J Surg Med. 2023;7(10):656-659.
DOI: 10.28982/josam.7980

Research article

Journal of Surgery and Medicine
e-ISSN: 2602-2079
https://jsurgmed.com/

Evaluation of inferior mesenteric vein drainage patterns in the Turkish population: A multidetector computed tomography study

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Abstract

Background/Aim: The inferior mesenteric vein (IMV) plays a crucial role in the venous system as it joins the superior mesenteric vein (SMV) and splenic vein to form the portal vein. The widespread adoption of multidetector computed tomography (MDCT) has greatly enhanced our ability to assess abdominal vascular structures. This study aimed to investigate the IMV drainage patterns in a Turkish population using MDCT.

Methods: This descriptive, single-center, retrospective study included patients who had undergone abdominal computed tomography (CT) in the portal phase at our hospital for various clinical indications. Excluded from the study were patients who did not undergo imaging in the portal venous phase, those with incomplete evaluation of all IMV segments, and individuals who had undergone pancreaticoduodenal or intestinal surgery for any reason. We retrospectively analyzed a total of 877 contrast-enhanced MDCT examinations performed at our hospital between March 2022 and March 2023. Patients were classified based on their IMV drainage patterns into the following categories: type 1 (drainage into the splenic vein), type 2 (drainage into the SMV), type 3 (drainage at the junction level), type 4 (drainage into the branches of the SMV), and type 5 (patients in whom IMV assessment was not possible).

Results: The mean age of the patients was 48.7 years (range: 24–92 years), with 449 (51.2%) being male and 428 (48.8%) female. The distribution of patients according to IMV drainage patterns was as follows: type 1, n=379 (43.2%); type 2, n=398 (45.4%); type 3, n=71 (8.1%); type 4, n=15 (1.7%); and type 5, n=14 (1.6%).

Conclusion: Our study findings indicate that in the Turkish population, the IMV predominantly drains into the SMV before joining the splenic vein. This disparity from certain studies in the literature underscores the variability in IMV drainage patterns, emphasizing the importance of individualized patient evaluation in this regard.

Keywords: inferior mesenteric vein, computed tomography, variation

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Ethics Committee Approval
The study was approved by the local ethics committee of Kocaeli Health and Technology University (no:2023-54, date: August 2, 2023). All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

Conflict of Interest
No conflict of interest was declared by the authors.

Financial Disclosure
The authors declared that this study has received no financial support.

Published
2023 October 6

How to cite: Yılmaz K. Evaluation of inferior mesenteric vein drainage patterns in the Turkish population: A multidetector computed tomography study. J Surg Med. 2023;7(10):656-659.

Introduction

The inferior mesenteric vein (IMV) is a significant venous structure that combines with the superior mesenteric vein (SMV) and splenic vein (SpV) to create the portal vein (PV). The IMV is responsible for draining the superior rectum, sigmoid colon, and descending colon, but its venous drainage pattern exhibits variability. Anatomical references related to PV structures primarily focus on the SMV and SpV, offering limited information about the IMV, except for its common drainage into the SpV [1]. Nevertheless, recent studies have revealed that the IMV can also merge and discharge into the SMV, the junction between the SpV and SMV, or other mesenteric venous drainage regions [2,3].

A thorough comprehension of portal venous drainage is crucial for preventing bleeding and postoperative gastric congestion in procedures concerning the pancreaticoduodenal region. It is also vital for assessing the intestinal segments that may be affected in cases of mesenteric venous thrombosis. The study of IMV changes through cadaveric investigations is hampered by the scarcity of cases, limiting the ability to conduct comprehensive evaluations on a larger scale. However, the widespread adoption of multidetector computed tomography (MDCT) has greatly facilitated the assessment of abdominal vascular structures [4].

This study aimed to assess the IMV drainage patterns within the Turkish population using MDCT.

Materials and methods

The descriptive study received approval from the local ethics committee of Kocaeli Health and Technology University (Approval Number: 2023-54, Date: August 2, 2023). Prior to commencing the study, a minimum sample size of 774 was determined through power analysis, ensuring a power of 0.8 and a significance level of 0.05.

Retrospectively, a total of 877 contrast-enhanced MDCT examinations conducted at our hospital between March 2022 and March 2023 were assessed. The study included patients who underwent abdominal computed tomography (CT) in the portal phase for any medical indication at our hospital. Patients who did not undergo imaging in the portal venous phase, cases where evaluation of all segments of the IMV was not feasible, and individuals who had undergone pancreaticoduodenal or intestinal surgery for any reason were excluded from the study.

All participants in the study shared Turkish ancestry. Data regarding the age and gender of each patient were meticulously documented. The assessment of IMV drainage involved a comprehensive evaluation of all segments of this structure within abdominal CT images.

Based on their respective IMV drainage patterns, the patients were categorized into the following groups: Type 1: Drainage into the splenic vein (Figure 1); Type 2: Drainage into the SMV (Figure 2); Type 3: Drainage occurring at the junction between the splenic vein (SpV) and SMV (Figure 3); Type 4: Drainage into the branches of the SMV.

Furthermore, cases where assessment was possible for the distal segments of the IMV while the proximal segments remained unassessable, as well as instances where IMV evaluation was unachievable despite the availability of a portal phase, were classified as type 5.

Figure 1: Curved planar reformatted multiplanar reconstruction multidetector computed tomography image of a 45-year-old male patient, showing that the inferior mesenteric vein drains into the splenic vein, consistent with type 1 drainage pattern (arrow).

Figure 2: Curved planar reformatted multiplanar reconstruction multidetector computed tomography image of a 52-year-old female patient, showing that the inferior mesenteric vein drains into the superior mesenteric vein, consistent with type 2 drainage pattern (arrow).

Figure 3: Curved planar reformatted multiplanar reconstruction multidetector computed tomography image of a 37-year-old female patient, showing that the inferior mesenteric vein drains at the junction level, consistent with type 3 drainage pattern (arrow).

Images were acquired utilizing a Siemens Somatom Definition 128-MDCT device based in Erlangen, Germany. All examinations were conducted with a detector configuration of 128x0.6 mm, employing a tube potential of 120 kVp. Additionally, automatic tube current modulation (CARE Dose, Siemens) was activated to optimize radiation exposure.

A contrast-enhanced triphasic examination, encompassing arterial, portal, and venous phases, was administered to all patients. For contrast injection, a 21-G intravenous line was inserted via the medial cubital vein. The MDCT examination scope was precisely adjusted to encompass the region from the liver to the pelvic inlet.

Non-ionic iodinated contrast material (300 mg I/mL, Omnipol, Polifarma, Istanbul, Turkey) was administered using an auto-injector (Medrad Stellant CT Injection System, Bayer HealthCare, The Netherlands). The arterial phase was initiated with the bolus tracking method when a threshold of 200 Hounsfield units was reached at the level of the abdominal aorta. The time interval between the initiation of contrast material injection and the commencement of the arterial phase was 25 s. Subsequently, the portal phase and venous phase were triggered 15 s and 30 s after the initiation of the arterial phase, respectively.

The imaging data were transferred to a dedicated workstation (Syngo.via, Siemens, Erlangen, Germany). Multiplanar reconstruction (MPR) images were generated from the portal phase images, and the drainage pattern of the IMV was identified on these reconstructed images.

Statistical analysis

Statistical analysis was conducted using MedCalc (version 12, Ostend, Belgium). Descriptive statistics were presented as the mean (standard deviation), while categorical variables were expressed as frequencies and percentages.

Results

The study included CT images from a total of 877 patients. The mean age of these patients was 48.7 years (SD=24). Out of the patients, 449 (51.2%) were male, while 428 (48.8%) were female. The distribution of patients based on their IMV drainage patterns was as follows: type 1, n=379 (43.2%); type 2, n=398 (45.4%); type 3, n=71 (8.1%); type 4, n=15 (1.7%); and type 5, n=14 (1.6%). A convergence of the IMV with the SMV and its branches (type 2 and type 4 junction) was observed in 413 (47.1%) patients (Table 1).

Table 1: Distribution of patients according to their inferior mesenteric vein drainage patterns.

	n	%
Type 1	379	43.2
Type 2	398	45.4
Type 3	71	8.1
Type 4	15	1.7
Type 5	14	1.6

Discussion

The most significant outcome of our study reveals that the IMV most commonly drained into the SMV within the Turkish population. In a study conducted by Krumm et al. [5] involving 916 patients, they reported that the IMV drained into the splenic vein (SpV) in roughly 40% of the cases, into the portal junction in approximately 30%, and into the SMV in about 20%. Another study by Graf et al. [6], which assessed mesenteric venous anatomical variations in a total of 54 patients, revealed that the IMV drained into the SpV in 56% of the cases and into the SMV in 26%. In a separate investigation, Sakaguchi et al. [4] examined mesenteric venous patterns in 102 patients, reporting that the IMV converged with the SpV in 68.5% of cases, with the SMV in 18.5% and with the SMV in 18.5%. In a study involving 66 patients, Arimoto et al. [7] observed that the IMV drained into the SpV in 48.5% of cases and into the SMV in 40.9%, a finding that closely mirrors our own. These variations in results among these studies can be attributed to the diverse populations on which the studies were conducted.

The MDCT technique plays a pivotal role in assessing the IMV. Our MDCT protocol entails imaging 70 s after the administration of 150 ml (300 mg/dl) of iodinated contrast material, facilitated by an auto-injector (3–5 ml/h). Curved multiplanar reconstruction (MPR) images prove particularly valuable for IMV evaluation, given the considerable variability in its course and the challenges associated with visualizing the entire structure in thin coronal reformatted Minimum Intensity Projection (MIP) images. We recommend a slice thickness of less than 10 mm for MPR images, while a range of 10-35 mm is employed for thin MIP images. Volumetrically processed images offer valuable insights, especially in cases involving the premature filling of the IMV, such as those associated with inflammation or arteriovenous fistulas [8]. In our study, we also utilized curved planar MPR images.

Alternative modalities for IMV visualization include Digital Subtraction Angiography (DSA) and Magnetic Resonance Angiography (MRA). DSA boasts the distinct advantage of dynamic and high-resolution IMV visualization. However, it lacks the capability for three-dimensional and cross-sectional imaging. Conversely, MRA, while radiation-free, comes with certain limitations, including extended examination times and the potential for artifacts [9]. The chief advantage of MDCT lies in its ability to meticulously depict anatomy during a standard abdominal CT examination, all accomplished within a remarkably brief timeframe [10,11].

In recent years, mounting evidence has underscored the oncological benefits of complete mesocolic excision coupled with central vascular ligation and lymphadenectomy. This surgical approach, which can also be conducted laparoscopically, has exhibited superior outcomes compared to traditional colonic resections, manifesting in a lower five-year local recurrence rate and enhanced overall survival rates [12]. The effectiveness of laparoscopic surgery has been substantiated through evidence attesting to its surgical safety, improved perioperative results, and comparable long-term oncological outcomes [13]. However, it is important to note that these surgical procedures are technically demanding and carry a heightened risk of intraoperative organ injuries and severe non-surgical complications [14]. A comprehensive grasp of the intricate three-dimensional anatomy of the IMV is crucial in mitigating iatrogenic injuries, especially during contemporary radical resections performed for colon cancer [15].

Our study stands out for several key features. It represents a novel undertaking as the first investigation conducted within the Turkish population in this specific domain.

Furthermore, it boasts the distinction of including the largest patient cohort among the existing body of literature.

Limitations

Our study is subject to several limitations. First, the sample size was relatively small. Second, the study was conducted retrospectively and was centered at a single institution. Third, the lack of clinical and laboratory data prevented the execution of relevant statistical analyses. Fourth, the assessment of CT images was performed by a single radiologist, thus rendering it impossible to assess interobserver variations. Lastly, the MDCT findings were not corroborated with the gold standard method, DSA. In the future, more comprehensive prospective studies, potentially incorporating DSA, can be envisioned to address these limitations.

Conclusion

Based on our study, it is observed that within the Turkish population, the IMV predominantly drains into the SMV before converging with the splenic vein. The variance in this finding compared to certain studies in the literature underscores the variability in IMV drainage patterns. In this regard, a patient-specific assessment holds significant importance.

References

1. Horton KM, Fishman EK. Volume-rendered 3D CT of the mesenteric vasculature: normal anatomy, anatomic variants, and pathologic conditions. Radiographics. 2002;22(1):161-72. doi: 10.1148/radiographics.22.1.g02ja30161
2. Nepal P, Mori S, Kita Y, Tanabe K, Baba K, Sasaki K, et al. Anatomical study of the inferior mesenteric vein using three-dimensional computed tomography angiography in laparoscopy-assisted surgery for left-sided colorectal cancer. Surg Today. 2021;51(10):1665-70. doi: 10.1007/s00595-021-02292-8
3. Kaur R, Sharma A, Sharma MK, Singh R, Sharma A. Variations in drainage pattern of inferior Mesentric vein. Int J Anat Res. 2017;5(4.2):4581-4.
4. Sakaguchi T, Suzuki S, Morita Y, Oishi K, Suzuki A, Fukumoto K, et al. Analysis of anatomic variants of mesenteric veins by 3-dimensional portography using multidetector-row computed tomography. Am J Surg. 2010;200(1):15-22. doi: 10.1016/j.amjsurg.2009.05.017
5. Krumm P, Schraml C, Bretschneider C, Seeger A, Klumpp B, Kramer U, et al. Depiction of variants of the portal confluence venous system using multidetector row CT: analysis of 916 cases. Rofo. 2011;183(12):1123-9. doi: 10.1055/s-0031-1281745
6. Graf O, Boland GW, Kaufman JA, Warshaw AL, Fernandez del Castillo C, Mueller PR. Anatomic variants of mesenteric veins: depiction with helical CT venography. AJR Am J Roentgenol. 1997;168(5):1209-13. doi: 10.2214/ajr.168.5.9129413
7. Arimoto A, Matsuda T, Hasegawa H, Yamashita K, Nakamura T, Sumi Y, et al. Evaluation of the venous drainage pattern of the splenic flexure by preoperative three-dimensional computed tomography. Asian J Endosc Surg. 2019;12(4):412-6. doi: 10.1111/ases.12657
8. Akpinar E, Turkbey B, Karcaaltincaba M, Karaosmanoglu D, Akata D. MDCT of inferior mesenteric vein: normal anatomy and pathology. Clin Radiol. 2008;63(7):819-23. doi: 10.1016/j.crad.2007.09.001
9. Taydas O, Kantarci M, Bayraktutan U, Ogul H. Supradiaphragmatic origin of the renal artery; frequency on contrast-enhanced MR imaging. Clin Imaging. 2018;52:152-6. doi: 10.1016/j.clinimag.2018.07.018
10. Iannaccone R, Laghi A, Passariello R. Multislice CT angiography of mesenteric vessels. Abdom Imaging. 2004;29(2):146-52. doi: 10.1007/s00261-003-0096-9
11. Yılmaz BK, Diker M, Aslan S, Atasoy B, Karahasanoglu R, Gocgun N, et al. Evaluation of left renal vein and IVC variations in MDCT examinations performed in patients with a preliminary diagnosis of renal calculi. J Surg Med. 2023;7(1):128-32. doi: 10.28982/josam.7681
12. West NP, Kobayashi H, Takahashi K, Perrakis A, Weber K, Hohenberger W, et al. Understanding optimal colonic cancer surgery: comparison of Japanese D3 resection and European complete mesocolic excision with central vascular ligation. J Clin Oncol. 2012;30(15):1763-9. doi: 10.1200/jco.2011.38.3992
13. Siani LM, Lucchi A, Berti P, Garulli G. Laparoscopic complete mesocolic excision with central vascular ligation in 600 right total mesocolectomies: Safety, prognostic factors and oncologic outcome. Am J Surg. 2017;214(2):222-7. doi: 10.1016/j.amjsurg.2016.10.005
14. Bertelsen CA, Neuenschwander AU, Jansen JE, Kirkegaard-Klitbo A, Tenma JR, Wilhelmsen M, et al. Short-term outcomes after complete mesocolic excision compared with 'conventional' colonic cancer surgery. Br J Surg. 2016;103(5):581-9. doi: 10.1002/bjs.10083
15. Negoi I, Beuran M, Hostiuc S, Negoi RI, Inoue Y. Surgical Anatomy of the Superior Mesenteric Vessels Related to Colon and Pancreatic Surgery: A Systematic Review and Meta-Analysis. Sci Rep. 2018;8(1):4184. doi: 10.1038/s41598-018-22641-x.