PATTERN OF GASTRIC INNERVATION

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BRANCH - V

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CERTIFICATE

This is to certify that the dissertation title, **"PATTERN OF GASTRIC INNERVATION"** is an original work done by **Dr. K.C.Shanthi**, PG Student, Stanley Medical College, Chennai-1, under my supervision and guidance.

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DECLARATION

I solemnly declare that this dissertation **"PATTERN OF GASTRIC INNERVATION"** was written by me in the Department of Anatomy, Govt. Stanley Medical College and Hospital, Chennai, under the guidance and supervision of **Prof. Dr. Sudha Seshayyan, M.S.,** Professor and Head of the Department of Anatomy, Govt. Stanley Medical College, Chennai - 600 001.

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CONTENTS

AIM OF THE STUDY

Surgical therapy for peptic ulcer began as an empiric extension of the procedures first used in the nineteenth century for gastric cancer.

Simple gastro jejunostomy and later, partial distal gastrectomy were the most widely adopted for this disease, but these procedures were plagued by high rates of ulcer recurrence and a plethora of undesirable digestive and nutritional sequelae, respectively.

The technique of proximal gastric vagotomy represents the culmination of decades of surgical research and appears to have greatly improved the functional outcome of ulcer surgery.

It is ironic that while such remarkable progress was achieved in surgical therapy, the number of operations for peptic ulcer disease steadily decreased, owing to changes in the natural history of the disease as well as major advances in medical management.

Classically, the indications for operative therapy of peptic ulcer were intractability, haemorrhage, perforation and obstruction.

Nowadays, few patients have duodenal ulcer that are absolutely refractory to optimal medical treatment.

However, for some patients, elective operation may represent an excellent therapeutic alternative.

There currently exists no pharmacologic agent that permanently controls the duodenal ulcer diathesis.

Various surgical procedures adopted to treat peptic ulcer and duodenal ulcer. They are,

1. Truncal Vagotomy with drainage or resection
2. Selective Vagotomy with drainage or resection
3. Proximal gastric vagotomy.

Among these proximal gastric vagotomy is the newest addition to the armamentarium of definitive ulcer operations. This procedure limits vagotomy to the fundus of the stomach and preserves antral innervation, thereby avoiding the need for a drainage or resectional procedure.

The success reported in early European series and the duplication of these promising results in prospective trials by **Jordan**.

Proximal gastric vagotomy is a technically more difficult procedure to perform properly than other standard forms of vagotomy.

By sparing antro pyloric function, near-normal gastric emptying is achieved, and with preservation of extragastric vagal innervation, the incidence of postvagotomy diarrohea and dumping is minimal.

The incidence of wound infection, anastomotic leakage, and afferent or efferent limb obstruction are greatly reduced.

The major issue concerning proximal gastric vagotomy is ulcer recurrence.

There is compelling evidence that the success of the procedure in terms of ulcer recurrence depends primarily on the experience of the operator and knowledge of anatomy of vagus nerve in the abdomen.

The knowledge of variants of branching and disposition of the vagus nerve branches decreases the risk of incomplete and inadequate vagotomy.

It is imperative that the surgeon be fully aware of the anatomy of the vagus nerve and its common variations in location and distribution.

I planned to study the gastric branches of anterior vagus nerve and the variation in branching and termination of anterior nerve of Latarjet.

Knowledge of this branching and its variations are very much important for a surgeon to perform a successful proximal gastric vagotomy. I hope my study will help them in this regard.

ANATOMY OF THE STOMACH

The stomach is the most dilated part between the oesophagus and the duodenum in the abdomen. It lies in the epigastric region and extends to left hypochondrium and umbilical region.

The stomach has two orifices, two borders, two surfaces and three parts.

ORIFICES

Cardiac orifice lies in the gastro oesophageal junction 2.5 cm to the left of the midline at the level of 10^{th} thoracic vertebrae.

Pyloric orifice lies in the gastro duodenal junction 2.5 cm to the right of the midline at the level of lower border of body of 1^{st} lumbar vertebra posteriorly, at transpyloric plane anteriorly (an imaginary line) which corresponds to the 9^{th} costal cartilage.

BORDERS

Lesser curvature is concave and the concavity is facing towards the right. Lesser curvature extends from the cardiac orifice to the pyloric orifice. A constant notch present in the lower part of the lesser curvature

near the pyloric end is called as incisura angularis. Lesser curvature is the right border of the stomach.

Greater curvature is the left border of the stomach. Greater curvature is convex. Convexity is facing towards the left.

Greater curvature is much longer than the lesser curvature and extends from the left of the cardiac orifice over the dome of the fundus and along the left border of the stomach to the pyloric orifice.

SURFACES

Ventral or anterior surface is related to,

i) The inferior surface of the left lobe of liver.

ii) Diaphragm which separates it from the 7^{th} and 8^{th} ribs and their costal cartilages

iii) Anterior abdominal wall in between the diverging costal margins.

iv) Gastric area of the spleen is related with the upper and left corner of the anterior surface of the stomach.

Dorsal or posterior surface is related to the structures forming stomach bed. The stomach bed forming structures are

i) Anterior Surface of the part of the head, neck and body of pancreas.

ii) Root of the transverse colon.

iii) Upper part of the anterior surface of the left kidney.

iv) Anterior surface of the upper part of the left suprarenal gland

v) Splenic artery

vi) The gastric surface of spleen.

PARTS

Fundus is dome shaped and projects upwards and to the left from the cardiac orifice.

Body is the largest part of the stomach. It extends from the fundus to the incisura angularis.

Pylorus is the part that extends from the incisura angularis to the gastroduodenal junction. It consists of pyloric antrum and pyloric canal. The distal end of the pyloric canal is thickened to form the pyloric sphincter.

The wall of the stomach has four layers.

1. Mucous Membrane

2. Submucosa

3. Muscular layer

4. Serous Layer

1. Mucous membrane is made up of lining epithelium, lamina propria and muscularis mucosa.

Lining epithelium is simple columnar and mucous secreting, which dips into the lamina propria to form gastric pits. Deep to the gastric pits the mucous membrane is packed with numerous gastric glands.

The gastric glands have peptic and parietal cells secreting pepsin and hydrochloric acid. These glands are more numerous in the body of the stomach.

In the pyloric region the glands have mucous secreting cells.

Lamina propria contains connective tissue cells and occasional aggregation of lymphoid tissue.

Muscularis mucosa is well developed. It is made up of inner and outer circular layer and middle longitudinal layer of smooth muscle fibre.

2. Submucosa consists of collagen bundles elastic fibres, blood vessels and nerve plexus called Meissner's plexus.

3. Muscular layer is made up of inner oblique layer, middle circular layer and outer longitudinal layer. The inner oblique layer is more dense in the fundus than the antrum.

These fibres run obliquely from the fundus to the greater curvature. So there is absence of these fibres along the lesser curvature.

This creates a depression called 'Magenstrasse' along the lesser curvature.

The middle circular layer is dense in antrum and helps in gastric emptying.

5. Serous layer is the outermost layer of the stomach formed by visceral peritoneum.

BLOOD SUPPLY

The stomach is developed from foregut it receives blood supply through branches of foregut artery the Coeliac trunk. The branches supplying the stomach are right and left gastric arteries, right and left gastro epiploic arteries and short gastric arteries. Veins accompany the corresponding arteries and drain into the portal vein.

NERVE SUPPLY

The stomach is supplied by sympathetic fibres from the coeliac plexus and para sympathetic fibres from the vagus nerves.

SYMPATHETIC SUPPLY

The sympathetic supply originates from the fifth to twelfth thoracic spinal segments and is mainly distributed to the stomach through greater and lesser splanchnic nerves and the cardiac plexus. The greater and lesser splanchnic nerves enter the abdomen through the openings present in the crus of the diaphragm. Periarterial plexuses form along the arteries and supply the stomach by sending branches along the branches of coeliac axis.

Sympathetic fibres are vasomotor in function and stimulate the contraction of pyloric sphincter but inhibits the rest of the gastric musculature.

PARA SYMPATHETIC SUPPLY

The parasympathetic supply is derived from the anterior and posterior vagus nerves.

The right and left vagus nerves enter the abdomen through the oesophageal opening. Because of 90° rotation in anticlockwise in vertical axis that occurs during development of stomach, the left and

right vagus nerves become as anterior and posterior vagus nerves respectively.

The anterior vagus nerve supply the cardiac orifice and then divides near the upper end of the lesser curvature into gastric branches, pyloric branches and hepatic branches.

Gastric branches, four to ten in number, run towards the anterior surface of the body and fundus and supplies it.

The greater anterior gastric nerve is the major gastric branch, that lies along the lesser curvature. This nerve is also called as anterior gastric nerve of Latarjet. The anterior gastric nerve ends at incisura angularis by forming crow's foot appearance.

Two pyloric branches originate near the cardiac orifice. These branches passes between the layers of lesser omentum and supplies the pylorus.

Hepatic branches run in the upper part of lesser omentum to join the plexus on the hepatic artery.

Posterior vagus nerve divides to form gastric and coeliac branches.

Gastric branches supply the posterior surface of the stomach. The largest branch is called as greater posterior gastric nerve or posterior gastric nerve of Latarjet. This nerve ends at the angular notch.

Coeliac branches runs along the left gastric artery and joins the coeliac plexus.

The parasympathetic fibre stimulates the gastric musculature, inhibit the pyloric sphincter and is secretomotor to the gastric glands.

The sympathetic stimulation causes contraction of pyloric sphincter and does not have any effect on gastric acid secretion.

The parasympathetic stimulation is mainly secretomotor in function. It's stimulation causes acid secretion in the stomach. Acid secreting parietal cells are abundant in the body of the stomach.

Stimulation of vagi causes contraction of body musculature and relaxation of pyloric sphincter. In the pyloric region the glands are mucous secreting in nature.

So mainly the gastric branches are involved in the secretion of hydrocholoric acid.

REVIEW OF LITERATURE

Swan (1834 ; 1864) described, one anterior vagus nerve and two posterior vagus nerves entering the abdomen and also described the presence of anterior plexus and absence of posterior plexus.

Bourgery (1844) described three anterior vagus nerve and double posterior vagus nerves enter the abdomen through the oesophageal opening of the diaphragm. He also stated that there are plexuses only in the anterior surface of the stomach.

Kollman (1860) explained in his study that one anterior vagus nerve and one posterior vagus nerve entering the abdomen through oesophageal opening of the diaphragm. He also stated that the anterior and posterior plexuses may or may not be present.

Sappey (1872), **Sheifer & Symington** (1909) found one anterior vagus nerve and one posterior vagus nerve entering the abdomen and the absence of plexuses formation over the surfaces of stomach.

According to Quain's (1909) the anterior vagus nerve divides into many branches opposite the cardiac orifice, the largest branch extends over the cardiac end of the stomach and unite with the gastric

plexus of the sympathetic. Some of the gastric from the anterior vagus nerve also continued between the layers of the lesser omentum to the hepatic plexus.

The posterior vagus nerve descends on the posterior aspect of the oesophagus and descends down to the stomach and then divides into branches to supply the posterior surface of the stomach. Most of the fibres of the posterior vagus nerve takes part in the formation of coeliac, splenic and left renal plexuses along with the sympathetic fibres.

Perman (1916), described in his study that the pyloric part of the stomach is supplied by anterior gastric nerve.

In 1921, **Latarjet** described in his study that one anterior vagus nerve and one posterior vagus nerve entering the abdomen.

The anterior vagus nerve divides into three sets of branches.

1) The first set consisting of four to five branches near the upper part of lesser curvature and supply the fundus and cardiac end of stomach. One of the branches in this group is big and very prominent for which he named, "principle anterior nerve of lesser curvature".

2) Second set, usually three to five in number arises from the hepatic branch of the anterior vagus nerve. These branches descend in the lesser omentum to supply the superior margin of the pylorus and first part of duodenum. He called these nerves as "Superior pyloric nerves".

3) Third set consists of numerous branches arising from the hepatic branch of anterior vagus nerve. These branches supply the inferior margin of pylorus and 1st part of duodenum for which he named as "Inferior pyloric nerves".

As per the study of **Latarjet**, the anterior vagus nerve divided into two functional sets of division. The 1st set supplying the reservoir part of the stomach and 2nd set supplying the sphincteric part of the stomach.

The reservoir part includes fundus and body of the stomach whereas the sphincteric part includes pylorus of the stomach and first part of the duodenum.

According to **McCrea** (1924), the anterior vagus nerve divides into three to six branches. He divides the branches into two groups as right and left groups.

From the left group the branches supplying the anterior surface of the cardia, fundus and the proximal portion of the body of the stomach are given out. These branches arising from the left group may or may not form the plexus.

McCrea describes the right group into three main branches.

1) Hepatic branches proceeding laterally in the lesser omentum towards porta hepatis. Its terminal twigs are divided into two series namely a proximal branch which supplies the porta hepatis and a distal branch which turns downwards towards the pylorus.

2) Anterior gastric nerve, a large nerve passes downwards between the layers of the lesser omentum, a short distance from the lesser curvature of the stomach, parallel to the lesser curvature. It is distributed to the anterior surface of the pyloric antrum and body of the stomach but does not reach the pyloric canal.

3) The third branch unnamed by him lies on lesser curvature along the attachment of the lesser omentum upto incisura angularis.

All these branches may communicate with the coeliac sympathetic plexus and posterior vagal branches in the region of the fundus.

McCrea concludes his study as,

1) The pyloric canal, pyloric sphincter and first part of the duodenum are supplied by the hepatic branches of the anterior vagus nerve.

2) The rest of the stomach other than the parts mentioned above is supplied by the gastric and second and third right branches.

3) The second branch supplies the body and the anterior surface of the antrum, but it does not reach the pyloric canal.

G.A.G.Mitchell (1940), in his study describes the parasympathetic supply to the stomach is conveyed by the vagi. He observed in his study both single and double anterior vagus nerves.

Anterior vagus nerve supplies several filaments to the cardiac orifice before dividing near the proximal end of the lesser curvature into four branches, namely,

a) gastric branches

b) pyloric branches

c) hepatic branches

d) coeliac branches

a) Gastric branches are four to ten in number and supplies the anterior aspects of the cardiac orifice and fundus and lower most branch reaches almost to the pylorus. One of the branch is longer than the other branches and lies along the anterior part of the lesser curvature between the layers of lesser omentum. He termed the longer nerve as greater anterior gastric nerve. He described that he had never seen a true anterior gastric plexus.

b) Pyloric branches are two in number. One branch arises from the anterior vagus, near the upper end of the lesser curvature, passes horizontally between the layers of the lesser oemntum to the left side of the hepatic artery to reach the pylorus and proximal part of the duodenum.

c) Hepatic branches are two to four in number, arises from the anterior vagus nerve, these branches run towards the porta hepatis and gives descending branches to supply the pylorus.

d) coeliac branches arising from the anterior vagus nerve joins the coeliac plexus.

Jackson in (1948) studied the distribution of the anterior vagus nerve in 50 cadavers. He described that the presence of principle anterior nerve of the lesser curvature, named by **Latarjet** (1921), in only twenty-eight of fifty dissections. He also stated that sometimes the principle anterior nerve of the lesser curvature instead of following the lesser curvature arose high and passed between the layers of lesser omentum to reach the stomach. He described in his study that he observed an average of four gastric branches from the anterior vagus nerve.

Legros and **Griffith** in (1964) describes in their study, one anterior vagus nerve and one posterior vagus nerve. He also demonstrated that vagal branches that are subserosal at the surface may penerate the muscular layer and continue downward to the antrum by the submucosal plexus.

C.V.Ruckley (1964, 1970) described in his study, presence of one to two anterior vagus nerve and one to three posterior vagus nerve. He

also stated that, presence of posterior gastric plexus and absence of anterior gastric plexus.

Loeweneck et al in (1967) described the presence of one to four anterior vagus nerve and one posterior vagus nerve. He described that one branch arising from the anterior gastric nerve was long and he named the branch as antral nerve.

He also described in his study the presence of anterior gastric plexus and absence of posterior plexus.

Cunningham in 1972 described that the anterior vagal trunk gives a hepatic branch to the liver. From the hepatic branch a branch arises and passes to supply the pyloric region.

Brizzi et al (1973) described in his study, one to five anterior vagus nerve and one to three posterior vagus nerve entering the abdomen. He also stated that, in 20% of cases, the presence of plexus over the anterior surface of the stomach.

Civalero's (1979) described one anterior vagus nerve and one posterior vagus nerve passing through the oesophageal opening of the

diaphragm. He also describes that, there is no presence of plexus on the stomach either anteriorly or posteriorly.

T.W.Mackay and **P.L.R.Andrews** in (1981) described in their study, the presence of anterior gastric plexus in 58% of cadavers and presence of posterior gastric plexus in 65% of cadavers.

Skandalakis et al (1986) described in their study, that the anterior vagal trunk divided into anterior gastric and hepatic divisions at the gastro oesophageal junction. They described that, the major branch of the anterior gastric division forms the anterior nerve of Latarjet. They also stated that the anterior nerve of Latarjet ends at the level of incisura angularis in most of the specimens.

Skandalakis et al observed the anterior nerve of Latarjet in 96 out of 100 specimens. The anterior nerve of Latarjet terminates at the level of incisura angularis in 79 specimens out of 100 specimens.

They also stated that in some specimens the anterior nerve of Latarjet extended upto the first part of the duodenum.

S.A. Derbyshire, Dr.M.Lagopoulos, T.Lee. J.N.Primrose. In their study observed the following findings.

1. The distribution of the nerves supplying the pyloric antrum, distal to the termination of the nerve of Latarjet.

2. Parietal cells extended upto the distal pylorus in 35% of cases.

3. Parietal cells present in the pylorus of the stomach was innervated by antral branches of anterior nerve of Latarjet in 55% of cases.

4. Branches from the anterior vagal trunk terminated on the posterior antral surface of the stomach in 25% of cases.

5. Branches from the posterior vagal trunk terminated on the anterior surface of the stomach in 20% of cases. The above findings suggest that there is an anatomical limitation to complete denervation of the distal parietal cell mass during a standard highly selective vagotomy. Where the nerve of **Latarjet** and all the branches distal to it are spared.

Shuang Qin Yi (1990) in his study described that the anterior nerve of Laterjet was present, parallel to lesser curvature approximately 1 cm from it. It gives off one to seven branches to the anterior aspect of

the body of the stomach before it ended in four to six terminal branches as a crow's foot arrangement in the region of the incisura angularis.

Double anterior nerves of laterjet were present in seven cadavers. Nerve of laterjet goes upto pylorus in six cases out of ten.

Trinh VM, Le Vd, Nguyen Dv. observed different characteristics of the vagus nerve in 38 formalin preserved specimens. At the end of their study demonstrated hitherto unknown or poorly known supra selective branches of vagus nerve.

Dia A, Ouedraogo T, Zida M, Sow ML. described in their study about various distribution of vagus nerve at various level.

1. At the level of oesophageal hiatus, the double anterior vagus nerve, found in 46% of the cases and double posterior vagus nerve found in 24% of the cases.

2. At the level of abdominal oesophagus, the single anterior vagus nerve, found in 68% of cases and single posterior vagus nerve in 64% of cases.

3. At the level of lesser curvature, plexus formation anteriorly in 8% of cases and plexus formation posteriorly in 6% of cases.

4. At the level of Incisura angularis the crows foot appearance, found in 20% of cases anteriorly and 32% of cases posteriorly.

According to **Richard S. Snell** the anterior vagal trunk may be single or double and they divides into branches to supply the anterior surface of the stomach. A large hepatic branch passes upto the liver and from this a pyloric branch passes down to the pylorus.

According to **Lasts** Anatomy, anterior vagal trunk gives off one or two hepatic branches, which run in the upper part of lesser omentum to join the hepatic plexus. It also gives off several gastric branches which supply the fundus and body and one large branch (greater anterior gastric nerve or anterior nerve of Latarjet) which runs down in the lesser omentum near the lesser curvature and subdivides in the manner of a crow's foot to supply the antrum and pyloric sphincter.

According to **Morris,** the anterior vagal trunk usually has four or more anterior gastric branches. They are distributed to the cranial portion of the stomach along the lesser curvature and on to the ventral surface towards the greater curvature.

There may be a "Principal anterior nerve" running longitudinally on the ventral surface.

The hepatic branch of the anterior vagal trunk passes to the porta hepatis in the lesser omentum and then along the arteries to the pyloric portion of the stomach.

MATERIALS AND METHODS

This study of pattern of gastric innervation was conducted in 55 specimens in the following method.

MATERIALS

1. Cadaveric specimens - 12
2. Autopsy specimens - 40
3. Foetal specimens - 3

METHOD OF STUDY

Manual dissection method.

1. CADAVERIC STUDY

The stomach specimens with which the study of pattern of gastric innervation was studied in cadavers which was used in Dissection Hall for study purposes.

The study was done on 12 formalin-fixed dissecting room cadavers. The mean age of the cadavers was 60 years (range 45-75) with a sex distribution of 10 males and 2 females.

An midline incision was made in the anterior abdominal wall from the xiphisternum upto the umbilicus. From the lower end of the incision, a transverse incision was made till the mid axillary line. Skin flap was raised and the rectus abdominis were reflected in the same plane. Peritoneum was opened. Liver and stomach was visualized.

The lesser omentum was cut closer to the liver to release the stomach from its liver attachment. Care taken not to disrupt the nerves closer to the lesser curvature of the stomach.

Ligature made in the abdominal part of oesophagus and in the 1st part of the duodenum.

Gastro phrenic and gastro splenic ligaments were dissected. Greater omentum is also cut to release the stomach.

Now the stomach is taken out by cutting the ligatured ends.

The collected stomach specimens were washed thoroughly and dissected under water to visualize the anterior gastric nerve, otherwise known as nerve of Latarjet. Serous layer of the stomach dissected carefully to trace the nerve and care taken not to injure the nerve and its

branches. At the cardio oesophageal junction lower end of the left vagus and its cardiac branches are visualized.

2. AUTOPSY SPECIMEN STUDY

This study was done on 40 specimens that were collected from mortuary during post mortem.

Specimens were washed thoroughly in running water to remove the contents within it and to clean the surface.

The collected specimens were immersed in 10% formalin solution for fixation of the tissues.

Then the underwater dissection of the specimen was done. The fat over the surface of the stomach and along the lesser curvature were removed in piece meal.

The serosal layer of the stomach was dissected carefully to trace the anterior gastric nerve. Care must be taken during dissection because the nerves may be injured because of its slenderness.

FOETAL SPECIMEN STUDY

3 foetuses were collected from the department of Obstetrics and Gynaecology.

Foetuses were embalmed by injecting 10% formalin solution using 18 G needle for preservation and fixation.

The abdomen was opened by an midline incision from xiphi sternum to pubic symphysis.

Transverse incision is made at the lower end of the midline incision upto the mid axillary line.

Peritoneal cavity is opened. Lesser omentum was cut closer to the liver, gastro phrenic, gastro splenic ligaments are cut to free the stomach. Greeter omentum was cut along the greater curvature of the stomach and the stomach was dissected out.

Then the specimen was dissected carefully and course of the anterior nerve of Latarjet and its branches were studied.

OBSERVATION

The study was done in 55 specimens (Table 4) by following manual dissection method in

A) CADAVERIC SPECIMENS - 12

B) AUTOPSY SPECIMENS - 40

C) FOETAL SPECIMENS - 3

The stomach is supplied by parasympathetic and sympathetic nerves.

Parasympathetic nerve supply to the stomach is given through anterior vagus nerve and posterior vagus nerve.

Anterior vagus nerve at the lower end of the abdominal osophagus divides to give,

a) Hepatic Branches

b) Gastric Branches

c) Pyloric Branches

Among the gastric branches one branch is long and it descends along the lesser curvature of the stomach as anterior gastric nerve. It appears that the trunk of anterior vagus continues as anterior gastric nerve otherwise known as the anterior gastric nerve of Latarjet.

In highly selective vagotomy the branches of anterior gastric nerve are cut to reduce the gastric acid secretion. The nerve is divided just before it's level of termination during surgery to retain the antral nerve supply.

Usually the anterior nerve of Latarjet ends at the level of incisura angularis by giving 4 to 5 branches that appear as a crow's foot.

In this study of 55 specimens, the gastric branches of anterior vagus nerve, branches of anterior nerve of Latarjet and its level and mode of termination was observed.

The observed findings are given below.

(A) CADAVERIC SPECIMENS (Table 1)

In eleven specimens the anterior vagus nerve traced from the lower end of abdominal oesophagus shows that the nerve gives four to five gastric branches at the cardiac end of the stomach.

These branches run towards the anterior surface of the upper part of the stomach.

Then the nerve descends along the lesser curvature of the stomach as anterior nerve of Latarjet. In its course no branches were observed till its termination.

The nerve terminates at the level of incisura angularis of the stomach by giving 5 terminal branches.

These branches gives a crow's foot appearance at the terminal end of the anterior nerve of Latarjet.

In, one cadaveric specimen there were no branches observed in the cardiac end of the stomach.

The anterior nerve of Latarjet was observed along the lesser curvature of the stomach and it ends at the level of incisura angularis **(Fig 1)**.

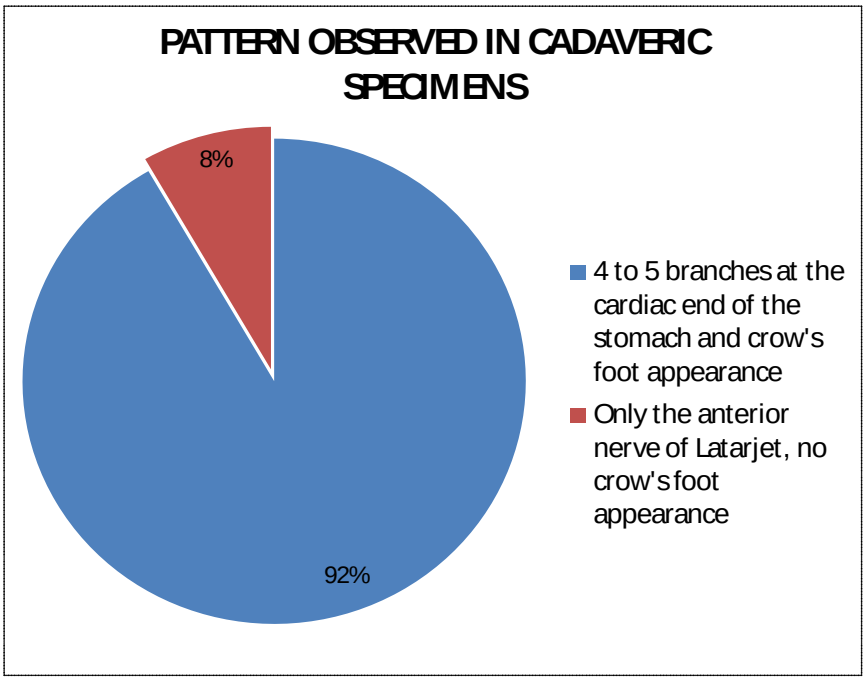
No branches were observed in its course along the lesser curvature of the stomach and there were also no terminal branches seen at the termination of anterior nerve of Latarjet **(Chart 1)**.

TABLE - 1

PATTERNS OBSERVED IN 12 CADAVERIC SPECIMENS

S. No.	Various Pattern Observed	Number of Specimens	%
1.	4 to 5 branches at the cardiac end of the stomach and crow's foot appearance	11	91.67
2.	Only the anterior nerve of Latarjet, no crow's foot appearance	1	08.33
	Total	**12**	**100.00**

Chart 1



B) AUTOPSY SPECIMENS (Table 2)

In eight specimens at the cardiac end of the stomach five branches were observed. These branches run towards the fundus and upper area of the stomach and supplies it.

All these branches divides again and again to give more branches and forms a plexus at this region of the stomach.

Then the anterior nerve of Latarjet was observed along the lesser curvature of the stomach and ends at the level of incisura angularis.

Anterior nerve of Latarjet gives one branch to the body of the stomach just above its level of termination.

At the level of incisura argularis the anterior nerve of Latarjet ends by dividing into branches that gives a crow's foot appearance **(Fig 2 & 3)**.

The anterior vagus nerve traced from the lower end of the oesophagus, closer to the cardiac end of the stomach gives two branches arising from it, and supplies the fundus of the stomach.

Then the nerve gives two more branches which run towards the anterior surface of the body of the stomach. These two branches again divides into two branches and supplies the stomach.

The anterior nerve of Latarjet was observed. It ends at the level of incisura angularis showing the crow's foot appearance.

These findings are observed in ten specimens of the forty autopsy specimens studied.

In six specimens, near the cardiac end of the stomach two branches arising from the anterior vagus nerve was observed. These two branches run towards the fundus of the stomach without further branching.

Anterior nerve of Latarjet was observed along the lesser curvature of the stomach. Along its course a branch was observed at the middle of the lesser curvature. This branch run over the anterior surface of the stomach without further branching. It ends as a single branch.

Then the anterior nerve of Latarjet ends at the incisura angularis by forming crow's foot appearance. These branches supply the antrum of the stomach **(Fig 4)**.

In five specimens formation of nerve plexus was observed at the cardiac end of the stomach. Branches from these plexus runs towards the fundus of the stomach to supply it.

Another nerve plexus was found at the level of the middle of the lesser curvature of the stomach. Branches arising from the anterior nerve of Latarjet divides into branches to form the plexus.

The anterior nerve of Latarjet ends by dividing into five branches to form the crow's foot appearance at the level of incisura angularis **(Fig 5 & 6)**.

In three specimens, a nerve plexus was observed at the cardiac end of the stomach. No other branches were observed along the course of the anterior nerve of Latarjet to the body of the stomach.

The anterior nerve of Latarjet ends at the level of incisura angularis. It ends by giving branches that forms crow's foot appearance **(Fig 7).**

In one specimen the terminal branches of the anterior nerve of Latarjet was observed at the level of incisura angularis. No other branches were observed.

In one specimen a branch from the anterior nerve of Latarjet was observed. No more branches were seen. No plexus was seen. The nerve ends as a single branch at the incisura angularis without forming a crow's foot appearance **(Fig 8).**

In four specimens the following findings were observed.

Six branches arising from the anterior nerve of Latarjet. These branches were seen in the interval between the cardiac end of the stomach and the level of incisura angularis.

These branches run towards the body of the stomach. These branches end within the stomach as a single nerve. No further branching of the nerves were observed.

The anterior nerve of Latarjet ends at the level of incisura angularis. The nerve terminates without forming any branches. In all these specimens the crow's foot appearance was not observed **(Fig 9)**.

In two specimens no branches were seen at the cardiac end or in the upper part of the stomach.

Only one branch arising from the anterior nerve of Latarjet just above the level of incisura angularis was observed.

Then the termination of the anterior nerve of Latarjet was at the level of incisura angularis. Here it gives branches that form a crow's foot appearance **(Fig 10) (Chart 2)**.

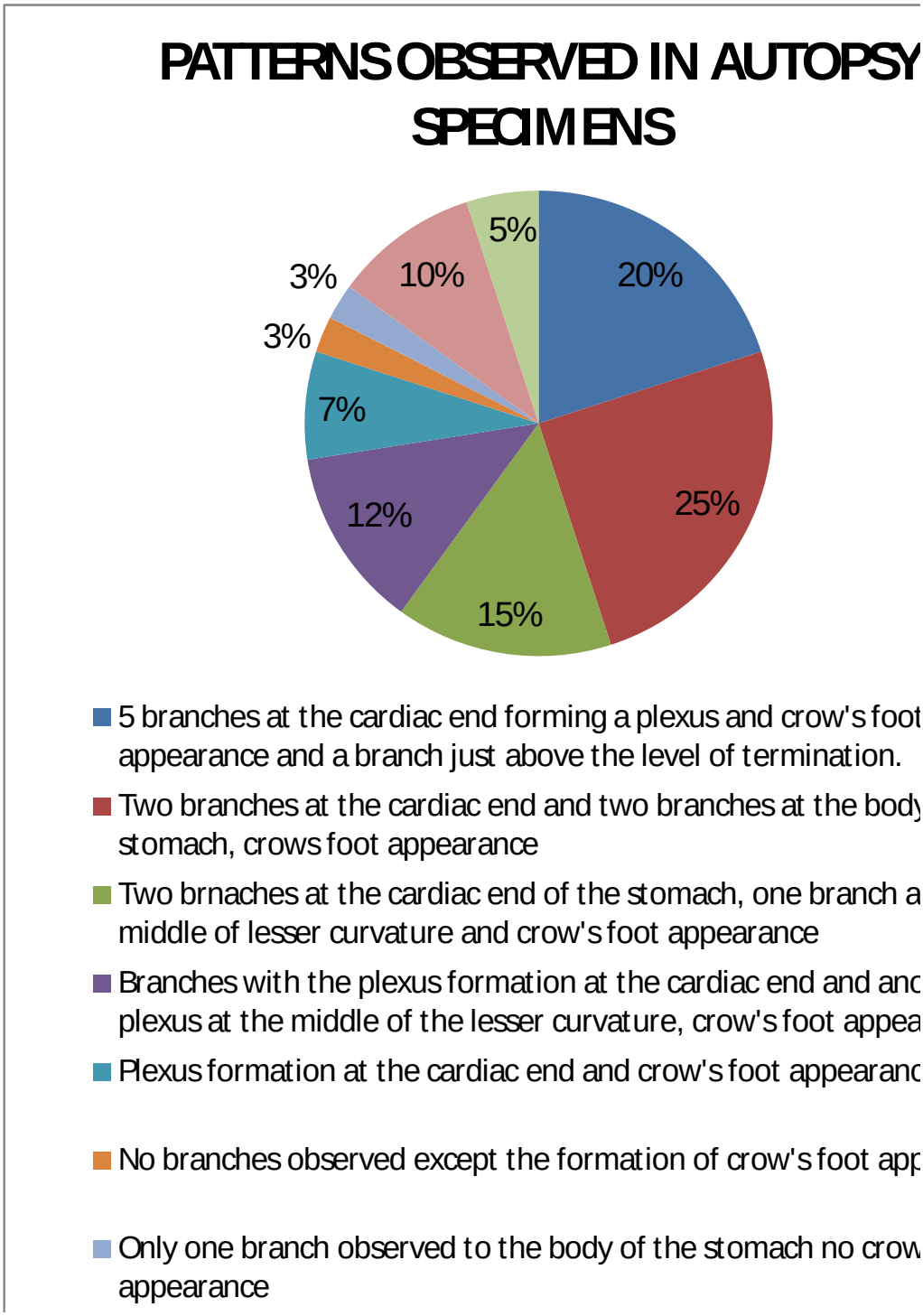
TABLE - 2

PATTERNS OBSERVED IN AUTOPSY SPECIMEN

S. No.	Various Pattern Observed	Number of Specimens	%
1.	5 branches at the cardiac end forming a plexus and crow's foot appearance, a branch just above the level of termination.	8	20
2.	Two branches at the cardiac end and two branch at the body of the stomach, crow's foot appearance	10	25
3.	Two branches at the cardiac end of the stomach, one branch at the middle of lesser curvature and crow's foot appearance	6	15
4.	Branches with the plexus formation at the cardiac end and another plexus at the middle of the lesser curvature, crow's foot appearance	5	12.5
5.	Plexus formation at the cardiac end and crow's foot appearance	3	7.5
			Contd...

S. No.	Various Pattern Observed	Number of Specimens	%
6.	No branches observed except the formation of crow's foot appearance	1	2.5
7.	Only one branch observed to the body of the stomach, no crow's foot appearance	1	2.5
8.	6 branches arising from the anterior nerve of Latarjet to the body of the stomach, no crow's foot appearance.	4	10
9.	No branches observed at the cardiac end and one branch to the body of the stomach, crow's foot appearance was present.	2	5
	Total	**40**	**100**

Chart 2


PATTERNS OBSERVED IN AUTOPSY SPECIMENS
5%
20%
3%
10%
3%
7%
12%
25%
15%
5 branches at the cardiac end forming a plexus and crow's foot appearance and a branch just above the level of termination.
Two branches at the cardiac end and two branches at the body stomach, crows foot appearance
Two brnaches at the cardiac end of the stomach, one branch a middle of lesser curvature and crow's foot appearance
Branches with the plexus formation at the cardiac end and anc plexus at the middle of the lesser curvature, crow's foot appea
Plexus formation at the cardiac end and crow's foot appearanc
No branches observed except the formation of crow's foot app
Only one branch observed to the body of the stomach no crow appearance

C) FOETAL SPECIMEN (Table 3)

3 foetuses were dissected. In all the 3 specimens anterior nerve of Latarjet was observed. But there were no branches or crow's foot appearance visualized. The anterior gastric nerve ends at the level of incisura angularis **(Fig 11 & 12)**.

TABLE - 3

PATTERNS OBSERVED IN 3 FOETAL SPECIMENS

S. No.	Various Pattern Observed	Number of Specimens	%
1.	Only the anterior nerve of Latarjet, no crow's foot appearance	3	100

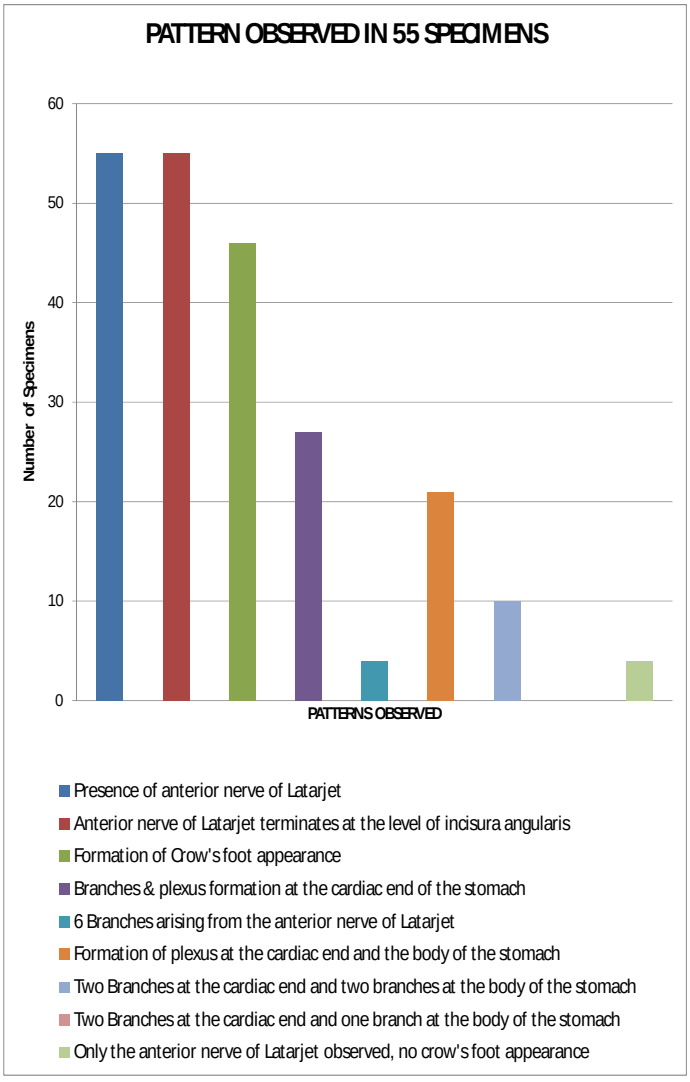
TABLE - 4

VARIOUS PATTERNS OBSERVED IN

55 SPECIMENS STUDIED IN THE PRESENT STUDY

S. No.	Various Pattern Observed	Number of Specimens
1.	Presence of anterior nerve of Latarjet	55
2.	Anterior nerve of Latarjet terminates at the level of incisura angularis	55
3.	Formation of crow's foot appearance	46
4.	Branches and plexus formation at the cardiac end of the stomach.	27
5.	6 branches arising from the anterior nerve of laterjet	4
6.	Formation of plexus at the cardiac end and the body of the stomach	21
7.	Two branches at the cardiac end and two branches at the body of the stomach	10
8.	Two branches at the cardiac end and one branch at the body of the stomach	6
9.	Only the anterior nerve of Latarjet observed, no crow's foot appearance	4

Chart 3


PATTERN OBSERVED IN 55 SPECIMENS
Number of Specimens
60
50
40
30
20
10
0
PATTERNS OBSERVED
Presence of anterior nerve of Latarjet
Anterior nerve of Latarjet terminates at the level of incisura angularis
Formation of Crow's foot appearance
Branches & plexus formation at the cardiac end of the stomach
6 Branches arising from the anterior nerve of Latarjet
Formation of plexus at the cardiac end and the body of the stomach
Two Branches at the cardiac end and two branches at the body of the stomach
Two Branches at the cardiac end and one branch at the body of the stomach
Only the anterior nerve of Latarjet observed, no crow's foot appearance

DISCUSSION

The pattern of gastric innervation was studied in 55 specimens by manual dissection method. Among the 55 specimens 52 were adult specimens of different age groups and 3 were foetal specimens.

The observations and results of this study are compiled in a systematic manner with relevant tables **(Table 5)**.

These observations are discussed here with the purpose of helping surgeons performing gastric surgeries and vagotomy procedures with improved techniques.

The observations of the present study was compared and correlated with the observations of previous studies.

In the present study the greater anterior gastric nerve which is otherwise called as anterior nerve of **Latarjet** was found in all specimens.

This observation was similar to the study of **Latarjet** et al (1921) who found this nerve in all his specimens studied.

Skandalakis et al 1986 observed this nerve in 96 specimens out of 100 specimen i.e. 96%.

Jackson (1948) observed this nerve only in 28 cases out of 50 specimens (56%).

Shuang Qin Yi (1990) studied in 10 cadavers about this nerve. He observed double anterior nerves of **Latarjet** in 7 cadavers.

The anterior nerve of Latarjet ends at the level of incisura angularis in all the specimens observed in this study.

This finding was more or less nearing to the observation of **Skandalakis** et al (1986).

He stated that in 79% of cases the nerve ends at the level of incisura angularis. **Shuang Qin Yi** (1990) observed this finding in 40% of cases.

In the present study the anterior nerve of Latarjet ends at the incisura angularis by forming crow's foot appearance in 46 (83.6%) specimens.

Shuang Qin Yi (1990) found the crow's foot appearance in all his specimens studied. **Skandalakis** et al mentioned that he found this observation in some of the specimens studied by him.

Gastric branches arising from the anterior vagus nerve at the cardiac end was 4 to 5 in number, was observed in the present study. This observation was found in 27 specimens and in 16 specimens the gastric branches at the cardiac end showed plexus formation.

The gastric branches at the cardiac region in this study was also described by **Jackson** (1948), **T.W.Mackay & P.L.R Andrews** (1981)**, G.A.G. Mitchell** (1940)

T.W.Mackay and P.L.R.Andrews (1981) found 4 to 6 branches at the cardiac end in 51.72% of cases. **Jackson** gave the average of 4 branches (1948) at the cardiac end in all cases.

G.A.G.Mitchell (1940) observed 4 to 10 branches at the cardiac end of the stomach in all his specimens studied.

In **Gray's** Anatomy the number of gastric branches quoted varies from 4 to 10 in number.

In the present study 6 branches arising from the anterior nerve of Latarjet to the body wall of stomach was observed in 4 (7.27%) specimens.

Skandalakis et al (1986) observed an average of 6 branches from the anterior nerve of Latarjet to the body wall of stomach.

Shuang Qin Yi (1990) observed 1 to 7 branches from the anterior nerve of Latarjet to the body wall of stomach in his study.

In the present study in 5 specimens a formation of plexus was observed. These plexus were formed by the branches arising from the anterior nerve of Latarjet.

These plexus was present at the middle of the lesser curvature. In 16 specimens plexus formation was observed at the cardiac end. So the plexus formation observed in this study comes to 38.18% of cases.

Formation of plexus over the anterior surface of the stomach was observed in previous studies. **Swan** (1834), **Bourgery (**1844), **Mc Crea** (1924)**, Loeweneck et al** (1967)**, Brizzi et al** (1973) **and T.W.Mackay and P.L.R. Andrews** (1981) all observed the presence of plexus over the anterior surface of the stomach.

T.W. Mackay & P.L.R.Andrews (1981) stated that they observed anterior gastric plexus formation in 58% of cadavers.

Jackson (1948) mentioned in his results that he observed anterior gastric plexus in 2% of cases.

So the present study's observation of anterior gastric plexus is closer to the finding of **T.W.Mackay and P.L.R. Andrews.**

In the present study in 10 specimens two branches at the cardiac end and two branches at the body of the stomach was observed. In 6 specimens two branches at the cardiac end and only one branch at the middle of the lesser curvature which runs to the body was observed. In 3 foetal and 1 cadaveric specimen only the anterior nerve of Latarjet was observed.

TABLE - 5

VARIOUS PATTERNS OBSERVED IN

55 SPECIMENS STUDIED IN THE PRESENT STUDY was

COMPARED WITH PREVIOUS STUDIES

S. No.	Pattern Observed	Present Study	Previous Study
1.	Anterior nerve of Latarjet	100%	Latarjet et al 1921 100% Skandalakis et al 1986 96%
2.	Anterior nerve of Latarjet terminates at the level of incisura angularis	100%	Skandalakis et al 79% ShuangQinYi 40%
3.	Gastric branches at the cardiac end of the stomach	49.09%	T.W.Markay and P.L.R.Andrews 51.72%
4.	Formation of plexus at cardiac end and body of the stomach	38.18%	T.W.Mackay and P.L.R.Anrews 58.06%
5.	Branches arising from the anterior nerve of Latarjet	7.27%	Skandalakis et al 1986 ShuangQinYi 1990

SUMMARY

In this study of pattern of gastric innervation observed in 55 specimens shows that there is

1. Variation in the distribution of gastric branches over the cardiac end of the stomach.

2. Plexus formation in the cardiac end of the stomach and in the body of the stomach.

3. Branches arising from the anterior nerve of Latarjet to the body of the stomach varies in number.

So there is a considerable variation in the distribution of gastric branches, branches arising from anterior nerve of Latarjet and plexus formation.

The observations in the previous studies also shows variation in the distribution of branches and plexus formation over the anterior surface of the stomach.

But there is a fairly constant finding of termination of anterior nerve of Latarjet at the level of incisura angularis in this study.

The observations of the present study will be helpful for the surgeons to perform a successful proximal gastric vagotomy.

The surgeon can think of possible variations in the distribution of branches over the anterior surface of the stomach especially over the body of the stomach where the acid producing cells are abundant.

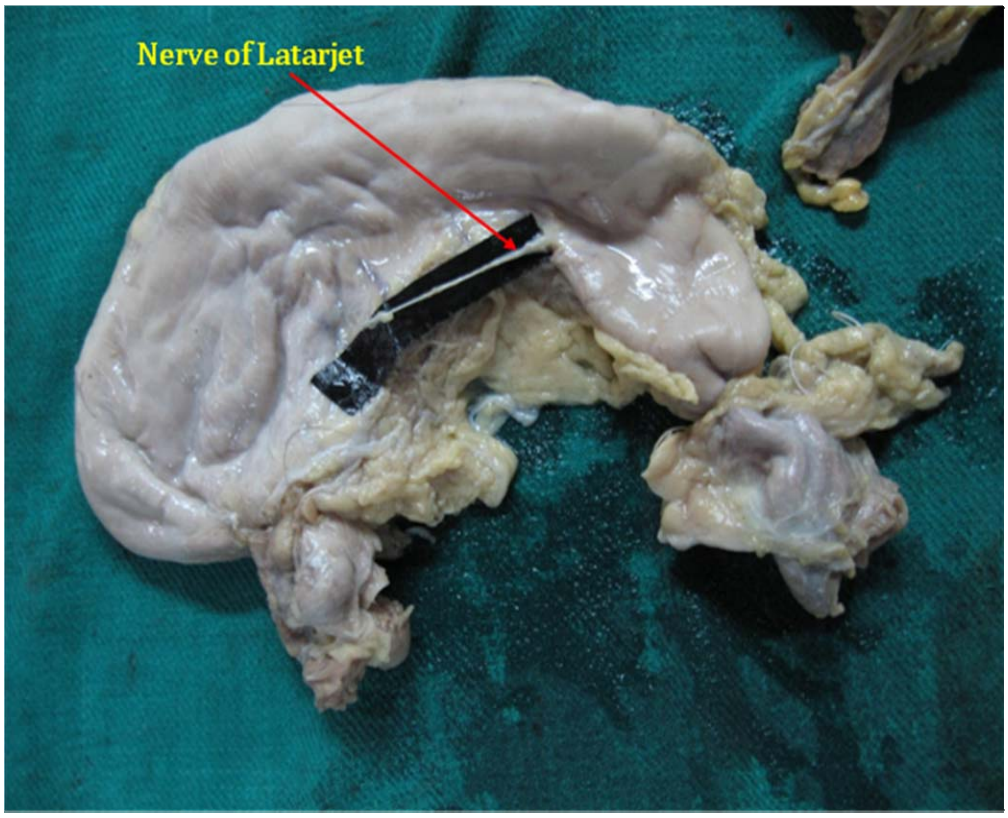


Fig 1 Only the Anterior Nerve of Latarjet

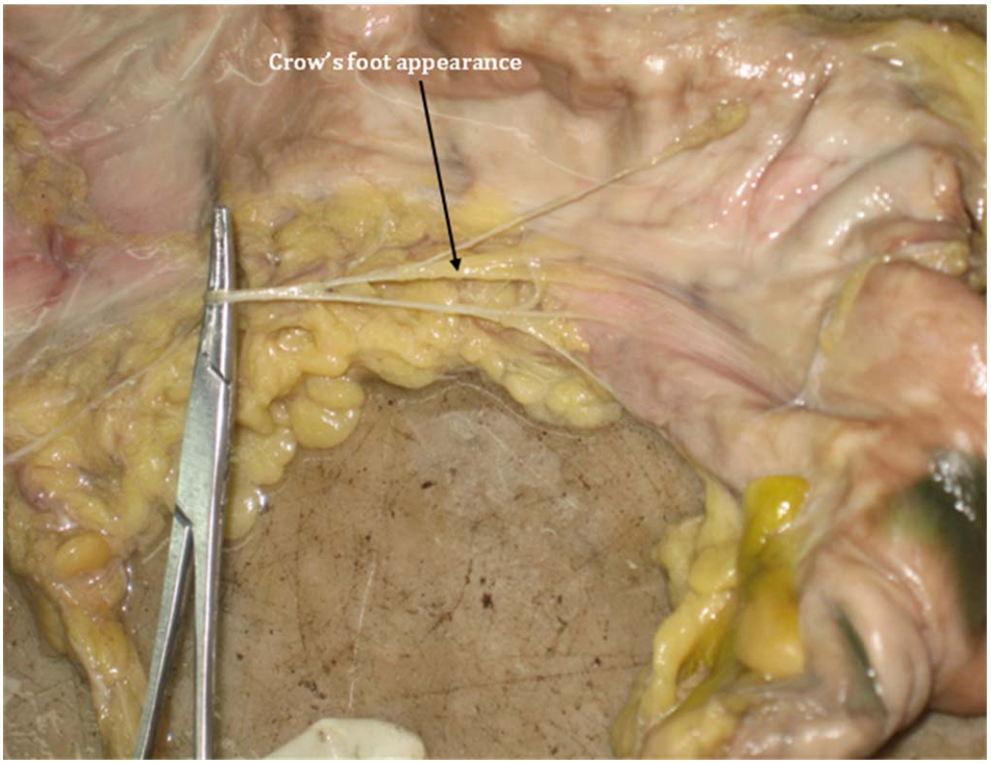


Fig 2 Crow's Foot Appearance

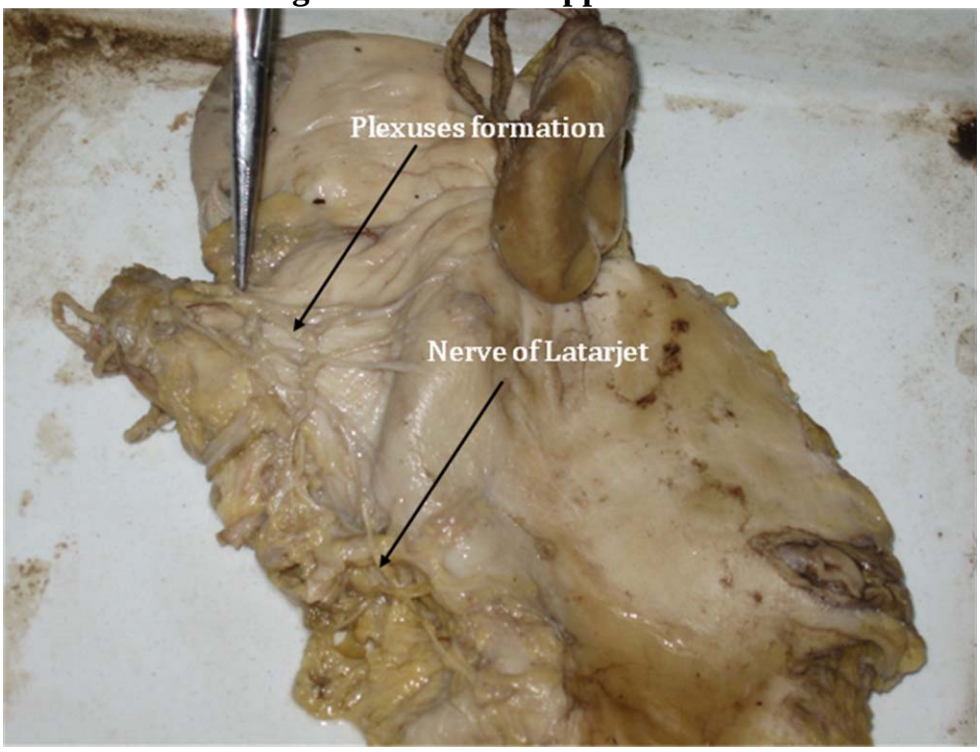


Fig 3 Plexuses Formation at the Cardiac End of the Stomach

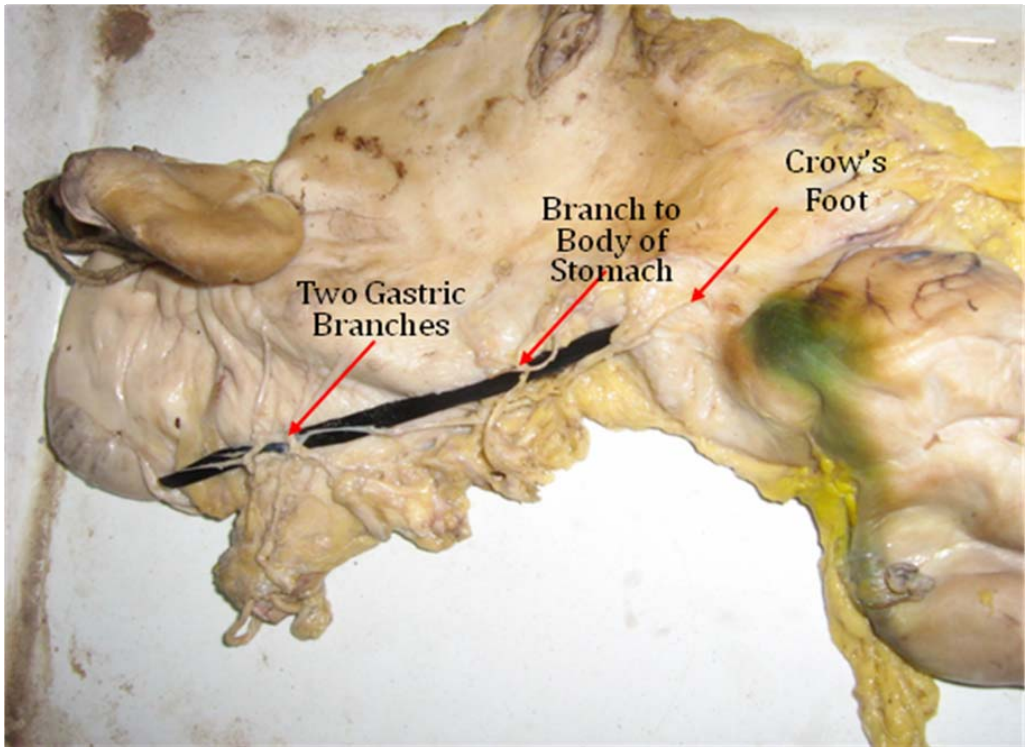


Fig 4 Two Branches at Cardiac End and One Branch to the Body and Crow's Foot Appearance

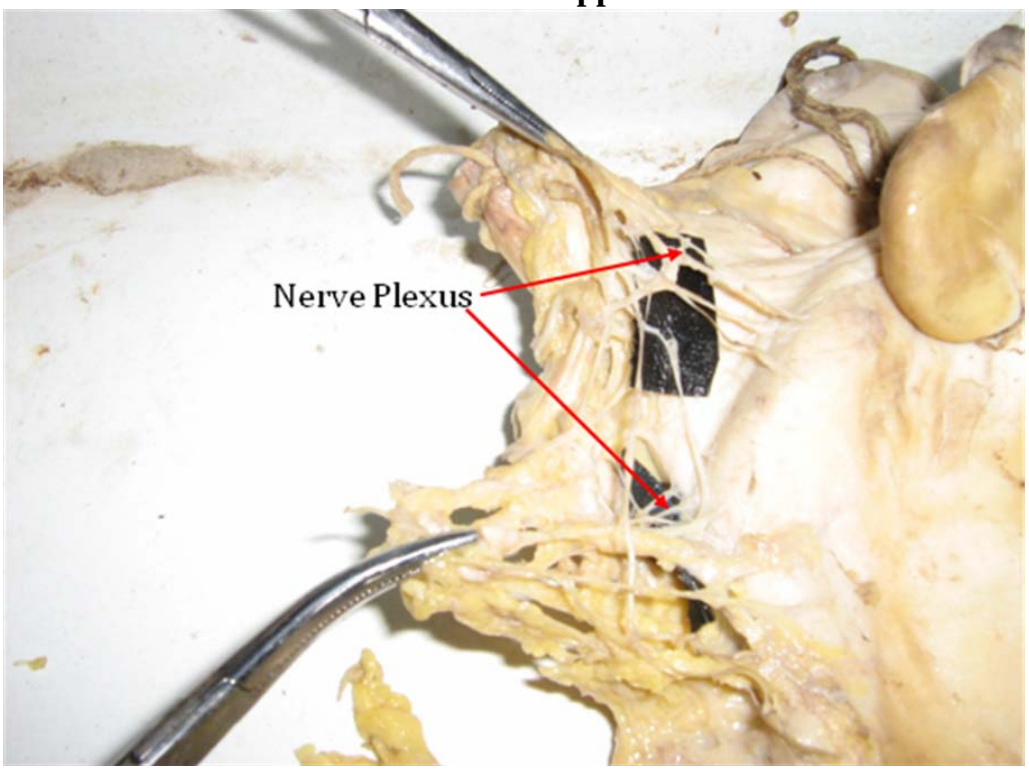


Fig 5 Plexuses formation at the Cardiac End and Middle of the Body of the stomach

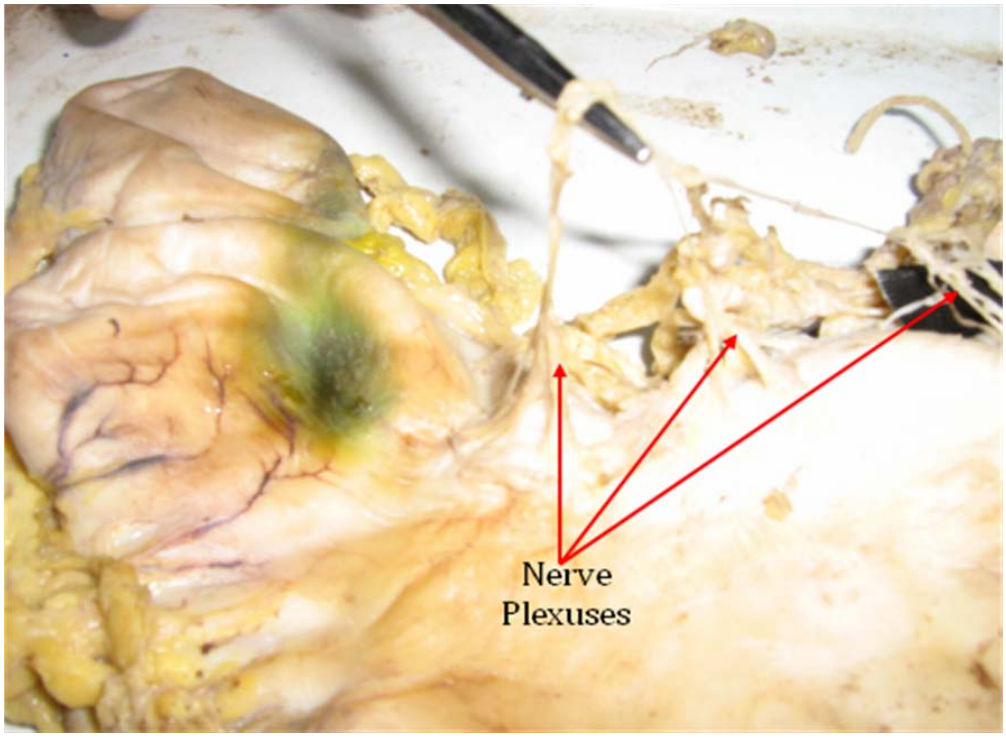


Fig 6 Plexuses Formation at the Cardiac End and Body and Crow's Foot Appearance

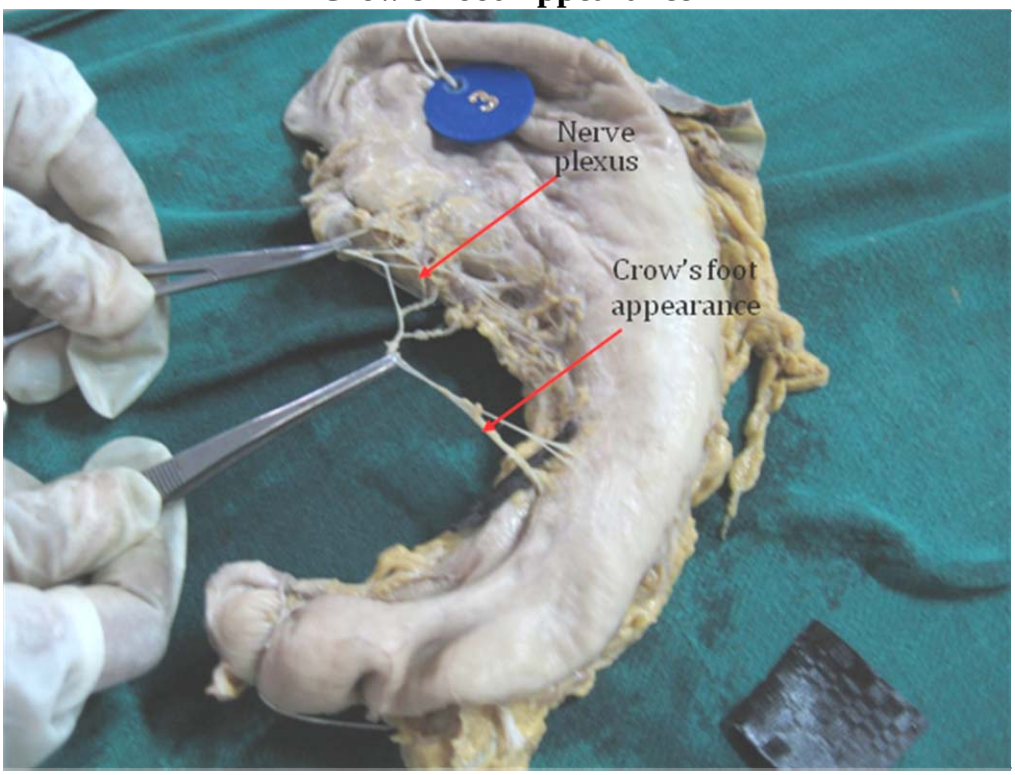


Fig 7 Plexus Formation at the Cardiac End of the Stomach and Crow's Foot Appearance

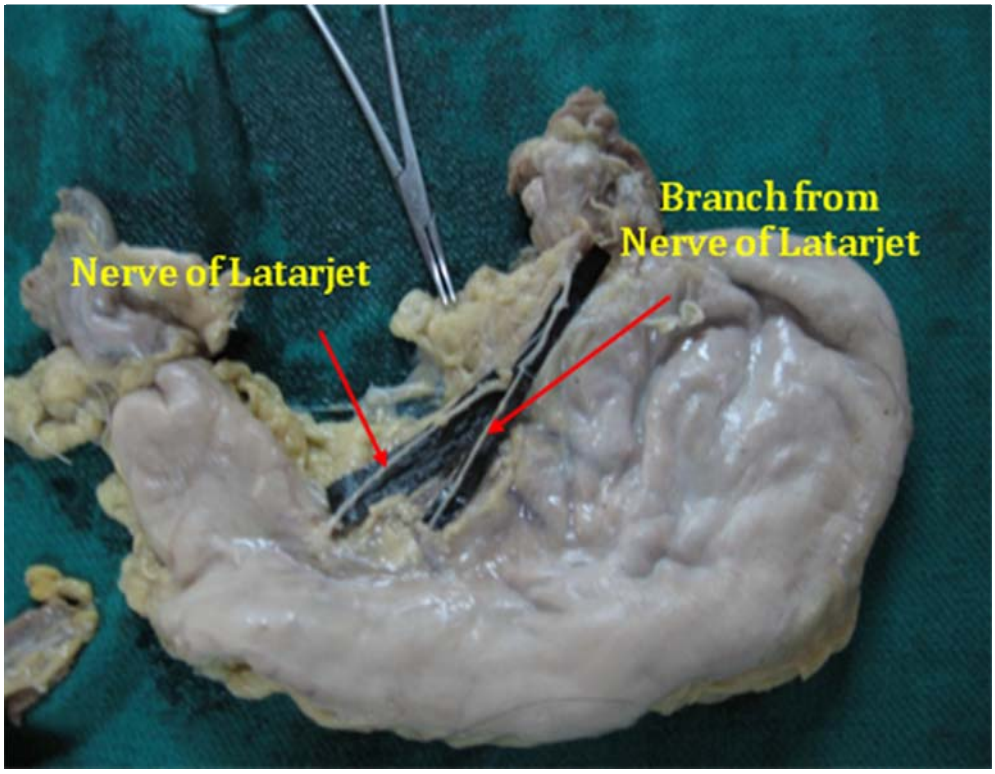


Fig 8 One Branch arising from Anterior Nerve of Latarjet

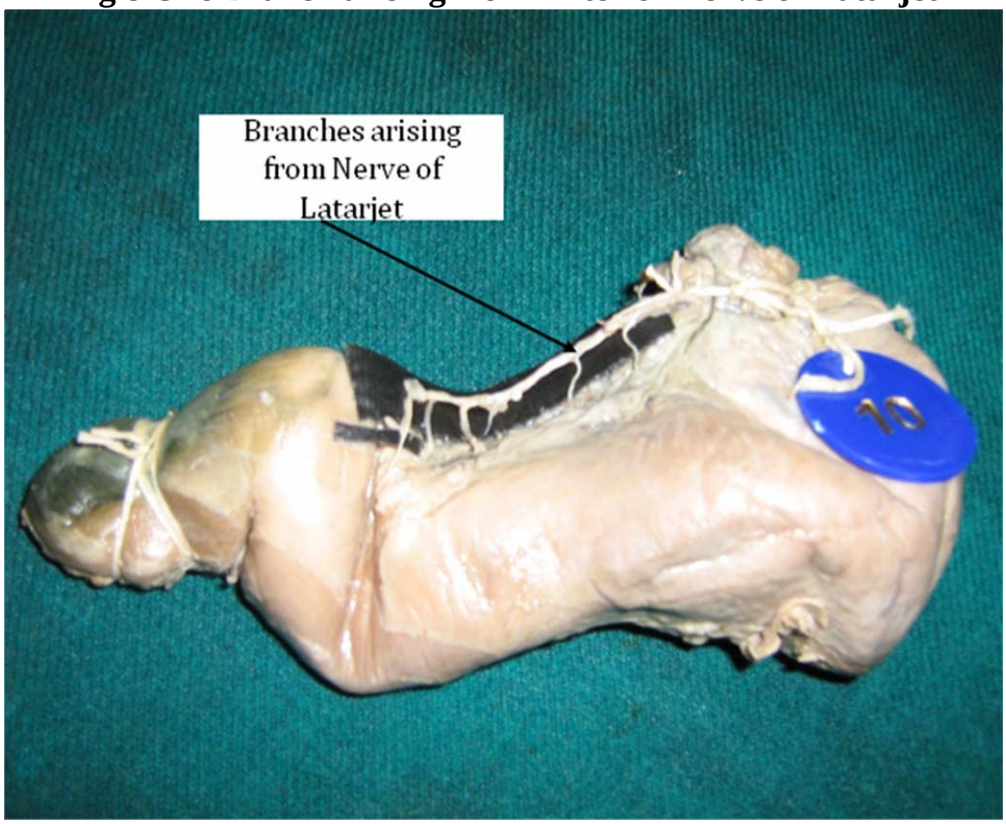


Fig 9 Branches Arising from Anterior Nerve of Latarjet

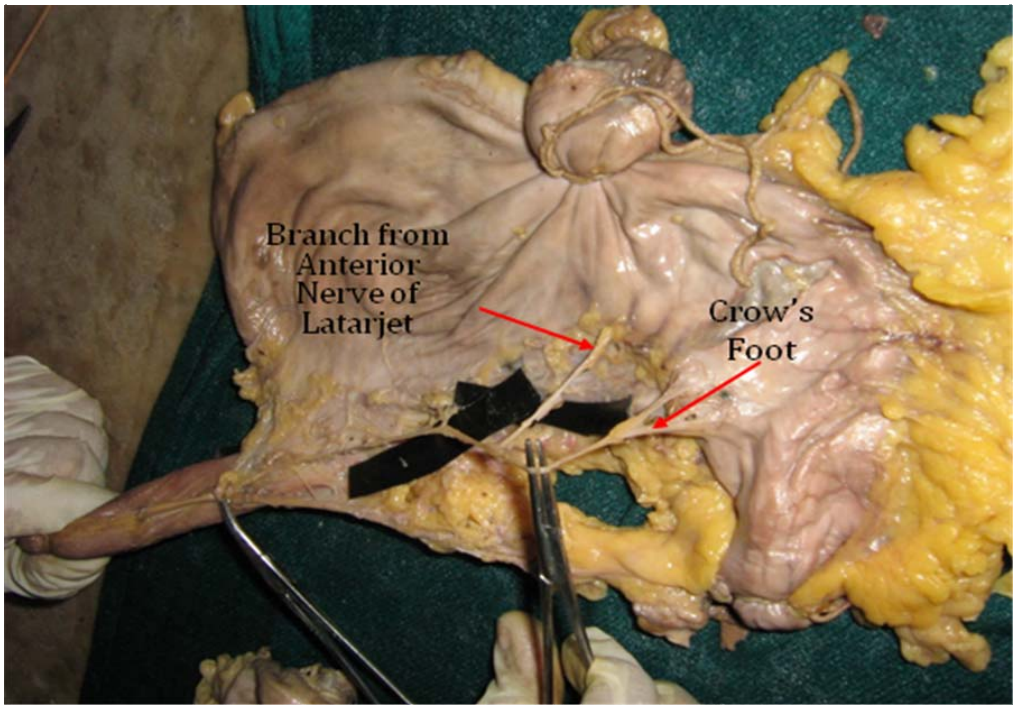


Fig 10 Branch of Anterior Nerve of Latarjet and Crow's Foot Appearance

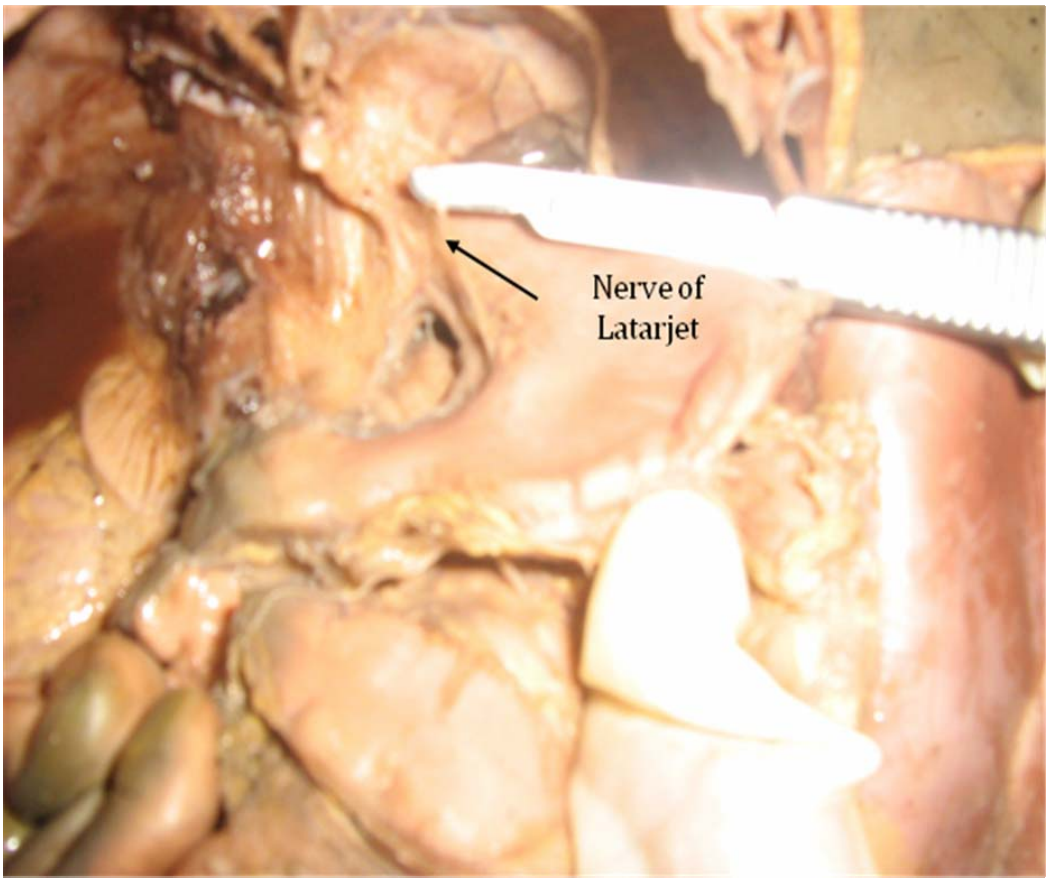
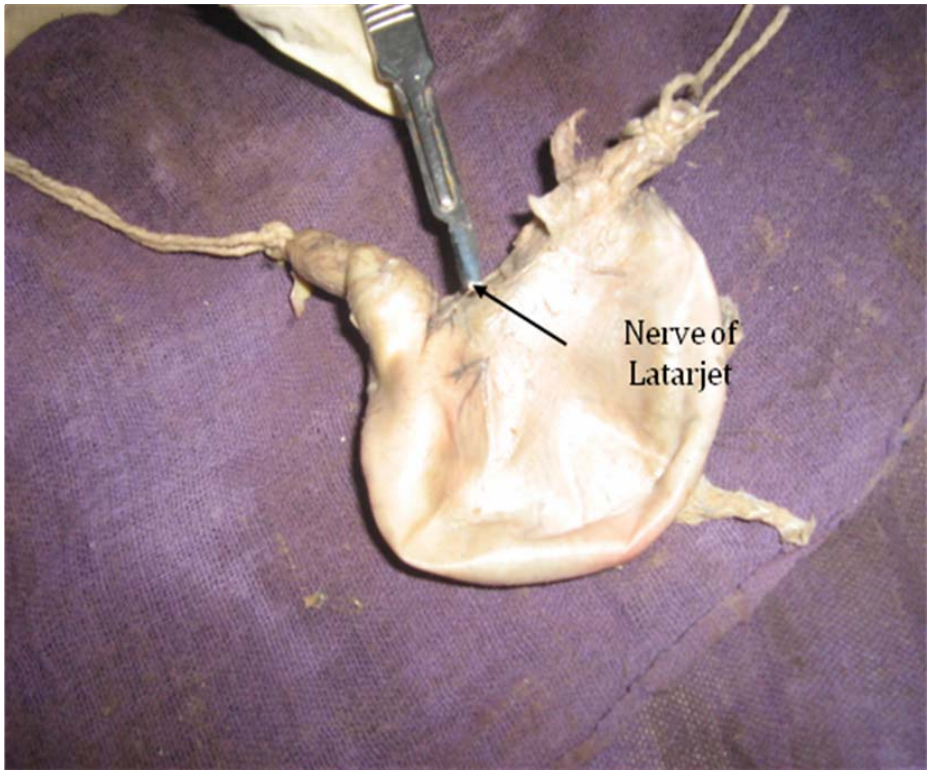


Fig 11 Foetal Specimen - Anterior Nerve of Laterjet


Nerve of
Latarjet


Nerve of
Latarjet

Fig 12 Foetal Specimen - Anterior Nerve of Latarjet

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