

Goepp's
Medical State Board
Questions and Answers

FLIPPIN

N I N T H E D I T I O N

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Questions and Answers

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W. B. SAUNDERS COMPANY
Philadelphia London

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Reprinted, February, 1958

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MADE IN THE UNITED STATES OF AMERICA

PRESS OF W. B. SAUNDERS COMPANY

Library of Congress Catalog Card Number: 8-17568

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In Memory Of
R. MAX GOEPP
1866 – 1950

Preface to the Ninth Edition

The aim of this book has remained unchanged since publication of the first edition fifty years ago—to present to the student of medicine reliable, up-to-date medical information in convenient, concise, yet adequate form.

Since the publication of the eighth edition, in 1950, much of both physiologic and therapeutic importance has been discovered and is now employed in the practice of medicine. The introduction of ACTH and adrenocortical steroids; new antimicrobial agents (benzathine penicillin G, penicillin V, tetracycline, erythromycin, novobiocin, nitrofurantoin, stilbamidine, Primaquine, etc.); measures for the control of malignant diseases (folic acid antagonists, nitrogen mustards, 6-mercaptopurine, radioactive isotopes, cobalt 60, etc.); new cardiovascular drugs (procaine amide, Rauwolfia, Diamox, levarterenol, etc.); improvements in anticoagulant therapy; a better understanding of water and electrolyte balance; advances in anaesthesiology; new surgical techniques, especially in cardiovascular surgery; new diagnostic procedures (PBI, transaminase determinations, etc.); and the tranquillizers represent but some of these advances in medicine.

In order to reflect these many strides which have taken place during the past seven years and to retain the basic fundamentals within the confines of a single volume, certain necessary changes have been made in this edition. Most of the material has been entirely rewritten. Chapters on Anatomy and Pathology have been subjected to extensive revision and more space has been allotted to the chapters on Chemistry and Physiology, Pharmacology, and Clinical Pathology.

The editor wishes to express his thanks to the members of the Editorial Board, whose important contributions made the revision of this book possible, to Philip H. Strubing, Esq., for his advice on the section pertaining to legal medicine, and to the publishers for their cordial cooperation and many helpful suggestions.

H. F. F.

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ANATOMY

CIRCULATORY SYSTEM

THE HEART

Give a brief yet comprehensive description of the heart.

The heart is a hollow muscular pump surrounded by the pericardium. It contains four cavities: a right and left atrium and a right and left ventricle. The right atrium receives blood from the superior and inferior venae cavae and transmits it through the tricuspid valve opening into the right ventricle. Part of the right atrium is like the large veins in structure and is called the sinus. Each atrium has a small appendage, the auricle. On the septum between the right atrium and the left atrium there is the limbus ovalis, which surrounds the fossa ovalis. The fossa is the remnant of the foramen joining the right and left atrium in fetal life. There is a small fold of membrane at the opening of the inferior cava called the valve of the vena cava (Eustachian). The coronary sinus bringing blood from the heart wall empties at this location. The pulmonary artery, which has semilunar valves at its mouth, leaves the right ventricle at the pulmonary conus. The tricuspid valve leaflets are attached to the papillary muscles of the ventricle wall by the chorda tendinea.

The left atrium receives the blood returning from the lungs and passes it through the bicuspid valve (mitral) to the left ventricle. The left ventricle is smaller than the right but the wall is thicker and the papillary muscles are much larger. The blood is pumped from the left ventricle into the aorta, which has at its orifice three semilunar valves. The coronary arteries arise from behind two of these cusps and supply arterial blood to the heart. The coronary veins return the blood. The nerve supply is from the vagus nerve and from the cardiac plexus of the sympathetic.

The heart muscle is a special form of striated muscle. The muscle of the atrium does not continue with the muscle of the ventricles but stops at the annulus fibrosus. The ventricular muscle begins at the annulus fibrosus and is oriented in a special pattern. The outer layer of the muscle forms a helix which goes around both ventricles. The deeper layers surround each ventricle and in the interventricular septum cross over like a figure of eight to the ventricle of the other side. Each ventricle has a set of fibers belonging wholly to it. These begin at the annulus and proceed around the ventricle as a helix until they reach the apex of the ventricle. Here they weave into the interior of the ventricle and turn upward to be continued as the papillary muscles. The chorda tendinea continues from here to the valve flaps, which in turn are attached to the annulus fibrosus, thus furnishing the second point of attachment of the heart muscle and making of the ventricle a contractible chamber.

Locate and describe the pericardium.

A pyramidal, fibroserous sac surrounding the heart and great vessels, the base attached to the central tendon of the diaphragm, the apex corresponding to the great vessels at the base of the heart and connected with the deep cervical fascia by fibrous prolongations. It is placed behind the sternum and the cartilages of the fourth, fifth and sixth ribs of the left side, in the interval between the pleurae. The inner, serofibrous layer forms a closed sac which covers the heart and great vessels and sometimes contains a small quantity of fluid—the *liquor pericardii*.

Arterial supply from *internal mammary* artery and *descending aorta*.
Nerves: *phrenic*, *sympathetic* and *tenth*.

Describe the endocardium.

A thin membrane lining the internal surface of the heart. It assists in forming the valves by its reduplications and is continuous with the intima of the vessels. It is smooth and transparent and covered with a single layer of *endothelial cells*.

What is the atrioventricular bundle (of His)?

A bundle of conducting tissue, 2 mm. broad and 1 mm. thick, begins at the atrioventricular node in the lower part of the interatrial septum and passes into the interventricular septum at the membranous part where it divides into right and left branches which arborize throughout the myocardium.

The sinoatrial node is related to this complex but not directly connected with it. It is the pathway by which the impulse initiating the contraction of the heart is conveyed from the atrium to the ventricle.

Beneath what points on the anterior surface of the chest are the cardiac valves?

Pulmonary: to the left of the upper part of the third left chondro-sternal junction. *Aortic*: behind left half of sternum, opposite lower border of third costal cartilage. *Bicuspid (Mitral)*: behind left half of sternum, opposite fourth rib. *Tricuspid*: opposite middle of sternum, at the level of the fourth and fifth cartilages.

What are the special characteristics of the left ventricle of the heart?

It forms the apex of the heart and contains the aortic opening. Its walls are thicker than those of the right ventricle. Its papillary muscles are fewer and larger. The atrioventricular (mitral) valve is made up of two segments.

What arteries supply the heart with blood, and where do they originate?

The two coronary arteries springing from the ascending aorta: the right from the *right (anterior) aortic sinus* (sinus of Valsalva); the left from the *left (anterior) aortic sinus*.

Where is the foramen ovale of the heart and what purpose does it serve?

In the wall between the atria. In the fetus it permits the passage of blood from the right to the left atrium, and carries the blood which enters the right atrium from the inferior vena cava to the left atrium, thereby saving the pulmonary circulation from engorgement.

Describe the changes that take place in the vascular system at birth.

The blood ceases to flow through the *umbilical vein* and *ductus venosus* into the inferior cava; the *umbilical arteries* become obliterated after ligation of the umbilical cord. The foramen ovale no longer serves to balance the circulation and gradually closes. The *ductus arteriosus*, which connects the pulmonary artery with the arch of the aorta, is functionally useless when the pulmonary circulation is established with the first breath and is slowly obliterated.

THE ARTERIES

Describe the structure of the arteries and give their nerve and blood supply.

Arteries have three coats or tunicae. The inner endothelial layer, the intima, has a basement membrane of elastic tissue. The next layer, the media, consists of smooth muscle fibers in a circular arrangement. The outer layer, the externa, is the connective tissue layer which is the sheath of the artery. When an artery is surgically clean this layer has been removed. A plexus of unmyelinated nerve fibers is found in the externa. These come from sympathetic ganglia and are basically motor nerves. A few unmyelinated nerves, afferent in function, are found in the larger arteries. Vessels over a millimeter in diameter have vasa vasorum. In the tunica externa, these arise from the artery and supply the wall except the intima. The returning veins empty into adjacent veins.

What is the *circulus arteriosus*?

The *circulus arteriosus* (circle of Willis) is an arterial anastomosis on the base of the brain. It begins behind with the two terminal branches of the basilar, the posterior cerebrals. The posterior communicating arteries join these with the internal carotid arteries. The anterior part is continued by the two anterior cerebrals which leave the carotids. The most anterior link is the anterior communicating artery.

What arteries unite to form the basilar artery?

The two vertebrals.

Give the origin, distribution, and branches of the middle meningeal artery.

It is a branch of the internal maxillary artery which enters the cranium through the foramen spinosum. Its branches course upward and backward in the dura mater in two groups, anterior and posterior. At the anterior end of the middle cranial fossa, it usually has a short intra-osseous course. This is the section commonly ruptured in skull fracture. The ultimate distribution is to the dura mater and especially the vault of the skull. There is generally a small separate artery, the anterior meningeal artery in the anterior cranial fossa, and a small posterior meningeal artery in the posterior cranial fossa.

Give the origin and course of the pulmonary artery.

The pulmonary artery is the most anterior artery of the heart. It arises from the pulmonary conus of the right ventricle. It ascends to the left of the aorta and curving under the arch divides at this point into the

right and left pulmonary arteries. This is on a line with the angle of the sternum in front and the fifth vertebra behind.

What blood vessels pass to and from the liver?

The *arteria hepatica propria* ascends to the liver through the hepato-duodenal ligament. In addition, the *vena porta* also enters from below. A series of large and small hepatic veins drain the liver directly into the inferior vena cava.

Describe the external carotid artery.

It arises opposite the upper border of the thyroid cartilage and then slopes backward to the space between the mandible and the external auditory canal, where it divides into the superficial temporal and the internal maxillary. On its upward course it gives off the superior thyroid, lingual, external maxillary, occipital, posterior auricular, and ascending pharyngeal arteries.

Name the branches of the subclavian artery.

Although the left subclavian coming from the arch of the aorta is longer than the right which comes from the innominate, the branches are similar. They are the vertebral, internal mammary, **superior intercostal**, thyrocervical trunk, inferior thyroid, transverse cervical, and transverse scapular. The subclavian artery at the outer border of the first rib becomes the brachial artery.

Through what arteries is the collateral circulation carried on after ligation of the subclavian artery?

After ligation of the third part of the subclavian (site of election), the circulation is maintained chiefly by *three* sets of vessels: a *posterior* set, consisting of the transverse scapular and posterior scapular branches of the subclavian, anastomosing with the subscapular branch of the axillary; an *internal* set, consisting of the internal mammary, anastomosing with the superior and long thoracic and subscapular branches of the axillary; a *middle* set, consisting of small branches of the subclavian anastomosing with branches of the axillary artery.

Give the origin, main branches, and relations of any one of the following arteries: external carotid, axillary, and femoral.

The *axillary artery* is the continuation of the subclavian and becomes the brachial artery. It extends from the outer border of the first rib to the lower border of the *teres major* where it becomes the *brachial artery*. It is divided into *three* portions by the *pectoralis minor*. Relations of first portion: *in front*, *pectoralis major*, costocoracoid membrane; *outer side*, brachial plexus; *inner side*, axillary vein; *behind*, ribs and intercostal muscles. Second portion: *in front*, *pectoralis minor*; *outer side*, outer cord; *inner side*, inner cord; *posteriorly*, posterior cord and subscapularis muscle. Third portion: *in front*, *pectoralis major*; *outer side*, coracobrachialis muscle, median and musculocutaneous nerves; *inner side*, ulnar and medial cutaneous nerves, and axillary vein; *behind*, subscapularis, latissimus dorsi and *teres major* muscles, radial and axillary (circumflex) nerves. *Branches*: supreme thoracic, thoraco-acromial, lateral and alar thoracic; subscapular; and anterior and posterior circumflex.

Give the origin, course, and branches of any one of the following arteries: brachial, temporal, and left common carotid.

The *brachial* commences at the lower margin of the tendon of the *teres major* and passes down the inner and anterior aspects of the arm, terminating about $\frac{1}{2}$ inch below the bend of the elbow, where it divides into the radial and ulnar arteries. Its *branches* are: the profunda artery of the arm, muscular and nutrient branches, superior ulnar collateral, and inferior ulnar collateral.

What would be the collateral circulation if the brachial artery were ligated below the profunda artery of the arm?

The profunda and superior ulnar collateral anastomose with the inferior ulnar collateral, the radial and interosseous recurrent, and the volar and dorsal ulnar recurrent.

Describe the location of the intercostal arteries.

They are located below the subcostal grooves on the under surface of the ribs.

What arteries, muscles, and nerves would be severed in a cross section at the middle of the humerus?

The brachial, profunda, and superior ulnar collateral arteries; the biceps and triceps muscles, the insertion of the deltoid, coracobrachialis, and the origin of the brachialis muscles; the musculocutaneous, medial cutaneous of the forearm, median, ulnar, and radial nerves.

Describe the ulnar artery as to (a) origin, (b) course, and (c) distribution.

(a) It is the larger terminal branch of the brachial and commences in the cubital fossa, terminating in the palm. (b) From its origin it runs obliquely downward and inward, beneath the muscles arising from the medial epicondyle to the junction of the proximal and middle thirds of the forearm. From that point it descends to the wrist, passing to the radial side of the pisiform bone, and forms the *superficial volar arch*. (c) The ulnar artery supplies the structures on the inner side of the elbow, the ulnar side of forearm and wrist, interosseous membrane and adjacent muscles, also flexor surface of the hand.

In amputation of the forearm 3 inches above the wrist, what arteries will it be necessary to tie, and of what are they branches?

Radial and ulnar arteries, branches of the brachial; volar and dorsal interosseous arteries, branches of the ulnar.

Describe the position of the volar arterial arches.

The *superficial volar arch* lies upon the flexor tendons and passes across the palm at the level of the medial border of the thumb when in extreme abduction. The *deep volar arch* lies upon the metacarpal bones and interosseous muscles, $\frac{1}{2}$ inch nearer the carpus than the superficial arch.

Name the branches of the abdominal aorta.

Visceral: celiac axis, superior mesenteric, inferior mesenteric (unpaired); suprarenal, renal, testicular or ovarian (paired).

Parietal: Middle sacral (unpaired); inferior phrenic, lumbar (4 pairs), common iliac (paired).

Mention the principal branches of the celiac axis.

Left gastric, hepatic, and splenic arteries.

Where does the abdominal aorta commence and where does it terminate?

It commences at aortic opening in diaphragm, on body of twelfth thoracic vertebra; terminates on body of fourth lumbar vertebra, just to left of median line.

Mention the branches of the hypogastric (internal iliac) artery.

Anterior trunk: superior, middle, and inferior vesical, obturator, middle hemorrhoidal, uterine, vaginal, internal pudendal, and inferior gluteal. *Posterior trunk:* ilio-lumbar, superior gluteal, and lateral sacral.

What arteries supply the bladder in the male? Of what vessel are they branches?

Superior, middle, and inferior vesical, branches of hypogastric.

Describe the relation of the deep (inferior) epigastric artery to the abdominal inguinal (internal abdominal) ring.

The artery descends to reach the inguinal (Poupart's) ligament, then ascends obliquely along the medial margin of the abdominal inguinal ring and passes upward in the abdominal wall, between the transversalis fascia and the peritoneum.

Describe the femoral artery and its branches.

The femoral artery is the continuation of the external iliac. Commencing immediately behind the *inguinal ligament*, midway between the anterior superior spine and the symphysis, it passes down the thigh and terminates at the opening in the adductor magnus muscle. The proximal portion lies in the *femoral trigone* (Scarpa's triangle) and is superficial; at the apex of the trigone it passes to the sartorius muscle and enters the adductor (Hunter's) canal, becoming more deeply placed.

Branches: Superficial circumflex iliac, superficial epigastric, superficial external pudendal; muscular, deep external pudendal, profunda femoris, and arteria genu suprema (anastomotica magna).

The *profunda artery* (profunda femoris) is the largest branch of the femoral artery. It arises $1\frac{1}{2}$ inches below the inguinal ligament; curving backward it passes posterior to the femoral artery and runs distally along the medial side of the femur to the back of the thigh, after perforating the adductor magnus muscle.

Branches: Three perforating arteries: lateral and medial circumflex arteries, arteria genu suprema. Terminates as the fourth perforating artery.

Describe the femoral sheath.

A funnel-shaped sheath formed by the transverse fascia anteriorly and the iliac fascia posteriorly, which surrounds the femoral artery and vein at their entrance into the *femoral trigone*. The three compartments into which it is divided by anteroposterior septa contain the following structures:

Lateral compartment: femoral artery and lumbo-inguinal branch of the genitofemoral nerve.

Medial compartment: constitutes the femoral canal. Medial wall pierced by great saphenous vein.

Intermediate: femoral vein.

If the femoral artery were obstructed at the apex of the femoral triangle, through what channels would the blood flow to reach the tibial arteries?

The new channels would be formed by the profunda and its branches. The lateral circumflex anastomoses with the arteria genu suprema, the medial circumflex with the superior articular, and both anastomose with muscular branches. The arteria comitans nervi ischiadici branch of the inferior gluteal anastomoses with branches from the popliteal and posterior tibial arteries.

Describe the popliteal artery and give its branches.

The popliteal artery is the direct continuation of the femoral. It begins at the proximal and medial part of the popliteal fossa and terminates at the distal border of the popliteus muscle, where it divides into the anterior and posterior tibial arteries. It lies upon the posterior surface of the femur, the posterior part of the capsule of the knee joint, tibia, and the fascia covering the posterior surface of the popliteus, bisecting the popliteal space longitudinally.

Branches: Proximal and distal (sural) muscular branches; superior and inferior lateral genicular (articular); superior and inferior medial genicular; middle genicular; anterior and posterior tibial.

Give the course of the posterior tibial artery.

It commences at the border of the popliteus muscle and terminates midway between the tip of the medial malleolus and the calcaneus. The artery runs downward and inward between the superficial and deep flexor muscles of the calf.

In an amputation of the leg 5 inches below the knee, what arteries will it be necessary to tie and of what are they branches?

Anterior and posterior tibial, branches of popliteal; peroneal artery, branch of posterior tibial.

THE VEINS

Describe the superior vena cava.

It returns the blood from the head, neck, upper extremities, thoracic wall, and a portion of the upper part of the posterior wall of the abdomen. It is formed behind the first right costal cartilage by the *union of the two innominate veins*, and descends, with a slight convexity to the right, to the level of the third right costal cartilage, where it opens into the upper and back part of the right atrium. The lower half is within the pericardium. Its *tributaries* are the vena azygos (vena azygos major), pericardial, and mediastinal veins.

Describe the inferior vena cava and name the veins that enter into its formation.

It returns the blood to the heart from practically all parts of the body below the diaphragm. It is formed by the *junction of the two common iliac veins* on the right side of the intervertebral disk between the fourth

and fifth lumbar vertebrae. Passing upward on the front of the spine, where it lies to the right of the aorta, it traverses the under surface of the liver in the fissure of the vena cava, perforates the central tendon of the diaphragm at the level of the eighth thoracic vertebra and enters the pericardium, terminating in the lower back part of the right atrium.

Describe the right and left subclavian veins.

The *subclavian vein* extends from the lower border of the first rib to a point behind the sternoclavicular articulation, where it unites with the internal jugular to form the innominate. The vein lies in front of the artery, separated from its second portion by the anterior scalene muscle. Its *tributaries* are the external and anterior jugular.

On the *right side* the right lymphatic duct empties into the subclavian vein at its junction with the internal jugular; the *left* subclavian vein receives the thoracic duct at this point; otherwise the course and relations of the vein are the same on the two sides.

Describe the internal jugular vein.

The vein is formed in the jugular foramen by the junction of the lateral and inferior petrosal sinuses. It comes down the neck, beneath the anterior border of the sternocleidomastoid muscle, accompanied first by the internal, and then by the common carotid artery, and throughout its course by the vagus (pneumogastric) nerve. The vein is contained *in the same sheath with the artery and nerve*, but separated from these structures by a distinct septum. At first the vein lies behind the internal carotid artery; but as it descends it gradually passes to the other side of the vessel and later along the outer side of the common carotid, partially overlapping the artery in front, to its termination behind the sternoclavicular articulation, where it unites with the subclavian to form the innominate.

Give the course and relations of the external jugular vein.

The vein is formed on the surface of the sternocleidomastoid muscle, below the angle of the jaw, by the *union of the posterior auricular with a branch of the posterior facial* (temporomaxillary) vein. It descends to the anterior part of the subclavian portion of the posterior triangle of the neck and there terminates in the subclavian vein, after piercing the deep fascia and crossing the third portion of the subclavian artery.

Describe the portal system.

It is made up of veins which drain the spleen, stomach, pancreas, and large and small intestines. The *splenic vein*, after receiving the inferior mesenteric, joins the superior mesenteric to form the *portal vein*, which receives the *gastric*. The portal vein passes behind the hepatic artery and bile duct in the lesser omentum and enters the *porta hepatis* or *gate* (transverse fissure) of the liver, where it divides into minute branches.

How are the saphenous veins formed? Where do the saphenous veins empty?

The great (internal) is formed by the union of the medial extremity of the dorsal venous arch with the dorsal vein of the great toe; it empties into the femoral vein. The small (external) is formed by the union of