



## The Pattern of Distribution of Inferior Mesenteric Artery – A Cadaveric Study

**Dr. Rekha Mane**

Assistant Professor MGM Medical College, kamothe Navi Mumbai 410209  
Maharashtra, India

**Dr. Charushila D. Shinde**

Assistant Professor MGM Medical College, kamothe Navi Mumbai 410209  
Maharashtra, India

### ABSTRACT

*The arterial supply of the abdomen is unique for each individual. The conventional description and illustration of the arterial blood supply to the intestinal tract are too incomplete which may mislead the surgeons in the intestinal surgery. Surgical procedure for diseases of colon is one of the most common operative procedures performed by the surgeons.*

*The blood supply to the intestinal tract is mainly from the superior mesenteric artery (SMA) & inferior mesenteric artery (IMA), Branches from abdominal aorta. Variations in branching pattern of arteries are common. These variations are usually due to the changes occurring during the development of vessels. The knowledge of the anatomy of colonic mesenteric arteries & its distribution is necessary to accomplish successful uncomplicated abdominal operations, especially laparoscopic colonic resections in which the mesenteric vessels can't be palpated. We studied the pattern of distribution of the Inferior mesenteric artery (IMA) & its branches in formalin preserved 50 cadavers at the department of Anatomy, MGM Medical College, Navi Mumbai, India. This study was conducted to enlighten our knowledge about colonic blood supply.*

**KEYWORDS :** Inferior Mesenteric Artery, Superior Mesenteric Artery, Colon, Abdominal aorta

### INTRODUCTION:

The arterial supply of the abdomen is unique for each individual, much the same way as a fingerprint.<sup>1</sup> The conventional description and illustration of the arterial blood supply to the intestinal tract, especially to the descending colon, sigmoid flexure in most standard textbooks of anatomy and surgery are too incomplete, inaccurate and misleading to be relied upon in the intestinal surgery. Surgical procedure for diseases of colon continues to be one of the most common operative procedures performed by the surgeons. The colon is drained by a rich and vast network of lymphatics which frequently follow the course of the major vessels. The nodes may be involved with inflammatory or neoplastic diseases, and knowledge of their location is critical to curative cancer resection. The colon has a variant blood supply; this factor should be taken into consideration while planning the colonic surgery. A thorough knowledge of the normal and variant anatomy of the major unpaired arteries originating from the abdominal aorta and their variants is necessary to accomplish a successful, uncomplicated abdominal operation.

As the field of intestinal surgery advanced over the recent century, challenge of performing more complex resection and anastomoses highlighted the presence of vascular variants. The current clinical interest of these anatomic finding is to laparoscopic colon surgeon. During laparoscopic colon surgery, these vessels must be isolated without the possibility of its direct palpation.

The inferior mesenteric artery is usually smaller in caliber than the superior mesenteric artery. It arises from anterolateral aspect of the aorta at the level of the third lumbar vertebra (L3). Its origin lays 3 or 4 cm proximal to aortic bifurcation and below the third part of the duodenum. It makes an angle of 70-90 degrees with abdominal aorta. It is about 4mm in diameter. It supplies the left one third of the transverse colon, descending colon, sigmoid colon and most of the rectum.<sup>2,3</sup>

### Branches of IMA are as follows:

Left colic Artery- It divides into ascending and descending branches. The ascending branch anastomoses with left branch of the middle colic artery. The descending branch anastomoses with the highest sigmoid artery. From the arches formed by these anastomoses branches are distributed to the distal one third of the transverse colon and the descending colon.

### Sigmoid (Inferior left colic) arteries :

They are two to five in number. They supply the distal descending colon, and the sigmoid colon. It anastomoses superiorly with the left

colic, and inferiorly with the superior rectal artery.

### Superior rectal/ haemorrhoidal artery (SRA):

It is the principal continuation of the inferior mesenteric artery. Opposite the third sacral vertebra it divides into two branches. It descends one on either side of the rectum and about 10 or 12 cm from the anus, breaks up into several small branches. It forms collateral network with the middle rectal arteries and inferior rectal arteries.<sup>2,3</sup>

### AIM:

To study the pattern of distribution of the Inferior mesenteric artery (IMA) & its branches.

### OBJECTIVES:

1. To identify the origin of the IMA and trace their branches.
2. To observe the anatomical variations of inferior mesenteric artery.
3. To study branching pattern of these artery.

### MATERIAL AND METHODS:

After approval from institutional ethical committee, the study was conducted between Sept 2010 – Sept 2012 in the Anatomy dissection hall of the MGM Medical College and hospital of Navi Mumbai. Fifty adult human formalin fixed cadavers, irrespective of sex were used in this study. The dissection was conducted as per Cunningham's manual of practical anatomy. The peritoneum and the viscera's were carefully separated and cleaned from the field of view.

### OBSERVATION-

#### INFERIOR MESENTRIC ARTERY

##### ORIGIN:

In all the 50 cadavers, IMA originated from abdominal aorta few cm proximal to bifurcation of aorta.

##### BRANCHES OF IMA :

In most of our cases IMA gave three branches. There was only a single case in which LCA was absent and additional branch from SMA supplied left colon [Table 1].

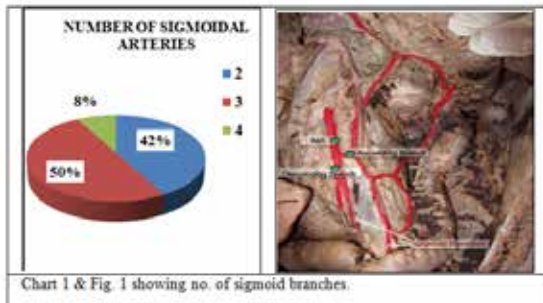
Branches	No. of cadavers	Percentage
LCA	49	98%

Sigmoid Artery	50	100%
Superior Rectal Artery	50	100%

**Table 1: Branches given by IMA**

**NUMBER OF SIGMOID BRANCHES:**

Sigmoid arteries are those which run in sigmoid mesocolon and may be derived from ascending, descending or middle branch of IMA. Total numbers of sigmoid arteries were calculated [Chart 1, and Fig 1



**DIVISION OF SUPERIOR RECTAL ARTERY (SRA):**

Two pattern of superior rectal artery division were seen- SRA is bifurcated 86% (43) & non bifurcated 14% (7) .

**TYPE OF DISTRIBUTION:**

On the basis of course of ascending branch (LCA) we have two types:

Type A: LCA reached splenic flexure

Type B: LCA reach midregion of the descending colon.

In all, in 50 cadavers, ascending branch reaches splenic flexure and supplied it. So all cases showed type A. Bifurcation of LCA was about 3-8 cm from gut wall .

**TYPE OF BRANCHES:**

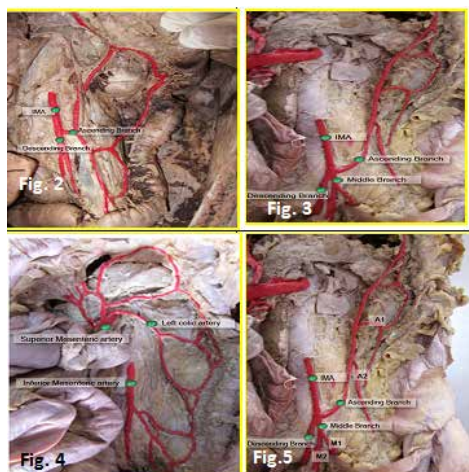
Divisional patterns of IMA consist of the following types .

Type A: IMA divided into ascending and descending branch [Fig. 2].

Type B: IMA divided into ascending middle and descending branches [Fig3].

Type C: IMA divided into ascending and descending branch and anastomosis between it.

Type D: some variant pattern [Fig 4].



**Figures: showing type& no. of branches**

In our study type A was most common 62% (31/50).Type B was

36%(18),with no case of type C. In 2%(1/50)of sample variant pattern was seen.

**NUMBER OF BRANCHES:**

Ascending middle and descending branch of IMA gave number of branches to part of transverse colon descending colon and sigmoid colon. These branches were counted [Table 2, Fi

Branch	Number of branches							
	0		1		2		3	
	No	%	No	%	No	%	No	%
Ascending	--	--	1	2%	24	48%	25	50%
Middle	31	62%	--	--	16	32%	3	6%
Descending	-	--	30	60%	20	40%	--	--

**Table 2: Number of branches**

Amongst 50 dissection substantial anastomoses between lowest sigmoid and superior rectal artery was seen in about 70%.

Due to limitation of dissection method it was difficult to comment about its existence or nonexistence in remaining sample. This requires further justification by injection experiment.

**DISCUSSION:**

**INFERIOR MESENTRIC ARTERY**

**ORIGIN:**

Generally IMA is very stable, arises directly from abdominal aorta.<sup>4</sup> In all our 50 cases it arises from abdominal aorta 100%. Lippert H and Pabst R had mentioned the frequency of the variation in which the IMA arise from SMA to be <0.1%.<sup>5</sup> A rare case of common trunk of CA, SMA and IMA (celiaco-bimesentric trunk) was reported.<sup>6</sup> Benton RS and Cotter WB had reported an extremely rare variation of double IMA, which arose from the abdominal aorta.<sup>7</sup>

In the Michels NA et al. study, 400 cadavers dissected to observe variant blood supply of the descending colon, rectosigmoid and rectum, but did not mention any case of common trunk of SMA and IMA.<sup>8</sup> Sierocinski W had studied arterial supply of descending colon in 100 cadavers; IMA was constant in all of them and common trunk was not noted. 9

**BRANCHES OF IMA:**

IMA gave three branches LCA (98%), sigmoid and superior rectal artery (100%).In 2% of cases LCA was absent. The LCA was absent Lee McGregor in 6% of cases.<sup>3</sup>

Few cases of variant branches of IMA had been reported in past. Piersol GA and Eisendrath DN had described lower polar artery from IMA but there were no statistical data on the prevalence of this arrangement.<sup>10,11</sup>

**NUMBER OF SIGMOIDAL ARTERY:**

Sigmoid vessels were defined as those, irrespective of their precise origin, which travel some part at least of their course in the sigmoid mesocolon.<sup>12</sup>

The number of arteries supplying sigmoid flexure is dependent on the length and width of the mesocolon. In our study sigmoidal arteries varied from 2-4 in number. Total number of sigmoidal arteries was 2-3 in number (92%).

In Michels NA et al. study, sigmoidal arteries were 2-3 in number (85%). Sigmoidal arteries had composite origin. They arose from ascending, middle or descending branch of IMA.

According to Michels NA et al. study, they arose as follows:

1. One from descending branch 1%
2. One from ascending, the other from the descending branch 41%
3. One from ascending, two from the descending branch 44%

4. Two from ascending, two from the descending branch 11%
5. One from ascending, two from middle and two from the descending branch 2%.<sup>8</sup>

**DIVISION OF SUPERIOR RECTAL ARTERY:**

In our 50 sample 83% of cases bifurcated.7% of cases it's difficult to comment that they did not bifurcate as bifurcation may be at lower level.

Four patterns of the superior rectal artery were noted 1) 81% bifurcated 2) 13% trifurcated 3) 4% more than three branches 4) 2% from anastomotic loop.<sup>8</sup>

**TYPE OF DISTRIBUTION:**

In study of Michels NA et al. 127 cadavers had found two types of distribution Type A (86%) where ascending branch reached the splenic flexure and Type B (14%) where it reached midregion of the descending colon.<sup>8</sup> In our study all 50 sample shows type A (100%) distribution.

**TYPE OF BRANCHES:**

In our study divisional patterns were as follows: Type A 62%, Type B 18%, Type C 0%, Type D 2%. Results stated by Michels NA et al. were Type A 56%, Type B 38%, Type C 6%.Type A being 56% most common pattern.<sup>8</sup> In our study also Type A was most common pattern (62%).

**NUMBER OF BRANCHES:**

Branches from IMA were left colic artery, sigmoid artery and superior rectal artery; those were described in literature as ascending, middle and descending respectively. Ascending branch (LCA) gave supply to the splenic flexure and descending colon and sigmoid colon by single branch that bifurcated or by additional branches from its stem. The left colic artery gave rise to an accessory left middle colic artery or it may be absent. In past literature was documented that branch from LCA may form a collateral pathway with MCA known as 'Arc of Riolan'. Now 'Arc of Riolan' was considered to be misnomer and proposed to be completely abolished.<sup>4</sup> Middle branch (sigmoidal artery) varied from 2-3 in number. Middle branch was not seen in few cases in them sigmoid colon was supplied by branches from IMA or LCA. Descending branch (Superior rectal artery), it was a continuation of IMA and gave branches to sigmoid colon.

Author	Sample	Number of branches						
		0	1	2	3	4	5	6
Griffith JD <sup>12</sup>	100	---	---	23%	41%	32%	3%	1%
Michels NA <sup>8</sup>	127	---	---	23%	41%	32%	3%	1%
Present study	50		2%	48%	50%	---	---	---

**Table 3: Number of branches from Ascending branch (Literature Review)**

Author	Sample	Number of branches						
		0	1	2	3	4	5	6
Griffith JD <sup>12</sup>	100	----	50%	41%	8%	1%	----	----
Michels NA <sup>8</sup>	127	----	50%	41%	8%	1%	----	----
Present study	50	----	60%	40%	----	---	----	----

**Table- 4 :Number of branches from Descending branch (Literature Review)**

Author	Sample	Number of branches						
		0	1	2	3	4	5	6
Griffith JD <sup>12</sup>	100	----	12%	83%	5%	----	----	----
Michels NA <sup>8</sup>	127	----	12%	83%	5%	----	----	----
Present study	50	62%	----	32%	6%	----	----	----

**Table 5: Number of branches from Middle branch (Literature Review)**

**CONCLUSION:**

Knowledge of morphology and embryology of the visceral arteries is of immense significance. In depth knowledge of the anomalous branching pattern of IMA & distribution is essential for the surgeon, oncologist for successful operative & interventional procedure.

In all 50 cases IMA originated from abdominal aorta, 3.62 cm ±0.76 proximal to bifurcation of aorta..Number of sigmoid branches were 2 (42%), 3 (50%), 4(8%). Superior rectal artery divided in 86% of cases. Type A pattern of distribution was noted in all 50 samples. Divisional patterns of IMA were Type A (62%), Type B (36%), Type C (0%) and Type D (2%). Number of branches from ascending descending and middle were 1(2%), 2(48%),3(50%), 0 (62%), 2(32%), 3(6%) and 1(60%), 2(40%) respectively.

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