

# Incidentally Discovered Middle Mesenteric Artery In A Renal Donor

Ahmed Kamel Abdel-Aal<sup>1</sup>, Amr Soliman Moustafa<sup>1</sup>

1. Department of Radiology, University of Alabama at Birmingham (UAB), Birmingham, Alabama, USA

\* Correspondence: Ahmed K. Abdel-Aal, M.D, MSc., PhD, 619 19th Street South, Birmingham, AL 35249, USA  
(✉ [akamel@uabmc.edu](mailto:akamel@uabmc.edu))

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## ABSTRACT

The middle mesenteric artery is a very rare anomalous artery originating from the ventral surface of the abdominal aorta in-between the superior mesenteric artery and inferior mesenteric artery. We identified a middle mesenteric artery during abdominal computed tomographic angiography in a renal donor patient as a part of his work up. The middle mesenteric artery branched out into ileal and ileocolic arteries, supplying the terminal ileal loops as well as the cecum. The anomalous artery had no effect on patient's eligibility as a renal donor candidate.

## CASE REPORT

### CASE REPORT

A 51-year-old white male presented to our hospital as a renal donor candidate. He was eager to donate with his kidney to his wife. He had a past medical history of controlled hypercholesterolemia, past surgical history of tonsillectomy and left knee arthroscopy. He had a significant family history of arterial hypertension and diabetes. He denied use of tobacco, alcohol or any illegal drugs.

Computed tomographic angiography (CTA) for renal artery as a part of renal donor evaluation protocol was performed. An extra abdominal aortic branch emerging from its ventral aspect was noted. The anomalous artery arose from the anterior aspect of the aorta at L2 Vertebra level, 48 mm below superior mesenteric artery (SMA) and 55 mm above inferior mesenteric artery (IMA). The anomalous artery was recognized as the middle mesenteric artery (MMA) (Fig. 1 and Fig. 2).

The MMA branched into ileal and ileocolic arteries. The branches supplied the distal part of the ileal loops as well as the cecum. The SMA gave rise to jejunal and ileal branches as well as right and middle colonic arteries. The SMA supplied

the small intestine, ascending, transverse and upper half of the descending colon. The IMA supplied the lower half of the descending colon and sigmoid colon by giving rise of the left colic artery as well as the upper part of the rectum by terminating as the superior rectal artery. The middle colic artery was seen anastomosing with the left colic artery at the descending colon. The celiac axis showed no anatomical variation. The anomalous artery had no effect on patient's eligibility as a renal donor candidate.

### DISCUSSION

Classically, there are three unpaired visceral branches arising from the ventral surface of abdominal aorta namely the celiac trunk supplying the foregut derivatives, the SMA supplies the midgut derivatives and the IMA which feeds the hindgut with its blood supply [1]. Vascular anatomical variations in the foregut and midgut are relatively common. However, hindgut vascular variation is not commonly reported. Reports regarding the MMA are quite infrequent [2].

The MMA is a third mesenteric artery originating from the ventral surface of the abdominal aorta in-between the SMA

and IMA. It was first reported by Delannoy [3] and then given its name as MMA by Lawdahl and his colleagues [4].

#### Etiology & Demographics:

The wide range of visceral vascular variations are attributed to its embryological development. Embryologically, at every vertebral level, paired ventral and dorsal branches develop from the paired dorsal aorta. The fetal blood supply to the mesentery comes from the vitelline arteries which represent the paired ventral arteries branching from the paired aorta. Later on, the paired aorta fuses, some of the vitelline arteries regress but the 10th, 13th and 21st vitelline arteries persist and fuse, giving rise of the Celiac trunk, SMA and IMA respectively. Failure of regression of other vitelline arteries explains the presence of any additional ventral abdominal aortic branch. The vitelline artery that fails to regress and later on becomes the MMA is likely located in between 13th and 21st vitelline segments [5-7]. Among 114 cadaveric case study of variation in blood supply to the colon, a single case demonstrated the anomalous artery representing 0.88% of the studied cases [6]. This was the only cadaver-based study to report this rare anomaly. To our knowledge, only 10 MMA cases were reported in the literature. However, our case has a vascular distribution that is distinct from the previously reported MMA in literature. (Table 1, Fig. 3)

#### Clinical & imaging findings:

In 1923, Delannoy [3] was the first one to report an extra ventral branch arising from the abdominal aorta below the renal arteries level. This artery had a vascular distribution to the cecum, ascending and transverse colon. Benton and his colleagues [8] identified an artery branching from the abdominal aorta in between the SMA and IMA. They reported it as a duplication of IMA. This artery has a vascular supply to the superior part of the descending colon and the transverse colon.

Lawdahl et al. [4] was the first one to give MMA its name in 1987. They identified an extra ventral abdominal artery during angiography of a patient with massive hematochezia. The anomalous artery supplied the distal transverse colon, splenic flexure and the superior portion of the descending colon. Lawdahl defined the MMA as any artery that arise in-between SMA and IMA from the ventral abdominal aorta and gives blood supply to the mesentery or to the colon. LeQuire and his colleagues [9] reported a case of colonic bleeding in which the feeding artery was the MMA. This MMA branched out to the ileocolic, right colic, and middle colic arteries and the source of bleeding was in the splenic flexure. This was the first report of an MMA that provides vascular supply to terminal ileal loops.

Yoshida et al. [7] incidentally catheterized an artery during angiographic evaluation of a patient with renal mass. This artery was an additional ventral branch that had a blood supply to the transverse colon, splenic flexure and the proximal descending colon.

Koizumi and colleagues [10] incidentally found MMA during CTA for a patient with suspected renovascular hypertension. The vascular territory of this MMA was the

cecum, ascending colon, transverse colon, and splenic flexure. An infra-renal aortic aneurysm in combination with MMA in same patient was first reported by Falkensammer et al [11] in which the patient underwent endovascular repair of the aneurysm. Both the celiac artery and the SMA were occluded in this patient with subsequently dominant MMA perfusing the entire colon. Another case report by Woodfield et al. [12] documented a patient with MMA and bowel non-rotation during pre-surgical imaging work up for abdominal aortic aneurysm repair. The MMA in this patient branched out to supply cecum, ascending colon, hepatic flexure, transverse colon, and splenic flexure.

A middle mesenteric artery arising from infra-renal aortic aneurysm was first reported by Dirrigl and colleagues [13]. It branched out into jejunal, ilial, ileocolic, middle and left colic arteries. Its vascular territory extended to include: the distal jejunum, the ileum, the cecum, the upper ascending colon, the transverse colon and the proximal descending colon. This was the first report to identify a MMA supplying jejunal loops.

Finally, Bryce et al. [5] reported a case of incidentally discovered MMA in a healthy patient who underwent abdominal CTA for evaluation of a suspected abdominal bruit. The artery branched out to ileal, ileocolic, right and middle colic branches.

In our case, The MMA branched into ileal and ileocecal arteries, supplying terminal ileal loops and the cecum, which is a vascular distribution that is distinct from the previously reported MMA in literature. The SMA branched out into jejunal, ileal, right and middle colic artery. The IMA supplied the descending, sigmoid colon and proximal part of the rectum. The Celiac trunk showed its classic anatomy. The MMA had no effect on patient's eligibility as a renal donor candidate.

#### Differential Diagnoses:

The differential diagnosis of the MMA is restricted to other more common vascular variants:

The Celiacomesenteric trunk in which both the SMA and the celiac artery arise from a common origin from the ventral surface of the aorta and branch out to at least two major branches of the celiac artery and SMA [14].

The replaced middle colic artery which arises from the celiac artery instead of arising from the superior or inferior mesenteric arteries and supplying the transverse colon [15]. (Table 2, Fig. 4)

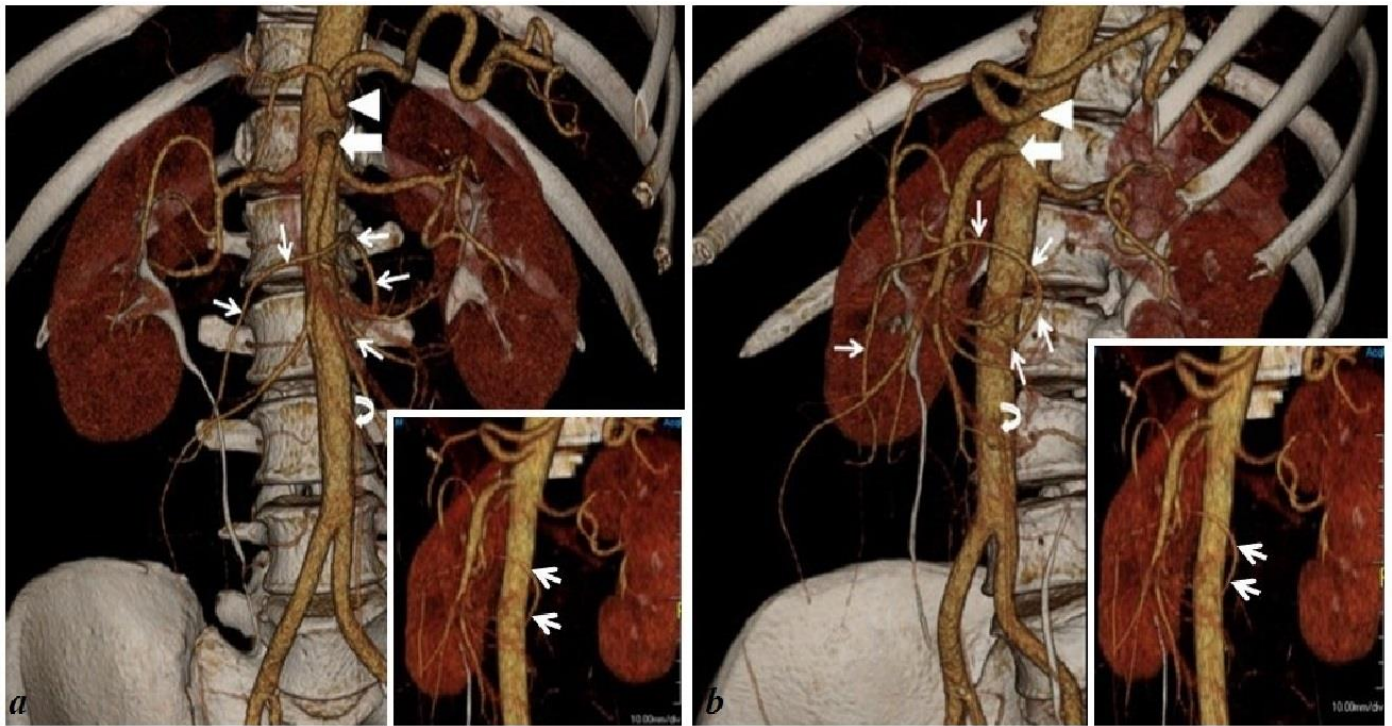
#### TEACHING POINT

It is essential for interventional radiologists to know variations in visceral anatomy, since it influences the approach to treatment of many diseases that involves catheterization of arteries supplying the small bowel. This is particularly important in gastrointestinal hemorrhage where endovascular management is one of the pillars in the treatment algorithm.

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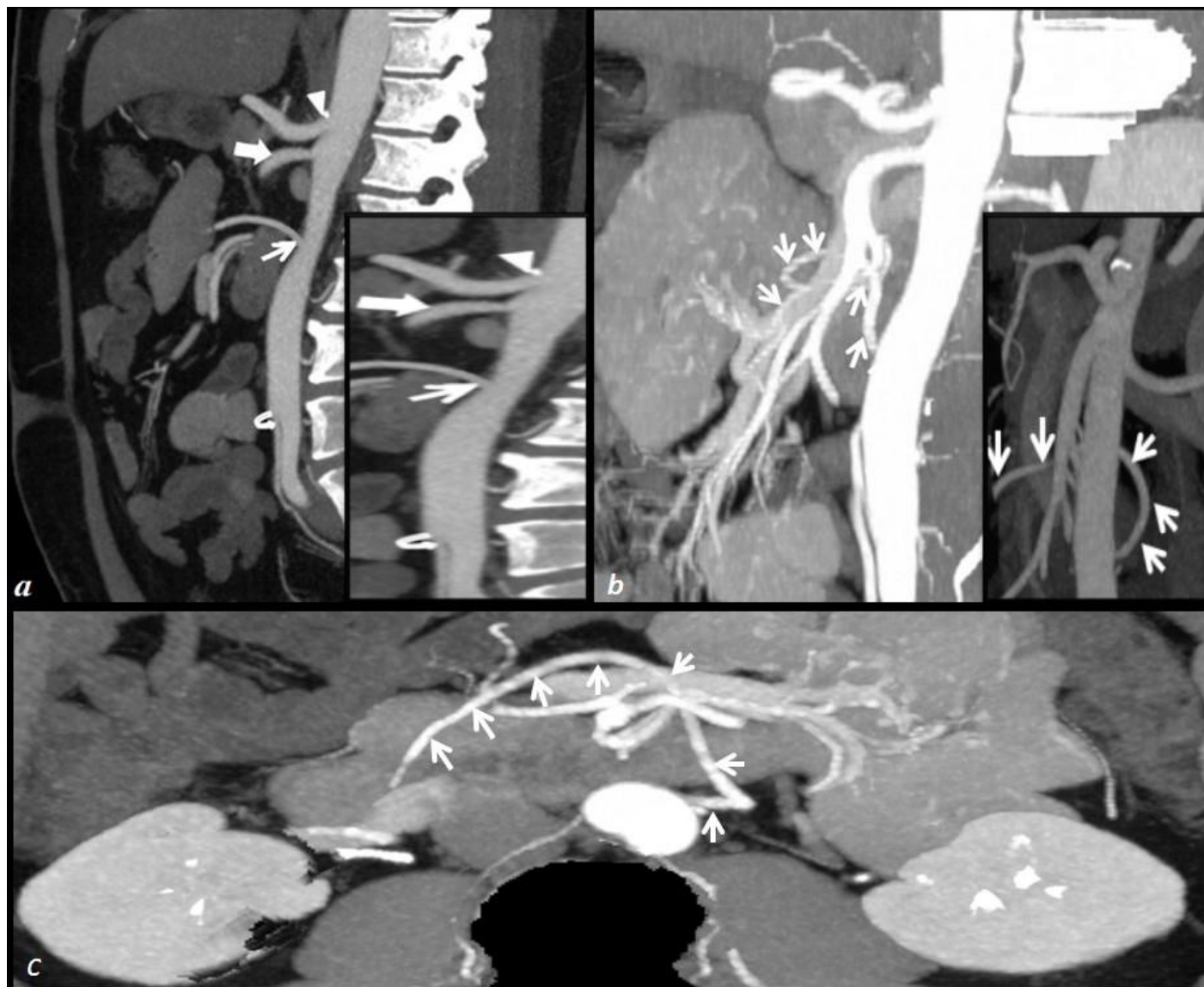
FIGURES



**Figure 1:** A 51-year old male with middle mesenteric artery anatomical variation.

**FINDINGS:** 3-D volume rendered images from CTA in anteroposterior [A] and oblique [B] views demonstrating the Middle mesenteric artery [Multiple small arrows], Celiac trunk [Arrowhead], Superior mesenteric artery [Big arrow] and Inferior mesenteric artery [Curved arrow].

**TECHNIQUE:** 3-D volume rendered image from CTA obtained in the arterial phase. mA: 485. kvp: 120. Slice thickness: 1.25 mm. Contrast agents: 140 mL of Isovue 370 IV contrast.



**Figure 2:** A 51-year old male with middle mesenteric artery anatomical variation.  
**FINDINGS:** Maximum intensity projection images (MIP) from CTA in lateral [A], oblique [B] and axial [C] views demonstrating the Middle mesenteric artery [Multiple small arrows], Celiac trunk [Arrowhead], Superior mesenteric artery [Big arrow] and Inferior mesenteric artery [Curved arrow].  
**TECHNIQUE:** MIP images from CTA obtained in the arterial phase. mA: 485. kvp: 120. Slice thickness: 0.65 mm. Contrast agents: 140 mL of Isovue 370 IV contrast.

<b>Etiology</b>	Embryologic failure of regression of the vitelline artery located in between 13 <sup>th</sup> and 21 <sup>st</sup> vitelline segments.
<b>Incidence</b>	Only 10 cases reported.
<b>Gender ratio</b>	Occurs in both sexes.
<b>Age predilection</b>	No specific age predilection.
<b>Risk Factors</b>	No known risk factors.
<b>Treatment</b>	No treatment is needed unless other pathology incidentally coexists.
<b>Finding on CTA imaging</b>	An extra abdominal aortic branch arising from the ventral aspect of the aorta at L2 Vertebra level, 48 mm below SMA and 55 mm above IMA.

**Table 1:** Summary table for middle mesenteric artery.

Variant	CTA findings
MMA	An extra abdominal aortic branch arising from the ventral aspect of the aorta in-between SMA and IMA.
Celiacomesenteric trunk	A common origin of both SMA and celiac artery arising from ventral surface of the aorta and branching out to at least two major branches of the celiac artery and the SMA.
Replaced middle colic artery from the celiac artery	An artery supplying the transverse colon arising from the celiac artery instead of arising from the superior mesenteric artery.

**Table 2:** Differential diagnosis table of middle mesenteric artery.

#### ABBREVIATIONS

CTA: Computed tomographic angiography  
 IMA: Inferior mesenteric artery  
 MIP: Maximum intensity projection  
 MMA: Middle mesenteric artery  
 SMA: Superior mesenteric artery

#### KEYWORDS

Middle mesenteric artery; Anatomical variation; Vascular anomaly; CT angiography; Aorta

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