Chapter 1. The Head & Neck

Ronald N. Bogdasarian

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Radiology-Based USMLE Board Prepbook

Chapter 1 The Head & Neck

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Introduction

The Radiology-Based USMLE Board Prepbook provides medical students with an efficient, interactive resource to enhance USMLE National Board Step 1 and 2 preparation and mastery. The workbook also aids students in learning clinical interpretation of computed tomography (CT) images. The atlas portion is also published separately as an anatomical reference for students and clinical practitioners.

Most of the images are axial or cross-sectional and include the major anatomical structures of the musculoskeletal, cardiovascular, respiratory, digestive, genitourinary, reproductive, nervous, endocrine, and lymphatic systems. These images are supplemented by synchronized frontal, sagittal, and three dimensional images. The images are organized in two sets. One set contains all body systems except the lymphatic system. The other set includes the cardiovascular system and lymph node regions. Each labeled CT image is preceded by an unlabeled version of the same image. This format allows the reader to continuously test his or her knowledge. The unlabeled images are used as the platform for USMLE Step 1 and 2 review questions which test comprehension of anatomy, pathology, and physiology.

The images were generated using the Varian Eclipse radiation therapy treatment program* in the University of Massachusetts Medical School Radiation Oncology Department. Physicians, an anatomist, and other multi-disciplinary medical professionals reviewed the content of each case before the final images were generated.

Disclaimer
The anatomical content of each image was reviewed by practicing medical professionals prior to the creation of each image. Each image was ultimately created by Ronald N. Bogdarsarian and thus any error that might be present should not be attributed to any of the reviewers. The author and reviewers are not responsible for any use of this atlas by third parties.

Copyright Statement
Preface

Interactive Learning
The Radiology-Based USMLE Board Prepbook is designed to engage users at multiple levels of learning. Through the continuous mental review of the labeled images with comparison to the unlabeled images and the question/answer sections, the user can improve his or her ability to identify the structures and interpret the computer tomography (CT) images. Active participation by the user in these exercises with real life data, opportunity to reflect on the information and self-assessment of the knowledge acquired provides active learning.

USMLE Style Questions
All first and second year medical students should include in their studies early and consistent review of anatomy with a focus on the USMLE Step 1 (and later Step 2) National Board Exam. The questions that are included on most of these unlabeled images test high-yield anatomy and physiology topics. These questions will enhance and reaffirm the user's ability to interpret CTs in an active manner. A pathology section highlighted by high-yield USMLE topics is also included to further enhance the user's ability to interpret abnormal CT images, medical knowledge and test-taking skills.

An understanding of cross-sectional anatomy and the ability to properly interpret CT images is essential in nearly all fields of medicine. This guidebook utilizes an intuitive format that encourages learning and review as well as serves as a basic anatomy reference. The PDF format enables download to minimize internet requirement, stores and travels easily with user-friendly note taking and self-assessment capabilities.

Interactive learning is vital to the success of the medical student or any other medical professional. It is essential to use efficient, engaging learning methods with constant testing of knowledge. The Radiology-Based USMLE Board Prepbook provides such a resource.
Future Versions of this Prepbook

This prepbook was designed to offer full web-based interactivity. However, resources are not yet available to execute this plan. This version uses a pseudo-activation format. Each unlabeled image is followed by a labeled image which allows the user to continuously test his or her knowledge, by comparison between the student’s own answers and the expert answers which follow. Users may create comment boxes on each page to record personal answers and notes. To create a comment box, right click within the atlas image and select “add sticky note”. We have found that this level of interactivity improves recall and retention.

Future versions of this guidebook will permit greater levels of interactivity. We plan to build links on the anatomical structures in order to view their names. We also plan to create links after multiple choice questions to reveal the answers and explanations. We hope to offer users a more formal ability to type and save their own explanations or notes on anatomical and question slides. Dedicated areas for answers and notes will be integrated into each page.

This current pseudo-activated version of the guidebook could easily be converted to print and has practical utility for students and medical professionals. The next iteration would encompass full web based activation with more integrated learning opportunities. We are currently seeking funding to achieve these goals.
Acknowledgements

I would like to thank the University of Massachusetts Medical School Radiation Oncology Department and the Massachusetts Medical Society for providing me with the opportunity, advice, support, and resources to complete this project.
Chapter 1
The Head & Neck

Ronald N. Bogdasarian, Adam J. Fusick, Andrew Chen, Richard S. Pieters, TJ FitzGerald

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Axial (All Structures)
Axial (Lymphatic System)

Images of Pathology
USMLE Style Questions

References

Age of Subject: 17

Reviewed By:
Richard Gacek, MD
David Goff, MD
Alan Stark, MD
Of the University of Massachusetts Medical School
Ozan Toy, BA
Skeletal System Anterior View
1. 7th Cervical Vertebra (Body)
2. 7th Cervical Vertebra (Transverse Process)
3. Clavicle (Acromial End)
4. Clavicle (Sternal End)
5. Cricoid Cartilage
6. Ethmoid Bone (Nasal Septum)
7. Ethmoid Bone (Orbital Plate)
8. Frontal Bone
9. Humerus (Head)
10. Inferior Nasal Concha Bone
11. Lacrimal Bone
12. Mandible (Body)
13. Mandible (Ramus)
14. Maxilla Bone
15. Nasal Bone
16. Parietal Bone
17. 1st Rib
18. Scapula (Acromion)
19. Scapula (Coracoid Process)
20. Sphenoid Bone (Greater Wing)
21. Sphenoid Bone (Lesser Wing)
22. Sternum (Manubrium)
23. Temporal Bone (Mastoid Process)
24. Temporal Bone (Squamous Part)
25. 1st Thoracic Vertebra (Body)
26. Thyroid Cartilage
27. Zygomatic Bone
Skeletal System Posterior View
1. 1st Cervical Vertebra (Posterior Arch)
2. 2nd Cervical Vertebra (Odontoid Process)
3. Clavicle (Acromial End)
4. Humerus (Head)
5. Mandible (Ramus)
6. Occipital Bone (External Occipital Protuberance)
7. Parietal Bone
8. 1st Rib
9. Scapula (Spine)
10. Temporal Bone (Mastoid Process)
11. 1st Thoracic Vertebra (Lamina)
Muscular System Anterior View
1. Deltoid Muscle
2. Inferior Rectus Muscle
3. Lateral Rectus Muscle
4. Masseter Muscle
5. Medial Rectus Muscle
6. Pectoralis Major Muscle
7. Platysma Muscle
8. Sternocleidomastoid Muscle
9. Sternohyoid Muscle
10. Sternothyroid Muscle
11. Superior Oblique Muscle
12. Superior Rectus Muscle
13. Temporalis Muscle
14. Trapezius Muscle
Deep Muscular System
Anterior View
1.
2.
3.
4.
5.
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7.
8.
9.
10.
11.
12.

Deep Muscular System
Anterior View
1. Biceps Brachii Short Head Tendon
2. Levator Scapulae Muscle
3. Omohyoid Muscle
4. Pectoralis Minor Muscle
5. Scalene Anterior Muscle
6. Scalene Middle and Posterior Muscles
7. Sternothyroid Muscle
8. Subclavius Muscle
9. Subscapularis Muscle
10. Supraspinatus Muscle
11. Serratus Anterior Muscle
12. Trapezius Muscle

Musculoskeletal System
Posterior View
1. Deltoid Muscle
2. Infraspinatus Muscle
3. Levator Scapulae Muscle
4. Nuchal Ligament
5. Rhomboid Muscle
6. Splenius Capitis Muscle
7. Splenius Cervicis Muscle
8. Sternocleidomastoid Muscle
9. Supraspinous Ligament
10. Teres Major Muscle
11. Trapezius Muscle
Deep Muscular System
Posterior View

Deep Muscular System
Posterior View
1. Digastric Muscle
2. Inferior Obliquus Capitis Muscle
3. Infraspinatus Muscle
4. Levator Scapulae Muscle
5. Longissimus Capitis Muscle
6. Rectus Capitis Posterior Major Muscle
7. Rectus Capitis Posterior Minor Muscle
8. Splenius Cervicis Muscle
9. Superior Obliquus Capitis Muscle
10. Supraspinatus Muscle
11. Teres Major Muscle
12. Transversospinalis Muscles

Vascular System Anterior View
1. Anterior Jugular Vein
2. Brachiocephalic Trunk
3. Brachiocephalic Vein
4. Common Carotid Artery
5. External Jugular Vein
6. External Carotid Artery
7. Facial Vein
8. Internal Carotid Artery
9. Internal Jugular Vein
10. Subclavian Artery
11. Subclavian Vein
12. Transverse Cervical Vein
13. Vertebral Artery
Vascular System Posterior View
1. Aortic Arch
2. Brachiocephalic Trunk
3. Brachiocephalic Vein
4. Common Carotid Artery
5. External Jugular Vein
6. External Carotid Artery
7. Facial Vein
8. Internal Carotid Artery
9. Internal Jugular Vein
10. Subclavian Artery
11. Subclavian Vein
12. Transverse Cervical Vein
13. Vertebral Artery
Digestive and Respiratory Systems Anterior View

Digestive System
1.
2.
3.
4.

Musculoskeletal System
5.
6.
7.
8.
9.
10.

Respiratory System
11.
12.
13.
14.

Note: The Digestive and Respiratory Systems are shown together in the Head and Neck because of their overlapping and closely related structures. The muscles of the tongue and the tonsils are also included.
**Digestive and Respiratory Systems Anterior View**

**Digestive System**
1. Esophagus
2. Parotid Gland
3. Submandibular Gland
4. Teeth (See Note Opposite)

**Musculoskeletal System**
5. Cricoid Cartilage
6. Thyroid Cartilage
7. Genioglossus Muscle
8. Geniohyoid Muscle
9. Mylohyoid Muscle
10. Tongue Dorsum

**Respiratory System**
11. Laryngopharynx
12. Lung
13. Nasopharynx
14. Trachea

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Note: The Digestive and Respiratory Systems are shown together in the Head and Neck because of their overlapping and closely related structures. The muscles of the tongue and the tonsils are also included.

Note: Moving to the right of the viewer, starting with the selected tooth: Top Teeth: Central Incisor, Lateral Incisor, Canine, First Premolar, Second Premolar, First Molar, Second Molar.
Digestive and Respiratory Systems Posterior View

Digestive System
1.
2.
3.
4.
5.
6.

Immune System
7.

Musculoskeletal System
8.
9.
10.
11.
12.
13.
14.

Respiratory System
15.
16.
17.
18.
19.
20.

Note: The Digestive and Respiratory Systems are shown together in the Head and Neck because of their overlapping and closely related structures. The muscles of the tongue and the tonsils are also included.
Note: The Digestive and Respiratory Systems are shown together in the Head and Neck because of their overlapping and closely related structures. The muscles of the tongue and the tonsils are also included.
Nervous System Anterior View

1. 
2. 
3. 
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11. 
12. 

1. 
2. 
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7. 
8. 
9. 
10. 
11. 
12.
Nervous System Anterior View
1. Cerebellum
2. Cerebrum
3. Cochlea
4. Eye Globe
5. Lens
6. Medulla Oblongata
7. Optic Chiasm
8. Optic Nerve
9. Pituitary Gland
10. Pons
11. Retina
12. Spinal Cord
Deep Nervous System Anterior View

1.  
2.  
3.  
4.  
5.  
6.  
7.  
8.  
9.  
10.  
11.  
12.  

Deep Nervous System Anterior View
1. Cerebellum
2. Corpus Callosum
3. Hypothalamus
4. Lateral Ventricle
5. Medulla Oblongata
6. Midbrain
7. Optic Chiasm
8. Optic Nerve
9. Pituitary Gland
10. Pons
11. Thalamus
12. Spinal Cord

Nervous System Posterior View
1. Cerebellum
2. Cerebrum
3. Spinal Cord
Deep Nervous System
Posterior View

Removed Structures Relative to Slide 26: The Cerebellum, Cerebrum, and Cochlea Structures.
Deep Nervous System
Posterior View
1. Corpus Callosum
2. Eye Globe
3. Lateral Ventricle
4. Medulla Oblongata
5. Midbrain
6. Optic Nerve
7. Pineal Body
8. Pons
9. Retina
10. Spinal Cord
11. Thalamus
12. 3rd Ventricle
13. 4th Ventricle

Removed Structures Relative to Slide 26: The Cerebellum, Cerebrum, and Cochlea Structures.
Lymphatic System Anterior View
1.
2.
3.
4.
5.
6.
7.
8.
9.

Note: Only the head and neck lymph node levels are included in this three-dimensional image. Use the two dimensional axial images to view descriptive names of lymph node regions. The major arteries and veins of the head and neck are included in this image to show their spatial relationship with the Lymph Node Regions. http://www.ajronline.org/doi/pdf/10.2214/ajr.174.3.1740837 is an excellent resource to understand better the lymphatic drainage of the head and neck.
Lymphatic System Anterior View
1. Head & Neck Level 1A
2. Head & Neck Level 1B
3. Head & Neck Level 2A
4. Head & Neck Level 2B
5. Head & Neck Level 3
6. Head & Neck Level 4
7. Head & Neck Level 5
8. Head & Neck Level 6
9. Retropharyngeal

Note: Only the head and neck lymph node levels are included in this three-dimensional image. Use the two dimensional axial images to view descriptive names of lymph node regions. The major arteries and veins of the head and neck are included in this image to show their spatial relationship with the Lymph Node Regions. http://www.di.org/content/174/3/174083? is an excellent resource to understand better the lymphatic drainage of the head and neck.
Lymphatic System Posterior View

1.
2.
3.
4.
5.
6.
7.
8.

Note: Only the head and neck lymph node levels are included in this three-dimensional image. Use the two dimensional axial images to view descriptive names of lymph node regions. The major arteries and veins of the head and neck are included in this image to show their spatial relationship with the Lymph Node Regions. http://www.ajronline.org/doi/pdf/10.2214/ajr.174.3.1740837 is an excellent resource to understand better the lymphatic drainage of the head and neck.
Lymphatic System Posterior View
1. Head & Neck Level 1B
2. Head & Neck Level 2A
3. Head & Neck Level 2B
4. Head & Neck Level 3
5. Head & Neck Level 4
6. Head & Neck Level 5
7. Head & Neck Level 6
8. Retropharyngeal

Note: Only the head and neck lymph node levels are included in this three-dimensional image. Use the two dimensional axial images to view descriptive names of lymph node regions. The major arteries and veins of the head and neck are included in this image to show their spatial relationship with the Lymph Node Regions. http://www.ajronline.org/doi/pdf/10.2214/ajr.174.3.1740837 is an excellent resource to understand better the lymphatic drainage of the head and neck.
Digestive System
1. First Molar
2. Sublingual Gland

Musculoskeletal System
3. Ethmoid Sinus (Air Cells)
4. Frontal Bone (Orbital Surface)
5. Mandible (Body)
6. Maxillary Sinus
7. Zygomatic Bone (Orbital Surface)
8. Digastric Muscle
9. Genioglossus Muscle
10. Geniohyoid Muscle
11. Mylohyoid Muscle
12. Tongue Muscle

Nervous System
13. Cerebrum (Frontal Lobe)
14. Eye Globe
15. Retina

Respiratory System
16. Inferior Nasal Concha (Turbinate)
Question: After an automobile accident an unconscious patient displays enophthalmos. CT demonstrates separation of the frontozygomatic, frontomaxillary and nasofrontal sutures. (The pterygoid plates are also fractured but not shown.) What type of skull fracture has this patient likely suffered?
A. Le Fort 1; B. Le Fort 2; C. Le Fort 3
Question: After an automobile accident an unconscious patient displays enophthalmos. CT demonstrates separation of the frontozygomatic, frontomaxillary and nasofrontal sutures (The pterygoid plates are also fractured but not shown.) What type of skull fracture has this patient likely suffered? A. Le Fort 1; B. Le Fort 2; C. Le Fort 3

Answer: C. All Le Fort fractures involve the pterygoid plates. This patient has suffered a Le Fort 3 skull fracture, characterized by separation of the sutures described above. A Le Fort 1 fracture separates the alveolar process of the maxilla (housing the teeth) from the rest of the skull. A Le Fort 2 fracture travels from the nasofrontal suture inferolaterally through the maxilla. Damage to deeper sutures and bones is also more substantial.
Cardiovascular System
1. Common Carotid Artery
2. Internal Jugular Vein

Musculoskeletal System
3. 1st Cervical Vertebra (Transverse Process)
4. 2nd Cervical Vertebra (Odontoid Process)
5. Occipital Bone (Foramen Magnum)
6. Parietal Bone
7. Temporal Bone (Squamous Part)

Nervous System
8. Cerebrum (Temporal Lobe)
9. Cochlea
10. Corpus Collosum
11. Lateral Ventricle (Body)
12. Midbrain
13. Pons
14. Thalamus
15. 3rd Ventricle
Question: An unconscious alcoholic arrives at the emergency department with hyponatremia. This condition is rapidly corrected by infusion of saline. Which area will be gravely affected by this error? A. 1; B. 2; C. 3; D. 4
Question: An unconscious alcoholic arrives to the emergency department with hyponatremia. This condition is rapidly corrected by infusion of saline. Which area will be gravely affected by this error?
A. 1; B. 2; C. 3; D. 4

Answer: A. Central pontine myelinolysis can occur after rapid correction of hyponatremia. The classic risk factors for hyponatremia are alcoholism and malnutrition. It is hypothesized that prolonged hyponatremia followed by rapid correction of sodium results in cellular and myelin damage potentially leading to paralysis.
Digestive System
1.

Musculoskeletal System
2.
3.
4.
5.

Nervous System
6.
7.
8.
9.
10.
11.
12.
13.
14.
15.
Digestive System
1. Esophagus

Musculoskeletal System
2. 5th Cervical Vertebra (Body)
3. Temporal Sinus (Mastoid Air Cells)
4. Scalene Middle and Posterior Muscles
5. Sternocleidomastoid Muscle

Nervous System
6. Cerebellum
7. Cerebrum
8. Corpus Collosum (Splenium)
9. Lateral Ventricle (Body and temporal horn)
10. Medulla Oblongata
11. Midbrain
12. Pineal Body
13. Spinal Cord
14. Thalamus
15. 4th Ventricle
Question: Name the layers and purpose of the meninges.
Question: Name the layers and purpose of the meninges.

Answer: The meninges, from outer to inner, are made up of the dura mater (tough membrane adhered to bone), the arachnoid mater (web-like, attached to the pia mater), and the pia mater (a soft membrane that is adhered to the central nervous system). Between the arachnoid and pial layers is the subarachnoid space. This space is filled with cerebral spinal fluid (CSF). The meninges and CSF act to protect and cushion the central nervous system.
Cardiovascular System
1. Internal Jugular Vein

Digestive System
2. 3rd Molar

Musculoskeletal System
3. Clavicle (Body)
4. Frontal Sinus
5. Maxillary Sinus
6. Parietal Bone
7. Sphenoid Bone (Greater Wing)
8. Lateral Pterygoid Muscle
9. Medial Pterygoid Muscle
10. Platysma Muscle

Nervous System
11. Cochlea
12. Eye Lens
13. Retina
Question: A stroke affecting this part of the brain would likely cause
A. Dyscalculia; B. Aphasia;
C. Paralysis; D. Left Sided Neglect
Question: A stroke affecting this part of the brain would likely cause  
A. Dyscalculia; B. Aphasia;  
C. Paralysis; D. Left Sided Neglect

Answer: D. Damage to the right superior parietal lobe may result in left sided neglect—a condition in which the patient loses awareness of the left side of the world. Damage to the left inferior parietal lobe may lead to dyscalculia and also loss of the ability to integrate sensations. Aphasia is often due to damage to Broca’s (left frontal) and Wernicke’s (left temporal) areas. Contralateral paralysis is often due to damage of the precentral gyrus of the frontal lobe, also known as the motor strip.
Cardiovascular System
1. Common Carotid Artery
2. External Carotid Artery
3. Internal Carotid Artery

Musculoskeletal System
4. 7th Cervical Vertebra (Transverse Process)
5. Sphenoid Bone (Pterygoid Process – Lateral Plate)
6. Parietal Bone
7. Inferior Rectus Muscle
8. Mylohyoid Muscle
9. Semispinalis Capitis Muscle
10. Splenius Capitis Muscle
11. Trapezius Muscle

Nervous System
12. Optic Nerve
13. Retina
Question: During a neurological exam you shine a light in your patient's right eye. Only the left pupil contracts. You then shine the light in the patient's left eye. Again, only the left pupil contracts. Where is the deficit?
A. Right CN2; B. Left CN2; C. Right CN3; D. Left CN3
Question: During a neurological exam you shine a light in your patients right eye. Only the left pupil contracts. You then shine the light in the patients left eye. Again, only the left pupil contracts. Where is the deficit?
A. Right CN2;  B. Left CN2;  
C. Right CN3;  D. Left CN3

Answer: C. This patient has lost parasympathetic (PNS) innervation to the right eye, mediated by the oculomotor nerve (CN3). In the pupillary reflex, the optic nerve (CN2) mediates the afferent signal of light to the pretectal nucleus in the midbrain. An interneuron connects to the Edinger-Westphal Nucleus which provides efferent PNS innervation to both eyes through the oculomotor nerves (CN3) so that both pupils constrict.
Musculoskeletal System
1. Sphenoid Bone (Sella Turcica)

Nervous System
2. Cerebellum
3. Cerebrum (Frontal Lobe)
4. Corpus Colosum (Genu)
5. Falx Cerebri (Dura Mater)
6. Hypothalamus
7. Lateral Ventricular (Anterior Horn)
8. Medulla Oblongata
9. Midbrain
10. Optic Chiasm
11. Pons
12. Spinal Cord
13. Thalamus
14. 4th Ventricle

Respiratory System
15. Laryngopharynx
16. Nasopharynx
17. Oropharynx
18. Trachea
Q: A 12 year old Indian immigrant suffered from chronic middle ear infections resulting in bilateral chorda tympani palsies. Which functions will be lost?
A. Lacrimation; B. Facial Movements; C. Taste and Salivation; D. Blinking
Q: A 12 year old Indian immigrant suffered from chronic middle ear infections resulting in bilateral chorda tympani palsies. Which functions will be lost?
A. Lacrimation; B. Facial Movements; C. Taste and Salivation; D. Blinking

A: C. The chorda tympani, a branch of the facial nerve (CN7), passes through the middle ear. This nerve carries the special sense of taste from the anterior 2/3 of the tongue. It also provides parasympathetic innervation to the submandibular and sublingual glands for salivation after synapsing with the submandibular ganglion. The other functions are mediated by other branches of CN7 and do not pass through the middle ear.
Musculoskeletal System
1. Coronal Suture
2. Frontal Bone
3. Parietal Bone
4. Sagittal Suture
Question: Name the layers of the scalp.
Question: Name the layers of the scalp.

Answer: 

SCALP: Skin, Connective tissue, Galea Aponeurotica, Loose areolar tissue, Pericranium
Cardiovascular System
1. Superior Sagittal Sinus
7. Central Sulcus

Musculoskeletal System
2. Falx Cerebri
8. Precentral Gyrus
3. Frontal Bone
9. Postcentral Gyrus
4. Parietal Bone
5. Temporalis Muscle

Nervous System
6. Cerebral Cortex
(Frontal Lobe)
Question: The gyri anterior and posterior to this sulcus control or mediate what functions or sensations?
Question: The gyri anterior and posterior to this sulcus control or mediate what functions or sensations?

Answer: The star indicates the central sulcus. Anterior to this is the precentral gyrus, the location of the upper motor neurons, also known as the primary motor cortex. These neurons control motor function of the contralateral body. Posterior to the central gyrus is the postcentral gyrus, the primary somatosensory cortex. Neurons of the primary somatosensory cortex receive sensory information from the contralateral side of the body.
The sinuses of the head, including the Frontal, Sphenoid, Maxillary, Ethmoid and Mastoid sinuses, are included in the musculoskeletal lists of this atlas due to their bony walls. They also function as parts of the respiratory system. Sinuses act to filter and warm inspired air, modulate the voice and reduce the weight of the head.
Question: Name the dural sinuses and describe the drainage of blood and cerebral spinal fluid from the brain.
Question: Name the dural sinuses and describe the drainage of blood and cerebral spinal fluid from the brain.

Answer: The indicated dural sinus is the superior sagittal sinus. It meets the straight sinus, occipital sinus, and transverse sinuses at the confluence of sinuses. The transverse sinuses become the sigmoid sinuses which drain into the internal jugular vein.
Cardiovascular System
1.
Musculoskeletal System
2.
3.
4.
Nervous System
5.
6.
Cardiovascular System
1. Lateral Ventricle (Body)

Musculoskeletal System
2. Frontal Bone (Temporal Fossa)
3. Parietal Bone (Temporal Fossa)
4. Temporalis Muscle

Nervous System
5. Cerebral Cortex (Frontal Lobe)
6. Corpus Callosum (Genu)
Question: Which of the following is considered a communicating hydrocephalus, a condition that would result in the enlargement of the indicated structures?
A. Cerebral Aqueduct Obstruction; B. Arnold Chiari Type 2; C. Hydrocephalus Ex Vacuo; D. Obstructions of the Foramina of Luschka and Magendie
Question: Which of the following is considered a communicating hydrocephalus, a condition that would result in the enlargement of the indicated structures?
A. Cerebral Aqueduct Obstruction; B. Arnold Chiari Type 2; C. Hydrocephalus Ex Vacuo; D. Obstructions of the Foramina of Luschka and Magendie

Answer: C. Brain atrophy can result in hydrocephalus ex vacuo, characterized by enlarged ventricles and sulci. The other conditions are due to obstruction and result in non-communicating hydrocephalus. They will also result in enlarged ventricles. The other commonly encountered communicating hydrocephalus is Normal Pressure Hydrocephalus which is thought to be due to decreased absorption of cerebral spinal fluid.
Cardiovascular System
1.

Musculoskeletal System
2.
3.
4.
5.

Nervous System
6.
7.
Cardiovascular System
1. Lateral Ventricle
   (Choroid Plexus)
2. Falx Cerebri
3. Frontal Bone (Crest,
   Posterior Shelf)
4. Occipital Bone
5. Parietal Bone

Musculoskeletal System

Nervous System
6. Cerebral Cortex (Parietal
   Lobe)
7. Corpus Callosum
   (Splenium)
Question: What nerve innervates this muscle?
A. Auriculotemporal Nerve; B. Ophthalmic Nerve (V1); C. Maxillary Nerve (V2); D. Mandibular Nerve (V3)
Question: What nerve innervates this muscle?
A. Auriculotemporal Nerve; B. Ophthalmic Nerve (V1); C. Maxillary Nerve (V2); D. Mandibular Nerve (V3)

Answer: D. The mandibular branch of the trigeminal nerve (cranial nerve V) innervates the temporalis muscle and the other muscles of mastication (masseter, medial pterygoid, lateral pterygoid). This nerve also innervates the mylohyoid, anterior belly of the digastric, tensor velli palatini and the tensor tympani muscles.
Question: In a last resort to treat epilepsy, this entire structure was divided in a procedure known as a corpus callosotomy. After this procedure, a patient will likely not be able to
A. Name an object visualized in the left visual field;  B. Name an object visualized in the right visual field
Question: In a last resort to treat epilepsy, this entire structure was divided in a procedure known as a corpus callosotomy. After this procedure, a patient will likely not be able to
A. Name an object visualized in the left visual field;  B. Name an object visualized in the right visual field

Answer: A. When the corpus callosum is severed, the cerebral hemispheres are unable to communicate. The left visual field is channeled to the right occipital lobe. The voice centers (Broca’s and Wernicke’s areas) are normally found in the left side of the brain. After a corpus callosotomy, these regions are unable to communicate.
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<th>Cardiovascular System</th>
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Musculoskeletal System

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<td>1. Lateral Ventricle</td>
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<td>2. 3rd Ventricle</td>
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<td>4. Frontal Sinus</td>
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<td>7. Temporal Bone (Squamous Part)</td>
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Question: A patient explains that he lost consciousness when he fell from a ladder and hit his head on the pavement. He is now lucid but quickly begins to lose consciousness again. A fracture to this region, known as the pterion, can result in an epidermal hematoma. This condition results from a rupture of which blood vessel?

A. Communicating Vein;  B. Cerebral Artery;  C. Meningeal Artery;  D. Cerebral Capillaries
Question: A patient explains that he lost consciousness when he fell from a ladder and hit his head on the pavement. He is now lucid but quickly begins to lose consciousness again. A fracture to this region, known as the pterion, can result in an epidural hematoma. This condition results from a rupture of which blood vessel?
A. Communicating Vein; B. Cerebral Artery; C. Meningeal Artery; D. Cerebral Capillaries
Answer: C. A rupture of a meningeal artery (usually middle meningeal artery) results in an epidural hematoma, often secondary to a skull fracture. This injury is classically characterized by a lucid period shortly after the injury followed by a rapid loss of consciousness. Communicating vein rupture can cause a subdural hematoma. Cerebral artery rupture causes a subarachnoid hemorrhage (into the cerebrospinal fluid) or intracerebral hemorrhage (within brain tissue). These hemorrhages are often not associated with trauma, but rather cerebral aneurisms or chronic hypertension. Damage to cerebral capillaries causes petechial hemorrhages. In severe trauma, multiple forms of hemorrhage are often encountered.
## Cardiovascular System
1. Lateral Ventricle (Posterior Horn)
2. 3rd Ventricle

## Endocrine System
3. Hypothalamus
4. Pineal Gland

## Musculoskeletal System
5. Ethmoid Bone (Crista Galli)
6. Frontal Bone (Orbital Surface)

## Nervous System
7. Occipital Bone
8. Parietal Bone
9. Squamous Suture
10. Sphenoid Bone (Greater Wing)
11. Temporal Bone (Squamous Part)
12. Cerebral Cortex (Frontal Lobe)
13. Corpus Callosum
14. Thalamus
Question 1: This structure secretes which hormone?
A. Epinephrine; B. Acetylcholine; C. Melanin; D. Melatonin

Question 2: What major arterial vessels cross this region?
Question 1: This structure secretes which hormone?
A. Epinephrine; B. Acetylcholine; C. Melanin; D. Melatonin

Answer: D. The pineal gland releases melatonin which, through communication with the hypothalamus, induces drowsiness as part of the sleep-wake cycle or circadian rhythm.

Question 2: What major arterial vessels cross this region?

Answer: The anterior cerebral arteries. Symptoms of an ACA occlusion may include weakness or paralysis and sensory loss of the contralateral foot and leg, diminished motivation, and altered reflexes.
Question: This muscle is innervated by which cranial nerve?
A. Optic; B. Oculomotor; C. Trochlear; D. Abducens
Question: This muscle is innervated by which cranial nerve?
A. Optic; B. Oculomotor; C. Trochlear; D. Abducens

Answer: C. The trochlear nerve (CN4) innervates the superior oblique muscle. One can remember this relationship as the superior oblique is supported by the pulley-like trochlea. The optic nerve (CN2) conducts the special sense of vision. The oculomotor nerve (CN3) innervates the superior, medial, inferior rectus and inferior oblique muscles. The abducens nerve innervates the lateral oblique and abducts the eye.
Question: A loss of dopaminergic cells from this region of the midbrain results in Parkinson’s Disease. This region is known as the
A. Raphe Nucleus; B. Solitary Nucleus; C. Substantia Nigra; D. Putamen
Question: A loss of dopaminergic cells from this region of the midbrain results in Parkinson's Disease. This region is known as the
A. Raphe Nucleus; B. Solitary Nucleus; C. Substantia Nigra; D. Putamen

Answer: C. The substantia nigra produces the dopamine that is required for proper function of the basal ganglia. When cells of this region are lost, Parkinson's disease ensues. Parkinson's disease is characterized by dementia, asymmetric tremor, bradykinesia, postural instability, and a fenestrating gait. Lewy body inclusions are seen on histopathology.
Question 1: Foramina of this bone provide a passageway for which cranial nerve?
A. Trigeminal Nerve; B. Olfactory Nerve; C. Accessory Nerve; D. Vagus Nerve

Question 2: Name the collateral arterial system and its components that rings this region.
Question 1: Foramina of this bone provide a passageway for which cranial nerve?  
A. Trigeminal Nerve; B. Olfactory Nerve; C. Accessory Nerve; D. Vagus Nerve

Answer: B. Axons of the olfactory nerve pass through the cribriform plate of the ethmoid bone.

Question 2: Name the collateral arterial system that rings this region.

Answer: The circle of Willis is centered in the suprasellar cistern. The basilar artery becomes the posterior cerebral arteries (PCAs). The posterior communicating arteries connect the PCAs to the intracranial internal carotid arteries (ICAs). The distal portions of the ICAs bifurcate into the ACAs and MCAs. Both ACAs connect through the anterior communicating artery. The classic complete circle anatomy is only seen in approximately one third of the population.
Endocrine System
1. Pituitary Stalk (Infundibulum)

Musculoskeletal System
2. Ethmoid Bone (Septum)
3. Frontal Bone
4. Lacrimal Bone
5. Maxilla Bone (Frontal Process)
6. Nasal Bone
7. Occipital Bone (Crest)
8. Parietal Bone
9. Sphenoid Bone (Optic Canal)
10. Sphenoid Bone (Tuberculum Sellae)
11. Temporal Bone (Squamous Part)
12. Zygomatic Bone (Frontal process)
13. Lateral Rectus Muscle
14. Medial Rectus Muscle

Nervous System
15. Cerebellum
16. Cerebral Cortex (Temporal Lobe)
17. Lens
18. Optic Nerve
Question 1: A craniopharyngioma invading into this area would cause what type of visual disturbance?  
A. Bitemporal Hemianopsia;  B. Quadrantopia;  C. Homonymous Hemianopsia;  D. Binasal Hemianopsia

Question 2: Occlusion of the cerebral artery passing through this region would likely cause what signs and symptoms?
Question 1: A craniopharyngioma invading into this area would cause what type of visual disturbance?  
A. Bitemporal Hemianopsia; B. Quadrantopia; C. Homonymous Hemianopsia; D. Binasal Hemianopsia  
Answer: A. Pressure on the center of the optic chiasm from a pituitary gland tumor leads to bitemporal hemianopsia. In this disorder, the patient loses the lateral visual fields.

Question 2: Occlusion of the cerebral artery passing through this region would likely cause what signs and symptoms?  
Answer: The left middle cerebral artery passes through this area. Occlusion of this artery may cause paralysis and sensory loss of the contralateral (right) face and body. Broca’s and/or Wernicke’s aphasias are also common symptoms. MCA occlusion of the non-dominant hemisphere (usually the right side) may also classically result in contralateral (left) sided neglect when the spatial recognition region of the parietal lobe is involved.
Endocrine System
1. Pituitary Gland
2. Ethmoid Sinus (Air Cells)
3. Lacrimal Bone
4. Maxilla Bone (Frontal Process)
5. Nasal Bone
6. Occipital Bone (Crest)
7. Parietal Bone

Musculoskeletal System
8. Sphenoid Bone (Sella Turcica)
9. Sphenoid Sinus
10. Zygomatic Bone (Frontal process)
11. Lateral Rectus Muscle
12. Medial Rectus Muscle

Nervous System
13. Cerebellum
14. Cerebral Cortex (Occipital Lobe)
15. Lens
16. Pons
17. Retina
Question: A 67 year old female with a 20 year history of type two diabetes complains of blurred vision in her right eye. Which enzyme is lacking in this structure that protects against a build up of osmotically active glucose derivatives in other organs such as the liver and seminiferous tubules?
A. Aldose Reductase; B. Sorbitol Dehydrogenase; C. Glucose-6-Phosphatase; D. Aldolase B
Question: A 67 year old female with a 20 year history of type two diabetes complains of blurred vision in her right eye. Which enzyme is lacking in this structure that protects against a build up of osmotically active glucose derivatives in other organs such as the liver and seminiferous tubules? 
A. Aldose Reductase; B. Sorbitol Dehydrogenase; C. Glucose-6-Phosphatase; D. Aldolase B

Answer: B. The lens lacks sufficient sorbitol dehydrogenase to protect against diabetic cataract formation. Aldose reductase converts glucose to sorbitol which builds up in the lens and leads to cataract formation. Sorbitol dehydrogenase in the liver, seminiferous tubules, and other organs converts sorbitol to fructose which can be metabolized.
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<th>Endocrine System</th>
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<tr>
<td>1. Pituitary Gland</td>
<td>8. Sphenoid Bone (Sella Turcica)</td>
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<td>2. Ethmoid Bone (Orbital</td>
<td>9. Zygomatic Bone (Frontal process)</td>
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<td>3. Lacrimal Bone</td>
<td>10. Temporalis Muscle</td>
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<td>4. Maxilla Bone (Frontal</td>
<td>11. Cerebellum</td>
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<td>5. Nasal Bone</td>
<td>12. Cerebral Cortex (Temporal Lobe)</td>
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<td>6. Occipital Bone (Crest)</td>
<td>13. Optic Nerve</td>
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<td>7. Parietal Bone at the</td>
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<td>Pterion</td>
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Question: Which cranial nerves have nuclei in this part of the brain stem?
A. CN1, CN2, CN3, CN4;  B. CN5, CN6, CN7, CN8;  C. CN9, CN10, CN11, CN12;  D. B+C
Question: Which cranial nerves have nuclei in this part of the brain stem?
A. CN1, CN2, CN3, CN4; B. CN5, CN6, CN7, CN8; C. CN9, CN10, CN11, CN12; D. B+C

Answer: B. This section of the brainstem is the pons. Cranial nerve 5 eminates from the pons while cranial nerves 6, 7, and 8 emanate from the pontomedullary sulcus. The nuclei of these cranial nerves are located in the pons. Cranial nerves 3 and 4 exit the midbrain. Cranial nerves 9, 10, 11, and 12 exit the medulla oblongata.
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<th>Cardiovascular System</th>
<th>Respiratory System</th>
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<td>Cardiovascular System</td>
<td>7. Occipital Bone (Crest)</td>
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<td>1. Cerebral Aqueduct</td>
<td>8. Parietal Bone</td>
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<td>2. Internal Carotid Artery</td>
<td>9. Sphenoid Bone (Greater Wing)</td>
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<td>Musculoskeletal System</td>
<td>11. Zygomatic Bone (Orbital Surface)</td>
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<td>4. Ethmoid Bone (Middle Nasal Concha or Turbinate)</td>
<td>12. Inferior Rectus Muscle</td>
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<td>5. Lacrimal Bone</td>
<td><strong>Nervous System</strong></td>
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<td>6. Maxilla Bone (Frontal Process)</td>
<td>13. Cerebellum</td>
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<td>15. Eye Globe</td>
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<td>16. Pons</td>
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<td>17. Middle Nasal Concha</td>
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Question: Name the nerves and blood vessels that pass through this important dural sinus.
Question: Name the nerves and blood vessels that pass through this important dural sinus.

Answer: This is the cavernous sinus, a collection of venous tissue surrounded by dura mater. Passing through the lateral wall of this structure are the oculomotor nerve (CN3), trochlear nerve (CN4), ophthalmic nerve (CNV1), and the maxillary nerve (CNV2). The Abducens nerve (CN6) passes through the center of the cavernous sinus near the internal carotid artery. The Optic Nerve (CN2) passes outside of this sinus. A hemorrhage of the internal carotid artery into the cavernous sinus can cause palsies of the contained nerves. Because of its central location, the abducens nerve may be the first to be affected.
Musculoskeletal System

1. 
2. 
3. 

The dotted white line around the face is a mask. Masks are used to ensure consistent position during radiation therapy treatment.
Musculoskeletal System
1. Ethmoid Sinus (Ethmoid Air Cells)
2. Sphenoid Sinus
3. Temporal Sinus (Mastoid Air Cells)

Note: By altering the contrast to a brighter level we are able to see the thin bones of the Ethmoid Air Cells. Changing the grey scale is an important diagnostic tool. Bone, soft tissue, and lung windows are important variations.

The dotted white line around the face is a mask. Masks are used to ensure consistent position during radiation therapy treatment.
Question: Describe the drainage of the sinuses.
Question: Describe the drainage of the sinuses.

Answer: The sphenoid sinus and posterior ethmoid air cells share a common drainage pathway called the sphenoethmoid recess. The frontal sinuses, maxillary sinuses, and anterior/middle ethmoid air cells share a common drainage site called the ostiomeatal unit.
Question: A lesion above this structure, completely separating it from the rest of the brain, would result in which abnormal posture?  
A. Decorticate; B. Decerebrate; C. Thoracic Kyphosis; D. Lumbar Lordosis
Question: A lesion above this structure, completely separating it from the rest of the brain, would result in which abnormal posture?
A. Decorticate; B. Decerebrate; C. Thoracic Kyphosis; D. Lumbar Lordosis

Answer: B. Decerebrate posture, typified by abnormal arm and leg extension, is due to predominant innervation of the body by the lateral vestibulospinal tract after higher innervation is severed. This occurs when the body is disconnected from the brain above the pons. Decorticate posture, with arms flexed and legs extended, is due to a lesion above the midbrain, leaving the upper limbs predominantly innervated by the rubrospinal tract. Lesions below the pons typically result in death.
Note: By altering the grey scale to increase visibility through bone, we are able to see the Cochlea and other bony structures.
Musculoskeletal System
1. Internal Acoustic Meatus (Contains Cranial Nerves 7 and 8)

Nervous System
2. Cochlea

Note: By altering the grey scale to increase visibility through bone, we are able to see the Cochlea and other bony structures.
Question: Damage to this region would most likely cause:
A. Vertigo; B. Dysdiadochokinesia; C. Aphasia; D. Loss of taste
Question: Damage to this region would most likely cause:
A. Vertigo; B. Dysdiadochokinesia; C. Aphasia; D. Loss of taste

Answer: A. The semicircular canals and utricle and saccule are found near this part of the temporal bone. The semicircular canals sense rotational movement while the utricle and saccule sense linear acceleration and head position. Dysfunction of these perilymph filled organs causes vertigo (dizziness or spinning). Hearing loss or tinnitus may also occur from damage to this area as the membranous labyrinth (cochlear, semicircular canals, utricle and saccule) are all connected and share perilymph.
Question: A 35 year old male patient presents with hearing loss. On Weber test, the patient hears sound louder in the left ear. Rinne test on the right ear is normal (air conduction heard louder than bone conduction). You suspect an injury to which structure?
A. Cranial Nerve 8; B. Middle Ear Ossicles; C. Tympanic Membrane; D. External Auditory Canal
Question: A 35 year old male patient presents with hearing loss. On Weber test, the patient hears sound louder in the left ear. Rinne test on the right ear is normal (air conduction heard louder than bone conduction). You suspect an injury to which structure?
A. Cranial Nerve 8; B. Middle Ear Ossicles; C. Tympanic Membrane; D. External Auditory Canal

Answer: A. This patient has sensorineural hearing loss of the right ear. Damage to the auditory portion of cranial nerve 8, the vestibulocochlear nerve, results in sensorineural hearing loss. Sound waves vibrate the tympanic membrane and are transmitted to the malleus, incus, and stapes bones of the inner ear which transmit the vibration to the oval window. The sound waves are transmitted through the perilymph of the scala vestibuli of the cochlea in the inner ear. Damage to any of these structures results in conductive hearing loss. Movement of the perilymph is sensed by the hair cells of the cochlea. A neural signal is sent to the brain through cranial nerve 8.
Cardiovascular System
1.
Nervous System
2.

Note: By altering the grey scale to increase visibility through bone, we are able to better visualize components of the temporal bone.
Cardiovascular System
1. Internal Carotid Artery
Nervous System
2. Inner Ear

Note: By altering the grey scale to increase visibility through bone, we are able to better visualize components of the temporal bone.
Question: An enhancing nodule is noted in this region. What is the most likely cause?
A. Anterior Cerebral Artery Aneurism; B. Vestibular Schwannoma; C. Cavernous Sinus Thrombosis; D. Von Recklinghausen Syndrome
Question: An enhancing nodule is noted in this region. What is the most likely cause?
A. Anterior Cerebral Artery Aneurism; B. Vestibular Schwannoma; C. Cavernous Sinus Thrombosis; D. Von Recklinghausen Syndrome

Answer: B. Vestibular Schwannomas may occur in the internal acoustic meatus where the vestibulocochlear nerve resides. These are benign tumors that usually arise idiopathically. When bilateral, they are associated with Neurofibromatosis 2 until proven otherwise. These slow growing tumors may cause sensorineuronal hearing loss, vertigo, and tinnitus. The rare facial (CN7) neuroma can present with similar symptoms because of its proximity to the vestibulocochlear nerve within the cranial vault. Von Recklinghausen Syndrome, also known as Neurofibromatosis 1, is characterized by cutaneous neurofibromas, cafe au lait spots, optic gliomas and multiple other lesions.
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<th>Musculoskeletal System</th>
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The diagram shows a cross-sectional view of the head and neck, with labels corresponding to specific structures in the Musculoskeletal, Nervous, and Respiratory Systems.
### Musculoskeletal System

1. Ethmoid Bone (Septum)
2. Inferior Nasal Concha Bone
3. Lacrimal Bone
4. Mandible (Condylar Process)
5. Mandible (Coronoid Process)
6. Maxillary Sinus
7. Occipital Bone (Basilar)
8. Palatine Bone (Perpendicular Plate)
9. Sphenoid Bone (Pterygoid Process)
10. Temporal Bone (Zygomatic Arch)
11. Vomer Bone (Ala)
12. Zygomatic Bone (Zygomatic Arch)
13. Semispinalis Capitis Muscle
14. Splenius Capitis Muscle
15. Sternocleidomastoid Muscle
16. Trapezius Muscle
17. Cerebellum
18. Cerebral Cortex
19. Medulla Oblongata

### Respiratory System

20. Inferior Nasal Concha
21. Nostril

### Nervous System

17. Cerebellum
18. Cerebral Cortex
19. Medulla Oblongata

[Diagram showing the anatomical structures labeled with numbers corresponding to the list above.]
Question: An affluent, 42 year old male complains of persistent ear discomfort. Otoscope examination is normal. You locate an ulcerated oropharyngeal mass. What nerve mediates this ear pain?
A. Auricular Nerve of Arnold (CN10); B. Tympanic Nerve of Jacobson (CN9); C. Facial Nerve; D. Vestibulocochlear Nerve
Question: An affluent, 42 year old male complains of persistent ear discomfort. Otoscope examination is normal. You locate an ulcerated oropharyngeal mass. What nerve mediates this ear pain? 
A. Auricular Nerve of Arnold (CN10); B. Tympanic Nerve of Jacobson (CN9); C. Facial Nerve; D. Vestibulocochlear Nerve

Answer: B. Referred pain to the ear, known as secondary otalgia, is an important clinical finding and can be mediated by cranial nerves 5, 7, 9, 10, and cervical nerves C1 and C2. The tympanic nerve of Jacobson can cause referred pain to the ear from pathology of the pharynx and tongue base. The Auricular Nerve of Arnold (CN10) can cause otalgia from pathology of the pharynx, larynx, and even trachea due to their sensory innervation from the vagus nerve. View http://www.ajnr.org/content/30/10/1817.full for an excellent resource on otalgia. The increasing prevalence of oropharyngeal cancer due to human papilloma virus 16 and 18 underlies this case.

Corollary: Arnold’s reflex is described as cough due to irritation of the ear canal.
Musculoskeletal System
1.
2.
Respiratory System
3.

Note: By altering the grey scale to a brighter level we are able to see the soft tissue within the Maxillary Sinus.
Musculoskeletal System
1. Maxillary Sinus
2. Temporal Sinus
(Mastoid Air Cells)
Respiratory System
3. Nostril

Note: By altering the grey scale to a brighter level we are able to see the soft tissue within the Maxillary Sinus.
Question: An elderly patient with history of chronic, recalcitrant middle ear infections is brought to the ER with fever, headache, and altered mental status. He complains of severe pain behind the left ear. Otoscopic exam demonstrates bloody debris behind the tympanic membrane. What is the most likely underlying cause of this patient's condition?
Question: An elderly patient with history of chronic, recalcitrant middle ear infections is brought to the ER with fever, headache, and altered mental status. He complains of severe pain behind the left ear. Otoscopic exam demonstrates bloody debris behind the tympanic membrane. What is the most likely underlying cause of this patient’s condition?

A. Otosclerosis; B. Otitis Externa; C. Cholesteatoma; D. Exostosis

Answer: C. The most likely underlying cause of this patient’s presentation is cholesteatoma. Cholesteatoma is an inner ear pathology characterized by a mass of destructive, keratinizing squamous epithelium. It is associated with chronic middle ear infections. Cholesteatomas may erode into the mastoid air cells, the inner ear, and even into the meninges or brain. This patient likely suffers from meningitis due to this process. Otosclerosis is scarring of the middle ear ossicles. Otitis externa is inflammation of the external ear canal, often due to pseudomonas bacteria. Exostosis is overgrowth of the external ear canal bone and is associated with chronic cold water immersion.
Cardiovascular System
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Musculoskeletal System
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Nervous System
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Respiratory System
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Question: A 15 year old patient suffers from a trinucleotide repeat disease affecting the part of the brain indicated below. What symptoms do you expect?
A: Chorea; B. Ataxia; C. Liver Failure; D. Renal Failure
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A: Chorea; B. Ataxia; C. Liver Failure; D. Renal Failure

Answer: B. Friedreich’s Ataxia is an autosomal recessive trinucleotide repeat disease that results in severe cerebellar symptoms beginning around ages 5-15. Truncal ataxia, nystagmus, dysarthria, dysmetria, and dysdiadochokinesia are common findings. Huntington’s disease is an autosomal dominant trinucleotide repeat disease characterized by cognitive decline, psychosis, chorea and depression, sometimes leading to suicide.
<table>
<thead>
<tr>
<th>System</th>
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<tbody>
<tr>
<td>Cardiovascular System</td>
<td>1</td>
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<td>Digestive System</td>
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<td>Respiratory System</td>
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<td></td>
<td>20</td>
<td>Medulla Oblongata</td>
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<td></td>
<td>21</td>
<td>Nasopharynx</td>
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</table>
Question: A 54 year old female patient complains that she has trouble eating. She has difficulty at the onset of swallowing, especially in pushing food from the back of her mouth down the “food pipe”. The superior pharyngeal constrictor muscle is innervated by which cranial nerve?  
A. Mandibular (V3); B. Facial; C. Glossopharyngeal; D. Vagus
Question: A 54 year old female patient complains that she has trouble eating. She has difficulty at the onset of swallowing, especially in pushing food from the back of her mouth down the “food pipe”. The superior pharyngeal constrictor muscle is innervated by which cranial nerve?

A. Mandibular (V3); B. Facial; C. Glossopharyngeal; D. Vagus

Answer: D. The vagus nerve (CN10) innervates most of the pharyngeal and laryngeal muscles. This nerve has many other motor, sensory, and autonomic responsibilities. The mandibular branch of the trigeminal nerve (CN5) innervates the muscles of mastication as well as the mylohyoid, tensor tympani, and tensor veli palatini muscles. The glossopharyngeal nerve (CN9) innervates the stylopharyngeus muscles, transmits parasympathetic innervation to the parotid gland, conveys taste from the posterior 1/3 of the tongue, and mediates visceral sensory information from the carotid bodies and sinuses.
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<tr>
<th>Digestive System</th>
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<td>3. Inferior Nasal Concha Bone</td>
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<td>13. Longissimus Capitis Muscle</td>
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**Image Description:** The image shows a cross-sectional view of the human head, labeling various anatomical structures. The table outlines the corresponding labels and structures in each system.
Question: A patient is diagnosed with carcinomatous meningitis and suffers from multiple cranial nerve palsies. In a rare manifestation, the dural lining around the foramen ovale is inflamed. Which function do you expect to be deficient?
A. Swallowing; B. Lacrimation; C. Salivation; D. Mastication
Question: A patient is diagnosed with carcinomatous meningitis and suffers from multiple cranial nerve palsy. In a rare manifestation, the dural lining around the foramen ovale is inflamed. Which function do you expect to be deficient?
A. Swallowing; B. Lacrimation; C. Salivation; D. Mastication

Answer: D. The mandibular nerve (V3) passes through the foramen ovale and innervates the muscles of mastication. The following is a list of key foramina and their contents: cribriform plate (CN1 bundles); optic canal (ophthalmic artery, CN2); superior orbital fissure (superior ophthalmic vein, CN3, CN4, branches of V1, CN6); foramen rotundum (V2); foramen ovale (accessory meningeal artery, V3, occasionally the lesser petrosal nerve); foramen spinosum (middle meningeal artery, meningeal branch V3); foramen lacerum (internal carotid artery, nerve of pterygoid canal); internal acoustic meatus (labyrinthine artery, CN7, CN8); jugular foramen (sigmoid sinus, CN9, CN10, CN11); hypoglossal canal (CN12); foramen magnum (anterior and posterior spinal arteries, vertebral arteries, medulla oblongata); stylomastoid foramen (CN7).
**Cardiovascular System**
1. Facial Vein
2. Internal Carotid Artery

**Digestive System**
3. Upper Second Molar (Root)

**Musculoskeletal System**
4. 1st Cervical Vertebra (Atlas)
5. 2nd Cervical Vertebra (Odontoid Process)
6. Mandible (Ramus)
7. Maxilla Bone (Anterior Nasal Spine)
8. Maxilla Bone (Palatine Process)
9. Occipital Bone (Condyle)
10. Occipital Bone (Foramen Magnum)
11. Palatine Bone (Horizontal Plate)
12. Sphenoid Bone (Pterygoid Process)
13. Temporal Bone (Styloid Process)
14. Zygomatic Bone
15. Lateral Pterygoid Muscle
16. Longus Capitis Muscle
17. Masseter Muscle
18. Medial Pterygoid Muscle
19. Rectus Capitis Posterior Major Muscle
20. Temporalis Muscle

**Nervous System**
21. Cerebellum (Tonsil)
22. Medulla Oblongata
Question: A 24 year old man presents one week after an automobile accident with neck pain and instability. You suspect a fracture of the structure indicated below. The purpose of this structure is to?
A. Support the head;  B. Provide a lever for head tilting;  C. Provide an axis for head rotation;  D. Protect the spinal cord
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A. Support the head;  B. Provide a lever for head tilting;  C. Provide an axis for head rotation;  D. Protect the spinal cord

Answer: C. The purpose of the odontoid process, also known as the dens, is to provide an axis for head rotation. It is part of the second cervical vertebra (axis) and it articulates with the anterior arch of the first cervical vertebra (atlas). It is fixed into this position by the transverse atlantal ligament. The condition known as Os Odontoideum occurs when this structure is fractured. Os Odontoideum is controversial as the true cause may be congenital.
<table>
<thead>
<tr>
<th>Digestive System</th>
<th>Musculoskeletal System</th>
<th>Nervous System</th>
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<td>2. Soft Palate</td>
<td>Capitis Muscle</td>
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<tr>
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<td>3. 1st Cervical Vertebra or Atlas</td>
<td>21. Trapezius Muscle</td>
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<td>4. 2nd Cervical Vertebra (Odontoid Process)</td>
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<td>8. Occipital Bone (Foramen Magnum)</td>
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<td>21. Trapezius Muscle</td>
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<td>22. Medulla Oblongata</td>
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<td>23. Spinal Cord</td>
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</tbody>
</table>
Question: Parasympathetic innervation to this gland is mediated by which cranial nerve?
A. Oculomotor; B. Facial; C. Glossopharyngeal; D. Vagus
Question: Parasympathetic innervation to this gland is mediated by which cranial nerve?  
A. Oculomotor; B. Facial; C. Glossopharyngeal; D. Vagus

Answer: C. The glossopharyngeal nerve mediates parasympathetic innervation to the parotid gland through the otic ganglion. The oculomotor nerve and ciliary ganglion provide parasympathetic innervation to the ciliary body for accommodation and to the iris for pupillary constriction. The facial nerve, along with the submandibular ganglion, innervates the submandibular and sublingual salivary glands. The facial nerve, through the pterygopalatine ganglion, innervates the lacrimal glands and nasal mucosa. The vagus nerve provides parasympathetic innervation to the thoracic viscera and abdominal viscera ending at the transverse colon. Sacral parasympathetic nerves innervate the remainder of the gastrointestinal tract.
Question: A 79 year old woman presents with a dark, blistered, itchy rash covering the skin of this portion of the face. The rash spreads laterally but does not pass midline. The area was itchy before a vesicular rash erupted which eventually crusted. The virus causing this rash has traveled through which nerve?
A. Facial Nerve; B. Mandibular Nerve; C. Maxillary Nerve; D. Ophthalmic Nerve
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A. Facial Nerve; B. Mandibular Nerve; C. Maxillary Nerve; D. Ophthalmic Nerve

Answer: C. The rash described is the classic presentation of shingles in the CNV2 (Maxillary) dermatome. The Varicella zoster virus causes chickenpox. This virus can become latent in dorsal root ganglia, including the trigeminal ganglion. The virus can reactivate and spread through sensory nerves, causing a painful rash that is restricted to the specific dermatome of that nerve.
<table>
<thead>
<tr>
<th><strong>Cardiovascular System</strong></th>
<th><strong>Musculoskeletal System</strong></th>
<th><strong>Respiratory System</strong></th>
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<tbody>
<tr>
<td><strong>Musculoskeletal System</strong></td>
<td>9. Sphenoid Bone</td>
<td>14. Tongue Dorsum</td>
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<tr>
<td>4. 1st Cervical Vertebra (Inferior Articular Process)</td>
<td>10. Inferior Obliquus Capitis Muscle</td>
<td><strong>Respiratory System</strong></td>
</tr>
<tr>
<td>5. 1st Cervical Vertebra (Transverse Foramen)</td>
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<td>15. Nasopharynx</td>
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</table>
Question: When asked to protrude the tongue, a patient’s tongue deviates to the right. Which cranial nerve is likely injured?
A. Left Hypoglossal; B. Right Hypoglossal; C. Left Glossopharyngeal; D. Right Glossopharyngeal
Question: When asked to protrude the tongue, a patient’s tongue deviates to the right. Which cranial nerve is likely injured?
A. Left Hypoglossal; B. Right Hypoglossal; C. Left Glossopharyngeal; D. Right Glossopharyngeal

Answer: B. This patient suffers from right hypoglossal nerve palsy. The hypoglossal nerve innervates all intrinsic and extrinsic muscles of the tongue except for the palatoglossus muscles (CN10). The genioglossus muscle acts to protrude the tongue towards the contralateral side. With right hypoglossal nerve palsy only the left hypoglossal nerve functions to deviate the tongue to the right.
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<thead>
<tr>
<th>Digestive System</th>
<th>Musculoskeletal System</th>
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<td>2. Teeth (See Note)</td>
<td>7. Nuchal Ligament</td>
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<td>8. Digestive Muscle</td>
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<td>9. Inferior Obliquis</td>
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<td>Capitis Muscle</td>
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<td>3. 1st Cervical Vertebra (Transverse Process)</td>
<td>10. Levator Scapulae</td>
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<td>4. 2nd Cervical Vertebra (Body)</td>
<td>11. Longissimus Capitis</td>
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<td>5. 2nd Cervical Vertebra (Superior Articular Facet)</td>
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<td>18. Trapezius Muscle</td>
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The Soft Palate appears distorted, likely due to a swallow or other movement during the scanning process.
Question: A patient suffers from left sided Bell’s Palsy. You ask this patient to maintain position of the cheek muscles and blow through the mouth. What do you expect to see?
A. The right cheek puffs out; B. The left cheek puffs out; C. Both cheeks are sucked in; D. The left cheek is sucked in
Question: A patient suffers from left sided Bell's Palsy. You ask this patient to maintain position of the cheek muscles and blow through the mouth. What do you expect to see?
A. The right cheek puffs out; B. The left cheek puffs out; C. Both cheeks are sucked in; D. The left cheek is sucked in

Answer: B. Bell’s Palsy is paralysis of the facial muscles due to damage or dysfunction of the facial nerve (CN7). This results in the inability to contract the cheek (buccal) muscles so that the cheek “puffs out” when air is blown through the mouth. This patient would also experience difficulty with other left side facial movements. The forehead receives bilateral upper motor neuron (UMN) innervation. Therefore, an UMN lesion results in paralysis of the contralateral lower face, but not the forehead. A lower motor neuron lesion, or damage to the facial nerve, results in total ipsilateral paralysis.
Cardiovascular System
1. Facial Vein
2. Internal Carotid Artery
3. Internal Jugular Vein
4. Vertebral Artery
Digestive System
5. Parotid Gland
6. Soft Palate
7. Uvula

Musculoskeletal System
8. 2nd Cervical Vertebra (Lamina)
9. Mandible (Ramus)
10. Genioglossus Muscle
11. Longus Capitis Muscle
12. Longus Colli Muscle
13. Masseter Muscle
14. Medial Pterygoid Muscle
15. Platysma Muscle
16. Tongue Dorsum

Respiratory System
17. Nasopharynx
18. Oropharynx
Question: During a neurological head and neck exam, you touch the starred side of the soft palate with a probe and the patient coughs symmetrically. You touch the opposite side and there is no response. Which cranial nerve is dysfunctional?
A. Right Vagus; B. Left Vagus; C. Right Glossopharyngeal; D. Left Glossopharyngeal
Question: During a neurological head and neck exam, you touch the starred side of the soft palate with a probe and the patient coughs symmetrically. You touch the opposite side and there is no response. Which cranial nerve is dysfunctional?
A. Right Vagus; B. Left Vagus; C. Right Glossopharyngeal; D. Left Glossopharyngeal

Answer: C. The pharyngeal reflex has an afferent (sensory) component (glossopharyngeal, CN9) and efferent (motor) component (Vagus, CN10). Touch to the left side of the soft palate elicited a normal, symmetrical response. Therefore, the left CN9 and both CN10s are functional. Touch to the right soft palate elicited no response, however. Therefore, the right CN9 is deficient and is unable to elicit a response from the intact CN10s.
Question: Name the muscles and contents of the suboccipital triangle.
Question: Name the muscles and contents of the suboccipital triangle.

Answer: The suboccipital triangle is bounded by the rectus capitis posterior major, the obliquus capitis superior, and the obliquus capitis inferior. The contents of the suboccipital triangle include the posterior ramus of the C1 vertebra, the vertebral artery, and the suboccipital nerve (dorsal ramus of C1) a unique peripheral nerve which conveys only motor innervation. The greater occipital nerve (dorsal ramus of C2) ascends from under the obliquus capitis inferior and passes up along the suboccipital triangle before it pierces the semispinalis capitis muscle. This nerve provides motor innervation and sensory innervation to the upper neck and posterior scalp.
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<th>Musculoskeletal System</th>
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</table>
Cardiovascular System
1. External Carotid Artery
2. External Jugular Vein
3. Facial Vein
4. Internal Carotid Artery
5. Internal Jugular Vein
6. Vertebral Artery

Digestive System
7. Teeth (See Note)

Lymphatic System
8. Lingual Tonsil
9. Palatine Tonsil

Musculoskeletal System
10. 2nd Cervical Vertebra (Body)
11. 2nd Cervical Vertebra (Spinous Process)
12. 3rd Cervical Vertebra (Superior Articular Process)

Nervous System
13. Mandible (Ramus)
14. Genioglossus Muscle
15. Hyoglossus Muscle
16. Masseter Muscle
17. Medial Pterygoid Muscle
18. Mylohyoid Muscle
19. Tongue Dorsum
20. Spinal Cord

Note: Moving clockwise, starting with the selected tooth: Bottom Teeth: Central Incisor, Lateral Incisor, Canine, First Premolar, Second Premolar, First Molar, Second Molar, Third Molar (Roots).
Question: A patient with poor dental hygiene complains of severe tooth pain. An infection has spread to a nerve that innervates the lower teeth. What is the name of this nerve?
A. Lingual Nerve; B. Mandibular Nerve; C. Maxillary Nerve; D. Inferior Alveolar Nerve
Question: A patient with poor dental hygiene complains of severe tooth pain. An infection has spread to a nerve that innervates the lower teeth. What is the name of this nerve?
A. Lingual Nerve; B. Mandibular Nerve; C. Maxillary Nerve; D. Inferior Alveolar Nerve

Answer: D. The inferior alveolar nerve, a branch of the mandibular nerve (V3), innervates the teeth. This nerve enters the mandibular foramen and passes through the mandibular canal as it forms the inferior dental plexus. The inferior alveolar nerve becomes the mental nerve when it passes through the mental foramen and provides sensory innervation to the chin and lower lip. The inferior alveolar nerve is commonly anesthetized by injection of lidocaine at the mandibular foramen. The needle is placed at an angle into the open mouth with injection of anesthetic under the mucosa covering the medial aspect of the mandibular ramus. This maneuver will anesthetize the ipsilateral lower teeth.
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<tbody>
<tr>
<td></td>
<td>2. External Carotid Artery</td>
<td>8. 3rd Cervical Vertebra (Body)</td>
<td>17. Transversospinalis Muscles</td>
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<td>5. Submandibular Gland</td>
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<td>15. Splenius Capitis Muscle</td>
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Note: The Transversospinalis Muscles Include the Semispinalis Capitis, Cervicis, and Thoracis Muscles, the Multifidus Muscles, and the Rotatores Cervicis, and Thoracis Muscles.

The Laryngopharynx is also considered part of the Digestive System.
Question: The action of this muscle, working alone, is to
A. Tilt the head forwards; B. Tilt the head backwards; C. Rotate the head to face the ipsilateral side; D. Rotate the head to face the contralateral side
Question: The action of this muscle, working alone, is to
A. Tilt the head forwards; B. Tilt the head backwards; C. Rotate the head to face the ipsilateral side; D. Rotate the head to face the contralateral side

Answer: D. The sternocleidomastoid muscle, innervated by the spinal accessory nerve (CN11), acts alone to turn the head to face the contralateral side. Working together, both sternocleidomastoids act to tilt the head forward.
Digestive System
1. Canine Tooth Root (Lamina)
2. Epiglottis
3. Sublingual Gland
4. Submandibular Gland
Lymphatic System
5. Lingual Tonsil
Musculoskeletal System
6. 3rd Cervical Vertebra (Body)

Respiratory System
7. 3rd Cervical Vertebra
8. Hyoid Bone
9. Mandible (Body)
10. Digastric Muscle
11. Genioglossus Muscle
12. Hyoglossus Muscle
13. Longus Capitis Muscle
14. Longus Colli Muscle
15. Mylohyoid Muscle
16. Platysma Muscle
17. Laryngopharynx
18. Vallaca
Question: A 55 year old patient with a 35 pack year smoking history is recovering from a laryngectomy in which this structure was removed. The most important function of the indicated structure is to
A. Aid breathing; B. Protect the airway during swallowing; C. Aid speech; D. Mediate taste
Question: A 55 year old patient with a 35 pack year smoking history is recovering from a laryngectomy in which this structure was removed. The most important function of the indicated structure is to

A. Aid breathing; B. Protect the airway during swallowing; C. Aid speech; D. Mediate taste

Answer: B. The indicated structure is the epiglottis. During swallowing, the epiglottis folds posteriorly and inferiorly over the glottis so that food or liquid does not pass between the vocal folds and into the trachea. While the epiglottis does have taste buds, taste is not its most important function. Note that after a laryngectomy, the entrance to the upper airway is closed off surgically, and the patient breathes through a permanent tracheostomy.
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<tr>
<th>Cardiovascular System</th>
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<td>Musculoskeletal System</td>
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<th>Nervous System</th>
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<td>Musculoskeletal System</td>
<td>Cardiovascular System</td>
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<tr>
<td>2. External Jugular Vein</td>
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<td>3. Facial Vein</td>
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<td>5. Vertebral Artery</td>
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<tr>
<td>7. 3rd Cervical Vertebra (Body)</td>
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</table>
Question: A patient recovering from recent carotid artery surgery has difficulty drawing down this bone, an action that occurs when depressing the tongue during a deep breath. You suspect damage to which nerve?
A. Recurrent Laryngeal; B. Ansa Cervicalis; C. C1 Ramus; D. Hypoglossal
Question: A patient recovering from recent carotid artery surgery has difficulty drawing down this bone, an action that occurs when depressing the tongue during a deep breath. You suspect damage to which nerve?
A. Recurrent Laryngeal; B. Ansa Cervicalis; C. C1 Ramus; D. Hypoglossal

Answer: B. The hyoid bone is indicated below. Three of the four infrahyoid muscles are innervated by the ansa cervicalis—a looping portion of the cervical plexus that exists embedded in the carotid sheath. The ansa cervicalis is made up of a superior root (C1 and C2) anteriorly and an inferior root (C2 and C3) posteriorly. It innervates the infrahyoid, sternohyoid, and sternothyroid muscles which draw the hyoid bone inferiorly. The thyrohyoid muscle, which draws together the thyroid cartilage and the hyoid bone, is innervated by C1 which travels with the hyoglossal nerve.
Question: Misalignment of the teeth or jaw can lead to which common condition?
A: Temporomandibular Joint Disorder (TMJD); B. Chondromalacia; C. Spondylosis; D. Sjogren’s Syndrome
Question: Misalignment of the teeth or jaw can lead to which common condition?
A: Temporomandibular Joint Disorder (TMJD);  B: Chondromalacia;  C: Spondylosis;  D: Sjogren’s Syndrome

Answer: A. TMJD is common in the general population. Symptoms often include pain (often headache), clicking, popping and locking of the jaw. Chondromalacia is due to poor articulation of the patella of the knee and painful damage to its underlying cartilage. Spondylosis is osteoarthritis of the spine, usually of the facet joints. Sjogren’s Syndrome is an autoimmune disease affecting the lacrimal and salivary glands. View slide 18 for an image of the temporomandibular joint.
Question: After eating a bony fish, a patient presents to the emergency department complaining of a choking sensation. One must beware of which nerve when removing an object from this area: A. Recurrent Laryngeal; B. Pterygopalatine; C. Anterior Palatine; D. Internal Laryngeal
Question: After eating a bony fish, a patient presents to the emergency department complaining of a choking sensation. One must beware of which nerve when removing an object from this area: A. Recurrent Laryngeal; B. Pterygopalatine; C. Anterior Palatine; D. Internal Laryngeal

Answer: D. The internal laryngeal nerve passes beneath the thin mucosa of the piriform fossa. The nerve conveys afferent (sensory) information from this area. It can be damaged when removing an object from this space. Therefore, testing of sensation of this space should be assessed if possible before manipulation of the area (this is an important concept to remember when any nerve is put at danger by a procedure). The recurrent laryngeal nerves, branches of the vagus nerves (CN10), innervate the musculature of the larynx. Damage to one of these nerves causes hoarseness. Damage to both nerves is an emergency due to the inability to open the airway, the action of the posterior cricoarytenoid muscles.
<table>
<thead>
<tr>
<th>Digestive System</th>
<th>Musculoskeletal System</th>
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<tbody>
<tr>
<td>1. Esophagus</td>
<td>2. 4th Cervical Vertebra (Body)</td>
</tr>
<tr>
<td>3. 5th Cervical Vertebra (Transverse Process)</td>
<td>4. Corniculate Cartilage</td>
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<tr>
<td>5. Nuchal Ligament</td>
<td>6. Thyroid Cartilage</td>
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<tr>
<td>7. Mandible (Mental Protuberance)</td>
<td>8. Levator Scapulae Muscle</td>
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<td>9. Longissimus Capitis Muscle</td>
<td>10. Semispinalis Capitis Muscle</td>
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<td></td>
<td>15. Trapezius Muscle</td>
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<td></td>
<td>16. Laryngopharynx</td>
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</table>
Question: A week after a thyroidectomy, a patient complains of hoarseness. The patient is able to swallow normally. Laryngoscopy demonstrates left vocal fold is paralyzed. Which nerve has been damaged?
A. Right Recurrent nerve; B. Left Recurrent Nerve; C. Right Vagus Nerve; D. Left Vagus Nerve
Question: A week after a thyroidectomy, a patient complains of hoarseness. The patient is able to swallow normally. Laryngoscopy demonstrates left vocal fold is paralyzed. Which nerve has been damaged?
A. Right Recurrent nerve; B. Left Recurrent Nerve; C. Right Vagus Nerve; D. Left Vagus Nerve

Answer: B. The left recurrent nerve is a branch of the vagus nerve, well known for its “recurrent” looping path under the aortic arch and behind the thyroid gland. This nerve provides sensory and motor innervation to many of the structures within the larynx. Damage to one of these nerves causes horiness. Damage to the left vagus nerve could also cause the same symptom, but this is much less likely to occur during a thyroidectomy. Damage to both nerves is an emergency due to the inability to open the airway, the action of the posterior cricoarytenoid muscles.
## Endocrine System
1. Thyroid Gland

## Musculoskeletal System
2. Arytenoid Cartilage
3. 4th Cervical Vertebra (Body)
4. 5th Cervical Vertebra (Lamina)
5. Corniculate Cartilage
6. Thyroid Cartilage

## 7. Mandible (Mental Protuberance)
8. Longus Capitis Muscle
9. Longus Colli Muscle
10. Omohyoid Muscle
11. Sternohyoid Muscle
12. Sternothyroid Muscle
13. Thyrohyoid Muscle

## Respiratory System
14. Laryngopharynx
Q: Name the contents of the carotid sheath.
Q: Name the contents of the carotid sheath.

A: The contents of the carotid sheath are the Common Carotid Artery, Internal Jugular Vein and Vagus Nerve (CN10). The Ansa Cervicalis is embedded in the anterior portion of the sheath.
Cardiovascular System
1.
2.
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Digestive System
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Endocrine System
6.

Musculoskeletal System
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10.
<table>
<thead>
<tr>
<th>Cardiovascular System</th>
<th>Musculoskeletal System</th>
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<tbody>
<tr>
<td>2. External Jugular Vein</td>
<td>8. 5th Cervical Vertebra (Body)</td>
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<tr>
<td>3. Internal Jugular Vein</td>
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<td>4. Vertebral Artery</td>
<td>9. Scalene Anterior Muscle</td>
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<tr>
<td>Digestive System</td>
<td>10. Scalene Middle and Posterior Muscles</td>
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<td>5. Esophagus</td>
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<tr>
<td>Endocrine System</td>
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<td>6. Thyroid Gland</td>
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Question: What is the first intracranial branch of this artery?
A. Basilar Artery; B. Posterior Inferior Cerebellar Artery (PICA); C. Anterior Inferior Cerebellar Artery (AICA); D. Superior Cerebellar Artery (SCA)
Question: What is the first intracranial branch of this artery?
A. Basilar Artery; B. Posterior Inferior Cerebellar Artery (PICA); C. Anterior Inferior Cerebellar Artery (AICA); D. Superior Cerebellar Artery (SCA)

Answer: B. The vertebral arteries pass up through the vertebral foraminae bilaterally. They enter the cranium through the foramen magnum and pass anteriorly along the inferior brainstem. The posterior inferior cerebellar arteries (PICAs) branch off the vertebral arteries to perfuse the inferior cerebellum. The vertebral arteries then join together to form the basilar artery which passes up along the medulla oblongata and pons. The basilar artery emits the anterior inferior cerebellar arteries, the pontine arteries, the superior cerebellar arteries, and then bifurcates to become the posterior cerebral arteries.
**Musculoskeletal System**

1. Arytenoid Cartilage
2. 5th Cervical Vertebra (Body)
3. 6th Cervical Vertebra (Superior Articular Process)
4. Cricoid Cartilage
5. Nuchal Ligament
6. Thyroid Cartilage (Laryngeal Prominence)
7. Levator Scapulae Muscle
8. Longissimus Capitis Muscle
9. Semispinalis Capitis Muscle
10. Splenius Capitis Muscle
11. Splenius Cervicis Muscle
12. Sternocleidomastoid Muscle
13. Transversospinalis Muscles
14. Trapezius Muscle
15. Laryngopharynx

**Respiratory System**

- **R**
- **L**
Question: A 25 year old woman suffers a stab wound to the indicated area. She is unable to elevate (shrug) her right shoulder against resistance. Which nerve innervates the muscle responsible for this motion?
A. C3; B. C5; C. Spinal Accessory Nerve; D. Axillary Nerve
Question: A 25 year old woman suffers a stab wound to the indicated area. She is unable to elevate (shrug) her right shoulder against resistance. Which nerve innervates the muscle responsible for this motion?
A. C3; B. C5; C. Spinal Accessory Nerve; D. Axillary Nerve

Answer: C. Elevation, or shrugging, of the shoulder is accomplished by the trapezius muscle. This muscle is innervated by the spinal accessory nerve (CN11). This nerve originates in the upper spinal cord. It enters the skull through the foramen magnum and exits the skull through the jugular foramen. The nerve descends posteriorly, innervates the sternocleidomastoid muscle (SCM), and continues between the SCM and the trapezius muscle (indicated area) on its path to innervation of the trapezius muscle. The upper cervical nerves innervate other muscles of the neck. The axillary nerve innervates the deltoid and teres minor muscles.
<table>
<thead>
<tr>
<th>System</th>
<th>Structure</th>
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<tbody>
<tr>
<td><strong>Cardiovascular System</strong></td>
<td>1. Anterior Jugular Vein</td>
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<td>2. Thyroid Gland</td>
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<td><strong>Endocrine System</strong></td>
<td>3. 6th Cervical Vertebra</td>
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<td>(Transverse Foramen)</td>
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<td><strong>Musculoskeletal System</strong></td>
<td>4. Cricoid Cartilage</td>
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<td>5. Thyroid Cartilage (Inferior Horn)</td>
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<td><strong>Nervous System</strong></td>
<td>6. Longus Colli Muscle</td>
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<td>7. Omohyoid Muscle</td>
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<td>8. Sternohyoid Muscle</td>
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<td>9. Sternothyroid Muscle</td>
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<td>10. Thyrohyoid Muscle</td>
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<td>11. Spinal Cord</td>
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Question: An infection occurs between the alar fascia and the deep cervical fascia. Name this space and explain where the infection may spread.
Question: An infection occurs between the alar fascia and the deep cervical fascia. Name this space and explain where the infection may spread.

Answer: The Danger Space is bound superiorly by the skull base, anteriorly by the alar fascia, and posteriorly by the prevertebral fascia, and inferiorly by the diaphragm. There is no median raphe so that infection can spread from side to side. Infection can spread down into the thorax and up to the base of the skull. Other important head and neck fasciae include the superficial cervical fascia (fat, platysma), the superficial layer of the deep cervical fascia (contains strap muscles, sternocleidomastoids, trapezius), the middle layer of deep cervical fascia or visceral fascia (contains thyroid, trachea, esophagus), and the deep layer of the deep cervical fascia (surrounds vertebrae and their muscles). The deep layer of the deep cervical fascia splits into pre-vertebral and alar fascias at the C2 vertebra. Although the deep layer of the deep cervical fascia splits at the C2 level, aggressive infections are still able to invade up to the skull base.
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<th>Cardiovascular System</th>
<th>Musculoskeletal System</th>
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<tr>
<td>2. Common Carotid Artery (Body)</td>
<td>9. 6th Cervical Vertebra (Spinous Process)</td>
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<td>3. External Jugular Vein</td>
<td>10. 7th Cervical Vertebra (Transverse Process)</td>
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<td>5. Vertebral Artery</td>
<td>12. Rhomboid Muscle</td>
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<td>Digestive System</td>
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<td>6. Esophagus</td>
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<td>Endocrine System</td>
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<td>7. Thyroid Gland</td>
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![Schematic diagram of the neck region](image_url)
Question: A high school wrestler complains of weakness and tingling in his left arm. There is no history of acute injury. You notice a thick neck and suspect:
A. Constriction of the brachial plexus; B. Infection; C. Factitious Behavior; D. Arthritis
Question: A high school wrestler complains of weakness and tingling in his left arm. There is no history of acute injury. You notice a thick neck and suspect:
A. Constriction of the brachial plexus; B. Infection; C. Factitious Behavior; D. Arthritis

Answer: A. This patient suffers from thoracic outlet syndrome in which the brachial neurovascular bundle is constricted by structures within the neck. Here, hypertrophy of the scalene muscles is the cause as the brachial plexus passes between the anterior and middle scalenes. The brachial plexus is made up of roots (exit from C5-T1), trunks, divisions, and cords. An excellent tool to learn the basic structure of the branchial plexus can be found here:
Musculoskeletal System
1. 6th Cervical Vertebra (Body)
2. 7th Cervical Vertebra (Lamina)
3. Cricoid Cartilage
4. Nuchal Ligament
5. Levator Scapulae Muscle
6. Longissimus Capitis Muscle
7. Rhomboid Muscle
8. Semispinalis Capitis Muscle
9. Splenius Capitis Muscle
10. Splenius Cervicis Muscle
11. Sternocleidomastoid Muscle
12. Transversospinalis Muscles
13. Trapezius Muscle
14. Laryngopharynx

Respiratory System
Question: As you enjoy dinner at a local steak house, a man begins to choke. The Heimlich maneuver fails as the man loses consciousness. You decide to perform a cricoidotomy to open the airway. Why did you decide to perform a cricoidotomy rather than a tracheostomy?
Question: As you enjoy dinner at a local steak house, a man begins to choke. The Heimlich maneuver fails as the man loses consciousness. You decide to perform a cricoidotomy to open the airway. Why did you decide to perform a cricoidotomy rather than a tracheostomy?

Answer: Cricoidotomies normally are performed during emergencies "in the field" such as this. A hole is punctured between the thyroid and cricoid cartilages through the cricothyroid membrane and a tube is placed to maintain a patent opening. These cartilagenous landmarks are easy to identify. This method also avoids structures such as the thyroid gland, vocal cords, and associated neurovasculature.
Question: At this C7 level, damage of the spinal cord from a fracture may result in which of the following symptoms to the upper extremities?
A. Total upper extremity paralysis; B. Partial upper extremity paralysis; C. No effect to the upper extremities
Question: At this C7 level, damage of the spinal cord from a fracture may result in which of the following symptoms to the upper extremities?
A. Total upper extremity paralysis;  B. Partial upper extremity paralysis;  C. No effect to the upper extremities

Answer: B. This is the seventh cervical vertebra, also known as vertebra prominens due to its large vertebral spine. Innervation to the upper limbs is mediated by the brachial plexus. The roots of the brachial plexus originate from vertebral levels C5-T1. With significant damage to the spinal cord at level C7, nerves C7, C8, and T1 of the brachial plexus will lose function. This will affect the musculocutaneous (C5-7), median (C5-T1), radial (C5-T1), and ulnar nerves (C7-T1). Muscles innervated by the former three nerves will become weak. Muscles of the ulnar nerve will be paralyzed. The axillary nerve (C5-6) will be spared.
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<th>Cardiovascular System</th>
<th>Musculoskeletal System</th>
<th>Respiratory System</th>
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<td>Digestive System</td>
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<td>Endocrine System</td>
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<td>Respiratory System</td>
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<tr>
<td>1. Anterior Jugular Vein</td>
<td>8. 7th Cervical Vertebra (Body)</td>
<td>15. Platysma Muscle</td>
</tr>
<tr>
<td>3. External Jugular Vein</td>
<td>10. 1st Thoracic Vertebra (Superior Articular Facet)</td>
<td>17. Scalene Middle and Posterior Muscles</td>
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<tr>
<td><strong>Digestive System</strong></td>
<td><strong>Endocrine System</strong></td>
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Question: A 64 year old alcoholic suffers from cirrhosis. She is jaundiced and has obvious ascites. She presents to the ER vomiting bright red blood. A diagnostic/therapeutic endoscopy is performed for suspected:
A. Boerhaave’s Syndrome; B. Barrett’s Esophagus; C. Esophageal Carcinoma; D. Ruptured Dilated Esophageal Varices
Question: A 64 year old alcoholic suffers from cirrhosis. She is jaundiced and has obvious ascites. She presents to the ER vomiting bright red blood. A diagnostic/therapeutic endoscopy is performed for suspected:
A. Boerhaave's Syndrome; B. Barrett's Esophagus; C. Esophageal Carcinoma; D. Ruptured Dilated Esophageal Varices

Answer: D. This patient suffers from severe alcohol cirrhosis of the liver. She likely suffers from portal hypertension which forces blood to flow through important anastomoses in order to return to the heart. Some of the major affected areas and their associated clinical conditions are the following: esophagus (esophageal varices), rectum (rectal varices or hemorrhoids), paraumbilical (caput medusae).
<table>
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<tr>
<th>Cardiovascular System</th>
<th>Musculoskeletal System</th>
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<tbody>
<tr>
<td>1. Transverse Cervical Vein</td>
<td>8. 1st Thoracic Vertebra (Lamina)</td>
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<tr>
<td>(Body)</td>
<td>9. Supraspinatus Muscle</td>
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<tr>
<td>2. 7th Cervical Vertebra</td>
<td>10. Levator Scapulae Muscle</td>
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<tr>
<td>(Body)</td>
<td>11. Longissimus Capitis Muscle</td>
</tr>
<tr>
<td>3. Clavical (Shaft Body)</td>
<td>12. Rhomboid Muscle</td>
</tr>
<tr>
<td>4. Humerus (Head)</td>
<td>13. Semispinalis Capitis Muscle</td>
</tr>
<tr>
<td>5. 1st Rib</td>
<td>14. Splenius Capitis Muscle</td>
</tr>
<tr>
<td>6. Scapula (Acromion)</td>
<td>15. Splenius Cervicis Muscle</td>
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<tr>
<td>7. Supraspinous Ligament</td>
<td>16. Sternocleidomastoid Muscle</td>
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<td>17. Surratus Anterior Muscle</td>
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<td></td>
<td>18. Transversospinalis Muscles</td>
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<td></td>
<td>19. Trapezius Muscle</td>
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</table>
Question: A 24 year old man complains of rapid heartbeat and heart palpitations. You suspect disease of which structure indicated below?
A. 1; B. 2; C. 3; D. 4
Question: A 24 year old man complains of rapid heartbeat and heart palpitations. You suspect disease of which structure indicated below?
A. 1; B. 2; C. 3; D. 4

Answer: A. This patient likely suffers from hyperthyroidism, a disease in which excessive thyroid hormone is released. The thyroid gland produces triiodothyronine (T3, more active) and thyroxine (T4, less active). These hormones increase the body’s metabolism and can exacerbate the effects of the sympathetic nervous system (tachycardia and palpitations). Calcitonin is also released from the thyroid gland and acts to decrease blood calcium and phosphate levels. There are normally four parathyroid glands found on the posterior surface of the thyroid gland. These release parathyroid hormone which increases blood calcium levels and decreases blood phosphate levels. The decrease in phosphate serves to increase the free calcium level even more, as phosphate binds to calcium in the blood.
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<th>Cardiovascular System</th>
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<tbody>
<tr>
<td>2. Common Carotid Artery</td>
<td>10. 2nd Rib</td>
<td>17. Omohyoid Muscle</td>
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<tr>
<td>7. Vertebral Artery</td>
<td>14. 1st Thoracic Vertebra</td>
<td>Respiratory System</td>
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<tr>
<td><strong>Musculoskeletal System</strong></td>
<td>(Spinous Process)</td>
<td>22. Left Lung Upper Lobe</td>
<td></td>
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<tr>
<td>8. Clavicle (Shaft Body)</td>
<td>15. 2nd Thoracic Vertebra</td>
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</tbody>
</table>
Question: A patient presents with left sided ptosis (dropping eyelid), anhidrosis (lack of sweat), and miosis (constricted pupil). Apraclonidine test is positive for left sided Horner's Syndrome. After waiting some time, you administer hydroxyamphetamine to the left eye. If the Horner's syndrome is caused by a Pancoast tumor in the location indicated below, what findings do you expect to see?
A. Pupil Dilation; B. Pupil Constriction; C. No Pupillary Change; D. Tear Formation
Question: A patient presents with left sided ptosis (dropping eyelid), anhidrosis (lack of sweat), and miosis (constricted pupil). Apraclonidine test is positive for left sided Horner's Syndrome. After waiting some time, you administer hydroxyamphetamine to the left eye. If the Horner's syndrome is caused by a Pancoast tumor in the location indicated below, what findings do you expect to see?
A. Pupil Dilation; B. Pupil Constriction; C. No Pupillary Change; D. Tear Formation

Answer: A. Apraclonidine confirmed the diagnosis of Horner's Syndrome. The next step is to locate the disruption along the path of the sympathetic innervation to the head and neck. Hydroxyamphetamine excites the sympathetics and causes mydriasis (pupil dilation) when the 3rd order neuron (superior cervical ganglion and above) is intact, as it is here. The lesion here is due to a Pancoast tumor which disrupts the second order neuron of the sympathetic chain. The first order neurons are found in the hypothalamospinal tract.
Question: Surgeons and radiation oncologists must beware of the indicated area so as to avoid:
A. Horner’s Syndrome; B. Bell’s Palsy; C. Upper Limb Paralysis; D. Pneumothorax
Question: Surgeons and radiation oncologists must beware of the indicated area so as to avoid:
A. Horner’s Syndrome;  B. Bell’s Palsy;  C. Upper Limb Paralysis;  D. Pneumothorax

Answer: C. The brachial neurovascular bundle passes through this area and includes the brachial plexus and subclavian artery and vein. The specific structures are difficult to delineate by CT scan. The brachial plexus is sensitive to radiation and can be damaged by improper radiation therapy planning. Damage to these nerves will result in loss of motor control and sensation of the upper limb. Damage to the brachial artery may cause arm ischemia while damage to the vein may cause swelling and edema.
### Cardiovascular System
1. Anterior Jugular Vein
2. Brachiocephalic Trunk
3. Brachiocephalic Vein
4. Common Carotid Artery
5. Internal Jugular Vein
6. Subclavian Artery
7. Subclavian Vein
8. Transverse Cervical Vein
9. Vertebral Artery

### Musculoskeletal System
10. Clavicle (Shaft Body)
11. Humerus (Head)
12. 2nd Rib
13. Scapula (Glenoid Cavity)
14. Supraspinous Ligament
15. 1st Thoracic Vertebra (Body)
16. 2nd Thoracic Vertebra (Body)
17. Levator Scapulae Muscle
18. Longissimus Capitis Muscle
19. Pectoralis Major Muscle
20. Pectoralis Minor Muscle
21. Rhomboid Muscle
22. Splenius Capitis Muscle
23. Splenius Cervicis Muscle
24. Transversospinalis Muscles
25. Trapezius Muscle
Question: Which nerve innervates the indicated muscle?
A. Accessory Nerve (CN11); B. Suprascapular Nerve; C. Upper Subscapular Nerve; D. Lower subscapular Nerve
Question: Which nerve innervates the indicated muscle?
A. Accessory Nerve (CN11); B. Suprascapular Nerve; C. Upper Subscapular Nerve; D. Lower subscapular Nerve

Answer: B. The muscle indicated is the supraspinatus muscle which is innervated by the suprascapular nerve from the superior trunk of the brachial plexus. The muscle works to abduct the arm from 0-15 degrees. The supraspinatus is one of four muscles that make up the rotator cuff. Other members of the rotator cuff (and their associated nerves) are the subscapularis (upper and lower subscapular nerves), infraspinatus (suprascapular nerve), and teres minor (axillary nerve) muscles.
<table>
<thead>
<tr>
<th><strong>Cardiovascular System</strong></th>
<th><strong>Musculoskeletal System</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Brachiocephalic Vein</td>
<td>Muscle and Biceps</td>
</tr>
<tr>
<td>3. Internal Jugular Vein</td>
<td>Bachii Short Head</td>
</tr>
<tr>
<td>4. Subclavian Artery (Right)</td>
<td>Muscle Tendons at</td>
</tr>
<tr>
<td>5. Subclavian Vein</td>
<td>Corocoid Process Origin</td>
</tr>
<tr>
<td><strong>6. Clavicle (Sternal End)</strong></td>
<td>15. Longus Colli Muscle</td>
</tr>
<tr>
<td>7. Humerus (Head)</td>
<td>16. Sternohyoid Muscle</td>
</tr>
<tr>
<td>8. 3rd Rib</td>
<td>17. Sternothyroid Muscle</td>
</tr>
<tr>
<td>10. 2nd Thoracic Vertebra (Body)</td>
<td></td>
</tr>
<tr>
<td>11. 2nd Thoracic Vertebra (Spinous Process)</td>
<td></td>
</tr>
<tr>
<td>12. 3rd Thoracic Vertebra (Superior Articular Process)</td>
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</tr>
<tr>
<td>13. 3rd Thoracic Vertebra (Transverse Process)</td>
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</tbody>
</table>
Question: Motor innervation to the indicated structure is mediated by which nerve(s)?
A. Esophageal Nerve; B. Glossopharyngeal Nerves (CN9); C. Recurrent Laryngeal Nerves; D. Vagus Nerves (CN10)
Question: Motor innervation to the indicated structure is mediated by which nerve(s)?
A. Esophageal Nerve; B. Glossopharyngeal Nerves (CN9); C. Recurrent Laryngeal Nerves; D. Vagus Nerves (CN10)

Answer: D. Peristalsis, the rhythmic contraction of smooth muscle in the gastrointestinal tract, is mediated by the enteric nervous system. Auerbach's, or the myenteric, plexus innervates the muscularis propria. Meissner's, or the submucosal, plexus controls secretions. These functions are controlled by many inputs. However, in the esophagus, the vagus nerve is mostly responsible for initiating peristalsis and swallowing. The top 1/3 of the esophagus is made up of striated muscle and is involved in voluntary swallowing, while the bottom 1/3 is made up of smooth muscle and is where involuntary peristalsis occurs alone. The middle 1/3 of the esophagus is a combination of smooth and striated muscle.
<table>
<thead>
<tr>
<th>Digestive System</th>
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<tbody>
<tr>
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<td>Musculoskeletal System</td>
<td>11.</td>
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<tr>
<td>Nervous System</td>
<td>Nervous System</td>
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<td>18.</td>
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<td>19.</td>
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</table>

Note: The radiopaque object penetrating the left Pectoralis Major Muscle and entering the left Brachiocephalic Vein is a Central IV line. These are often used to deliver medications or nutrition into the bloodstream.
Note: The radiopaque object penetrating the left Pectoralis Major Muscle and entering the left Brachiocephalic Vein is a Central IV line. These are often used to deliver medications or nutrition into the bloodstream.
Question: An intravenous port catheter, seen here, is placed into which blood vessel?
A. Brachiocephalic Vein; B. Superior Vena Cava; C. Inferior Vena Cava; D. Transverse Cervical Vein
Question: An intravenous port catheter, seen here, is placed into which blood vessel?
A. Brachiocephalic Vein; B. Superior Vena Cava; C. Inferior Vena Cava; D. Transverse Cervical Vein

Answer: A. This portal catheter, often referred to as a port-a-cath, has been inserted into the left internal jugular vein and passed into the left brachiocephalic vein. Ideally, the tip is placed in the distal superior vena cava or right atrium. Ports are often used to deliver total parenteral nutrition or chemotherapy. Important complications are infection, thrombosis, and pneumothorax. A radiograph (X-Ray) should always be ordered after insertion of foreign bodies such as port-a-caths, chest tubes, or endotracheal tubes.
<table>
<thead>
<tr>
<th>Cardiovascular System</th>
<th>Musculoskeletal System</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Aortic Arch</td>
<td>8. Clavicle (Sternal End)</td>
</tr>
<tr>
<td>2. Brachiocephalic Trunk</td>
<td>9. Costal Cartilage</td>
</tr>
<tr>
<td>(Left)</td>
<td>12. 3rd Rib</td>
</tr>
<tr>
<td>5. Subclavian Artery (Left)</td>
<td>13. Scapula (Medial Border)</td>
</tr>
<tr>
<td>7. Vertebral Artery (Left)</td>
<td>15. Supraspinous Ligament</td>
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<td></td>
<td></td>
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<tr>
<td>16. 2nd Thoracic Vertebra</td>
<td>17. 3rd Thoracic Vertebra</td>
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<tr>
<td>(Body)</td>
<td>(Body)</td>
</tr>
<tr>
<td>18. Levator Scapulae Muscle</td>
<td>19. Longissimus Capitis</td>
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<tr>
<td>22. Rhomboid Muscle</td>
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<td>23. Splenius Capitis Muscle</td>
<td></td>
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<tr>
<td>24. Splenius Cervicis Muscle</td>
<td></td>
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<tr>
<td>25. Transversospinalis Muscles</td>
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<tr>
<td>26. Trapezius Muscle</td>
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</tbody>
</table>
Question: What is the name of this vessel?
A. Brachiocephalic Artery; B. Right Common Carotid; C. Left Common Carotid; D. Thoracic Duct
Question: What is the name of this vessel?
A. Brachiocephalic Artery;  B. Right Common Carotid;  C. Left Common Carotid;  D. Thoracic Duct

Answer: A. The brachiocephalic artery lies within the superior mediastinum. The superior mediastinum is an anatomically compact area containing the trachea, esophagus, thoracic duct, thymus, aortic arch, the brachiocephalic, left common carotid and left subclavian arteries, brachiocephalic veins, superior vena cava, vagus nerves, cardiac plexi, phrenic nerves, and the recurrent laryngeal nerves.
Question: Dissecting ascending aortic aneurism is a serious risk for all but which of these conditions?
A. Marfan Syndrome; B. Ehlers-Danlos Type 4 Syndrome; C. Sjogren’s Syndrome; D. Syphilis Infection; E. Hypertension
Question: Dissecting ascending aortic aneurism is a serious risk for all but which of these conditions?
A. Marfan Syndrome; B. Ehlers-Danlos Type 4 Syndrome; C. Sjogren's Syndrome; D. Syphilis Infection; E. Hypertension

Answer: C. Sjogren's syndrome is an autoimmune disease, not known to be associated with aortic aneurism. Marfan Syndrome is an autosomal dominant disorder of fibrillin-1, an important component of elastin found in large arteries and heart valves. The Ehlers Danlos Syndromes are a group of genetic disorders that affect collagen type 1 or 3, major components of blood vessels, skin, and tendons. Patients often have highly stretchable skin and hypermobile joints. The tertiary stage of syphilis is associated with an aortitis that weakens and scars the aortic wall leading to aortic aneurysm. It has become rare in the developed world after the advent of penicillin after World War II. Over time, hypertension (HTN) can lead to atherosclerosis and the weakening of arteries. HTN and hyperlipidemia are also significant risk factors for abdominal aortic aneurisms.
Cardiovascular System
1. 
2. 
Lymphatic System
3.
Cardiovascular System
1. Basilar Artery
2. Internal Carotid Artery

Lymphatic System
3. Anterior Auricular
Cardiovascular System
1.
2.

Lymphatic System
3.
4.
5.
Cardiovascular System
1. Basilar Artery
2. Internal Carotid Artery

Lymphatic System
3. Anterior Auricular
4. Facial
5. Retropharyngeal
Cardiovascular System
1.
2.
3.

Lymphatic System
4.
5.
6.
7.
8.
Cardiovascular System
1. Facial Vein
2. Internal Carotid Artery
3. Vertebral Artery

Lymphatic System
4. Anterior Auricular
5. Deep Facial
6. Occipital
7. Parotid
8. Retropharyngeal
Cardiovascular System
1.
2.
3.

Lymphatic System
4.
5.
6.
7.
8.
Cardiovascular System
1. Facial Vein
2. Internal Carotid Artery
3. Vertebral Artery
Lymphatic System
4. Deep Facial
5. Facial
6. Occipital
7. Posterior Auricular
8. Retropharyngeal
Cardiovascular System
1.
2.
3.

Lymphatic System
4.
5.
6.
Cardiovascular System
1. Facial Vein
2. Internal Carotid Artery
3. Vertebral Artery

Lymphatic System
4. Deep Facial
5. Facial
6. Retropharyngeal
Cardiovascular System
1.
2.
3.
Lymphatic System
4.
Cardiovascular System
1. Facial Vein
2. Internal Carotid Artery
3. Vertebral Artery
Lymphatic System
4. Retropharyngeal
Cardiovascular System
1. Facial Vein
2. Internal Carotid Artery
3. Vertebral Artery

Lymphatic System
4. Deep Facial
5. Retropharyngeal
6. Retropharyngeal (Individual Nodes)
Question: A 58 year old male 20 pack year smoker is referred to an otolaryngologist due to nasal obstruction. On nasopharyngoscopy, the indicated area displays lymphadenopathy. Lymphatics from which areas drain to this area?
A. Brain; B. Nasal Cavity, Nasopharynx, Eustacian (Auditory) Tubes; C. Oropharynx; D. Scalp, Pinna of Ear
Question: A 58 year old male 20 pack year smoker is referred to an otolaryngologist due to nasal obstruction. On nasopharyngoscopy, the indicated area displays lymphadenopathy. Lymphatics from which areas drain to this area?
A. Brain; B. Nasal Cavity, Nasopharynx, Eustacian (Auditory) Tubes; C. Oropharynx; D. Scalp, Pinna of Ear

Answer: B. The nasal cavities, nasopharynx, and auditory tubes drain to the retropharyngeal lymph nodes.
<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>Lymphatic System</td>
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<td>2</td>
<td>Cardiovascular System</td>
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<td>9</td>
<td>5</td>
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</tbody>
</table>
Cardiovascular System
1. Facial Vein
2. Internal Carotid Artery
3. Vertebral Artery
Lymphatic System
4. Deep Facial
5. Facial
6. Head & Neck Level 2B
7. Parotid
8. Posterior Auricular
9. Retropharyngeal
Cardiovascular System
1.
2.
3.

Lymphatic System
4.
5.
6.
7.
Cardiovascular System
1. Facial Vein
2. Internal Carotid Artery
3. Vertebral Artery

Lymphatic System
4. Deep Cervical
5. Head & Neck Level 2A
6. Head & Neck Level 2B
7. Retropharyngeal
Cardiovascular System
1. Facial Vein
2. Internal Carotid Artery
3. Internal Jugular Vein
4. Vertebral Artery

Lymphatic System
5. Deep Cervical
6. Head & Neck Level 2A
7. Head & Neck Level 2B
8. Retropharyngeal
Cardiovascular System
1. Facial Vein
2. Internal Carotid Artery
3. Internal Jugular Vein
4. Vertebral Artery

Lymphatic System
5. Deep Cervical
6. Facial
7. Head & Neck Level 2A
8. Head & Neck Level 2B
9. Retropharyngeal
10. Subparotid
<table>
<thead>
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<th>Cardiovascular System</th>
<th>Lymphatic System</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. External Carotid Artery</td>
<td>9. Head &amp; Neck Level 1B</td>
</tr>
<tr>
<td>2. External Jugular Vein</td>
<td>10. Head &amp; Neck Level 2A</td>
</tr>
<tr>
<td>3. Facial Vein</td>
<td>11. Head &amp; Neck Level 2B</td>
</tr>
<tr>
<td>5. Internal Jugular Vein</td>
<td>13. Retropharyngeal</td>
</tr>
<tr>
<td>6. Vertebral Artery</td>
<td>14. Subparotid</td>
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<tr>
<td>7. Deep Cervical</td>
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<tr>
<td>8. Facial</td>
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</tbody>
</table>
Question: Name the branches of the external carotid artery.
Question: Name the branches of the external carotid artery.

Answer: The branches of the external carotid arteries mostly perfuse the muscles, skin, and glands of the head and neck. Branches of the external carotid artery, from inferior to superior, include the superior thyroid artery, ascending pharyngeal artery, lingual artery, facial artery, occipital artery, posterior auricular artery, maxillary artery, and superficial temporal artery. The internal carotid artery mostly supplies oxygenated blood to the brain as it ascends up through the foramen lacerum, enters the cavernous sinus, and bifurcates into the middle and anterior cerebellar arteries. Two branches of the internal carotid artery exit the skull to perfuse the forehead. These are the superior trochlear and superior orbital arteries.
<table>
<thead>
<tr>
<th>Cardiovascular System</th>
<th>Lymphatic System</th>
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</thead>
<tbody>
<tr>
<td>2. External Carotid Artery</td>
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<tr>
<td>4. Facial Vein</td>
<td>10. Head &amp; Neck Level 1B</td>
</tr>
<tr>
<td>5. Internal Carotid Artery</td>
<td>11. Head &amp; Neck Level 2A</td>
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<td></td>
<td>14. Lingual</td>
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<td>15. Retropharyngeal</td>
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<td>16. Superficial Cervical</td>
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</table>
Question: A 34 year old tobacco chewer is referred to you with a diagnosis of oropharyngeal cancer found at the base of the tongue. The cancer has metastasized. Where do you expect to find lymphadenopathy?
A. Level 2a;  B. Level 1b;  C. Level 2b;  D. Retropharyngeal Space
Question: A 34 year old tobacco chewer is referred to you with a diagnosis of oropharyngeal cancer found at the base of the tongue. The cancer has metastasized. Where do you expect to find lymphadenopathy?
A. Level 2a; B. Level 1b; C. Level 2b; D. Retropharyngeal Space

Answer: B. This area corresponds to head and neck lymph node level 1B. Lymphatic drainage of the lips, base of the tongue, and facial skin drain to this area. A corresponds to level 2A. C corresponds to level 2B. D corresponds to the Retropharyngeal Space or Lymph Nodes. http://www.ajronline.org/cgi/content/full/174/3/837 is an excellent resource to understand better lymphatic drainage patterns of the head and neck.
<table>
<thead>
<tr>
<th>Cardiovascular System</th>
<th></th>
<th>9. Head &amp; Neck Level 2B</th>
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<tbody>
<tr>
<td>2. External Jugular Vein</td>
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<td>11. Submandibular</td>
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<tr>
<td>3. Facial Vein</td>
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<td>12. Superficial Cervical</td>
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<tr>
<td>4. Internal Jugular Vein</td>
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<td>5. Vertebral Artery</td>
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<tr>
<td>Lymphatic System</td>
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<tr>
<td>6. Deep Cervical</td>
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<tr>
<td>7. Head &amp; Neck Level 1B</td>
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<tr>
<td>8. Head &amp; Neck Level 2A</td>
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</table>
Question: A 79 year old alcoholic and 20 pack year smoker complains of stuffy nose and chronic ear pain. On head and neck exam you palpate an enlarged lymph node in the region indicated below. Lymphatic from which areas drain here?
A. Lip, Oral Cavity, Facial Skin; B. Scalp, Pinna of Ear, Thyroid, Nasopharynx; C. Thyroid and Infraclavicular Region; D. Oropharynx, Larynx, and Hypopharynx
Question: A 79 year old alcoholic and 20 pack year smoker complains of stuffy nose and chronic ear pain. On head and neck exam you palpate an enlarged lymph node in the region indicated below. Lymphatics from which areas drain here?
A. Lip, Oral Cavity, Facial Skin; B. Scalp, Pinna of Ear, Thyroid, Nasopharynx; C. Thyroid and Infraclavicular Region; D. Oropharynx, Larynx, and Hypopharynx

Answer: D. The oropharynx, larynx, and hypopharynx drain to lymph node level 2, indicated here. Level 2 (2A+2B) is bound superiorly by the skull base, anteriorly by the posterior margin of the submandibular gland, posteriorly by the posterior margin of the sternocleidomastoid, and inferiorly by the bifurcation of the common carotid artery. Answer A drains to lymph node level 1. B drains to level 5. C drains to levels 4 and 6. D drains to both levels 2 and 3. http://www.ajronline.org/cgi/content/full/174/3/837 is an excellent resource for head and neck lymph node regions. The purpose of this question is to remind you to perform detailed head & neck exams when suspicious adenopathy is present.
Cardiovascular System
1. Common Carotid Artery
2. External Jugular Vein
3. Internal Jugular Vein
4. Vertebral Artery

Lymphatic System
5. Deep Cervical
6. Head & Neck Level 1B
7. Head & Neck Level 3
8. Head & Neck Level 5
Cardiovascular System
1. Common Carotid Artery
2. External Jugular Vein
3. Internal Jugular Vein
4. Vertebral Artery

Lymphatic System
5. Deep Cervical
6. Head & Neck Level 1A
7. Head & Neck Level 1B
8. Head & Neck Level 3

9. Head & Neck Level 5
10. Submental
Question: A 64 year old tobacco chewer arrives to your office for a routine checkup. On head and neck exam you palpate enlarged lymph nodes in the area indicated below. You must be certain to examine which other areas?
A. Scalp, Pinna of Ear;  B. Thyroid;  C. Infraclavicular Region;  D. Lips, Oral Cavity, Skin of Face
Question: A 64 year old tobacco chewer arrives to your office for a routine checkup. On head and neck exam you palpate enlarged lymph nodes in the area indicated below. You must be certain to examine which other areas?
A. Scalp, Pinna of Ear; B. Thyroid; C. Infraclavicular Region; D. Lips, Oral Cavity, Skin of Face

Answer: D. Region 1 (1A+1B) of the head and neck lymph nodes is bounded by the hyoid bone inferiorly, the mandible superolaterally, and the posterior edge of the submandibular gland posteriorly. Lymphatics of the lips, oral cavity, and local skin drain to this region. Thorough examination of the head and neck, especially of the oral cavity and pharynx, is important in the tobacco chewing population.
Cardiovascular System
1. Common Carotid Artery
2. External Jugular Vein
3. Internal Jugular Vein
4. Vertebral Artery

Lymphatic System
5. Deep Cervical
6. Head & Neck Level 1A
7. Head & Neck Level 1B
8. Head & Neck Level 3
9. Head & Neck Level 5
10. Submental
Question: A 60 year old southern Chinese immigrant presents to the ER complaining of a sore throat. On head and neck exam, you palpate an enlarged lymph node in the region indicated below. Lymphatics from which regions drain to this area?
A. Scalp, Pinna of Ear, Thyroid, Nasopharynx; B. Lips, Oral Cavity, Skin of face; C. Brain; D. Larynx, Hypopharynx
Question: A 60 year old southern Chinese immigrant presents to the ER complaining of a sore throat. On head and neck exam, you palpate an enlarged lymph node in the region indicated below. Lymphatics from which regions drain to this area?
A. Scalp, Pinna of Ear, Thyroid, Nasopharynx; B. Lips, Oral Cavity, Skin of face; C. Brain; D. Larynx, Hypopharynx

Answer: A. Lymphatic drainage from the scalp, pinna of ear, thyroid, and nasopharynx drain to lymph region 5 (5A+5B). This region is bound by the skull base superiorly, anteriorly by the posterior border of the sternocleidomastoid, posteriorly by the lateral surface of the trapezius, and inferiorly by the clavicle. Nasopharyngeal carcinoma is most common in Southern Chinese adults and in children of certain African regions.
Cardiovascular System
1. Common Carotid Artery
2. External Jugular Vein
3. Internal Jugular Vein
4. Vertebral Artery

Lymphatic System
5. Deep Cervical
6. Head & Neck Level 3
7. Head & Neck Level 5
Cardiovascular System
1. Common Carotid Artery
2. External Jugular Vein
3. Internal Jugular Vein
4. Vertebral Artery

Lymphatic System
5. Deep Cervical
6. Head & Neck Level 3
7. Head & Neck Level 5
Cardiovascular System
1. Anterior Jugular Vein
2. Common Carotid Artery
3. External Jugular Vein
4. Internal Jugular Vein
5. Vertebral Artery

Lymphatic System
6. Deep Cervical
7. Head & Neck Level 3
8. Head & Neck Level 5
Cardiovascular System
1. Anterior Jugular Vein
2. Common Carotid Artery
3. External Jugular Vein
4. Internal Jugular Vein
5. Vertebral Artery

Lymphatic System
6. Anterior Superficial Cervical
7. Deep Cervical
8. Head & Neck Level 3
9. Head & Neck Level 5
10. Head & Neck Level 6
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**Lymphatic System**

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Cardiovascular System
1. Anterior Jugular Vein
2. Common Carotid Artery
3. External Jugular Vein
4. Internal Jugular Vein
5. Vertebral Artery

Lymphatic System
6. Deep Cervical
7. Head & Neck Level 4
8. Head & Neck Level 5
9. Head & Neck Level 6
Question: A 55 year old female with 20 pack year smoking history presents with cough, neck swelling, and dyspnea. You palpate a large lymph node in the region indicated below. What lymphatic regions drain to this area?

A. Thyroid, Infraclavicular Cancers, Metastisized Upper Aerodigestive Cancers;  B. Oropharynx, Larynx, Hypopharynx;  C. Oral Cavity;  D. Nasopharynx
Question: A 55 year old female with 20 pack year smoking history presents with cough, neck swelling, and dyspnea. You palpate a large lymph node in the region indicated below. What lymphatic regions drain to this area?
A. Thyroid, Infraclavicular Cancers, Metastisized Upper Aerodigestive Cancers; B. Oropharynx, Larynx, Hypopharynx; C. Oral Cavity; D. Nasopharynx

Answer: A. Lymphatics from the thyroid, infraclavicular region, and the upper aerodigestive regions drain to lymph node level 4, indicated here. Level 4 is bounded superiority by the cricoid cartilage and remains adjacent to the sternocleidomastoid. Neck swelling in a smoker is alarming and may indicate superior vena cava syndrome. In this condition a direct obstruction (tumor, lymphadenopathy) causes back up of blood, usually at the superior vena cava, in the upper extremities, face, and neck.
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<th>Cardiovascular System</th>
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<td>11. Head &amp; Neck Level 6</td>
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Question: A 72 year old female patient presents to your office worried by an enlarged mass in the indicated area (mass not shown here). She does not suffer from any infections. The mass is fixed and does not move when she protrudes her tongue. On further examination you determine that the mass is an enlarged lymph node. You suspect:
A. Nasopharyngeal Cancer; B. Oropharyngeal Cancer; C. Thyroid Cancer; D. Thyroglossal Duct Cyst
Question: A 72 year old female patient presents to your office worried by an enlarged mass in the indicated area (mass not shown here). She does not suffer from any infections. The mass is fixed and does not move when she protrudes her tongue. On further examination you determine that the mass is an enlarged lymph node. You suspect:
A. Nasopharyngeal Cancer; B. Oropharyngeal Cancer; C. Thyroid Cancer; D. Thyroglossal Duct Cyst

Answer: C. The Delphian Node, located in lymph node level 6 at or just below the thyroid gland, is a classic indicator of thyroid cancer. Infracavicular cancers also drain to level 6. The Delphian Node’s name originates from the Temple of Apollo at Delphi where the phrase “know thyself” is inscribed. When this node is enlarged, one knows thyself, that he or she may have thyroid cancer. A thyroglossal duct cyst occurs with cystic enlargement of a congenital thyroglossal duct remnant. These cysts are benign and elevate when the patient protrudes the tongue due to the connection with the embryonic foramen cecum.
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<td>11. Head &amp; Neck Level 6 (Visceral Lymph Node Region)</td>
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Cardiovascular System
1. Anterior Jugular Vein
2. Brachiocephalic Trunk
3. Brachiocephalic Vein
4. Common Carotid Artery
5. Internal Jugular Vein
6. Subclavian Artery
7. Subclavian Vein
8. Transverse Cervical Vein
9. Vertebral Artery

Lymphatic System
10. Deep Cervical
11. Head & Neck Level 6
Question: A 67 year old male alcoholic with a 50 pack year smoking history presents to your office with dysphagia and a 20 pound weight loss over the last two months. Endoscopy reveals a friable mass in the upper-middle esophagus. Biopsy demonstrates squamous cell carcinoma. This lesion is most likely to spread to which lymph node region first? A. Supraclavicular; B. Head & Neck Level 5; C. Head & Neck Level 4; D. Head & Neck Level 6
Question: A 67 year old male alcoholic with a 50 pack year smoking history presents to your office with dysphagia and a 20 pound weight loss over the last two months. Endoscopy reveals a friable mass in the upper-middle esophagus. Biopsy demonstrates squamous cell carcinoma. This lesion is most likely to spread to which lymph node region first? A. Supraclavicular; B. Head & Neck Level 5; C. Head & Neck Level 4; D. Head & Neck Level 6

Answer: D. The most likely initial site of lymphatic spread of upper to middle esophageal cancer is to the visceral lymph nodes, or Head & Neck Level 6. This region is bounded by the carotid arteries laterally, the hyoid bone superiorly, and the manubrium inferiorly. Head & Neck Level 7, or the superior mediastinal lymph node region, is also a zone of esophageal cancer spread. Hard, fixed supraclavicular lymph nodes, often from aerodigestive malignancies, are a grave sign and are indications for further work up. http://www.ajronline.org/doi/pdf/10.2214/ajr.174.3.1740837 is an excellent resource to understand better the lymphatic drainage of the head and neck.
Cardiovascular System
1. Anterior Jugular Vein
2. Brachiocephalic Trunk
3. Brachiocephalic Vein
4. Common Carotid Artery
5. Internal Jugular Vein
6. Subclavian Artery
7. Subclavian Vein
8. Vertebral Artery

Lymphatic System
9. Head & Neck Level 6
Cardiovascular System
1.
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Lymphatic System
7.
Cardiovascular System
1. Brachiocephalic Trunk
2. Brachiocephalic Vein
3. Common Carotid Artery
4. Subclavian Artery
5. Subclavian Vein
6. Vertebral Artery

Lymphatic System
7. Head & Neck Level 6
Question: The Circle of Willis and cerebral arteries are shown below via CT angiogram. A patient who neglects the left side would likely have had an embolic event at which location? A; B; C; D; E
Question: The Circle of Willis and cerebral arteries are shown below via CT angiogram. A patient who neglects the left side would likely have had an embolic event at which location? A; B; C; D; E

Answer: B. Right middle cerebral artery occlusion may result in left sided neglect and apraxia (difficulty following commands). Ischemia of the left frontal lobe results in hemiplegia while ischemia of the parietal lobe results in sensory loss (face>arm>leg). Dysprosody, the inability to convey emotion in speech, may also occur. Left visual field anopsia is also possible. A: Anterior cerebral artery occlusion can result in contralateral hemiplegia (leg>arm>face), personality changes, and/or re-emergence of immature reflexes. C: Left middle cerebral artery occlusion can result in right sided hemiplesia, hemianesthesia, aphasia, and/or right visual field anopsia. D: Right posterior cerebral artery occlusion may cause left homonymous anopsia, visual agnosia (inability to name visualized objects), and other signs/symptoms. E: Basilar artery stroke may affect the areas of the brain perfused by the anterior inferior cerebellar artery and posterior cerebral arteries. The brainstem, cerebellum, midbrain, and other central structures experience hypoxia resulting in loss of consciousness, bulbar symptoms, “locked in syndrome” and/or death.
Question: A 7 year old child presents to the ER with his parents after being hit in the head with a baseball bat during gym class. The parents explain that their son lost consciousness briefly but now complains of a headache. When you ask the child about the incident he is unable to recall the moments immediately after the blow to the head and is not orientated to time or place. A CT scan without contrast is ordered and is shown below. Which vessel was most likely injured, causing these findings?
A. Right Bridging Veins; B. Right Middle Meningeal Artery; C. Right Temporal Artery; D. Lenticulostriate Artery
Question: A 7 year old child presents to the ER with his parents after being hit in the head with a baseball bat during gym class. The parents explain that their son lost consciousness briefly but now complains of a headache. When you ask the child about the incident he is unable to recall the moments immediately after the blow to the head and is not orientated to time or place. A CT scan without contrast is ordered and is shown below. Which vessel was most likely injured, causing these findings?
A. Right Bridging Veins; B. Right Middle Meningeal Artery; C. Right Temporal Artery; D. Lenticulostriate Artery

Answer: B. Along the inner table of the right parietal bone, there is a biconvex hyperdensity resulting in mild local mass effect on the right frontal lobe. In the setting of recent trauma, this is most consistent with an epidural hematoma. A lucid interval followed by headache and confusion is a common presentation for this type of injury. The most common cause of this type of injury is disruption of the middle meningeal artery. Epidural hematomas are considered neurosurgical emergencies. The treatment is decompressive surgery. Damage to bridging veins cause subdural hematomas. Ruptured cerebral artery berry aneurysms cause subarachnoid hemorrhages. Ruptured Charcot-Bouchard aneurysms of the lenticulostriate arteries, associated with hypertension, cause intracerebral hemorrhage.
Question: This patient recently was diagnosed with adult onset asthma and Churge Straus Syndrome. Her initial complaints were recurrent dyspnea and chronic sinusitis. Which area is known for its importance in draining frontal and maxillary sinuses as well as the anterior and middle ethmoid air cells?
A. Osteomeatal Unit (OMU); B. Lamina Papyracea; C. Fovea Ethmoidalis; D. Nasal Cavity
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A. Osteo-meta-Unit (OMU); B. Lamina Papyracea; C. Fovea Ethmoidalis; D. Nasal Cavity

Answer: A. A patent OMU is essential for proper sinus drainage from the frontal, maxillary, and ethmoid air cells. This area is often occluded in severe sinusitis, as in this patient with sinus polyposis due to Churge Straus Syndrome. It is often seen in severe allergic/atopic disease. B: The lamina papyracea (paper thin wall) is the medial wall of the orbit, abutting the ethmoid air cells. It is often fractured during facial trauma. C: The fovea ethmoidalis is the “roof of the ethmoid air cells” and separates the upper sinuses from the brain. D: This is the right nasal cavity in the region of the right middle meatus. This patient has had prior sinus surgery to open the OMU. The uncinate processes and portion of the superior medial wall of the maxillary sinuses have been resected, as have both middle turbinates. Despite this surgery, the patient still suffers from prominent residual mucosal thickening, obliterating the superior nasal cavity and ethmoid air cells.
Question: A 26yo male with history of Sturge Weber presents with progressive personality changes and headache. A CT scan was ordered and shows the following:
A. Hamartoma; B. Dense Cortical Calcification; C. Cavernous hemangioma; D. Meningioma; E. Neuroma
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A. Hamartoma; B. Dense Cortical Calcification; C. Cavernous hemangioma; D. Meningioma; E. Neuroma

Answer: B. This CT shows dense cortical calcification with atrophy of the right frontal lobe. Other associated findings (not shown) of Sturge Weber may include pial capillary angiomatosis and enlarged ipsilateral choroid plexus. This acquired syndrome is also known for its port-wine stained vascular lesion over a trigeminal dermatome of the face. See below for an overview of the commonly tested neurocutaneous syndromes. A: Tuberous Sclerosis: Autosomal dominant; CNS hamartomas; Facial angiofibromas, Ash leaf spots, Shagreen patches, Heart rhabdomyoma C: Von Hippel-Lindau Disease: Autosomal dominant; Cavernous hemangiomas; Renal cell carcinoma; Pheochromocytoma D: Neurofibromatosis I (von Recklinghausens Disease): Autosomal dominant; CNS meningiomas, Gliomas; Café au lait spots, Cutaneous neurofibromas E: Neurofibromatosis II: Autosomal dominant; Bilateral vestibular schwannomas, Meningiomas, Less frequent café au lait spots and cutaneous neurofibromas
Question: A patient has complained of chronic, severe sinus pain refractory to antibiotic, antihistamine, and corticosteroid treatment. The most likely underlying pathologic process in this patient is:
A. Allergic; B. Vascular; C. Malignant; D. Foreign Body
Question: A patient has complained of chronic, severe sinus pain refractory to antibiotic, antihistamine, and corticosteroid treatment. The most likely underlying pathologic process in this patient is:
A. Allergic; B. Vascular; C. Malignant; D. Foreign Body

Answer: C. Unilateral, chronic, invasive sinusitis is highly alarming and a sign of malignancy, inverted papilloma, or aggressive infection. The demonstrated mass has eroded, remodeled and demineralized the adjacent structures. Opacification of the left frontal and maxillary sinuses represents a combination of tumor and post obstructive fluid build up. A. Allergies are a common cause of acute and chronic sinusitis. Allergic sinusitis is often treated with nasal spray antihistamines and/or corticosteroids. B. Wegener’s Granulomatosis is a rare cause of sinus erosion and hemorrhage. D. Foreign bodies in the nasal cavities are common in pediatrics and can cause acute discomfort, epistaxis, and/or purulent nasal discharge.
Question: A 72-year-old man is brought to the ER due to persistent nausea and vomiting. The patient has been complaining of double vision and severe headaches for two days. The patient is confused and disoriented. Further history with family members reveals a fall from a horse two days ago. Which of the following is the most likely cause of the patient’s symptoms?
A. Rupture of Bridging Veins; B. Rupture of Middle Meningeal Artery; C. Berry Aneurysm Rupture; D. Rupture of Middle Cerebral Artery Aneurysm
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A. Rupture of Bridging Veins; B. Rupture of Middle Meningeal Artery; C. Berry Aneurysm Rupture; D. Rupture of Middle Cerebral Artery Aneurysm

Answer: A. This patient has a subdural hematoma (SDH). SDHs are caused by the rupture of the bridging veins. A "crescent shaped" opacity can be seen on CT (without contrast) as shown in the image below. This is caused by a slow bleed between the dura and arachnoid meningeal layers. Subdural hematomas are common in the elderly and in alcoholics because of cerebral atrophy. Cerebral atrophy stretches the bridging veins, which can cause them to tear more easily. Symptoms, such as blurry vision, frontal headaches, nausea and vomiting, and altered mental status are common. Due to the slow nature of the bleeding, these patients may have delayed presentations up to weeks or months after minor head trauma. In these cases, chronic SDH is the diagnosis.
Question: A 35 year old man complains of vision problems and inability to achieve erection. His past medical history includes treatment for recurrent peptic ulcers and kidney stones. Optic exam demonstrates bitemporal heminopsia. Post-endocrine work up, an MRI is ordered and is shown. What is the most likely diagnosis?
A. Carcinoid Syndrome; B. Insulinoma; C. Multiple Endocrine Neoplasia I; D. Multiple Endocrine Neoplasia 2A E. Multiple Endocrine Neoplasia 2B
Question: A 35 year old male complains of vision problems and the inability to achieve erection. His past medical history includes treatment for recurrent peptic ulcers and kidney stones. Optic exam demonstrates bitemporal hemianopsia. Post-endocrine work up, an MRI is ordered and is shown. What is the most likely diagnosis?
A. Carcinoid Syndrome; B. Insulinoma; C. Multiple Endocrine Neoplasia 1; D. Multiple Endocrine Neoplasia 2A E. Multiple Endocrine Neoplasia 2B

Answer: C. Multiple Endocrine Neoplasia 1 (MEN 1) is a constellation of pancreatic, parathyroid and pituitary endocrine neoplasms. Patients commonly present with gastric ulcers from pancreatic gastrinomas (Zollinger- Ellison syndrome), kidney stones (hyperparathyroidism), and bitemporal hemianopsia and impotence (prolactinoma). All MEN syndromes are autosomal dominant and the diagnosis in one patient is indication for work up of family members. A: carcinoid tumors are a type of neuroendocrine tumor which can make large amounts of hormone-like substances and neuropeptides. These substances can cause carcinoid syndrome which is characterized by bouts of fever, flushing and diarrhea. B: Insulinoma can cause severe hypoglycemia. D: MEN2A is characterized by medullary carcinoma of the thyroid, pheochromocytoma, and parathyroid hyperplasia. E: MEN2B is known for medullary carcinoma of the thyroid, pheochromocytoma, mucosal neuromas, and Marfanoid body habitus.
Question: A 15 year old South American immigrant adolescent is brought to the ER by his parents due to recurrent seizures. The parents say he has been complaining of headaches for two weeks. A CT is performed and Albendazole is prescribed. Which of the following is the most likely cause of this patient's symptoms?
A. Diphyllolothrium latum;  B. Toxocara canis;  C. Naegleria fowleri;  D. Taenia solium;  E. Toxoplasma gondii
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Answer: D. This patient is experiencing symptoms of Neurocysticercosis. The tapeworm Taenia solium causes this disease. Infections occurs from ingestion of undercooked pork or food or water contaminated with feces containing Taenia solium eggs. Neurocysticercosis is endemic to Central and South America, Asia and Africa. Clinical presentation varies but can include seizures, headaches, altered mental status and neurological deficits. Patients may be treated with Albendazole, corticosteroids and anticonvulsant therapy.
Question: A 40-year-old woman complains of an enlarged neck mass. TSH measurement is within reference range. Fine needle aspiration and ultrasound are performed and reveal papillary thyroid carcinoma. Her physician orders a CT scan for staging. What do you expect on histopathology?

A. Cells with amyloid deposition; B. Uniform follicles; C. Hurthle cells and lymphoid aggregates; D. Empty nuclei and psammoma bodies
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A. Cells with amyloid deposition; B. Uniform follicles; C. Hurthle cells and lymphoid aggregates; D. Empty nuclei and psammoma bodies

Answer: D. Papillary thyroid carcinoma is the most common type of thyroid cancer. It has an excellent prognosis and is more common in women. Risk factors include radiation exposure and genetic mutations of the RET and BRAF genes. With a palpable thyroid mass, fine needle aspiration biopsy can be performed in the office. With smaller masses, ultrasound is often ordered. Orphan Annie nuclei (empty nuclei) and psammoma bodies (concentric calcifications) are seen on light microscopy. A: Neoplastic cells in an amyloid stroma is typical of medullary thyroid carcinoma. B: Uniform cells can be seen in follicular adenoma or follicular carcinoma. An excisional biopsy to show invasion through the capsule is required to differentiate. C. Hurthle cells and lymphoid aggregates are seen in Hashimoto’s Thyroiditis.
Question: A 78-year-old man is brought to the ER because of confusion and numbness in his arm that began 1.5 hours ago. This patient has a previous medical history of atrial fibrillation and hypertension. Current medications include warfarin and verapamil. A CT in the ER reveals no acute hemorrhage. The patient is treated for a stroke using tissue plasminogen activator (tPA). The patient rapidly deteriorates after treatment. A second STAT CT is performed and is shown below. What is the cause of this patient's rapid decline? A. Hemorrhagic transformation; B. Picks disease; C. Transient ischemic attack; D. Hypertensive hemorrhage; E. Subarachnoid hemorrhage
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A. Hemorrhagic transformation; B. Picks disease; C. Transient ischemic attack; D. Hypertensive hemorrhage; E. Subarachnoid hemorrhage.

Answer: A. This patient presented to the ER with a stroke. Symptoms may include parasthesias, weakness, confusion, and headache. Major risk factors include atrial fibrillation, hypertension, diabetes, family history of stroke, high cholesterol and increasing age (after the age of 55). Hemorrhagic transformation is a complication of ischemic stroke. Hemorrhagic transformation can occur spontaneously, but occurs more frequently in patients who receive anti-coagulant therapy or tPA. Hemorrhagic transformation of a cerebral infarct can be devastating with rapid patient deterioration. tPA is administered only if ischemic stroke occurred within three hours of its infusion. Despite this criteria, hemorrhagic transformation is still a serious risk and must be explained to the patient.
Question: A 13 month old girl is brought to the pediatrician due to concerns that she has not begun to crawl. The child’s head is enlarged and there is a small tuft of hair on the child’s lower back. A CT is ordered and is shown below. Based on the CT results, what is the most likely cause of her developmental delay?
A. Spina bifida; B. Anencephaly; C. Dandy-Walker malformation; D. Arnold-Chiari malformation; E. Normal Development
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A. Spina bifida; B. Anencephaly; C. Dandy-Walker malformation; D. Arnold-Chiari malformation; E. Normal Development

Answer: C. The cerebellar vermis forms the posterior aspect of the fourth ventricle between the cerebellar hemispheres. No cerebellar vermis is present in this patient. Instead, it is replaced by a CSF density pocket. This is the congenital Dandy-Walker malformation. Symptoms occur in infancy, which include delayed motor development and progressive enlargement of the skull. Dandy-Walker malformation is associated with hydrocephalus and spina bifida. A: Spina bifida is due to protrusion of spinal canal contents through a defect in the vertebrae. Pre-natal folate supplementation reduces the risk of this malformation. B: Anencephaly refers to absence of the brain, a devastating defect. Maternal pre-natal folate also reduces the incidence of this congenital defect. D: Arnold-Chiari malformation is due to protrusion of the inferior cerebellum into the foramen magnum. E: Most children learn to crawl between the ages of 7 and 10 months.
Question: An 83 year old caucasian man complains of acute neck pain that is worse in the morning. He recently fell. The physician notes a heel spur on the patient's foot and orders a CT of the cervical spine. Ossification of the posterior longitudinal ligament is observed. What is the most likely diagnosis?
A. Ankylosing Spondilitis; B. Ossification of the Posterior Longitudinal Ligament (OPLL); C. Primary Osteoarthritis; D. Psoriatic arthritis; E. Paget's disease
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A. Ankylosing Spondylitis; B. Ossification of the Posterior Longitudinal Ligament (OPLL); C. Primary Osteoarthritis; D. Psoriatic arthritis; E. Paget’s disease

Answer: B. This patient suffers from OPLL. OPLL, when extensive, can cause spinal canal stenosis, as in this case. This patient also suffers from Diffuse Idiopathic Skeletal Hyperostosis (DISH), a condition more common in the elderly. DISH is considered a degenerative arthritis and is associated with inflammation and calcifications of the tendons, including heel spurs. Symptoms often involve back pain and stiffness that is worse in the morning. The cervical and thoracic vertebrae are usually affected. DISH alone is often asymptomatic. The acute neck pain is from a pathologic fracture at C6. Note that the pathologic fracture in this case is not due to tumor or infection but due to the combination of DISH/OPLL that results in a rigid spine. DISH can be diagnosed with radiography if calcifications and ossifications are seen on the anterolateral aspect of the vertebral bodies. It is important to note that DISH does not involve the sacroiliac joints while ankylosing spondylitis does.
Question: A 55-year-old female presents to the ER complaining of chest pain, especially with swallowing. She explains that the pain began yesterday after dinner. Her past medical history is unremarkable. There is no history of coronary disease. Based on this patient's symptoms and CT scan, what is most likely causing this patient's odynophagia and chest pain?
A. Esophageal stricture;  B. Boerhaave syndrome;  C. Foreign object;  D. Esophageal spasm
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A. Esophageal stricture; B. Boerhaave syndrome; C. Foreign object; D. Esophageal spasm

Answer: C. The CT shows an object that has perforated the esophagus. While not visible in this image, the patient had air in the superior mediastinum. The patient stated that her pain began after she ate the previous day and is worse with swallowing--key information for differentiating cardiac versus non-cardiac pain. The patient inadvertently ingested a fish bone. The bone should be removed immediately with further treatment if esophageal perforation is present to prevent mediastinitis.
Question: A 75-year-old man is brought to the ER by his daughter because of urinary incontinence and progressive memory loss. The patient also has poor balance when he walks. Past medical history is noncontributory. An MRI is performed. What is the most likely cause of his symptoms?
A. Alzheimer’s disease; B. Normal aging; C. Hydrocephalus ex vacuo; D. Normal pressure hydrocephalus (NPH); E. Parkinsons disease
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Answer: D. NPH is an abnormal accumulation of CSF that can cause enlargement of the ventricles. This distorts the corona radiata and causes the classic triad of urinary incontinence, ataxia and dementia. These symptoms may lead to the misdiagnoses of Alzheimer's disease, Parkinson's, or other dementia. A+C: Hydrocephalus ex vacuo and Alzheimer's disease are associated with parenchymal tissue loss. With parenchymal loss, the sulci around the cerebral hemispheres should enlarge. In this case, they are narrowed as the lateral ventricles are disproportionately enlarged and the intact gyri are compressed. Considering the clinical symptoms, NPH would be a good consideration. Obstructive hydrocephalus could also be considered on the image provided. E. Parkinson's Disease is a clinical diagnosis based on asymmetric resting tremor, bradykinesia, rigidity and festinating gait. The most common imaging appearance is of a normal brain. Utility of imaging in such a case is to exclude other disease processes that may mimic the clinical symptoms.
Question: 3 months after an ischemic stroke, a 77 year old female presents for follow-up imaging. What type of necrosis is present?  
A. Coagulative;  B. Liquefactive;  C. Caseous;  D. Gangrenous;  E. Fibrinoid;  F. Fat
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Answer: B. Liquefactive necrosis occurs in the CNS and in abscesses (walled off infections). A: Coagulative necrosis occurs in most solid tissues and is characterized by preservation of tissue structure with loss of intracellular contents. C: Caseous necrosis is seen within the granulomas of Tuberculous and fungal infections. The contents of the granulomas are often described as “cheesy”. D: Gangrenous necrosis can be described as wet, dry, or gas. It is due to loss of perfusion and is often associated with aggressive infections. E: Fibrinous necrosis is found in artery walls affected by certain vasculitides. F: Fat necrosis is seen in pancreatitis and trauma to fat, often seen in the female breast.
References


