

SURGICAL ANATOMY



A Student's Manual



SURGICAL ANATOMY

Sibani Mazumdar

Foreword
Tulsibhai C Singel



Contents

1. General Anatomy	1
Bones and Cartilages	2
Function of Bone	2
Metaphysis (Short Notes)	3
Characteristic Feature	4
Law of Union of Epiphysis and the Growing end of Long Bone	4
Degeneration of Articular Cartilage Results in Osteoarthritis	4
Clinical Anatomy	4
Joints	11
Definition	11
Stabilizing Factor of Joint (Short Note)	12
Certain Important Things about Joints	13
Clinical Anatomy (Joints)	13
Muscular System	16
Pennate Muscle (Short Notes)	19
Clinical Anatomy	19
Parallel Muscle (Short Notes)	20
Nervous System	22
Autonomic Nervous System	24

Arterial System 28

Terminology used in Description of
Blood Vessels 31

Veins 32**Lymphatic System 33**

Clinical Anatomy 36

2. Superior Extremity**38****Short Notes 39**

Bones 39

Muscles 40

Nerves 44

Arteries 58

Spaces 62

Others 70

Explanatory Notes 73

Nerve Entrapment of the Upper
Limb and Clinical Anatomy 82

Surface Anatomy 83

Clinical Importance (Surface Anatomy) 83

3. Inferior Extremity**94****Short Notes 95**

Femoral Triangle 95

Saphenous Opening 96

Great Saphenous Vein 97

Perforating Veins 100

Iliotibial Tract 101

Profunda Femoris Artery 102

Interosseous Membrane (Lower Limb) 103

Acetabular Labrum 104

Popliteus Muscle 104

Locking and Unlocking of the Knee Joint 105

Superficial Peroneal Nerve 106

Deep Peroneal Nerve	108
Obturator Nerve	109
Trendelenburg Test	111
Factors that Increase the Stability of Hip Joint	111
Extra-articular Ligament of Knee Joint	111
Deltoid Ligament	112
Spring Ligament	113
Greater Sciatic Foramen	114
Medial Longitudinal Arch of Foot	115
Inguinal Lymph Nodes	115
Explanatory Notes	116
Surface Anatomy of Lower Limb	123

4. Abdomen

126

Short Notes	127
Rectus Sheath	127
Inguinal Canal	128
Hesselbach's Triangle	130
Gastric Triangle	131
Stomach Bed	131
Bare Area of Liver	132
Common Bile Duct	133
Calot's Triangle	134
Extrahepatic Biliary Apparatus	134
Portal Vein	135
Peyer's Patches	136
Esophageal Varices	137
Second Part of Duodenum	138
Renal Fascia	139
Hepatorenal Pouch of Morison	140
Porta Hepatis	141
Epiploic Foramen	142
Pelvic Mesocolon	143
The Mesentery	144

Lesser Omentum	145
Coronal Section of Kidney	146
Base of Urinary Bladder	147
Membranous Urethra	148
Ectopic Testis	148
Ovarian Fossa of Lateral Pelvic Wall	149
Celiac Trunk	150
Pudendal Canal	151
Ischioanal/Ischiorectal Fossa	152
Fallopian Tube	153
True Ligaments of Uterus	155
Superficial Perineal Pouch	156
Deep Perineal Pouch	157
Pelvic Diaphragm	158
Ileocecal Orifice	159
Ligaments of Spleen	160
Fascia of Colles	161
Blood Supply of Vermiform Appendix	161
Phimosis	162
Bicornuate Uterus	162
Cremasteric Reflex	163
Explanatory Notes	163
Surface Anatomy of Abdomen which is Important to the Clinician and Surgeon	176
Planes	176
Points	176

5. Thorax

180

Short Notes	181
Sternal Angle	181
Typical Intercostal Nerve	181
Parietal Pleura	182
Costodiaphragmatic Recess of Pleura	184
Azygos Lobe of Lung	185

Mediastinal Surface of the Lungs	185
Root of the Lung	187
Bronchopulmonary Segments	188
Azygos Vein	190
Accessory Hemiazygos Vein or Inferior Hemiazygos Vein	191
Artery Supply to Heart (Coronary Circulation)	192
Blood Supply of Interventricular Septum	193
Superior Mediastinum	194
Arch of Aorta	195
Tetralogy of Fallot	196
Pericardial Cavity	197
Coronary Sinus	199
Constrictions of Esophagus with Clinical Importance	200
Thoracic Duct	201
Explanatory Notes	202
Surface Anatomy of Thorax which is Helpful to Clinician and Surgeon	206
Clinical Anatomy (Heart and Pericardium)	208

6. Head, Neck and Brain

211

Short Notes	212
Sutural Joint	212
Scalp	213
Lacrimal Apparatus	215
Posterior Cricothyroid Muscle	216
Palatine Tonsil	217
Waldeyer's Ring	218
Little's Area of Epistaxis	219
Cornea	220
Taste Buds	222
Temporalis Muscle	223
Hypoglossal Nerve	224

Movement of Temporomandibular Joint 225

Parotid Gland 226

Thyroid Gland 228

Orbital Fissure 230

Nasal Cavity 231

Brain and Eyeball 235

Filum Terminale 235

Types of Sulci 236

Neural Crest Cells 237

Paracentral Lobule 237

Blood-Brain Barrier 238

Ciliary Body 238

Iris 238

Corpus Callosum 239

Third Ventricle 242

Aqueous Humor 243

Arachnoid Granulations 244

Rhomboid Fossa 244

Circle of Willis 245

Midbrain 247

Explanatory Notes 249

Surface Anatomy of Head and Neck which is Helpful for Clinician 262

7. Histology

265

Short Notes 266

Transitional Epithelium **P.G.E.** 266

Respiratory Epithelium 266

Histology of Lung 266

Histology of Duodenum 267

Microanatomy of Appendix 268

Histology of Ureter 269

Histology of Parotid Gland 270

Kupffer Cells 271

Skin	271
Classical Hepatic Lobule	273
Histology of Esophagus	274
Structure of Lymph Node	275
Suprarenal Gland	276
White Pulp	277
Histology of Fallopian Tube	278
Histology of Spinal Cord (At T10 Segment)	280
Dermatome	281
Histology of Cerebellum	281
Explanatory Note	282
Pimples or Acne is Common in Puberty	282

8. Genetics 283

Definition	284
Short Notes	284
Chromosome	284
Karyotyping	285
Classification of Chromosomes	285
Codominant Genes	286
Down's Syndrome (Mongolism)	287
Nondisjunction	288
Turner Syndrome	288
Klinefelter Syndrome	290
Barr Body (Sex Chromatin) or X Chromosome Inactivation	291
Sex Chromosome	291
Allelic Gene	292
Translocation	293
Philadelphia Chromosome	294
Albinism	294
Abnormalities Due to Alteration of Chromosomal Morphology	295
Explanatory Note	296
Terms used in Genetics (Glossary)	297

9. Embryology**300****Short Notes 301**

Spermatogenesis 301

Oogenesis 301

Capacitation 303

Morula 304

Blastocyst 304

Zona Pellucida 305

Notochord 305

Chorion 306

Allantois or Allantoenteric

Diverticulum 307

Gastrulation 307

Different Types of Placenta 308

Placenta Previa 310

Placental Barrier 310

Umbilical Cord 311

Amnion 311

Meckel's Diverticulum 312

Ectopic Pregnancy 313

Somite 314

Septum Transversum 316

Physiological Umbilical Hernia 316

Nonfusion of Müllerian Duct 317

Abnormal form or Teratology 318

Development of Certain Important
Organs (Special Embryology) 319

Nerves 332

Explanatory Notes 347**10. Radiology: Imaging Technique****350**

Conventional Radiography 351

Standard Position used in Radiological
Examination 352

Other Methods of Imaging Technique	352
Superior Extremity	354
Anteroposterior view of Shoulder Joint	354
Elbow Joint	355
Posteroanterior view of Wrist Joint and Hand	357
X-ray of Chest (PA view)	359
Heart and Aorta	359
Lungs	361
Abdomen	362
Contrast Radiography	362
Pyelogram	365
Hysterosalpingogram	367
Head and Neck	367
Cervical Spine	370
Inferior Extremity	372

11. Postgraduate Short Notes

378

Mutagenic Agents	379
Role of Y Chromosome	379
Mucous Membrane of Small Intestine	379
Palmar Arterial Arch	382
Ethmoid Air Sinus	383
Endochondral Ossification	383
Blood Supply of Breast	385
Point Mutation	386
Duchenne Muscular Dystrophy	386
Embalming Techniques	387
Renshaw Cells	388
Apoptosis	389
Endocrine Cells of Gut	389
Coronary Circulation	390
Morphology and Maturation of T and B Lymphocyte	391
Cervical Rib	393
Immunohistochemistry	394

Superior Colliculus and its Connections 395
 Retina and its Structure 396
 Submandibular Salivary Gland 397
 Frey Syndrome (Auriculotemporal
 Syndrome or Gustatory Sweating) 399
 Pituitary 399
 Ossicles of Ear 402
 Movement of Ossicles 403
 Causes of Congenital Deafness 403
 Junctional Complexes 404
 Automatic Bladder 405
 Digital Synovial Sheath and Vinculae 405
 Role of Soft Palate in Swallowing and Phonation 406
 Acquired Immune Deficiency Syndrome 407
 Subphrenic Space 407
 Stem Cell 409
 Reticular Formation of Brainstem 410
 Blood Circulation of Brain 413
 Subclavian Steal Syndrome 414
 Cleidocranial Dysostosis 414
 Papez Circuit 415
 Embryological Types of ASD 415
 Sphincters of Gut 415

4

CHAPTER

Abdomen

CHAPTER OUTLINE

Short Notes

- ❖ Rectus Sheath
- ❖ Inguinal Canal
- ❖ Hesselbach's Triangle
- ❖ Gastric Triangle
- ❖ Stomach Bed
- ❖ Bare Area of Liver
- ❖ Common Bile Duct
- ❖ Calot's Triangle
- ❖ Extrahepatic Biliary Apparatus
- ❖ Portal Vein
- ❖ Peyer's Patches
- ❖ Esophageal Varices
- ❖ Second Part of Duodenum
- ❖ Renal Fascia
- ❖ Hepatorenal Pouch of Morison
- ❖ Porta Hepatis
- ❖ Epiploic Foramen
- ❖ Pelvic Mesocolon
- ❖ The Mesentery
- ❖ Lesser Omentum
- ❖ Coronal Section of Kidney
- ❖ Base of Urinary Bladder
- ❖ Membranous Urethra
- ❖ Ectopic Testis
- ❖ Ovarian Fossa of Lateral Pelvic Wall
- ❖ Celiac Trunk
- ❖ Pudendal Canal
- ❖ Ischioanal/Ischiorectal Fossa
- ❖ Fallopian Tube
- ❖ True Ligaments of Uterus
- ❖ Superficial Perineal Pouch
- ❖ Deep Perineal Pouch
- ❖ Pelvic Diaphragm
- ❖ Ileocecal Orifice
- ❖ Ligaments of Spleen
- ❖ Fascia of Colles
- ❖ Blood Supply of Vermiform Appendix
- ❖ Phimosis
- ❖ Bicornuate Uterus
- ❖ Cremasteric Reflex

SHORT NOTES

RECTUS SHEATH (FIG. 4.1)

It is an aponeurotic envelope for the rectus abdominis muscle on each side of linea alba. This aponeurotic envelop is derived from three flat muscles present on anterolateral abdominal wall namely: (1) external oblique, (2) internal oblique and (3) transversus abdominis.

Anterior Wall

- *Above the costal margin:* Wall is thin and formed by external oblique aponeurosis
- *From costal margin to midway between umbilicus and symphysis pubis:* The wall is thicker. It is formed by anterior lamella of internal oblique aponeurosis with external oblique aponeurosis
- *From rest part (midway between umbilicus and symphysis pubis) to symphysis pubis*

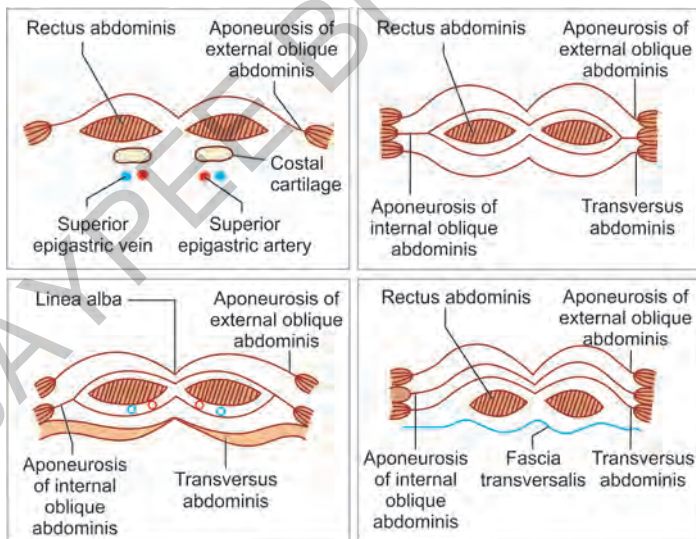


Fig. 4.1: Formation of rectus sheath at different level

Wall is thickest and formed by fusion of aponeurosis of the three muscles: (1) external, (2) internal oblique and (3) abdominis transversus.

Posterior Wall

1. *Above costal margin:* The wall is deficient and muscles rest on 5th, 6th, 7th costal cartilage
2. From the costal margin to midway between umbilicus and symphysis pubis. It is complete rectus sheath. Posterior layer is formed by posterior layer of internal oblique and transversus abdominis
 - *Medial margin:* It is formed by linea alba
 - *Lateral margin:* It is formed by linea semilunaris.
3. *Below the arcuate line:* The rectus muscle is covered posteriorly by fascia transversalis only.

Content

- Rectus abdominis
- Pyramidalis, if present
- Inferior epigastric and superior epigastric vessels
- Lower five intercostal nerves and the subcostal nerve.

INGUINAL CANAL

It is a muscular canal 4 cm long extending from deep inguinal ring to the superficial inguinal ring (Figs 4.2 and 4.3).

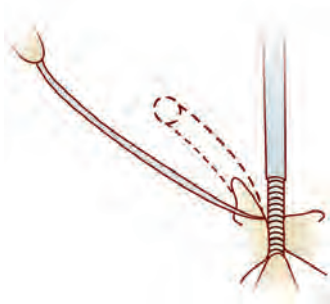


Fig. 4.2: Inguinal canal

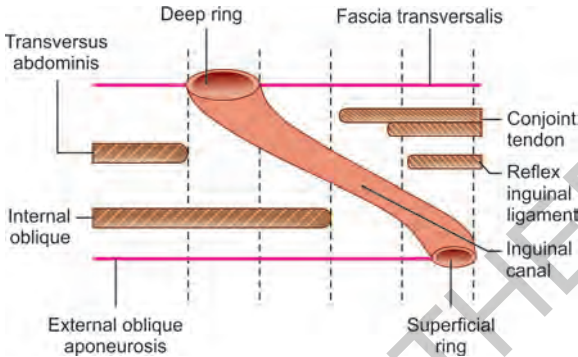


Fig. 4.3: Inguinal canal: Schematic representation of structures forming the anterior and posterior walls

Direction

Downwards, forwards and medially.

Boundary (Box 4.1)

Box 4.1: Inguinal canal boundaries

This canal is 4 cm long and extends from deep ring to superficial inguinal ring.

- **Anterior wall:**
 - Throughout its whole extent formed by external oblique aponeurosis
 - Anterolaterally reinforced by internal oblique and transversus abdominis
- **Posterior wall:** Throughout its whole extent, it is formed by fascia transversalis. Medial part of this wall is reinforced by conjoint tendon
- **Roof:** Formed by arched fibers of internal oblique and transversus abdominis
- **Floor:** Inguinal ligament

Contents

- The spermatic cord in male and round ligament of uterus in female
- **Ilioinguinal nerve:** (Partial content) enters the canal through roof and comes out through superficial inguinal ring, so the nerve is the partial content.

Development

The inguinal canal is formed in the intrauterine life during the descend of gonads. The gonads are developed in lumbar region of the posterior

abdominal wall. It descends with gubernaculum (rudder) and in male, it reaches the scrotum and in females it descends up to lesser pelvis. The processus vaginalis is a peritoneal sac that follows the course of gubernaculum.

- *Shutter mechanism or protection of inguinal canal:* It is the weak part of abdominal wall. So, there are some natural mechanisms, which protect the inguinal canal from developing hernia. The mechanisms are:
 - *Obliquity of inguinal canal:* Facilitates the closure during raised of intra-abdominal pressure
 - The contraction of cremaster provides an effective plug to the superficial inguinal ring
 - The internal oblique muscle lies in front, above and posterior wall and hence its contraction obliterate the canal.

HELSELBACH'S TRIANGLE

It is a triangular area situated in lower part of anterior abdominal wall (Fig. 4.4).

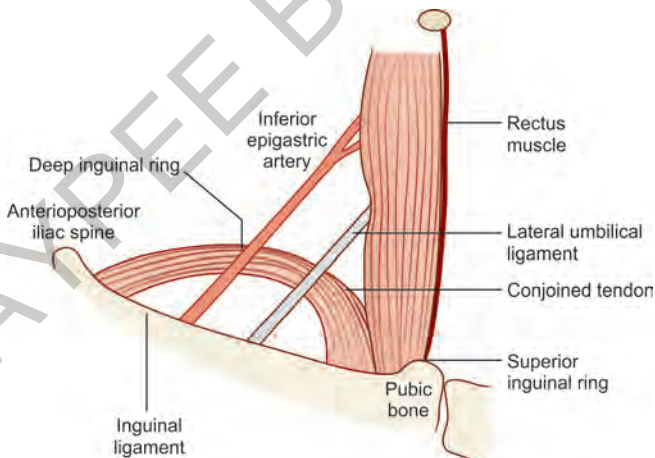


Fig. 4.4: Direct hernia arises through Hesselbach's triangle

Boundary

- Inferior epigastric artery (laterally)
- Lateral border of rectus abdominis (medially)
- Inguinal ligament (below).

Subdivisions

This triangle is also divided into medial and lateral parts by passage of obliterated umbilical artery. So, direct hernia is also divided into medial direct hernia and lateral direct hernia.

Clinical Importance

Direct inguinal hernia enters into inguinal canal through this triangle. So, the neck of direct inguinal hernia lies medial to inferior epigastric artery. By this, direct inguinal hernia is differentiated from indirect inguinal hernia.

GASTRIC TRIANGLE

This is an area overlying anterosuperior surface of stomach, which is not in relation with any viscera.

Boundary

- Above and to the right—inferior border of the liver
- Above and to the left—left costal margin
- Below—transverse colon.

Importance

This part of the anterosuperior surface the stomach is not in relation with any viscera and directly in relation with anterior abdominal wall.

Applied Anatomy

In gastrostomy operation, a Ryle's tube is introduced through this triangle into the stomach under local anesthesia to maintain nutrition in case of malignancy esophagus where the lumen is irreversibly obstructed.

STOMACH BED

Stomach bed is defined as the collection of structures on which stomach rests in supine posture separated by a cavity of lesser sac.

Structures

- Left crus of diaphragm
- Left suprarenal gland
- Anterior surface of left kidney
- Anterior surface of body of pancreas
- Tortuous splenic artery
- Transverse mesocolon
- *Spleen*—but always separated from stomach by a cavity of greater sac.

BARE AREA OF LIVER

It is the largest nonperitoneal area on the posterior surface of the right lobe of liver (Fig. 4.5).

Boundary

- Base is formed by groove for inferior vena caval
- Apex is formed by meeting of the two layers of the coronary ligament forming the right triangular ligament
- Above by superior layer of coronary ligament
- Below by inferior layer of coronary ligament.

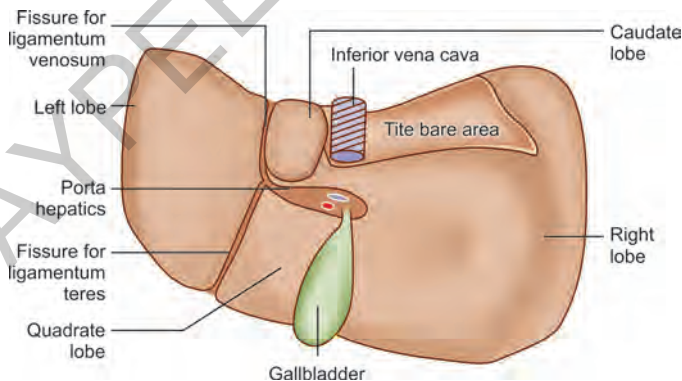


Fig. 4.5: Bare area of liver

Relations

- Part of right suprarenal gland comes to the relation with the bare area
- *Clinical importance:* Anastomosis between portal vein with the veins of diaphragm (systemic).

COMMON BILE DUCT (FIG. 4.6)

Formation

Common hepatic duct after joining with the cystic duct forms the common bile duct (CBD).

Length

It is 8 cm long and has a diameter of 6 mm.

Structures

It has four parts:

1. Supraduodenal
2. Retroduodenal
3. Infraduodenal
4. Intraduodenal.

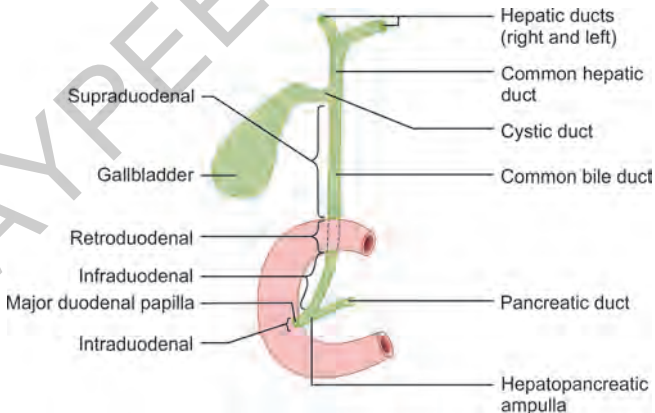


Fig. 4.6: Common bile duct

Draining At

Ampulla of Vater in the major duodenal papilla of second part of duodenum.

Blood Supply

Cystic artery

Clinical Anatomy

- *Cholangitis*—infection of CBD
- Bile duct obstruction causes obstructive jaundice
- *Cholelithiasis*—stone in the CBD
- Stricture of CBD may occur during cholecystectomy.
- Bile duct can be assessed by ERCP (endoscopic retrograde cholangiography).

CALOT'S TRIANGLE

The triangle presents in the abdomen in relation to biliary system.

This triangle is very important for surgeons during cholecystectomy.

Boundary

- Above—inferior border of liver
- Below—cystic duct
- Medially—common hepatic duct.

Contents

- Cystic artery
- Cystic lymph node
- Autonomic fibrous supplying in the gallbladder.

Triangle present in the right lumbar region.

EXTRAHEPATIC BILIARY APPARATUS (FIG. 4.7)

Biliary apparatus is subdivided into two parts: (1) intrahepatic and (2) extrahepatic.

Extrahepatic

The extrahepatic biliary apparatus collects the bile from the liver, by common hepatic duct, stores and concentrate the bile in the gallbladder and then transmit it to second part of duodenum by CBD. It consists of:

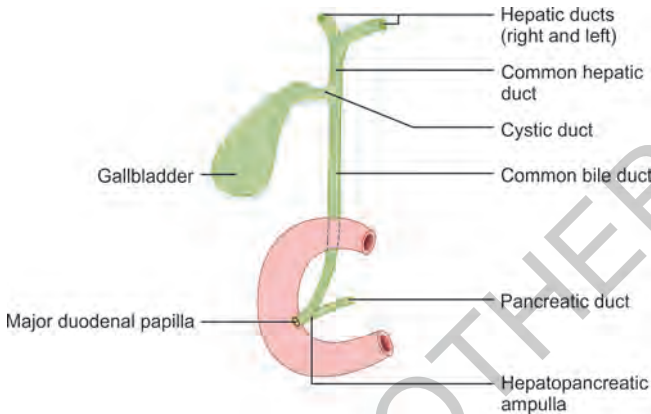


Fig. 4.7: Extrahepatic biliary apparatus

- Common hepatic duct
- Gallbladder
- Cystic duct
- CBD.

Clinical Importance

- Gallstone is very common. Stone may be impacted within cystic duct or CBD. Obstruction of CBD by gallstone produces obstructive jaundice
- Ultrasound is the widely used imaging technique for the diagnosis of a suspected gallstones and biliary tract disease.

PORTAL VEIN

The hepatic portal system collects blood from digestive tract and is valveless. The superior mesenteric vein unite with splenic vein and form a trunk—the portal vein, which enter into the liver and breaks up into capillaries (Fig. 4.8).

Important Portosystemic Anastomosis

Under normal condition, portal blood passes through the liver and drains in the inferior vena cava, by hepatic veins. But when this route is blocked some communication exists at:

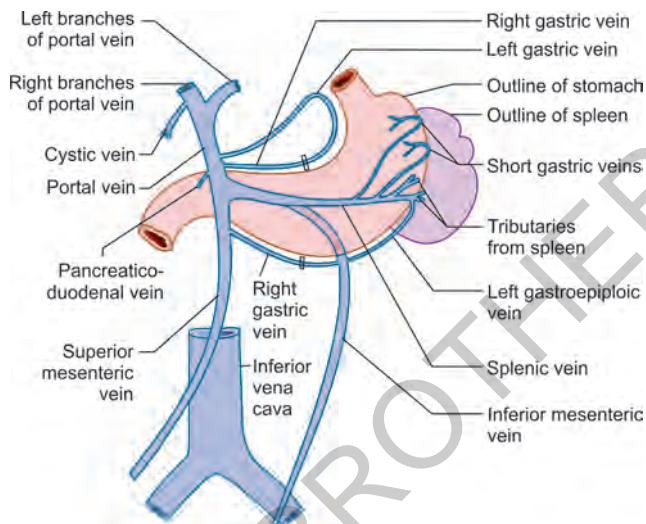


Fig. 4.8: Scheme to show the tributaries of the portal vein

- *Lower end of esophagus:* Communication between esophageal branch of left gastric (portal system) and esophageal branch of azygos system
- *In the distal part of anal canal:* The superior rectal vein (portal system) anastomoses between the middle and inferior rectal vein (systemic)
- *In umbilical region:* Paraumbilical vein connects left branch of portal vein with the superficial vein of abdomen (systemic).

Clinical Anatomy

The anastomotic channels may be distended and ruptures and produces severe hemorrhage. It may be treated with sclerotherapy.

PEYER'S PATCHES

These are the aggregations of lymphatic tissue within the ileum of small gut. Previously, in the enteric fever (typhoid) the Peyer's patches were infected. Previously, it produced perforation of gut and peritonitis. Nowadays, this perforation is prevented by the drug chloramphenicol.

ESOPHAGEAL VARICES

Normal pressure of portal vein is 5–15 mm Hg. When the pressure rises above 40 mm Hg is known as portal hypertension. It is due to cirrhosis of liver, Banti's disease and portal vein thrombosis. In this case, the venous blood can reach the heart via important portacaval anastomosis (Fig. 4.9) described below:

This communication exists at:

- *Lower end of esophagus:* Communication of esophageal branch of left gastric (portal system) with esophageal veins of azygos system (systemic). An abnormally large amount of blood passes through these channels and forms esophageal varices. Channels may rupture and produce severe hemorrhage. It may be corrected by giving sclerosing agent
- *In the distal part of anal canal:* The superior rectal vein (portal system) anastomoses with the middle and inferior rectal vein (systemic). In portal hypertension, these veins dilated and protruded through mucosa and form internal piles (hemorrhoids), which may rupture during passage of stool. It may be corrected by sclerosing agent

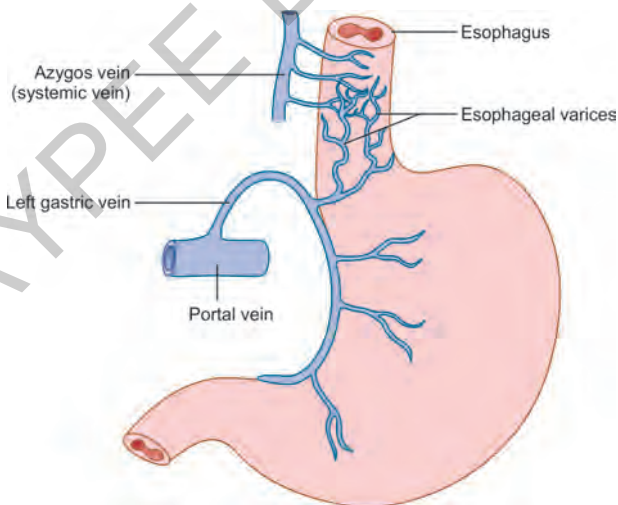


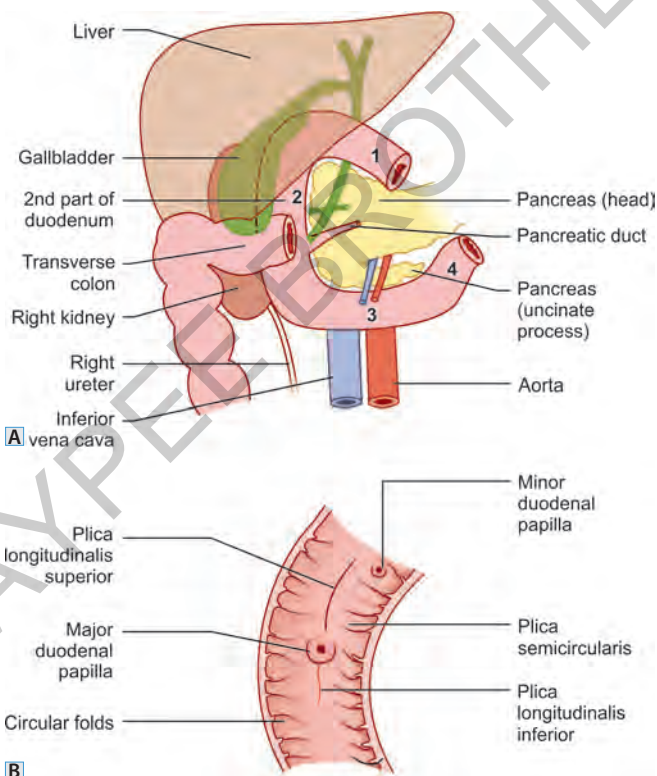
Fig. 4.9: Communication of blood via different veins

- *In umbilical region:* The paraumbilical vein connects with left branch of portal vein with the superficial vein of abdomen (systemic circulation). In portal hypertension, these veins are enlarged and radiates around the umbilicus and form caput medusae.

SECOND PART OF DUODENUM (FIGS 4.10A AND B)

Beginning

From superior duodenal flexure at the level of the neck of gallbladder.



Figs 4.10A and B: (A) Relations of the second and third parts of the duodenum; (B) Interior of the second part of the duodenum

SURGICAL ANATOMY

A Student's Manual

Salient Features

- This book bridges the gap between preclinics and clinics
- Short notes and explanatory notes on surgical and medical topics are given in lucid language for almost every anatomical part of the body in separate chapters
- Must-know areas are highlighted and at the end of every chapter there is a special note as 'points to remember'
- Salient points about surface anatomy are given with each chapter, so that student can learn how to examine a patient
- Easy reproducible diagrams are the strong points of the short notes and explanatory answers of surgical anatomy
- Imaging anatomy details both in points and writing are the specialty of this book.

Sibani Mazumdar MBBS MS is Professor and Head, Department of Anatomy, Calcutta National Medical College, Kolkata, West Bengal, India. She has been teaching anatomy for the last 35 years. She is thesis examiner of MD and PhD degree programs of different universities and has been entrusted with the job of Medical Inspector several times by Medical Council of India (MCI). She is also examiner of undergraduate and postgraduate examinations in several medical colleges in India. Besides, she has published many papers in several national and international journals.



Available at all medical bookstores
or buy online at www.jaypeebrothers.com



JAYPEE BROTHERS
Medical Publishers (P) Ltd.
www.jaypeebrothers.com

Join us on [facebook.com/JaypeeMedicalPublishers](https://www.facebook.com/JaypeeMedicalPublishers)

Shelving Recommendation
ANATOMY

ISBN 978-93-5270-149-0

