Traumatic Vascular Injuries

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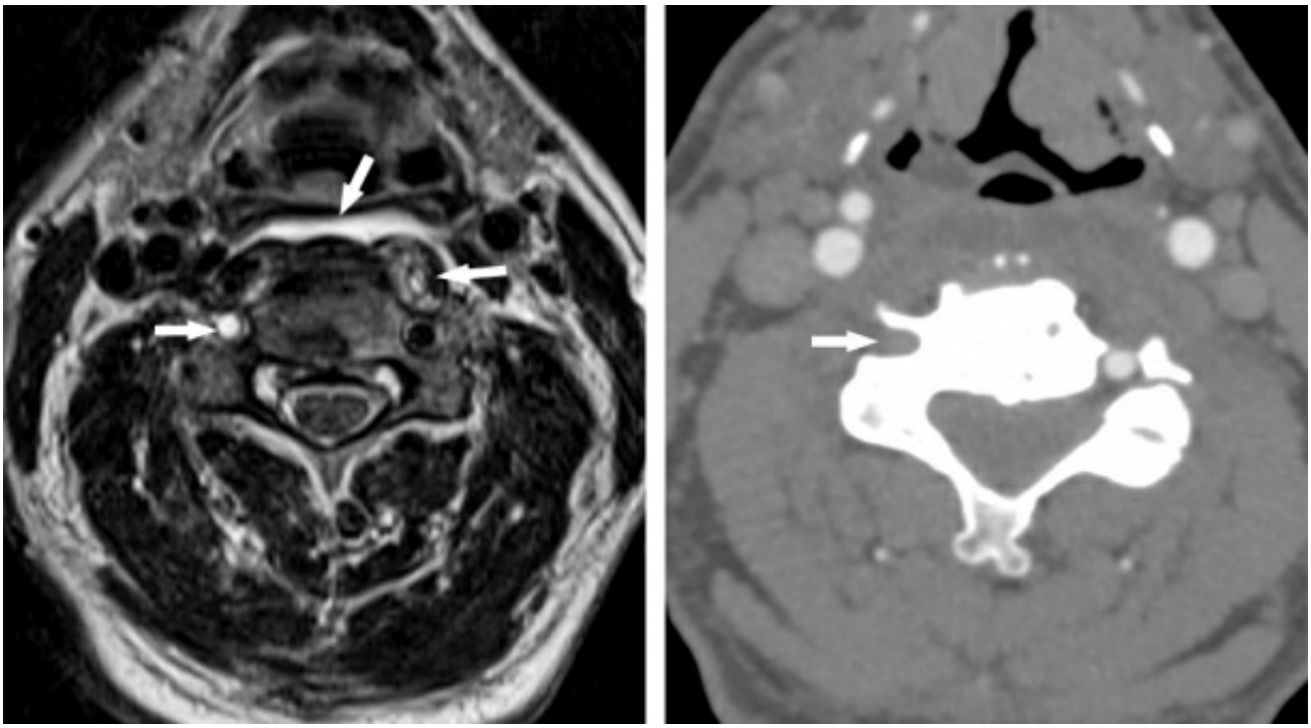

Figure 1: This patient receiving an MRI after motor vehicle accident demonstrates retropharyngeal and paraspinal muscle edema (left, middle arrow) on T2-weighted image (left), a finding suggestive of cervical spine fracture. More concerning, though, is the asymmetric abnormal signal in the right vertebral artery (left, left arrow), which should be black on T2-weighted images. On followup CT Angiogram (right), the right vertebral artery does not fill with contrast (right, arrow), indicating occlusion most commonly due to dissection in the traumatic setting.

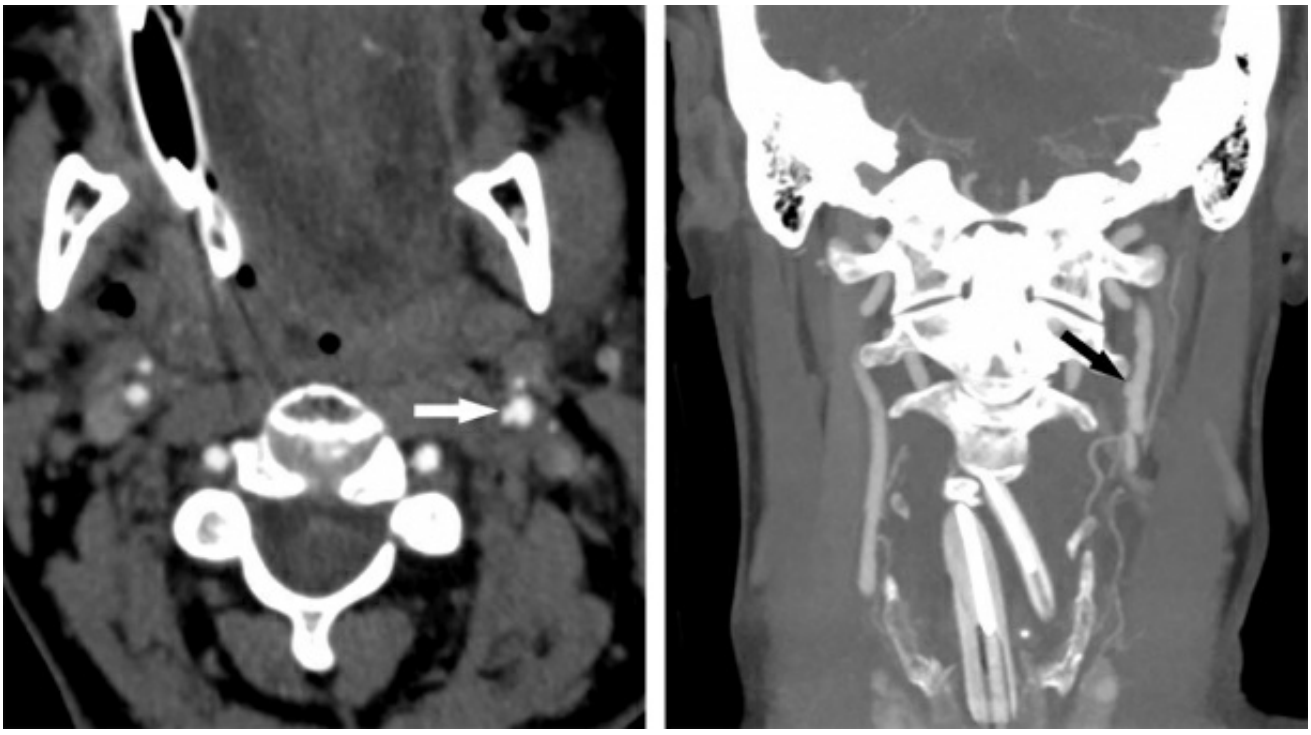

Figure 2: Axial (left) and coronal MIP (right) CT angiogram images through the neck in this patient after motor vehicle accident demonstrates a small focal outpouching of the left cervical internal carotid artery representing pseudoaneurysm due to vascular injury. The adjacent left internal carotid artery is also irregular and widened, suggestive of dissection.

Figure 3: Axial CT image through the level of the cavernous sinuses demonstrates a subtle widening of the left cavernous sinus. Subarachnoid blood can also be seen in the prepontine cistern. An axial CT angiographic image (top row right) demonstrates asymmetric early filling of the left superior ophthalmic vein during the arterial phase, a finding that should prompt a search for carotid-cavernous fistula. Axial CTA through the level of the cavernous sinuses (bottom row left) reveals the early filling of the cavernous sinuses, greater on the

right. This early cavernous sinus filling also manifested during conventional angiogram (bottom row right, left arrows). Cavernous sinus coils can also be seen in this partially treated fistula (bottom row right, right arrow). Pneumocephalus is also visible in each of the CT images as very low density (black) foci in the left middle cranial fossa and in the left basal cisterns.

Neuroimaging

- May involve *large arteries* (such as the internal carotid, vertebral, and middle meningeal arteries), *small cortical arteries* and bridging *cortical veins*
- Vessels can be injured either directly or indirectly
- Direct injuries include vessel laceration, dissection, thrombosis, pseudoaneurysm, or AV shunting. (See Figures 1-3)
- Indirect injuries include vascular occlusion and infarction from brain herniation
- The posterior cerebral artery territory is most commonly affected and is caused by unilateral descending transtentorial herniation (DTH)
- With severe brain swelling and complete bilateral DTH, perforating arteries from the circle of Willis may occlude, causing multifocal infarcts in the basal brain
- Injuries visible on imaging include dissection/transection, epidural hematoma, subarachnoid hemorrhage and cerebral ischemia/infarction
- Bridging cortical veins within the dural border cell layer and deep to the meningeal duramater, can also be torn, resulting in subdural hematoma
- Trauma related arterio-venous fistula can develop – For example - carotid cavernous fistula can result in vision impairment, limitation of ocular movements, exophthalmos, bruit and chemosis. (See Figure 3)

Perfusion and Metabolic Alterations

- A complex cascade of events causes vascular dysautoregulation with oxidative tissue damage, elevated reactive nitrogen species, and inflammation
- Local, regional, or generalized perfusion alterations vary in severity from focal cortical ischemia to frank infarction and laminar cortical necrosis
- Most severe perfusion reduction results from markedly elevated intracranial pressure and may result in brain death
- When intracranial pressure exceeds intraarterial pressure, severe perfusion reduction occurs resulting in complete and irreversible cessation of brain function
- Legal criteria for brain death vary with jurisdiction and imaging (Nuclear Medicine brain survival study with 99mTc-HMPAO) may confirm but not substitute for clinical diagnosis of brain death

For more information, please see the corresponding chapter in Radiopaedia.

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