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| SUBJECT: | HUMAN ANATOMY OF ORGANS AND SYSTEMS | | |
| CREDITS: | Total: 17 | Theory: 8.5 | Practical: 8.5 |

GENERAL OBJECTIVES

The general objectives of this subject are for students to learn the principles of embryonic development and the theoretical foundations of morphological and functional aspects of human anatomy of the central nervous system, sense organs and the cardiorespiratory, digestive and urogenital apparatus. The course will also introduce the foundations for identifying different anatomical structures through image analysis to allow students to integrate anatomical knowledge into the principal radiological explorations for clinical diagnosis.

SPECIFIC OBJECTIVES

As a result of the learning process, the student should be able to:

- Apply the appropriate anatomical nomenclature to describe structures and their localization, as well as the medical terminology associated with their respective functions.
- Describe the principal stages of development or organogenesis of the different apparatus and systems studied.
- Understand the principles of anatomical organization of the central nervous system and deduce the possible alterations to its normal function.
- Produce cross sections of portions of the apparatus and systems studied that have particular clinical relevance.
- Recognize studied structures and organs in a cadaver, according to shape and topography, and relate this to knowledge gained from image analysis techniques (Rx, TC, RMN).
- Describe the structure, normal patterns of arterial, venous and lymphatic vascularization, innervation and function of the apparatus and systems studied.

PROGRAMME

Theory

I. NEUROANATOMY

Introduction and morphogenesis of the nervous system

1. Introduction to the nervous system. Generalities, functions and systematization of the nervous system.
2. Development of the nervous system I. Induction of the nervous system. Neurulation. Vesiculation. Development of the ventricular system.
3. Development of the nervous system II. Derivatives of the neural tube. Neural crests.

Organization of the brain

4. External morphology of the brain. Lobes, fissures, sulci and cerebral convolutions.
5. Organization of the cerebral cortex. Principal types of cortex: isocortex and allocortex.
6. Cortical areas. Motor cortex. Sensitive-sensory cortices. Association areas. Hemisphere dominance. Limbic cortex.
7. Internal morphology of the brain. Cerebral commissures: corpus callosum, trigone, anterior white commissure. Association fibres.

8. Basal ganglia. Anatomical components. Connections. Functional organization.
9. Thalamus. Thalamic nuclei: relay, associative and nonspecific. Connections. Functions of the thalamus.
10. Hypothalamus. Subdivisions. Connections. Functions of the hypothalamus.
11. Hypophysis. Adenohypophysis. Neurohypophysis. Hypothalamic-hypophyseal portal system. Functions of hypophysis. Hypothalamic-hypophyseal axis.
12. Epithalamus. Pineal gland. Ependymal organs.
13. Olfactory system and limbic system. Rhinencephalic structures. Olfactory pathways. Structures, connections and functions of the limbic system.
14. Optic pathways. Functional structure of the retina. Conscious optic pathways. Reflex optic pathways: photomotor reflex and accommodation-convergence reflex.
15. Internal capsule. Systematization of fascicles that pass through the internal capsule. Functional significance.

Organization of the encephalic trunk and cerebellum.

16. Macroscopic anatomy of the encephalic trunk. External morphology. Emergence of cranial pairs. Internal morphology.
17. Organization of the nuclei of cranial nerves. Functional components of cranial nerves. Systematization of their nuclei of origin and termination.
18. Somitic cranial nerves. Oculomotor nerves: oculomotor (III), trochlear (IV) and abducens (VI). Extrinsic ocular musculature.
19. Somitic cranial nerves II. Hypoglossal nerve (XII).
20. Branchial cranial nerves I. Trigeminal nerve (V).
21. Branchial cranial nerves II. Facial nerve (VII).
22. Branchial cranial nerves III. Glossopharyngeal (IX), vagus (X) and spinal (XI) nerves.
23. Specialized sensory nerves I. Vestibular nerve (VIII). Receptors. Conscious vestibular pathways. Reflex vestibular pathways. Vestibular nystagmus.
24. Specialized sensory nerves II. Cochlear nerve (VIII). Receptors. Conscious auditory pathways. Reflex auditory pathways. Descending auditory pathway.
25. Reticular formation. Organization. Ascending and descending reticular systems. Functions of the reticular formation.
26. Cerebellum I. External morphology. Organization of the cerebellar cortex. Intrinsic cerebellar connections.
27. Cerebellum II. Divisions according to phylogenetic and functional criteria. Extrinsic cerebellar connections.

Organization of the spinal medulla. Nerve pathways.

28. Spinal medulla. External morphology. Rachidian nerves and medullary segments.
29. Organization of grey matter in the spinal medulla: nuclei and Rexed's laminae. Segmental and multisegmental connections.
30. Ascending systems: sensitivity pathways. Types of sensitivity and receptors.
31. Spinothalamic system. Protopathic sensitivity pathways. Thermo-algesic sensitivity pathways. Endogenous analgesic system pathways.
32. Lemniscal system. Conscious proprioceptive sensitivity and tactile discrimination sensitivity.
33. Spinocerebellar system. Unconscious proprioceptive sensitivity pathways.
34. Descending systems I. Pyramidal motor system. Head motility pathway. Trunk motility pathway.
35. Descending systems II. Extrapyramidal motor system. Cortical and subcortical organization. Projection pathways.

Meninges, cephalorachidian liquid and vascularization.

36. Meninges. Cranial and spinal meninges. Meningeal spaces.
37. Ventricular system. Encephalic ventricles. Choroid plexes. Cephalorachidian liquid.
38. Arterial irrigation of the CNS. Arteries of the encephalon: carotid system and vertebrobasilar system. Spinal arteries.
39. Venous irrigation of the CNS. Sinus venosus. Cerebral veins.

Vegetative nervous system

40. Vegetative nervous system. Divisions. Organization of vegetative reflexes.
41. Parasympathetic nervous system. Cranial parasympathetic. Sacral parasympathetic.
42. Sympathetic nervous system. Cervical, thoracic, lumbar and sacral sympathetic.

II. ESTHESIOLOGY**Auditory apparatus**

43. Outer ear and middle ear. Auricular pavilion. External auditory canal. Tympanic cavity. Communications of the tympanic cavity.
44. Inner ear. Osseous labyrinth. Membranous labyrinth. The organ of Corti.

Visual apparatus

45. Ocular globe. Ocular tunics. Crystallin. Refracting media and ocular cameras. Vascularization.
46. Ocular annexes. Conjunctiva. Eyelids. Lacrimal apparatus. Tenon's capsule. Orbital cavity.

III. SPLANCHNOLOGY**Introduction**

47. Introduction to splanchnology. Generalities. Body cavities and compartments.

Cardiorespiratory apparatus

48. Development of the respiratory tract. Upper respiratory tract. Larynx (I). Vocal chords and laryngeal spaces. Laryngeal cartilage and articulations.
49. Larynx (II). Laryngeal musculature. Relations. Vascularization. Innervation. Function.
50. Trachea and principal bronchia. Morphology. Tracheobronchial cartilage and musculature. Relations. Vascularization. Innervation. Function.
51. Lungs. Morphology. Relations. Pulmonary pedicle. Pulmonary segments. Functional and nutritive vascularization. Innervation. Function.
52. Pleurae. Pleural surface. Pleural cavity and sinus.
53. Heart I. Morphology. Cardiac walls, partitions and cavities. Cardiac valves.
54. Heart II. Conduction system. Vascularization. Pericardium.
55. Mediastinum. Topography and divisions. Mediastinal structures. Principal arterial, venous and lymphatic systems of the thorax, neck and abdomen. Radiological anatomy of the thorax.

Digestive apparatus

56. Development of the digestive tube. Branchiogenic organs. Thyroid gland. Parathyroid gland. Thymus.
57. Oral cavity. Palate and tongue. Oral vestibule. Hard palate. Soft palate. Tongue: morphology, musculature, vascularization, innervation, function, taste buds.
58. Teeth. Primary and permanent teeth. Dental formula. Dental morphology.
59. Parotid gland. Morphology. Intrinsic and extrinsic relations. Vascularization. Innervation.
60. Submandibular and sublingual glands. Morphology. Intrinsic and extrinsic relations. Vascularization. Innervation.
61. Pharynx. Relations. Pharyngeal musculature. Innervation. Function.
62. Oesophagus. Morphology. Relations. Vascularization. Innervation. Function.
63. Stomach I. Morphology. Relations. Superficial topographical regions of the abdomen. Arrangement of the peritoneum and peritoneal compartments.
64. Stomach II. Vascularization. Innervation. Function.
65. Duodenum-pancreas. Morphology. Relations. Vascularization. Innervation. Function.
66. Jejunum-ileum. Morphology. Relations. Vascularization.
67. Large intestine. Morphology. Anatomical and functional divisions. Relations. Vascularization. Innervation. Function.
68. Rectum. Morphology. Relations. Vascularization. Innervation. Function.

69. Liver. Morphology. Relations. Hepatic pedicle. Hepatic segments. Vascularization. Portohepatic system. Portacaval communications.
70. Extrahepatic biliary pathways. Biliary vesicle and cystic duct. Common bile duct.
71. Spleen. Morphology. Relations. Splenic vesicle. Vascularization. Innervation. Function.

Urinary apparatus

72. Kidneys and suprarenal gland I. External and internal morphology of the kidney. Relations. Suprarenal gland: morphology, structure and relations.
73. Kidneys and suprarenal gland II. Renal pedicle. Vascularization. Innervation. Function.
74. Upper urinary pathways. Renal calyces. Renal pelvis. Ureters.
75. Urinary bladder. Morphology. Relations. Vascularization. Innervation. Function. Control of miction.
76. Urethra. Female and male urethra. Morphology. Relations.

Genital apparatus

77. Testicle. Morphology. Testicular descent. Vascularization. Innervation. Function.
78. Spermatic pathways. Epididymis. Deferent duct. Seminal vesicles. Ejaculatory ducts.
79. External male genitals. Scrotal sac. Penis.
80. Prostate. Morphology. Prostate lobes. Intrinsic and extrinsic relations. Vascularization. Innervation. Function. Cowper's bulbourethral glands.
81. Ovary. Morphology. Relations. Mesovary. Vascularization. Innervation. Function.
82. Fallopian tubes and uterus (I). Fallopian tubes: morphology, relations, mesosalpinx. Uterus: morphology, positions, relations.
83. Uterus (II). Means of fixation. Vascularization of the internal female genitals. Innervation. Function.
84. Vagina and external female genitals. Vagina: morphology, relations, vascularization, innervation. Bartholin's vulvovaginal glands. Vulva.
85. Mammary gland. Morphology. Relations. Vascularization. Function.

Practical training

Neuroanatomy

1. Generalities of the Central Nervous System. Embryology of the CNS.
2. External morphology of the brain.
3. Internal morphology of the brain: grey nuclei and formations of the hippocampus.
4. Internal morphology of the brain: white matter.
5. External morphology of the encephalon trunk, cerebellum and spinal medulla.
6. Sectional anatomy of the encephalon. Radiological images: CT, NMR. Ventricular system.
7. Peripheral path of cranial pairs I: Ocular motor nerves (III, IV, VI).
8. Peripheral path of cranial pairs II: Trigeminal nerve.
9. Peripheral path of cranial pairs III: Facial, vestibulo-cochlear, glossopharyngeal, vagus (cephalic part) and spinal nerves.
10. Arterial vascularization of the encephalon and spinal medulla. External carotid artery.
11. Cranial and spinal meninges. Venous vascularization of the encephalon and spinal medulla.

Splanchnology

1. Respiratory apparatus I: Nasal fossa and larynx. Branchiogenic organs: thyroid and parathyroid gland.
2. Respiratory apparatus II: Trachea, principal bronchia and lungs.
3. Circulatory apparatus. Heart. Large vessels and mediastinum.
4. Radiological anatomy of the respiratory apparatus, heart and mediastinum.
5. Digestive apparatus I: oral cavity, saliva glands, pharynx and oesophagus (cervical and thoracic).
6. Digestive apparatus II: oesophagus (abdominal), stomach, small intestine (duodenum), pancreas, liver and spleen.
7. Digestive apparatus III: small intestine (jejunum, ileum), large intestine, rectum (intrapertoneal portion).

8. Radiology of the digestive apparatus.
9. Urinary apparatus
10. Male genital apparatus.
11. Female genital apparatus.
12. Radiology of the urogenital apparatus.

LEARNING RESOURCES AND TEACHING METHODOLOGIES

Students will work towards the planned objectives and follow the teaching programme through the following means:

Theory classes

The areas outlined in the theory programme will be presented systematically, focusing particularly on functional aspects and those elements that require a higher degree of spatial and topographical understanding.

Practical classes

Practical classes will be held in:

a) Dissection room:

Students will receive direct explanations of the cadaver or anatomically dissected samples, relating to morphology, localization, topography, vascularization and innervation of the studied structures.

b) Seminars/bone bank:

Practical seminars focusing primarily on:

- Sectional anatomy, correlating anatomical models and standard imaging techniques (X-ray, CT, NMR) presented as X-rays and slides.
- Functional and applied anatomy, where appropriate audiovisual material will be used to analyze practical problems with particular relevance to doctor training and future professional practice.

c) Microscope room:

Planned practical sessions will involve the interpretation of embryological and central nervous system histological preparations.

d) Multimedia seminar:

Provided the necessary IT facilities are available, students will have access to programmes that aid understanding of the anatomical structures and functional interrelations studied previously on the cadaver or real anatomical samples. Students will also have access to interactive software designed to provide assisted learning of human anatomy.