

Prevalence of Counter-clockwise Superior Mesenteric Vein Rotation around the Superior Mesenteric Artery on Contrast-enhanced Computed Tomography Abdomen: A Retrospective Observational Study

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ABSTRACT

Introduction: The counter-clockwise swirl of the Superior Mesenteric Vein (SMV) around the Superior Mesenteric Artery (SMA) is a normal anatomical variant.

Aim: To observe the normal variant anatomy of a counter-clockwise swirl of the SMV around the SMA using a contrast-enhanced Computed Tomography (CT) scan of the abdomen.

Materials and Methods: A retrospective observational study was performed in the radiology department of SGT Medical College, Gurugram, Haryana, India from 2023 November to 2024 November. Abdominal CT scans from 200 consecutive patients, performed for various clinical indications, were included. The CT scans were evaluated for the absence or presence of a counter-clockwise swirl of the mesenteric vessels. The degree of vessel

rotation was also calculated based on the criteria proposed by the authors of the present study. The results were analysed, and the numbers of patients in different groups and subgroups were expressed as percentages.

Results: Of the 200 patients, 114 (57%) showed counter-clockwise rotation of mesenteric vessels. Out of these, 114 patients, 84 (42%) patients had $>90^\circ$ to $<180^\circ$ degrees, 19 (9.5%) patients had $>180^\circ$ to $<270^\circ$ degrees, and 11 (5.5%) patients had $>270^\circ$ degrees of counter-clockwise swirl of the SMV around the SMA.

Conclusion: Awareness of this normal branching pattern of mesenteric vessels is important to avoid an inadvertent laparotomy.

Keywords: Computed tomography, Swirl, Whirlpooling midgut malrotation

INTRODUCTION

The SMA is the second unpaired anterior branch of the abdominal aorta. It originates from the anterior surface of the aorta at the level of the first lumbar vertebra, just below the celiac trunk and above the renal arteries. Several important structures are related to the SMA. Anteriorly, it is associated with the pylorus, the neck of the pancreas, and the splenic vein, while posteriorly it is related to the uncinate process of the pancreas, the third part of the duodenum, and the left renal vein. The left renal vein traverses the space between the abdominal aorta and the origin of the SMA. Functionally, the SMA supplies arterial blood to the midgut structures, including the distal duodenum, jejunum, ileum, cecum, ascending colon, and the proximal portion of the transverse colon [1].

Most existing literature consists of malrotation/volvulus [2,3], while dedicated prevalence data on isolated counter-clockwise SMV rotation around the SMA on routine contrast-enhanced abdominal CT are sparse.

MATERIALS AND METHODS

A retrospective observational study was performed in the radiology department in SGT Medical College, Gurugram, Haryana, India from 2023 November to November 2024.

Inclusion criteria: Contrast-enhanced abdominal CT scans of 200 consecutive patients who presented to the Radiology department for various clinical indications were included in the study.

Exclusion criteria: Patients requesting a plain study without intravenous contrast, patients with pathologies such as collections or lesions in the region of the SMA and vein that obscured the anatomy

and those studied with suboptimal image quality due to motion artifacts were excluded from the study.

None of the CT scans had been performed for a suspected malrotation or volvulus. The CT examinations were accessed through the Picture Archiving and Communication System (PACS) system. The SMV and SMA were identified, and the images were evaluated by three radiologists by consensus. A note was made of the presence or absence of the counter-clockwise swirl of SMV around SMA. In the cases where the counter-clockwise swirl was present they were further classified into three groups based on the degree of rotation.

- Group I: Normal mesenteric vessels without any counter-clockwise swirl.
- Group II: Counter-clockwise swirl of SMV around SMA.

The Group II studies were further evaluated for the degree of counter-clockwise swirl of SMV around SMA and categorised as follows:

- Group II A: $>90^\circ$ to $<180^\circ$ counter-clockwise turn of SMV around SMA;
- Group II B: $>180^\circ$ to $<270^\circ$ counter-clockwise turn of SMV around SMA;
- Group II C: $>270^\circ$ counter-clockwise turn of SMV around SMA.

STATISTICAL ANALYSIS

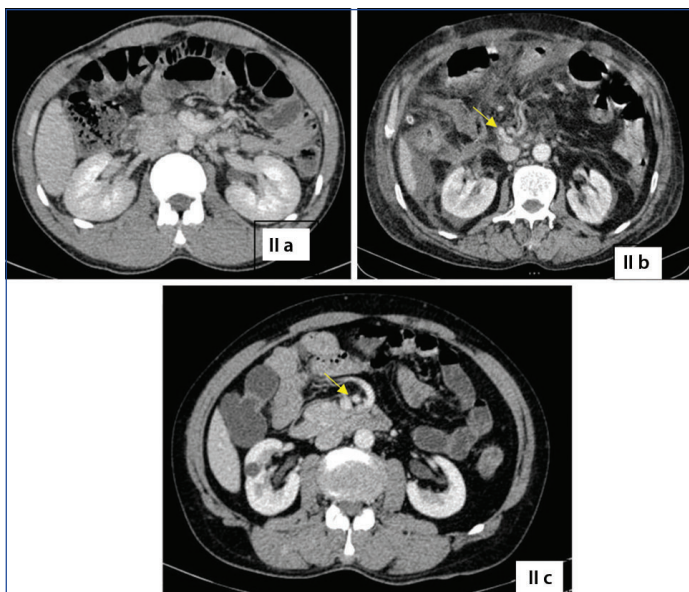
Analysis of the results was done and number of patients belonging to different groups and subgroups expressed in percentages.

RESULTS

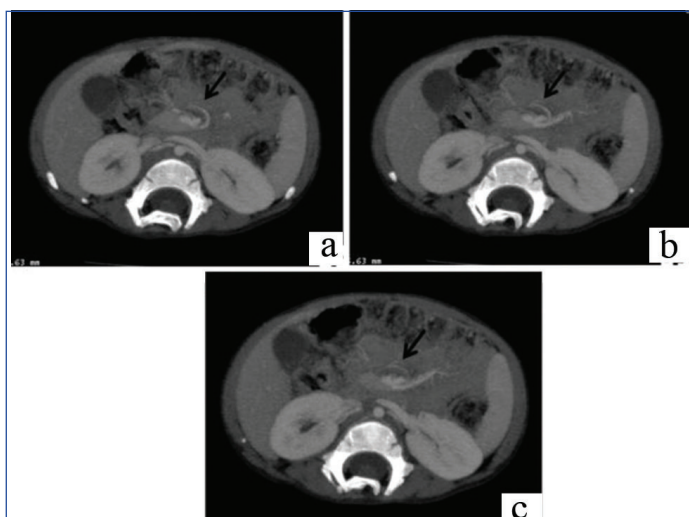
Of the 200 patients in the study group, 117 (58.5%) were male and 83 (41.5%) were female. The age range of the patients was 10 to 86 years, with a mean±SD age of 48±21.94 years. Of the 200 patients, 114 (57%) showed counter-clockwise rotation of mesenteric vessels. Distribution of subgroup Group II A, Group II B, and Group II C is shown in [Table/Fig-1-3].

Groups	Number of patients (%)
I	86 (43)
II	114 (57)
II A	84 (42)
II B	19 (9.5)
II C	11 (5.5)

[Table/Fig-1]: Categorisation of the patients (n=200) in different groups and sub-groups based on rotation of mesenteric vessels.



[Table/Fig-2]: Axial CT images of the patients showing the degree of anticlockwise swirl of SMV around SMA belonging to Group II A (>90° to <180°), II B (>180° to <270°) and II C (>270°) depicted by the yellow arrow.



[Table/Fig-3]: Consecutive axial thick maximum intensity projection images (cranial to caudal; a-c) of a patient belonging to Group II C showing the counter-clockwise rotation of the proximal jejunal tributary (black arrows) of SMV around SMA.

DISCUSSION

Imaging plays an important role in the diagnosis of intestinal malrotation with volvulus. CT shows signs of midgut malrotation which include inverted axis of SMA and SMV, rotation of the SMV around the SMA often described as whirlpool or concentric circle sign, horizontal part of duodenum not reaching medioventral line or

just reaching but encircled right down behind SMA, with the jejunal loops in right middle abdomen while ileal loops are on the left-side, and an ectopic ileocecal junction [4,5].

Sodhi KS et al., performed a similar study in 200 paediatric patients; 128 (64%) showed no clockwise or anticlockwise rotation of the mesenteric vessels. Counter-clockwise rotation of the SMV on the SMA was observed in 72 (36%) patients [6]. However, in the present study, of 200 patients, 114 (57%) showed counter-clockwise rotation of the mesenteric vessels.

The counter-clockwise rotation observed in the present study was present in 57% of patients, and none of the patients prior to CT were suggestive of malrotation/volvulus. In the present study, the presence of a counter-clockwise swirl of SMV around the SMA did not lead to any complications in the patient and is a commonly encountered normal variant. Hence, it is important that this finding should not be misinterpreted as a partial or incomplete midgut volvulus.

Malrotation in infants is characterised by bilious vomiting, acute duodenal obstruction, or abdominal tenderness, with haemodynamic decline that may occur with or without accompanying abdominal distension [7]. A significant complication associated with this condition is midgut volvulus, which leads to proximal bowel obstruction and ischaemia, potentially manifesting as bloody stool in some cases [8].

Intestinal malrotation typically presents without symptoms, with most cases diagnosed in childhood, making it a rare condition in adults [9]. However, as malrotation with midgut volvulus may result in fatal complications and sequelae in nearly half of the cases, failure of immediate intervention can lead to gangrenous changes, perforation, and peritonitis. Hence, it is usually treated as a critical diagnosis, and surgery is attempted at the earliest [10].

Limitation(s)

There were few limitations in the present study, including a small sample size for an anatomical description of variants in the branching pattern of abdominal vessels, a retrospective design, a single-centre study, the absence of surgical confirmation, potential observer variability, and a lack of clinical follow-up.

CONCLUSION(S)

The counter-clockwise swirl of SMV on SMA gives an appearance of whirlpooling of mesenteric vessels in otherwise normal mesenteric vessels and can be misinterpreted as midgut volvulus. It is a normal anatomical variation due to differences in the branching patterns of mesenteric vessels. Awareness of this normal branching pattern of mesenteric vessels is important to avoid misinterpreting it as a volvulus.

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