA can run either ventrally or dorsally to the SMV, six types of arterial-venous interactions were defined. Therefore, two major types of vessel interactions were defined based on ICA position: Type Ia-ICA lies ventrally, RCA is absent, and MCA lies ventrally; Type Ib-ICA lies ventrally, RCA lies ventrally, and MCA lies ventrally; Type Ic-ICA lies ventrally, RCA lies dorsally, and MCA lies ventrally; Type IIa-ICA lies dorsally, RCA is absent, and MCA lies ventrally; Type IIb-ICA lies dorsally, RCA lies dorsally, and MCA lies ventrally; Type IIc-ICA lies dorsally, RCA lies ventrally, and MCA lies ventrally.

Qualitative data were analyzed with a Chi-squared test, Fisher exact test (two samples, unpaired), or the McNemar test (two samples, paired). The Wilcoxon signed-rank test (two samples, paired) with correction for ties was used for quantitative data.

A total of 260 (130 from the Russian center and 130 from the Chinese clinic) CT scan images were analyzed. In the Russian group, men and women were distributed almost equally (66 and 64, respectively, $P = 0.861$), while in the Chinese group, men predominated the women (78 and 52, respectively, $P = 0.022$). Chinese patients were younger (58.8 ± 10.9 years, range: 27.0–84.0 years) than Russian patients (64.2 ± 13.1 years, range: 24.0–93.0 years), but not significantly ($P = 0.752$). Body mass index did not significantly differ between the groups: 24.38 and 24.42 ($P = 0.971$) in Russian and Chinese male patients and 25.02 and 24.97 ($P = 0.936$) in Russian and Chinese female patients, respectively.

The patterns of SMA branching and the relationship between the SMA branches and SMV are presented in

Table 1. All patients in the Russian group had ICA and MCA, whereas in two Chinese patients (1.5%), MCA was absent. RCA was significantly more frequent in the Chinese group than that in the Russian group (44.6% vs. 30.8%, $P = 0.020$). A major difference was observed in the predominant position of the ICA with respect to the SMV. In the Chinese group, the distribution of dorsal and ventral positions of the ICA was almost equal. In the Russian patients, there was a definite predominance of dorsal position over ventral position of ICA in relation to SMV (63 and 67; 83 and 47, respectively, $P = 0.013$), with the most common distribution of the patients within the groups tending to Type IIa (43.8% in the Russian group). There were no significant differences between Russian and Chinese patients in terms of distribution to either type of SMA branching, except for Type IIa.

This is a rare study to directly compare Russian and Chinese patients in terms of the vascular anatomy of the right colon. We discovered that Chinese patients have RCA coming as a separate trunk from the SMA significantly more often than Russian patients. Russian patients have SMA branches lying beneath the SMV significantly more often than Chinese patients. These findings suggest that certain ethnic differences may exist in the anatomy of the right colon vessels. These dissimilarities may influence the course and results of extended lymph node dissection for right colon cancer.

D3 lymph node dissection for right colon cancer is a technically demanding procedure, and to perform a complete removal of all tumor-related lymph nodes, it is essential to access the trunk of the SMA and clearly visualize its colonic branches to remove all the fatty and lymphatic tissues around their origins.^[6] Consequent to possible anatomical variations, a surgeon may face intraoperatively different situations, from the most frequent one with branches of SMA lying above SMV and ICA and RCA roots being freely accessible, to a more

Table 1: Branching of SMA and relationship of SMA branches to SMV.

Branching variant	Russian group (n = 130)	Chinese group (n = 130)	P
RCA			
Present (arises as a separate trunk from SMA)	40	58	0.020
Absent (absent or arises from either ICA or MCA)	90	72	
MCA			
Present	130	128	0.156
Absent	0	2	
ICA related to SMV			
Type I	47	67	0.012
Type II	83	63	
SMA branches related to SMV			
Type Ia	33	40	0.335
Type Ib	14	25	0.057
Type Ic	0	2	0.156
Type IIa	57	32	0.002
Type IIb	7	6	0.776
Type IIc	19	25	0.322

Types Ia, Ib, Ic, IIa, IIb, and IIc are defined according to the description in the text. ICA: Ileocolic artery; MCA: Middle colic artery; RCA: Right colic artery; SMA: Superior mesenteric artery; SMV: Superior mesenteric vein.

complex case when SMA branches are running beneath the SMV, RCA is missing, and ICA root is lying under SMV. These characteristics may affect the oncological outcomes in patients with right colon cancer.^[7]

The largest meta-analysis of 45 Western and Eastern studies estimated the pooled prevalence of SMA branches.^[5] ICA and MCA are the most commonly reported branches of SMA, found in 99.8% and 94.6% of all cases, respectively, and RCA was present in only 60.1% of the studied patients. However, this meta-analysis included both CT scan-based and cadaveric studies. Four trials of this meta-analysis were focused on the CT anatomy of the SMA.^[4-7] From these trials, it can be observed that Eastern populations might have a higher prevalence of RCA (as a separate branch of SMA) than Western populations. The results of our study are generally in line with these data, since in the Chinese group, the RCA (as a distinct trunk coming of SMA) was found in 44.6% of cases, while in the Russian group, it was only 30.8%.

Our results suggest that at least half and up to two-thirds of Western patients might have their ICA lying dorsal to the SMV. Conversely, Japanese and Chinese data showed that ICA is most commonly ventral to the SMV. In fact, it is technically easier to achieve a complete D3 lymph node dissection in circumstances where the ICA lies ventrally to the SMV than that in circumstances where the ICA lies dorsally to the SMV. In the first case, to clear off the origins of the SMA branches, a surgeon needs to gradually dissect the anterior leaf of the mesentery right over the SMA, identify its branches and divide them, move the lymphatic tissue surrounding the stumps to the specimen side, identify and divide the corresponding SMV branches, and thereafter, divide the dorsal leaf of the mesentery. Cases in which the ICA is located behind the SMV require meticulous dissection skills and great care; for example, taking out the lymph nodes around the SMA branches beneath the SMV is technically difficult and may cause intra-operative morbidity. To obtain access to SMA branches' origins in these patients, the surgeon needs to manipulate the SMV by moving it medially to reach the trunk of the SMA. Based on our findings and the results of other studies, a larger number of Western patients, as compared to Eastern populations, have their ICA behind the SMV, and are associated with a more difficult procedure than Eastern patients. Without studying the vascular anatomy of the right colon before the operation, Western surgeons tend to face more difficulties in executing D3 lymph node dissection than Eastern surgeons because of higher prevalence of surgically challenging anatomic variations in the right colon vessels.

The limitations of our study are due to its retrospective nature and lack of intraoperative checking of the vascular anatomy. However, we included all consecutive patients

treated during the same period in two major national centers for colorectal cancer. We decided to study only right colon cancer patients to exclude any possible variations in right colon anatomy between otherwise healthy subjects and those with right colon cancer. With regard to the lack of intraoperative checking, previous studies have demonstrated that CT reconstruction is a reliable tool to study the variants of SMA and SMV branching, as compared to intraoperative direct visualization.^[4]

Chinese and Russian patients with right-sided colon cancer, representing Eastern and Western ethnic groups, have different patterns of SMA branching. Compared to the Russian population, Chinese patients had a higher prevalence of RCA. The ICA is more often located ventrally to the SMV. These findings suggest that a higher number of Russian patients have surgically challenging variants of SMA branching.

Conflicts of interest

None.

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