1. Describe the vascular supply to the skin of the neck. Why is this important in planning incisions for neck dissections?

**Blood Supply (vertical arterial cutaneous branches)**

- Facial artery - supplies most of upper anterior neck skin
- Thyroceraval trunk branches (transverse cervical a. & suprascapular a. branches) supply most of lower neck
- Superior thyroid a. branches lesser contributor superiorly
- Watershed areas in the mid-neck and in the midline

Commonly used neck incisions:

1. **Modified apron incision** – used for exposure of level I, II, and II (supraomohyoid neck dissection). Mastoid tip to where omohyoid crosses the carotid sheath inferiorly & curves around into submental triangle. Flap supplied by cutaneous branches of facial a.
2. **Hockey stick incision** – used for exposure to levels II-V. Starts at mastoid tip and extends across posterior triangle, then curves sharply toward midline paralleling the clavicle approx 3 cm above it. Flap supplied by cutaneous branches of facial a.
3. **Inverted hockey stick incision** – provides excellent exposure to levels I-III with adequate exposure to IV and V. Extends from submental triangle along body of mandible towards the mastoid tip and turns inferiorly across the posterior triangle toward junction of clavicle with the trap. Flap supplied by cutaneous branches of transverse cervical & suprascapular aa.

2. What is the radiographic criteria for lymph node metastases?
   Differentiating between benign and malignant LAD radiographically remains a problem and is still a topic of debate. Some guidelines typically used to identify malignant lymph nodes are as follows:

   - Central necrosis (central low attenuation on CT or low intensity on T1 MRI)
   - Peripheral enhancement
   - Ill-defined margins indicating extracapsular spread, or invasion or displacement of adjacent structures
   - Clustering of nodes
   - Size – up for debate but generally considered potentially malignant if >1-1.5 cm
     A. > 0.5 cm for nodes in level I
     B. > 1.0 cm for nodes in the parotid or retropharyngeal chains
     C. Debate over nodes in spinal accessory, deep cervical, and submandibular groups. Some believe only >1.5 cm should be considered malignant while others maintain that ↑ in specificity is not worth the ↓ in sensitivity by this criteria & consider all nodes >1.0 cm to be malignant
     D. Debate also exists as to whether one should use and minimal or maximal axial diameter of a lymph node when measuring it.

   Inflammatory nodes are often less than 1 cm (rarely greater than 2cm), have central homogenous enhancement, well-defined margins, may have calcification, and are often numerous but do not cluster.

3. Review TNM Staging
   TNM staging is based on the premises that cancers of the same anatomic site and histology share similar patterns of growth and similar outcomes and as the size of the primary tumor (T) increases, regional lymph node
involvement (N) and/or distant metastases (M) become more likely. First developed by Pierre Denoix in the ‘40’s the system was adopted by the International Union Against Cancer (UICC) in 1968. Information obtained from clinical examination and radiologic imaging is used to assign a clinical stage (cTNM), which is then used to stratify patients for selection of therapy and to report outcomes of treatment. If the patient undergoes surgical resection, the pathologic stage (pTNM) derived from histopathologic examination of the tumor and/or regional lymph nodes is used to guide postoperative adjuvant therapy and to estimate prognosis. After assignment of TNM categories, tumors are stratified into stage groupings (I, II, III, or IV). Theoretically, across various types of cancer, 5-year survival is similar for all stage I, II, II and IV cancers. The TNM system is an evolving system last officially updated in 2003.
4. Discuss PET scan vs. CT and MRI in detecting cervical metastases

CT scans have been used in the evaluation of head and neck cancer since the 1970s and is now routinely used for preoperative evaluation of the neck for cervical metastases. Many reports indicate that CT scanning still has an edge over MRI for detecting cervical nodal involvement. Advances in MRI technology (eg, fast spin-echo imaging, fat suppression) have not yet surpassed the capacity of CT scanning to identify lymph nodes and to define nodal architecture. Central necrosis, as evaluated by unenhanced T1- and T2-weighted images, has been shown to provide an overall accuracy rate of 86-87% compared with CT scanning, which has an accuracy rate of 91-96%. The use of newer contrast media, especially supramagnetic contrast media agents, hopefully will improve the sensitivity of MRI. The value of MRI is its excellent soft tissue resolution. MRI has surpassed CT scanning as the preferred study in the evaluation of cancer at primary sites such as the base of the tongue and the salivary glands.

PET imaging relies on the uptake of 2-fluoro-2-deoxy-D-glucose (FDG) in metabolically-active lesions. The study may also be fused to a corresponding CT scan to facilitate the localization of the lesion of concern (PET/CT). In comparing the usefulness in the detection of cervical metastasis, PET/CT fusion images have been found to be superior and more accurate for the detection of cervical metastasis, compared to PET alone, as well as conventional imaging modalities. In addition, PET can contribute to the detection of residual or early recurrent tumors, leading to the institution of earlier salvage therapy.

The danger is that introduction of newer diagnostic tests such as CT and MRI or PET can result in assignment of higher clinical stages and “improved” outcome for patients in a particular stage group purely because of the increased accuracy of the diagnostic test compared with clinical examination.

5. What are the levels of the neck as it relates to lymph node groups? What are the anatomic boundaries of each level?

<table>
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<tr>
<th>Level</th>
<th>Nodes</th>
<th>Boundaries</th>
<th>Drainage</th>
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</table>
| IA    | Submental | superior: symphysis of mandible  
iinferior: hyoid bone  
medial: midline  
lateral: anterior belly of digastric m. | skin, lips, FOM |
| IB    | Submandibular | superior: body of mandible  
iinferior: posterior belly of digastric m.  
anteior: anterior belly of digastric m.  
posterior: stylohyoid | submandibular gland, oral cavity |
| II (A/B) | Anterior /Upper Jugular | superior: skull base  
iinferior: inferior border of hyoid  
anteior: stylohyoid muscle  
posterior: posterior border of the SCM  
IIA/IIB: anterior/posterior to SAN | nasopharynx, oropharynx, parotid, supraglottic larynx |
| III | Anterior / Middle Jugular | superior: inferior border of hyoid  
iinferior: inferior border of cricoid cartilage  
anteior: posterior border of sternohyoid  
posterior: posterior border of the SCM | oropharynx, hypopharynx, supraglottic larynx |
| IV | Anterior / Lower Jugular | superior: inferior border of cricoid cartilage  
iinferior: clavicle / sternal notch  
anteior: posterior border of sternohyoid  
posterior: posterior border of the SCM | subglottic larynx, hypopharynx, esophagus, thyroid |
| V (A/B) | Posterior | superior: convergence of SCM & trapezius m.  
iinferior: clavicle  
anteior: posterior border of SCM  
posterior: anterior border of trapezius m.  
VA/VB: above/below a horizontal plane defined by lower border of cricoid cartilage | nasopharynx, oropharynx |
| VI | Central / Pretracheal | superior: hyoid  
iinferior: suprasternal notch  
medial/lateral: common carotid artery | thyroid, larynx |
6. Radical vs. modified radical neck dissection.....definition and indications

Radical neck dissection consists of a comprehensive nodal dissection with removal of lymph node levels I-V, including removal of the sternocleidomastoid muscle, internal jugular vein, and spinal accessory nerve. Modified radical neck dissection involves removal of all lymph node levels (I-V), but spares either the sternocleidomastoid muscle, internal jugular vein, or spinal accessory nerve.

Modified radical neck dissection can be further classified as follows:
- **Type I**: preserves spinal accessory nerve
- **Type II**: preserves spinal accessory nerve and internal jugular vein
- **Type III**: preserves spinal accessory nerve, internal jugular vein, and sternocleidomastoid muscle

Radical neck dissection results in neck deformity from removal of the SCM, shoulder droop from removal of CNXI, and a risk of facial edema from removal of the IJ vein. In light of the significant morbidity, indications for radical neck dissection have evolved, and generally modified RND is preferred whenever possible.

Indications for radical neck dissection include clinically positive nodes with primary cancer that has a high risk of occult nodes; advanced nodal disease in an untreated neck (multiple nodes, large matted nodes, or posterior nodes); extracapsular extension with involvement of SCM, IJ, or SAN; multiple nodes present after treatment with surgery, radiation, chemotherapy.

Indications for a modified radical neck dissection include primary cancers with low risk of occult nodes presenting with either N0 neck or clinically positive nodes. Based upon intraoperative assessment of involvement of the SCM, IJ, or SAN, Type I/II/III modified radical neck dissection is performed.

7. Name and describe four selective neck dissections.

Selective neck dissection is defined as any type of cervical lymphadenectomy where there is preservation of one or more lymph node groups removed by the radical neck dissection.

Four common subtypes:

1. **Supraomohyoid neck dissection.** This removes lymph tissue contained in regions I-III. The posterior limit of the dissection is marked by the cutaneous branches of the cervical plexus and the posterior border of the SCM. The inferior limit is the superior belly of the omohyoid muscle where it crosses the IJ vein.
2. **Posterolateral neck dissection.** Removal of the suboccipital lymph nodes, retroauricular lymph nodes, levels II-IV, and level V. Most often used to remove nodal disease from cutaneous melanoma of posterior scalp and neck.

3. **Lateral neck dissection.** Removes lymph tissue in levels II-IV only.

4. **Anterior neck dissection.** Removal of lymph nodes surrounding the visceral structures of the anterior aspect of the neck (Level VI).

8. You suspect a chylous fistula in patient status post modified radical neck dissection. How will you confirm and manage this problem? Could it have been prevented?

Chyle leak is an uncommon complication of neck complication, occurring in approximately 1% to 2% of cases. Most chyle leaks occur in the LEFT side of the neck (~75%) because of the anatomy of the thoracic duct, which empties into the left subclavian vein, near the entrance of the left internal jugular vein. The lymphatic duct is an analogous structure from the right side of the neck, draining lymph from the right head, neck, upper extremity, upper chest, and convex surface of the liver.

During dissection in the region of the lower jugular vein, the thoracic or lymphatic duct should be carefully ligated if identified. To ensure that no injury has occurred or to verify adequate repair, a Valsalva should be applied for 30 sec or more. If milky or oily-appearing fluid emanates from the jugular stump, repair and ligation should continue until this finding is no longer noted. Hemoclips, non-absorbable suture, Surgicel, and sclerosing agents have been used.

A chylous fistula post-op usually presents as high-output milky drainage. Management of this complication depends on the time of onset of the leak and the amount of chyle drainage in a 24-hour period. When the output of chyle >600mL over 24 hours (especially when it manifests immediately after surgery), conservative closed wound management is not likely to succeed. In such patients, early surgical exploration is preferred, before the tissues exposed to chyle become markedly inflamed and fibrinous material coating tissues becoming adherent, obscuring important structures such the vagus and phrenic nerves.

Chylous fistulas that become apparent only after enteral feedings are resumed, and particularly those that drain <600mL over 24 hours, are initially managed conservatively with head elevation, continued suction drainage, pressure dressings, replacement of fluid lost though the fistula (up to 4L/day), and nutritional modification using MCT (medium chain triglyceride) enteral diet. Medium-chain fatty acids are absorbed directly into the portal system and bypass the lymphatics. Parenteral through a central line can further reduce chylous output and may be considered for high-output or intractable fistulas.

9. Two possible complications from neck dissections, especially radical neck dissections that may affect mental status include embolism causing a stroke and air embolus.

**Embolism:** Embolism can occur during dissection along the carotid artery during neck dissection in patients with cerebrovascular disease. Dislodgement of arteriosclerotic plaques causes emboli to break off leading to stroke. Strokes often present with change in neurological function. **Air embolus:** occurs when dissection along IJV and a tear occurs allowing large volume of air to rapidly enter vein by negative pressure directly into right atrium causing sudden alteration of central circulation. Can cause cyanosis, hypotension and tamponade which may manifest as mental status change and even death. Treatment requires packing or clamping vein and place patient in left lateral decubitus position with head down.
10. Definition of the N0 neck and why it is controversial.

An N0 neck traditionally was determined by physical examination alone. Staging by palpation, however, has been demonstrated to be inaccurate. Much of the current literature uses a combination of palpation, CT (and/or MRI), and fine-needle aspiration of suspicious nodes.

How to address the N0 neck is controversial because there are several questions to answer:

1. Which patients with N0 necks actually have no cancer cells in the cervical lymphatics?
2. Which patients with N0 necks will eventually develop clinical disease?
3. Which patients who eventually develop clinical disease from cervical metastasis will die of this disease?
4. Which treatment modalities are most effective and least morbid for the prevention and/or treatment of recurrent and/or distant metastases?

Prospective randomized trials are needed to answer these questions which are lacking in the head and neck literature. Until we are able to accurately and reliably predict the presence of occult metastasis using the methods described above, we must base our treatment decisions on data from the current literature mostly comprised of retrospective data.

11. Workup and Management of Unknown Primary

Typically presents as painless neck mass for weeks-months.

Etiology of unknown primary depends on site of unknown primary:
- Upper aerodigestive tract: EtOH, tobacco, betel nut, risk factors (HPV, poor oral hygiene, GERD)
- NP: environmental factors (nitrosamines, polycyclic hydrocarbons, wood dust, nickel), EBV
- Sinonasal: nickel, wood dust
- Cutaneous: UV light, xeroderma pigmentosum

Symptoms can direct you to possible site of unknown primary:
- Otalgia/aural fullness: pharynx, larynx, NP, ear
- Dysphagia/odynophagia: pharynx, esophagus, OC
- Hoarseness: Larynx
- Trismus/dysarthria: OC/OP
- Nasal congestion, epistaxis: sinonasal tract
- Aspiration: OP/larynx

Physical Exam:
- Inspect and palpate skin (scalp, external ears).
- Palpate all zones of the neck (neck mass, fixation of the overlying skin, location of mass, unilateral/bilateral).
- Note nasal vestibule, OC/OP (manual palpation of OC/OP with special attention to BOT/FOM)
- Flexible laryngoscopy/mirror exam
- If anything is unusual and accessible, perform directed biopsy
- Cranial nerve exam

Panendoscopy:
- Biopsy samples obtained from high-yield anatomic sites (NP, tonsils, pyriform sinus, hypopharynx, postcricoid area, BOT).
- Perform full H&N exam while under anesthesia also.
Pathological nodes location can give you a good indication of possible location:
- Occiptial nodes: posterior scalp
- Postauricular nodes: posterior scalp, posterior auricle, mastoid
- Extraglandular parotid nodes: anterior scalp
- Intraglandular parotid nodes: parotid, anterior scalp
- Retropharyngeal nodes: posterior nasal cavity, sphenoid/ethmoid sinuses, hard/soft palate, NP, posterior pharyngeal wall.
- IA: middle 2/3 lower lip, anterior gingiva, anterior tongue
- IB: ipsilateral lower and upper lip, cheek, nose, medial canthus, OC to anterior tonsillar pillar
- II: OC, NC, NP, OP, hypopharynx, larynx, parotid gland. IIB more likely OP, IIA more likely OC/larynx.
- III: OC, OP, NP, hypopharynx, larynx
- IV: hypopharynx, thyroid, cervical esophagus, larynx
- VA/VB: NP, OP, posterior scalp/neck
- VI: thyroid, glottic/subglottic larynx, apex of pyriform sinus, cervical esophagus

If neck mass is bilateral, consider midline structures.

Lab Studies:
- Routine labs, EBV (NP)
- CXR
- CT head/neck with IV contrast (MRI if contrast allergy or BOT/sinonasal tumor)
- MRA if concern of vessel involvement/resectability
- PET vs. PET/CT (help guide biopsies during panendoscopy)