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Cranial Nerve Pathology: From Brainstem to Upper Mediastinum

SHORT ABSTRACT

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ubiquity press

Cranial nerve (CN) disorders might be due to various diseases. In clinical practice, imaging of CN disorders plays a major role in the etiological inquiry and the pretherapeutic planning. The first challenge is to define the location of the disease: into the brain (intraaxial lesion); into the skull and out of the brain (extraaxial intracranial lesion); or into the face and the neck (extracranial lesion). The second challenge is to determine the nature of the disease: congenital, vascular, inflammatory, infectious, tumoral, traumatic, or dysfunctional due to compression.

These hypotheses are useful to select the best imaging modality, to adapt the spatial coverage, and to choose the most appropriate protocol.

In clinical practice, imaging is used to identify or to rule out macroscopic lesions that may explain CN impairments related to:

- intraaxial lesions that may compromise supranuclear connecting fibers, CN nuclei, and intramedullary fibers;
- extraaxial intracranial lesions that may compromise cisternal and intraforaminal fibers; and
- extracranial lesions that may compromise facial or cervical nerves.

The best way to detect cranial nerve pathology is to compare the size and signal intensity of the paired nerves. Due to the course of the cranial nerves, this comparison is best achieved in the coronal plane for nerves I to VI and in the axial plane for nerves VII to XII. Frequently nerve enhancement is the only sign indicating cranial nerve involvement, and therefore the use of gadolinium is recommended in most cases (Figure 1). A phased array head coil is best suited to image all cranial nerves down to the level of the mandible, but an additional neck coil is needed to visualize the lower cranial nerves in the neck and upper mediastinum (left CN X).

Pathology at the level of the CN nuclei and intramedullary fibers is best seen on selective proton density, T2W and multi-echo (m-FFE, Medic, Merge) images. An additional DWI sequence is needed in the acute setting in older patients. The cisternal segment of the CN is surrounded by CSF, and therefore submillimetric heavily T2W images are best suited. Once the nerves are surrounded by a venous plexus (cavernous sinus, basilar plexus behind the clivus, jugular foramen and hypoglossal canal) they are best depicted as black structures surrounded by high signal intensity enhancing venous structures on 2D SE or TSE or 3D TSE or FFE contrast-enhanced T1-weighted images. The extracranial segments of the cranial nerves and surrounding lesions can best be depicted on high-resolution axial and coronal T1 and T2 weighted images. The abnormal enhancement of the nerves will be recognized more

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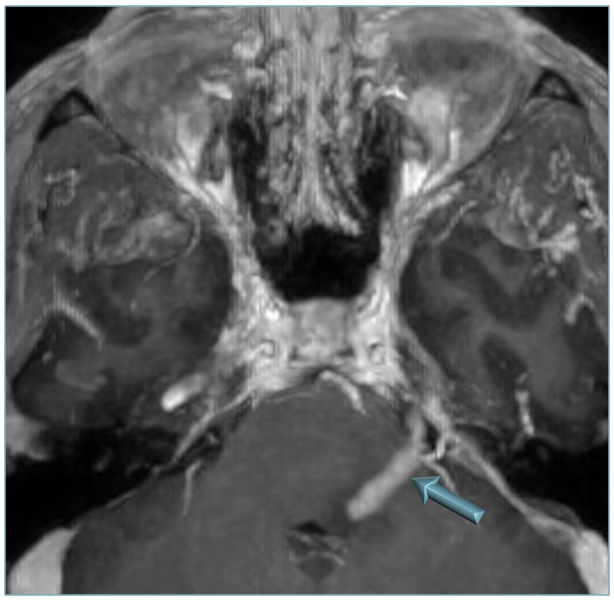

Figure 1 Covid-19 patient, with facial pain on the left side. Gd-enhanced T1W image: Enhancement is seen in the pontine nuclei and fascicular and cisternal segment of the left trigeminal nerve.

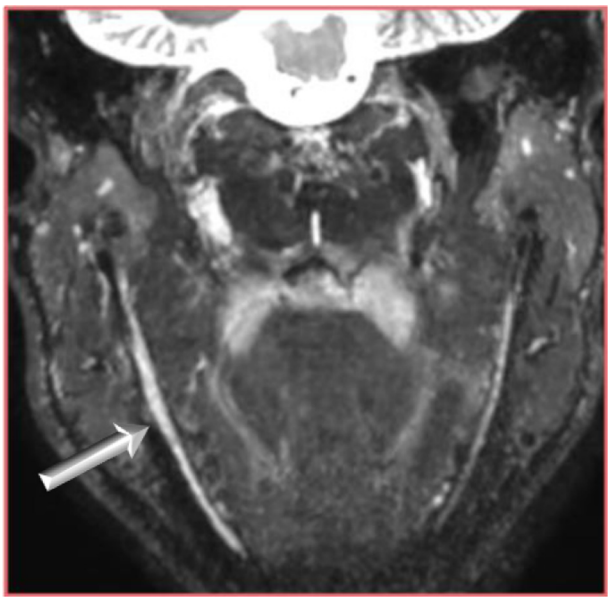

Figure 2 Patient with pain in the right mandible following several dental treatments on the right side. The para-coronal 3D-CRANI image shows a thickened high signal intensity inferior alveolar nerve, compatible with a mono-neuropathy, invisible on all other MR sequences and on CT.

easily on fat-suppressed images. A new isotropic 3D Gd-enhanced MR neurography sequence (3D CRANI) allow detailed visualisation of the normal and abnormal extracranial branches and course of nerves V, VII, IX–XII (Figure 2). The sece is based on a 3D STIR TSE sequence with fat suppression and a motion sensitized driven equilibrium function (black blood function parallel to the nerves). To acquire all the above-mentioned high-resolution images or isotropic submillimetric images in an acceptable time, parallel imaging and if available compressed sense should be used.

In the acute setting of trauma, inflammation (abscess), or in patients with compromised airways, CT can still be valuable because of its immediate availability, short scan time, and non-magnetic environment (support material, pacemakers etc.).

COMPETING INTERESTS

Casselman Jan - Philips Healthcare: Receipt of honoraria and consultation fees for customers visits and sponsored lectures.

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