



# Superior Mesenteric Artery Syndrome in Late Middle-Aged Man: Clinico- Radiological Findings

**Krishna Kumar <sup>a+++\*</sup>, Lavanya <sup>a#</sup>, Anil Kumar <sup>a†</sup>  
and Senthilnathan <sup>a‡</sup>**

<sup>a</sup> Department of Radio-Diagnosis, Trichy SRM Medical College Hospital & Research Centre,  
Irungalur, Trichy-621105, India.

## **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

## **Article Information**

DOI: 10.9734/JAMMR/2023/v35i205199

## **Open Peer Review History:**

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/105122>

**Case Report**

**Received: 18/06/2023**  
**Accepted: 25/08/2023**  
**Published: 06/09/2023**

## **ABSTRACT**

Superior mesenteric artery syndrome (SMAS) rarely causes duodenal obstruction by compression of the third part of duodenum between aorta & superior mesenteric artery (SMA). Clinical diagnosis and radiological features play crucial role in the diagnosis of SMAS. Majority of the patients diagnosed with SMAS are managed conservatively and surgery done for cases not responding to medical treatment. Here in we report a male aged 55 years, presenting with acute recurrent abdominal pain associated with vomiting, diagnosed to have SMAS who underwent surgical correction and describe the clinical and radiological findings.

<sup>++</sup> M. MBBS, DMRD, MD. Professor of Radiology;

<sup>#</sup> N.MBBS. Postgraduate Student & Resident;

<sup>†</sup> V. MBBS. Postgraduate Student & Resident;

<sup>‡</sup> V. MBBS, MD. Professor of Radiology;

\*Corresponding author: E-mail: drmkrishnakumar@gmail.com;

**Keywords:** Aorto-mesenteric angle; aorto-mesenteric distance; abdominal vascular compression syndrome; cast syndrome; superior mesenteric artery syndrome; wilkie syndrome.

## 1. INTRODUCTION

“SMAS, also known as Wilkie syndrome, Cast syndrome or Aorto-mesenteric duodenal compression syndrome, is an acquired vascular compression syndrome in which acute angulation of aorta and SMA, results in compression of the third part of the duodenum leading to intermittent post-prandial pain and signs of duodenal obstruction” [1,2]. “The commonest symptom in SMAS is intermittent epigastric pain and vomiting. Nausea and vomiting may result in anorexia and reduction in body weight. Reduced fat between the aorta SMA, either due to poor nutritional intake or weight reduction results in decreased aorto-mesenteric angle (AMA) and aorto-mesenteric distance (AMD)” [3]. “Prevalence of the SMAS varies from 0.2% to 0.78% in the barium meal studies of the upper gastrointestinal tract” [4-6]. “Manoeuvres similar as lying prone or espousing the left lateral decubitus position may relieve the pain” [7].

SMAS is frequently an over-looked condition, and diagnosis can be missed or delayed if not suspected clinically or known by the attending physician. High index of clinical suspicion and radiological features plays significant role in the diagnosis of this condition.

## 2. CASE PRESENTATION

An Indian male aged 55 years presented to our hospital with long history of intermittent epigastric pain and vomiting. There was characteristic history of relief of symptoms in prone position. He was previously hospitalized many times for

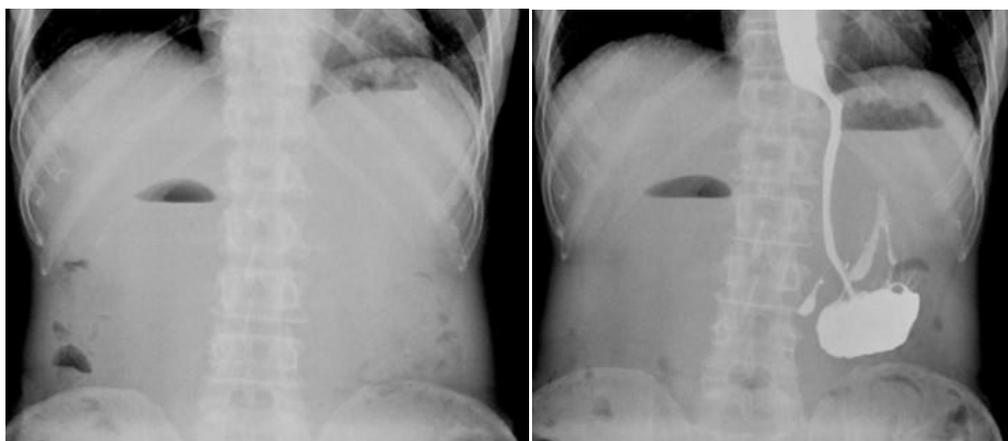
similar complaints resulting in significant weight loss for the past one year.

On general examination his pulse, blood pressure and respiratory rate were stable. Abdominal examination revealed epigastric tenderness. Cardiac system, respiratory system and neurological examination was normal. Liver function tests and routine blood and urine investigation, were within normal limits. Plain erect chest radiograph was normal. Plain and oral contrast erect abdomen (Fig. 1A, B) showed double bubble sign suggestive of duodenal obstruction.

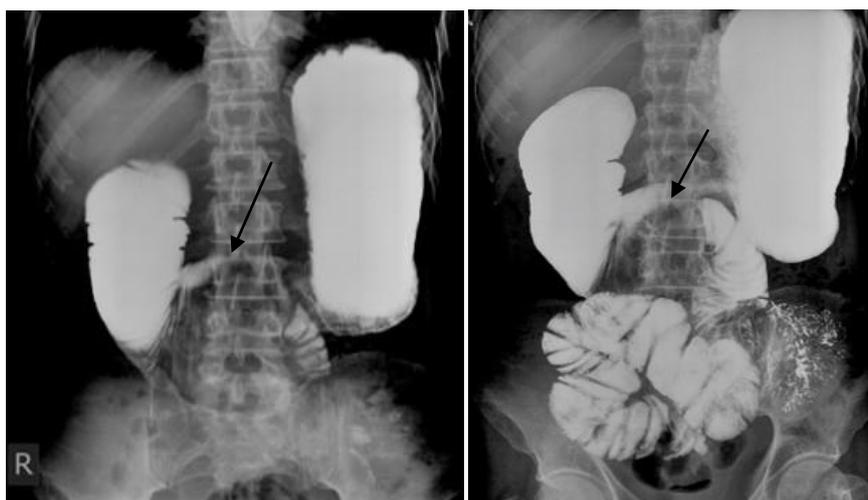
Barium meal study revealed dilated stomach, first and second part of duodenum with a significant luminal narrowing of the third part of duodenum without any intrinsic mucosal abnormality (Fig. 2 A, B). Distal bowel loops were opacified with barium on prone spot films (Fig. 3A, B).

Contrast enhanced computed tomography (CECT) was advised for further evaluation and confirmation. CECT revealed reduced AMA (20°) and short AMD (6.7 mm). Compression was seen at third part of duodenum with dilatation of stomach and proximal duodenum. (Fig. 4A, B).

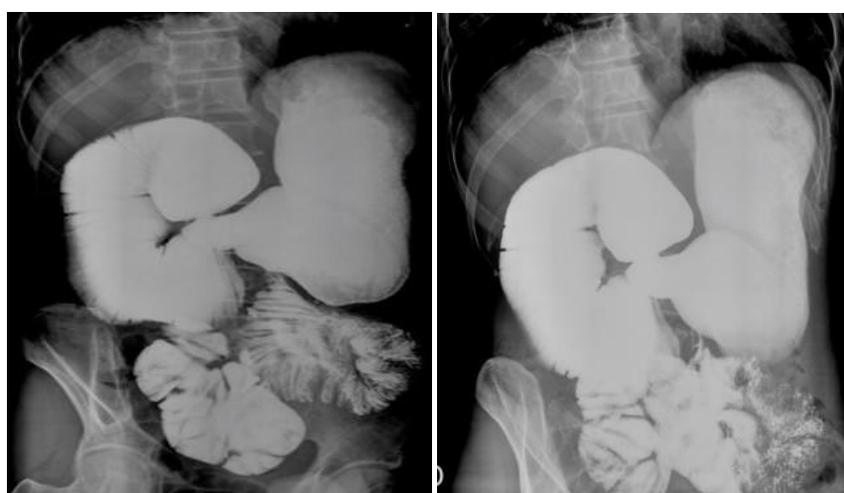
CECT images (Fig. 4A, B) were reviewed for AMA (measured on mid sagittal image between abdominal aorta and SMA, AMD (measured on axial image at level of horizontal third part of duodenum between abdominal aorta and SMA), and proximal duodenal dilatation. An AMA below 25° and AMD below 8 mm were considered positive for SMAS.



**Fig. 1 (A, B). Abdominal plain (A) and contrast (B) erect radiograph demonstrates air fluid levels in left & right hypochondrium(Double bubble sign) suggestive of duodenal obstruction**



**Fig. 2 (A, B). Barium meal study. Supine spot images of study demonstrating dilated stomach & duodenum with curvilinear extrinsic lucency (arrow) corresponding to SMA impression upon the third part of duodenum**



**Fig. 3 (A, B). Preoperative Prone barium meal spot images shows dilated stomach, duodenum emptying into the jejunum**

The abdominal ultrasound (US) showed dilated stomach & duodenum.

Diagnosis of SMAS was suggested on the basis of clinical features and radiological findings. Initial conservative approach was tried with nasogastric drainage, fluid electrolyte therapy, and small frequent meals, which did not improve the patient condition. Hence the patient was managed by duodeno-jejunostomy. After surgery our patient is symptom free.

### 3. DISCUSSION

Foremost depiction of the SMAS was by Carl Freiherr VonRokitansky in 1861 and later by

Wilkie in 1927, who handed a more detailed clinical, anatomical and patho-physiological aspect of this syndrome [6]. The frequency of SMAS grounded on fluoroscopic examination is estimated to be 0.013–0.3% [8], whereas other sources quote a frequency of 0.0965% in a chronic hospital setting versus 0.00108–0.0052% in an acute general hospital setting [9]. “There is a womanish preponderance (64–66%), with 75% of cases being in individualities in age range from 10 to 39 years” [10,11].

“SMA leaves the aorta at an acute downward angle in humans. This results in the conformation of vascular angle between SMA and aorta, through which the third part of duodenum

traverses” [6]. “The duodenum is typically girdled by mesenteric adipose tissue as it traverses the aortomesenteric plane. This tissue functions as a natural adipose cushion and prevents extrinsic compression” [10]. Normal AMD and AMA is 10–28 mm and 25–60° respectively. In SMA syndrome AMA narrowed to 7–22° and AMD reduced to 2–8 mm [1,6] Cut-off values were reported to be 22° for AMA (42% sensitivity and 100% specificity) and 8 mm for AMD (100% sensitivity and specificity) [12]. In this case, CT dimension of AMA and AMD is lower than cut off value.

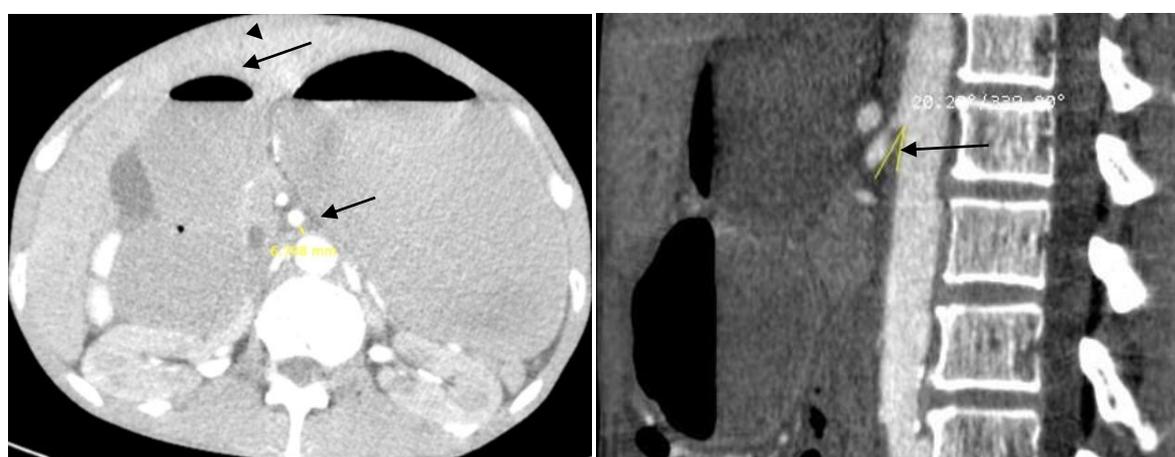
“The clinical presentation may be acute or chronic. The classical symptoms of SMAS are postprandial or intermittent abdominal pain and features of small bowel obstruction such as nausea, vomiting and anorexia” [11]. “The patient symptoms are relieved in left lateral decubitus, prone or knee to chest position” [13]. Analogous common symptoms and relieving factor was present in this case.

Causes of SMAS are multiple which include anorexia nervosa, severe cachexia or catabolic state due to neoplasm, severe head injury or burn, bariatric surgery, prolonged bed rest, high insertion of ligament of Treitz, low origin of SMA, Nissen fundoplication, spinal deformity, spinal scoliosis surgery, intestinal mal-rotation, peritoneal adhesions, and elderly patient with heavily calcified or tortuous aorta [13]. “Patients are often underweight, with a reported median BMI of 17.4 at diagnosis” [10].

Weight loss is not necessary for the development of the SMAS in the paediatric population but pubertal growth spurt is a threat factor for SMAS [14]. In adolescents whose visceral adipose tissue has formerly been depleted, acute and inordinate ingestion of water and food can spark a manifestation of SMAS. In adolescents with intermittent abdominal symptoms, it is important to consider SMAS in the differential diagnosis [14]. The association of acute pancreatitis with SMAS is infrequently reported [15,16]. Secondary occlusive post papillary syndrome due to SMAS may produce a retrograde reflux of bile into the pancreatic duct, which activates the inflammatory phenomena responsible for pancreatitis [16].

“Symptoms caused from duodenal obstruction include abdominal pain, vomiting, and weight loss. All other causes of duodenal obstruction, such as benign or malignant tumours, and extrinsic causes similar as pancreatitis, mesenteric mass, or aortic aneurysm must be ruled out with routine imaging modalities before a opinion of SMAS is confirmed” [7]. Elderly cachexic patient with decreased retroperitoneal fat and tortuous abdominal aorta was the cause of SMAS in this case.

Fluoroscopic studies of upper gastrointestinal tract can demonstrate extrinsic compression of the third part of the duodenum, dilatation of the first and second part of the duodenum (Fig.1A,B) and a fairly collapsed small bowel distal to point where the SMA crosses the duodenum [17].



**Fig. 4 (A, B). CT criteria suggestive of SMAS. Selected contrast enhanced mid abdominal axial (A) and mid sagittal (B) images demonstrating reduced AMD (small vertical line in region of interest in image A), dilated proximal second part of duodenum (arrow in image A), and reduced AMA (arrow in image B)**

Conventional Barium meal studies and Hypotonic duodenography are crucial for the diagnosis of SMAS. Still, the radiological appearances of these studies are non-specific, and have been reported as various conditions similar as scleroderma, diabetes, pancreatitis, peptic ulcer, lupus erythematosus, or idiopathic intestinal pseudo-obstruction [4,18]. Barium meal examination shows proximal gastric and duodenal dilatation with perpendicular band of external compression at the third part of the duodenum (Fig. 2A,B). Other findings on barium meal study include reverse barium flow or anti-peristaltic flow of barium proximal to the site of obstruction and relief of obstruction when the patient is in a left lateral decubitus or prone position [8] (Fig. 3A,B).

In the history, Angiographic dimension of the AMA was recognised as being a more accurate investigation than routine barium meal studies [19]. Still, the procedure is invasive, and some patients are unable to tolerate it.

Lately, Konen et al have noted the advantage of 3D CT angiographic reconstruction, which helps to exclude the incorrect diagnoses that appear from the angulations of the SMA [20]. The AMD is the shortest distance between the walls of the SMA and the aorta at the position where the third part of duodenum passes between them (Fig. 4A). The AMA is the angle between the SMA and the aorta, which is measured on sagittal MPR images (Fig. 4B). In SMAS, both AMA and AMD are reduced, with values of 6-22 degrees and 2-8 mm, respectively [20]. Imaging features of SMAS on CT include a dilated stomach and proximal duodenum, with an abrupt transition point at the third part of the duodenum, where the SMA crosses the duodenum. CT has been set up to be largely harmonious for diagnosing gastric and duodenal dilatation (Fig. 4A), which may be not well demonstrated by barium studies [21]. CT is of additional value in demonstrating the exact anatomic position of the duodenum and excluding other causes of duodenal obstruction [22]. The features described above were present in this case.

Low-cost, non-invasive, power Doppler ultrasound can detect reduced AMA and may lead to suspected diagnosis of SMAS, indeed in cases where gastroscopy and barium meal study do not detect duodenal compression. Ultrasound examination performed in the standard supine position in addition to the standing position assessed the AMA, indeed in the symptomatic-

free period, when gastroscopy and plain hypotonic duodenography cannot reveal diagnostic findings [23].

Differential diagnosis includes peptic ulcer, duodenitis, pancreatitis, cholelithiasis, neoplastic obstructions, adhesions, irritable bowel syndrome, visceral neuropathy, porphyria and aneurysm of the abdominal vessels [24].

Treatment is generally conservative, and includes fluid and electrolyte correction, naso-jejunal feeding and mobilisation of the patient into the prone or left lateral decubitus position. Conservative management focuses on nutritional support aimed at restoration of retroperitoneal fat and weight gain [8,22]. If conservative treatment fails, surgical procedures aiming to bypass the obstructed segment may be indicated. Options include duodeno-jejunostomy, gastro-jejunostomy or lysis of the ligament of Treitz with de-rotation of the bowel (Strong's procedure) [8]. Duodeno-jejunostomy is the surgical method of choice to relieve the obstruction, with good results being reported in 79-100% of the cases [8].

Bloomberg et al. [25] reported SMAS in a 18 years old female who presented with abdominal pain, distension and vomiting due to anorexia nervosa with narrow AMA and compression of duodenum.

Berken Jonathan A et al. [26] diagnosed SMAS in a 17 year old adolescent due to precipitous weight loss resulting from cannabinoid hyperemesis syndrome. Alvina Karam et al. [27] reported SMAS in a 20 year old malnourished female with nausea, vomiting, weight loss and abdominal pain who improved with conservative treatment. Kimura A et al. [28] diagnosed SMAS in a 64 year old man with appetite loss and vomiting who underwent laparoscopic gastro-jejunostomy and percutaneous endoscopic gastrostomy with no recurrence of symptoms on follow up.

The clinical features and radiological findings in our case were similar to the cases reported in the literature [25-28]. Due to severe malnutrition, our case was initially treated with both enteral and total parenteral nutrition with the aim of speeding recovery and optimising his nutritional state should he require surgery. When symptoms failed to ameliorate after 2 weeks, an open duodeno-jejunostomy was performed. The

patient subsequently made an uneventful recovery.

#### 4. CONCLUSION

SMAS is a rare disease with non-specific symptoms, and frequently mistaken with other anatomical or motility-related causes of duodenal obstruction. A history of post prandial vomiting, epigastric pain, and rapid weight reduction with pain being relieved in the prone or left lateral decubitus position should raise the clinical suspicion of SMAS. Hence SMAS is clinically a diagnosis of exclusion. Still, radiological examinations, particularly multidetector CT scan can conclusively diagnose this condition grounded on the objective parameters of AMD and AMA. For cases who have a short clinical history, conservative management with nutritional support is recommended and cases with habitual symptoms are more likely to require surgical management if symptoms don't ameliorate with nutritive support.

#### CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the author(s).

#### ETHICAL APPROVAL

As per international standard or university standard guideline participant consent and ethical approval has been collected and preserved by the authors.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

#### REFERENCES

1. Madhu B, Govardhan B, Krishna B. Cast syndrome. *Oxf Med Case Reports*. 2019;29(4):omz025. DOI: 10.1093/omcr/omz025. PMID: 31049210; PMCID: PMC6487991.
2. Waheed KB, Shah WJ, Jamal A, Mohammed HR, Altaf B, Amjad M, Al Bassam M, Almutawa DH, Arulanantham ZJ. Superior mesenteric artery syndrome: An often overlooked cause of abdominal pain!. *Saudi Medical Journal*. 2021; 42(10):1145.
3. Warncke ES, Gursahaney DL, Mascolo M, Dee E. Superior mesenteric artery syndrome: a radiographic review. *AbdomRadiol (NY)*. 2019;44(9):3188-3194. DOI: 10.1007/s00261-019-02066-4. PMID: 31127323.
4. Anderson JR, Earnshaw PM, Fraser GM. Extrinsic compression of the third part of the duodenum. *Clin Radiol*. 1982;33(1):75-81. DOI: 10.1016/s0009-9260(82)80358-9. PMID: 7067340.
5. Rosa-Jiménez F, Rodríguez González FJ, Puente Gutiérrez JJ, Muñoz Sánchez R, AdarragaCansino MD, Zambrana García JL. Duodenal compression caused by superior mesenteric artery: study of 10 patients. *Rev Esp Enferm Dig*. 2003;95(7):485-9:480-4. English, Spanish. PMID: 12952509.
6. Ahmed AR, Taylor I. Superior mesenteric artery syndrome. *Postgrad Med J*. 1997;73(866):776-8. DOI: 10.1136/pgmj.73.866.776. PMID: 9497945; PMCID: PMC2431524.
7. Merrett ND, Wilson RB, Cosman P, Biankin AV. Superior mesenteric artery syndrome: diagnosis and treatment strategies. *J Gastrointest Surg*. 2009; 13(2):287-92. DOI: 10.1007/s11605-008-0695-4. Epub 2008 Sep 23. PMID: 18810558.
8. Welsch T, Büchler MW, Kienle P. Recalling superior mesenteric artery syndrome. *Dig Surg*. 2007;24(3):149-56. Doi: 10.1159/000102097. Epub 2007 Apr 27. PMID: 17476104.
9. Lee CS, Mangla JC. Superior mesenteric artery compression syndrome. *Am J Gastroenterol*. 1978;70(2):141-50. PMID: 717365.
10. Lee TH, Lee JS, Jo Y, Park KS, Cheon JH, Kim YS, Jang JY, Kang YW. Superior mesenteric artery syndrome: where do we stand today? *J Gastrointest Surg*. 2012; 16(12):2203-11. DOI: 10.1007/s11605-012-2049-5. Epub 2012 Oct 18. PMID: 23076975.

11. Biank V, Werlin S. Superior mesenteric artery syndrome in children: a 20-year experience. *J Pediatr Gastroenterol Nutr.* 2006;42(5):522-5.  
DOI:10.1097/01.mpg.0000221888.36501.f2. PMID: 16707974.
12. Ushiki A, Koizumi T, Yamamoto H, Hanaoka M, Kubo K, Matsushita M. Superior mesenteric artery syndrome following initiation of cisplatin-containing chemotherapy: a case report. *J Med Case Rep.* 2012;16(6):14.  
DOI: 10.1186/1752-1947-6-14.  
PMID: 22248296;  
PMCID: PMC3275446.
13. Sophia R, Bashir WA. Superior mesenteric artery syndrome. In *New Advances in the Basic and Clinical Gastroenterology*, T. Brzozowski (ed.). InTech, Croatia, Europe. 2012;415-418.
14. Okamoto T, Takumi Sato, Yukio Sasaki. Superior mesenteric artery syndrome in a healthy active adolescent *BMJ Case Rep.* 2019;12:228758.  
DOI:10.1136/bcr-2018-228758.
15. Inoue M, Uchida K, Otake K, et al. Development of acute pancreatitis after Nissen fundoplication. *Pediatr Int.* 2015;57:48–9.
16. Sihuay-Diburga DJ, Accarino-Garaventa A, Vilaseca-Montplet J, et al. Acute pancreatitis and superior mesenteric artery syndrome. *Rev Esp Enferm Dig.* 2013;105:626–8
17. Van Horne N, Jackson JP. Superior Mesenteric Artery Syndrome. In: *Stat Pearls* [Internet]. Treasure Island (FL): Stat Pearls Publishing. 2023.PMID: 29489172.
18. Cohen LB, Field SP, Sachar DB. The superior mesenteric artery syndrome. The disease that isn't, or is it? *Clin Gastroenterol.* 1985;7:113-6.
19. Gustafsson L, Falk A, Lukes PJ, Gamklou R. Diagnosis and treatment of superior mesenteric artery syndrome. *Br J Surg.* 1984;71:499-501
20. Konen E, Amitai M, Apter S, et al. CT angiography of superior mesenteric artery syndrome. *AJR Am J Roentgenol.* 1998;171:1279-81
21. Birsen Ü, Aykut A, Gökhan K, et al. Superior mesenteric artery syndrome: CT and ultrasonography findings. *DiagnIntervRadiol.* 2005;11:90-5.
22. Agrawal GA, Johnson PT, Fishman EK. Multidetector row CT of superior mesenteric artery syndrome. *J Clin Gastroenterol.* 2007;41:62–5.
23. Neri S, Signorelli SS, Mondati E, Pulvirenti D, Campanile E, Di Pino L, Scuderi M, Giustolisi N, Di Prima P, Mauceri B, Abate G, Cilio D, Misseri M, Scuderi R. Ultrasound imaging in diagnosis of superior mesenteric artery syndrome. *J Intern Med.* 2005;257(4):346-51.  
DOI: 10.1111/j.1365-2796.2005.01456.x.  
PMID: 15788004.
24. Lippl F, Hannig C, Weiss W, Allescher HD, Classen M, Kurjak M. Superior mesenteric artery syndrome: diagnosis and treatment from the gastroenterologist's view. *J Gastroenterol.* 2002;37(8):640-3.  
DOI: 10.1007/s005350200101.  
PMID: 12203080.
25. Bloomberg, Lauren I. MD; Hoscheit, Matthew MD; Hendler, Steven MD; Abegunde, Ayokunle T. MD, MSc. Superior Mesenteric Artery Syndrome in an Adolescent Female With Anorexia Nervosa. *The American Journal of Gastroenterology.* 2021;116():p S1263-S1264..  
DOI:0.14309/01.ajg.0000785776.30275.70 S3061
26. Berken Jonathan A., Saul Samantha, Osgood Peter T. Superior Mesenteric Artery Syndrome in an Adolescent with Cannabinoid Hyperemesis. *Frontiers in Pediatrics.* 2022;10.  
URL=https://www.frontiersin.org/articles/10.3389/fped.2022.830280.  
DOI=10.3389/fped.2022.830280.
27. Alvina Karam, Talha Aziz, Haider Sarfaraz, Ahmad Sharjeel Karam, Abdul Moez Karam, Najeeb Ullah Khan, Superior mesenteric artery syndrome in a malnourished female: A rare cause of abdominal pain, *Radiology Case Reports.* 2022;17(9): 3165-3167,  
Available:https://doi.org/10.1016/j.radcr.2022.05.068.

28. Kimura A, Morinaga N, Wada W, et al. Laparoscopic gastrojejunostomy with laparoscopic-assisted percutaneous endoscopic gastrostomy for superior mesenteric artery syndrome with dysphagia: A case report. Surg Case Rep. 2022;8:163. Available: <https://doi.org/10.1186/s40792-022-01522-6>

---

© 2023 Kumar et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

*Peer-review history:*

*The peer review history for this paper can be accessed here:*  
<https://www.sdiarticle5.com/review-history/105122>