

Anatomy of Stomach and Its Variations

Dr. Y. Nissi Monica^{1*}, Dr. R.Somasekar², Dr.K.Chitty Narasamma³,
Dr.CH.Jayamma⁴, Dr.S.K.Vanisree⁵, Dr.L.Rajaneesh⁶, Dr.T.Prashanti⁷,
Mr.Punarjeevan⁸, Dr.Madhusudhan Reddy⁹

^{1*}Post Graduate, Department Of Anatomy, Kurnool Medical College, Kurnool, Andhra Pradesh, India.

²Assistant Professor, Department Of Anatomy, Kurnool Medical College, Kurnool, Andhra Pradesh, India.

³Professor and HOD, Department Of Anatomy, Kurnool Medical College, Kurnool, Andhra Pradesh, India.

⁴Professor, Department Of Anatomy, Kurnool Medical College, Kurnool, Andhra Pradesh, India.

⁵Associate Professor, Department Of Anatomy, Kurnool Medical College, Kurnool, Andhra Pradesh, India.

⁶Assistant Professor, Department Of Anatomy, Kurnool Medical College, Kurnool, Andhra Pradesh, India.

⁷Assistant Professor, Department Of Anatomy, Kurnool Medical College, Kurnool, Andhra Pradesh, India.

^{8,9}Tutor, Department Of Anatomy, Kurnool Medical College, Kurnool, Andhra Pradesh, India.

Corresponding Author: Dr. Y. Nissi Monica

Abstract

Background: The stomach is a muscular bag fixed at both ends, mobile elsewhere, extends from the lower end of oesophagus to the first part of duodenum. It lies in the epigastric, umbilical, and left hypochondric areas surrounded by supracolic compartment of the peritoneal cavity. The ligaments of stomach are peritoneal folds which connect the stomach with diaphragm (Gastrophrenic), spleen (Gastrosplenic) colon (Gastro colic), and with liver (Lesser omentum) having surgical importance.

Methods: The study was conducted on 70 adult cadavers obtained from department of Anatomy, department of forensic medicine and 30 dead fetuses obtained from department of Gynaecology, Kurnool medical college. The specimens were dissected according to the steps in Cunningham's manual of Practical Anatomy. The length of the stomach is measured from the highest point on the fundus and to the lowest point of pyloric region. If variations are present they are noted. Data obtained were consolidated, statistically evaluated using SPSS Version 16 and results were represented using charts and tables.

Results: Normally the stomach lies in epigastric, umbilical and left hypochondric areas. In the present study the location of the stomach is same as above except in one fetus (specimen 11) in which stomach is situated above the diaphragm. Average length of the stomach is about 11" and average width (at the widest part) is 5". In the present study the length is more in J shaped stomach, measuring 9-11", in reverse "L" shape, the length is 9-10", in crescentic shape the length is 8-9" and in cylindrical shape the length is 7-8". In fetuses the length is not measured. (Table No.1 & 2). Both the cardiac and pyloric sphincters are normal in the present study except in one fetus where double oesophagus is seen which joined together to form single tube that opened into cardiac end. (Specimen No.22).

Conclusion: In the present study, No marked variations regarding the position of stomach except in one fetal specimen. "J" shaped stomach noted in most of the adult specimens and is variable in fetuses. The average length of stomach is shorter in cadavers compared with normal description. There is no marked change in cardiac and pyloric orifices except in one fetus. There is no variation noted regarding the arterial supply, venous drainage and nerve supply of the stomach. A thorough knowledge about the stomach regarding its shape, position, blood supply, nerve supply, lymphatic drainage, mucosal pattern, development, relations with other organs and anatomical variations will aid the surgeon to avoid complications during surgery.

Key Words: stomach, diaphragm, lymphatic drainage, mucosal pattern.

Date of Submission: 05-10-2020

Date of Acceptance: 19-10-2020

I. Introduction

The "Simple Tube" of Gastrointestinal tract and its associated organs have many different tract and organ specific abnormalities, due to the complex nature (different germ layers contribution, organogenesis) of the growth, elongation and folding of the tract, there are also several mechanical disorders of folding (Rotation).¹

The stomach is the first abdominal representative and most dilated part of the Gastrointestinal tract.² Being a receptacle for food, it is extremely distensible when filled with food may actually extend down into the pelvis (David Sinclair), contract and move about.³

The stomach is a muscular bag fixed at both ends, mobile elsewhere, extends from the lower end of oesophagus to the first part of duodenum. It lies in the epigastric, umbilical, and left hypochondric areas surrounded by supracolic compartment of the peritoneal cavity.⁴

The shape, and position of the stomach varies greatly depending upon the amount, condition of food it contains, neighbouring organs, respiratory movements and posture of the body (Fig. No.2). It has two orifices upper cardiac and lower pyloric orifice two borders right concave border lesser curvature and left convex border Greater curvature. It has two surfaces anterosuperior and postero inferior surface, their relation with other organs is important during surgery. It is divided into three parts the left larger part body, the right narrowing part pylorus and the part of body left to cardiac orifice is fundus (Fig. No.1). The ligaments of stomach are peritoneal folds which connect the stomach with diaphragm (Gastrophrenic), spleen (Gastrosplenic) colon (Gastro colic), and with liver (Lesser omentum) having surgical importance.⁵

The main function of stomach is digestion but a little absorption takes place. The stomach acts as a temporary storage chamber, mixing chamber for food cools or warms it to the temperature of body and renders it fluid for its passage along the intestine. In addition, it produces internal secretions concerned with haematopoiesis (Sircharles illing worth) and intrinsic factor for absorption of Vitamin B12.⁶

II. Materials And Methods

The present work consists of the study of the stomach of human adults and fetuses. The adult specimens 24 were obtained from embalmed cadavers, placed for dissection in the Department of Anatomy, Kurnool Medical College, Kurnool during 2006-2008, 46 from post mortem bodies in the Department of Forensic Medicine, Kurnool Medical College, Kurnool and fetuses from the Department of Gynaecology and Obstetrics, Government General Hospital, Kurnool from 2006-2008. The total number of specimens studied are 100, out of which 70 are adult cadavers (male and female), and the rest 30 are dead fetuses, (male and female). The crown-rump length, features like development of nails, subcutaneous tissue, distribution of hair and vernix-caseosa were taken into consideration to determine the age of fetuses.

PRESERVATION: The fetuses are preserved by injecting the preservative fluid. Composition of the preservative fluid is as follows.

1.	10% formalin	:	5cc
2.	Glycerine	:	175 cc
3.	Water	:	75 cc
	Total	:	255 cc

Soon after the fresh fetuses are brought from the Government General Hospital, Kurnool they were injected with the preservative fluid through one of the arteries of the umbilical cord or femoral artery. The preservative fluid is injected in small quantity 25-30 cc into the abdominal cavity and 40cc fluid is also injected into the brain through orbits and fontanelle.

They are immersed in the tank containing preservative solution, made up of 10% formalin and 2% carbolic acid, for 2-3 days. The dissection is conducted directly on the bodies in the mortuary room, after autopsy or post mortem. The cadavers that are brought for the student's dissection in anatomy are given preservative solution (3 litre of 40% formalin + 1 litre of glycerin + 1 litre ethyl alcohol + water 4-5 litres). The bodies are kept in the tank, containing preservative fluid for 1-2 months.

DESCRIPTION: A vertical midline incision from the xiphisternum to symphysis, two horizontal incisions along the costal margin and along inguinal ligament. Incision carried through the layers of anterior abdominal wall then abdominal cavity is opened, stomach is identified greater omentum was separated anterior relation of the stomach are noted. In fetuses it was observed that the anterior surface of stomach is covered by the left lobe of the liver which has extended across nearly as far as spleen and only a small portion of the greater curvature of the stomach is visible anteriorly. The left lobe of liver is incised and details of the stomach are observed.

The cardiac end and pyloric end of the stomach are identified by palpating the musculature, the arterial supply, venous drainage and nerve supply of stomach noted. The attachments of lesser omentum and greater omentum to lesser curvature and greater curvature noted. The arterial arcade formed by gastro epiploic arteries in greater omentum is identified and gastric arterial anastomosis formed by right and left gastric arteries in lesser omentum is also identified. The posterior relations of stomach and celiac trunk branches noted.

Then both ends of the stomach are ligated with the thread and stomach is removed. To know the intragastric volume of the stomach water is injected at pyloric end, then cardiac end ligature is removed and water is poured into measuring jar, volume noted. The stomach serosal layer is removed by stripping to see the musculature of stomach. The stomach is opened by giving incision along the greater curvature and mucosa of the stomach is studied with hand lens and both orifices are also seen. The length of the stomach is measured

from the highest point on the fundus and to the lowest point of pyloric region. Finally if variations are present they are noted.

III. Results

Normal pattern: The stomach lies obliquely across the supracolic compartment from upper left to lower right extends between lower end of oesophagus to first part of duodenum in a “J” or “C” shaped curve. The greater part is hidden by liver, diaphragm and part of its anterior surface is in contact with anterior abdominal wall inferior to left lobe of liver. It has two ends cardiac and pyloric two orifices cardiac orifice, pyloric orifice, two surfaces anterosuperior postero inferior surface, two borders right border or lesser curvature and left border or greater curvature. Through various ligaments or peritoneal folds the stomach is connected to the neighbouring organs – through lesser omentum connected to liver, Gastrosplenic ligament to the spleen, gastrophrenic ligament to diaphragm and through greater omentum or gastrocolic ligament to the transverse colon.

In the present topic the following observations of the stomach are studied under the following headings.

Location, Length, Shape, Capacity of the stomach, Lower extent of the greater curvature , Arterial supply, Venous drainage, Nerve supply.

Location: Normally the stomach lies in epigastric, umbilical and left hypochondric areas. In the present study the location of the stomach is same as above except in one fetus (specimen 11) in which stomach is situated above the diaphragm.

Length: Average length of the stomach is about 11” and average width (at the widest part) is 5”. In the present study the length is more in J shaped stomach, measuring 9-11”, in reverse “L” shape, the length is 9-10”, in crescentic shape the length is 8-9” and in cylindrical shape the length is 7-8”. In fetuses the length is not measured.

Shape: Shape of the stomach varies from J-Shape, reverse ‘L’, crescentic and cylindrical. In the present study, majority of specimens are ‘J’ shaped and in the remaining specimens other shapes noted. The shape of the stomach not studied in fetuses because of its change with age (Table.No.3 & 4).

Table 1: Observations on shape of stomach in Adults

S.No.	Sex	Shape of stomach in adults
A1	Male	J
A2	Male	J
A3	Male	Reverse ‘L’
A4	Male	J
A5	Female	J
A6	Female	J
A7	Female	J
A8	Male	J
A9	Male	J
A10	Female	J
A11	Female	J
A12	Male	J
A13	Male	Reverse ‘L’
A14	Male	J
A15	Male	Crescentic
A16	Female	Cylindrical
A17	Female	J
A18	Male	J
A19	Male	Crescentic
A20	Male	J
A21	Male	J
A22	Male	J
A23	Male	J
A24	Male	Cylindrical
A25	Female	Reverse ‘L’
A26	Female	Crescentic
A27	Male	J
A28	Female	Reverse ‘L’
A29	Male	J
A30	Female	J
A31	Male	Crescentic
A32	Male	J
A33	Male	J
A34	Male	J
A35	Male	J

A36	Male	J
A37	Male	Cylindrical
A38	Female	Reverse 'L'
A39	Male	J
A40	Male	J
A41	Male	J
A42	Male	Reverse 'L'
A43	Female	Cylindrical
A44	Female	J
A45	Female	J
A46	Male	Reverse 'L'
A47	Male	J
A48	Male	J
A49	Male	Cylindrical
A50	Male	J
A51	Female	Reverse 'L'
A52	Female	J
A53	Male	J
A54	Male	J
A55	Male	Crescentic
A56	Male	J
A57	Male	J
A58	Male	J
A59	Male	J
A60	Male	J
A61	Female	J
A62	Male	Reverse 'L'
A63	Male	J
A64	Male	J
A65	Male	J
A66	Male	J
A67	Male	Reverse 'L'
A68	Female	J
A69	Female	J
A70	Male	J

Capacity: The mean capacity varies from 30ml at birth to 1000ml at puberty and 1500ml in adults. In the present study depending on the age of the fetus capacity varies from 1ml to 2.5ml and capacity markedly lowered because fetuses are formalin fixed. In adult cadavers allotted to students the capacity is 150ml and in postmortem specimens the capacity varies from 1200-1500ml.

Table 2: Observations on capacity of stomach in adults.

S.No.	Sex	Capacity of stomach in adults (in ml)
A1	Male	1500
A2	Male	1500
A3	Male	150
A4	Male	1200
A5	Female	150
A6	Female	1200
A7	Female	1500
A8	Male	1500
A9	Male	1400
A10	Female	150
A11	Female	150
A12	Male	1500
A13	Male	150
A14	Male	1200
A15	Male	150
A16	Female	150
A17	Female	1300
A18	Male	1400
A19	Male	150
A20	Male	150
A21	Male	1400
A22	Male	1500
A23	Male	1500

A24	Male	150
A25	Female	1500
A26	Female	150
A27	Male	1500
A28	Female	1400
A29	Male	1500
A30	Female	1400
A31	Male	150
A32	Male	1400
A33	Male	150
A34	Male	1200
A35	Male	1500
A36	Male	1500
A37	Male	150
A38	Female	150
A39	Male	1200
A40	Male	1200
A41	Male	1500
A42	Male	1500
A43	Female	150
A44	Female	1200
A45	Female	150
A46	Male	1200
A47	Male	150
A48	Male	1400
A49	Male	150
A50	Male	1500
A51	Female	150
A52	Female	1200
A53	Male	1500
A54	Male	1500
A55	Male	150
A56	Male	1200
A57	Male	1400
A58	Male	150
A59	Male	150
A60	Male	1200
A61	Female	1400
A62	Male	1200
A63	Male	1200
A64	Male	1200
A65	Male	1200
A66	Male	1500
A67	Male	1200
A68	Female	150
A69	Female	1200
A70	Male	1500

Table 3: Capacity of stomach in Adults

S.No.	Cadaver / specimen	No. of specimens	Capacity of stomach in adults	Percentage
1.	Cadavers	24	150ml	34.3
2.	Mortuary specimens	46	1200-150 ml	65.7

Table 4: Capacity of stomach in fetuses

S.No.	No. of fetuses	Capacity of stomach in fetuses	Percentage
1.	20	2 – 2.5ml	20.7
2.	6	1 – 1.5 ml	6.3
3.	4	1 ml	3.0

Orifices: Cardiac and pyloric orifices identified. The opening from oesophagus to stomach is cardiac orifice situated left to midline behind 7th costal cartilage. 2.5 cm in its sternal junction at the level of T11 vertebra, 10cm from anterior abdominal wall and 40cm from incisor teeth. In the present study no change. Pyloric orifice opens into the first part of duodenum. Identified by pyloric sphincter 1.2cms to right of mid line in transpyloric

plane at the level of lower border of L1 vertebra, pyloric sphincter identified by prepyloric vein on its anterior surface (Fig.No.15)

Curvatures: Lesser curvature extends between cardiac and pyloric orifices. It lies towards right side of the stomach. There is no much change except in one specimen (No.60) the lesser curvature is covered by left lobe and quadrate lobe of liver.

Greater curvature starts from cardiac notch and ends at the pylorus. The lowest part of greater curvature may be as high as the upper half of the 12th thoracic vertebra or on the first sacral vertebra. In the present study out of 70 cadavers dissected, in 50 cadavers the greater curvature ending at L3 and in the remaining at L2. In the fetuses out of the 30 dissected in 22 fetuses the greater curvature is ending at L2 vertebra & in one fetus the greater curvature directed upwards and seen at T2 vertebra.

Surface: In the present study the relations are same as above and there is no deviation in adults. In all the fetuses the entire stomach is covered by left lobe of liver which extends upto the spleen, depending on the age of fetus except in one fetus.

Musculature of the stomach: After removing the serosa with the hand lens outer longitudinal, middle circular and inner oblique muscle layers are observed. In the present study there is no deviation.

Interior of the stomach: The stomach is cut along the greater curvature and interior of the stomach observed with hand lens numerous pits are seen into which gastric glands are open, in the present study there is no deviation.

Gastric sphincter: Both the cardiac and pyloric sphincters are normal in the present study except in one fetus where double oesophagus is seen which joined together to form single tube that opened into cardiac end. (Specimen No.22)

Arterial supply: Arterial supply to the stomach is directly by coeliac trunk or indirectly by its branches.

Left gastric artery: Left gastric artery is the branch of coeliac trunk. It gives oesophageal branches, branches to lower end of oesophagus and anastomose with right gastric artery in the pyloric region, along the lesser curvature. In the present study there is no deviation except in one fetus it arises from common hepatic artery (Specimen No.20). About ten gastric branches arising from anastomosis between right and left gastric artery.

Right gastric artery: Right gastric artery is the branch of hepatic artery. It runs along lesser curvature and gives branches to anterior and posterior walls of stomach in pyloric region and anastomose with right gastric artery. In the present study, there is no deviation except in one fetus (Specimen No.12) double hepatic artery observed.

Left gastro epiploic artery: It is the artery of Greater curvature (epiploon means omentum) arises from splenic artery, gives branches to greater omentum and branches to anterior, posterior walls of the stomach and anastomose with right gastro epiploic artery along the greater curvature. In the present study about 15 gastric branches arising from the anastomosis between right and left gastroepiploic arteries. In the present study there is no deviation, but in one fetus it is arising from inferior terminal branch of splenic artery (Specimen No.25).

Right gastro epiploic artery: It is the terminal branch of gastroduodenal artery arises left to common bile duct. In the present study, in one fetus it is observed in front of common bile duct (Specimen No.22).

Short gastric artery: 3 or 4 in number, they are branches of splenic artery and supply the fundus of stomach. In the present study there is no deviation.

Nerve supply: Stomach is supplied by sympathetic nerves which are the branches of coeliac plexus that arises from T6-9 and parasympathetic supply through vagus nerve. The anterior vagal trunk predominantly consists of left vagus fibres and posterior vagal trunk predominantly consists of right vagus fibres. The anterior vagal trunk branches are hepatic and gastric branches. The anterior vagus divides into branches proximal to pylorus gives appearance of "CROW'S FOOT". The posterior vagal trunk branches are Gastric and coeliac branches. In the present study, there is no deviation.

IV. Discussion

The shape of the stomach is mostly 'J' shaped as described by Indian and foreign authors T.S.Ranganathan described it as pear shaped and in calendars surgical Anatomy the shape of stomach is given as cornucopia. In the present study 72% are 'J' shaped, 14% are reverse L, 7% are crescentic and remaining 7% are cylindrical.⁹

The length of the stomach varies between 9-11" in 72% and in remaining specimens between 8-10". In this present study the average length is 10". There is slight decrease in length in cadavers when compared to living.

There is no marked change regarding cardiac orifice, pyloric orifice and lesser curvature except in one fetus. The present study coincides with the standard text books like Gray's Anatomy.

The lower extent of Greater curvature varies considerably in fetuses and adults. In adult specimens 71.4% greater curvature ends at L3 level, 21.4% ends at L2 level and 7.2% at L4 level. In fetuses 73.3% ends at L2, 23.4% at L1 or above L1 and in one fetus at T2.

Coming to the capacity of the stomach, there is a gross difference between mortuary specimen and cadavers. In postmortem bodies the capacity varies between 1200-1500 mL and in cadavers, it is 150ml. The present study coincides with standard text books.

Coming to Arterial supply there is no much difference between present study and standard text books like Gray's Anatomy.

The left gastric artery usually arises from coeliac trunk. According to Lipshutz, it is directly arising from aorta in 15% cases, Eaton found in 4.5% cases, Michels in 2.5% cases. In the present study 97% cases, it is arising from coeliac trunk & in 3% cases, it is arising from common hepatic artery.¹⁰

V. Conclusion

No marked variations regarding the position of stomach except in one fetal specimen. "J" shaped stomach noted in most of the adult specimens and is variable in fetuses. The average length of stomach is shorter in cadavers compared with normal description. The capacity of the stomach markedly lowered in cadavers compared with normal description, but in postmortem specimens the capacity is same as normal description. There is no marked change in cardiac and pyloric orifices except in one fetus. There is no marked change observed in lesser curvature except in one specimen but there is marked change observed regarding lower extent of greater curvature in fetuses and adults. Regarding the arterial supply of the stomach there is no gross variation. Regarding the venous drainage of the stomach. There is no variation. There is no variation noted regarding the nerve supply of the stomach. True variations and anomalies are relatively rare inspite of great variations in shape and size of the stomach.

References

- [1]. Arson & Maddock, 1958, Callander surgical Anatomy 4th Edition, Page:420.
- [2]. Asim Kumar Datta, 2003, Essentials of Human Anatomy, Page:166-179 Current books International, Calcutta, Bombay.
- [3]. Basmajian, J.V. 1983, Grant's method of Anatomy 10th edition 1983 Page-16, S.Chand & Company Ltd., Ramnagar, New Delhi.
- [4]. Bailey and Love, 2004, Short practice of Surgery 24th edition, Page: 1026, Charles, V.Mann., Russel. RCG, Norman, S.Williams, ELBS with Chapman and Hall, London.
- [5]. Chakrabarty, N.C., Chakrabarty, D, 1995, Fundamentals of Human Anatomy, Vol.2, 1st edition, Page:122, New Central Book Agency Pvt. Ltd., 8/1, Chintamani Das Lane, Calcutta.
- [6]. David Sinclair, 1961, An introduction to functional anatomy. The stomach is extremely distensible down into the pelvis 2nd edition. Blackwell publication.
- [7]. Deftoor.W, Reeves.D, Minc Vich.E 2003, Gastrocystoplasty – long term follow up (Pub.Med. 1649-50).
- [8]. Dockray G, Dimaline.R, Varro.A2005, Gastrin old hormone New function (Pub.Med. 344-55).
- [9]. Du Plessis, D.J.1999, Lee Mc Gregor's Synopsis of Surgical Anatomy 12th edition, Page:10 Varghese publishing House Hind Rajasthan Building Dadar, Bombay.
- [10]. ERKL. Farquharson 1972, Text book of operative surgery 5th edition, page No. 514-561 edited by Churchill living stone.

Dr. Y. Nissi Monica, et. al. "Anatomy of Stomach and Its Variations." *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, 19(10), 2020, pp. 55-61.