Jugular foramen

The jugular foramen (JF) is one of a pair of openings between the lateral part of the occipital bone and the petrous part of the temporal bone.

The two jugular foramina exist at the base of the skull lateral to the foramen magnum. Importantly the internal jugular veins, which drain blood from the brain and intracranial tissues, make their way out of the cranium and terminate at the subclavian veins and ultimately join the brachiocephalic vein.

The foramen is usually divided in 2 by a bony spine from the petrous temporal bone that attaches via a fibrous bridge (which is bony in 26%) to the jugular process of the occipital bone $^{1)}$

The right JF is usually larger than the left $^{2) 3)}$.

The jugular foramen is a large aperture in the skull base. It is located behind the carotid canal and is formed in front by the petrous bone, and behind by the occipital bone; it is generally larger on the right than on the left side ^{4) 5)}.

Rhoton and Buza conducted an autopsy study of 50 jugular foramina and surrounding tissue, using the dissecting microscope ⁶⁾.

The carotid ridge separates the jugular foramen from the nearby carotid canal.





Contents

Jugular foramen contents.

Compartments

The jugular foramen may be subdivided into three compartments, each with its own contents.

The anterior compartment transmits the inferior petrosal sinus.

The intermediate transmits the glossopharyngeal nerve, vagus nerve, and accessory nerves (aka cranial nerves number IX, X, and XI respectively).

The posterior transmits the sigmoid sinus (becoming the internal jugular vein) and some meningeal branches from the occipital and ascending pharyngeal arteries ⁷⁾.

Nearby the hypoglossal nerve passes through the hypoglossal canal, just above the occipital condyle. The carotid artery with the sympathetic plexus enters the carotid canal.

Subdivisions

Pars vascularis

Pars nervosa.

Katsuta el al., divided the jugular foramen into three compartments: two venous and a neural or intrajugular compartment. The venous compartments consist of a larger posterolateral venous channel, the sigmoid part, which receives the flow of the sigmoid sinus, and a smaller anteromedial venous channel, the petrosal part, which receives the drainage of the inferior petrosal sinus. The petrosal part forms a characteristic venous confluens by also receiving tributaries from the hypoglossal canal, petroclival fissure, and vertebral venous plexus. The petrosal part empties into the sigmoid part through an opening in the medial wall of the jugular bulb between the glossopharyngeal nerve anteriorly and the vagus and accessory nerves posteriorly. The intrajugular or neural part, through which the glossopharyngeal, vagus, and accessory nerves course, is located between the sigmoid and petrosal parts at the site of the intrajugular processes of the temporal and occipital bones, which are joined by a fibrous or osseous bridge. The glossopharyngeal, vagus, and accessory nerves penetrate the dura on the medial margin of the intrajugular process of the temporal bone to reach the medial wall of the internal jugular vein. The operative approaches, which access the foramen and adjacent areas and are demonstrated in a stepwise manner, are the postauricular transtemporal, retrosigmoid, extreme lateral transcondylar, and preauricular subtemporalinfratemporal approaches⁸⁾.

A 73-year-old woman presented with cerebral infarction to the posterior circulation caused by

symptomatic common carotid artery stenosis with an unnamed and extremely rare persistent primitive artery. This anomalous vessel branched from the extracranial internal carotid artery and passed through the ipsilateral jugular foramen into the posterior cranial fossa and merged into the basilar artery.

This is the first case of a persistent primitive artery passing through the jugular foramen with symptomatic common carotid artery stenosis ⁹⁾.

Clinical significance

Obstruction can result in "Vernet's syndrome".

Damage to the motor division of the lower cranial nerves that run into the jugular foramen leads to hoarseness, dysphagia, and the risk of aspiration pneumonia; therefore, its functional preservation during surgical procedures is important. Intraoperative mapping and monitoring of the motor rootlets at the cerebellomedullary cistern using endotracheal tube electrodes is a safe and effective procedure to prevent its injury.

see jugular foramen stenosis.

Approaches

Tumors involving the jugular foramen (JF) have a variable relationship to the neurovascular structures (jugular vein, cranial nerves IX-XI) that traverse this conduit through the skull base. The surgeon familiar with the site of origin, growth pattern, and geometry of each of the common lesions affecting this region with respect to surrounding nerves and vessels is at a considerable advantage when undertaking a function-sparing procedure.

The endoscopic transnasal/transmaxillary transpterygoid corridor provides a less invasive route for selected lesions in the jugular foramen than the traditional open route through the preauricular subtemporal infratemporal fossa approach. However, the anterior endoscopic approach provides a smaller channel to the jugular foramen than the preauricular approach.

The anterior endoscopic approach to the anterolateral part of the jugular foramen is a useful alternative to the lateral microsurgical preauricular approach in carefully selected cases. The vaginal process of the tympanic part of the temporal bone provides a valuable landmark to aid in accessing the jugular foramen in both procedures and can be drilled to open the foramen in the preauricular approach ¹⁰.

Cohen et al., describe the rectus capitis lateralis (RCL) and its anatomical relationships, and discuss its utility as a surgical landmark for safe exposure of the jugular foramen in extended or combined skull base approaches. In addition, the condylar triangle is defined as a landmark for localizing the vertebral artery (VA) and occipital condyle.

Four cadaveric heads (8 sides) were used to perform far-lateral, extended far-lateral, combined transmastoid infralabyrinthine transcervical, and combined far-lateral transmastoid infralabyrinthine

transcervical approaches to the jugular foramen. On each side, the RCL was dissected, and its musculoskeletal, vascular, and neural relationships were examined.

The RCL lies directly posterior to the internal jugular vein-only separated by the carotid sheath and in some cases cranial nerve (CN) XI. The occipital artery travels between the RCL and the posterior belly of the digastric muscle, and the VA passes medially to the RCL as it exits the C-1 foramen transversarium and courses posteriorly toward its dural entrance. CNs IX-XI exit the jugular foramen directly anterior to the RCL. To provide a landmark for identification of the occipital condyle and the extradural VA without exposure of the suboccipital triangle, Cohen et al., propose and define a condylar triangle that is formed by the RCL anteriorly, the superior oblique posteriorly, and the occipital bone superiorly.

The RCL is an important surgical landmark that allows for early identification of the critical neurovascular structures when approaching the jugular foramen, especially in the presence of anatomically displacing tumors. The condylar triangle is a novel and useful landmark for identifying the terminal segment of the hypoglossal canal as well as the superior aspect of the VA at its exit from the C-1 foramen transversarium, without performing a far-lateral exposure ¹¹.

The jugular foramen (JF) is a canal that makes communication between the posterior cranial fossa and the upper neck for one third of the cranial nerves and for the main venous channel of the brain. From a lateral view, the JF is protected by multiple layers of muscles and by the outer surface of the petrous bone. Surgical exposure of the JF is usually justified by the removal of benign tumors that grow in this region.

Roche et al. described the surgical anatomy of the JF and detailed the relevant points of a stepwise surgical progression of three lateral skull base approaches with a gradual level of exposure and invasiveness. The infralabyrinthine transsigmoid transjugular-high cervical approach is a conservative procedure that associates a retrolabyrinthine approach to a lateral dissection of the upper neck, exposing the sinojugular axis without mobilization of the facial nerve. In the second step, the external auditory canal is transsected and the intrapetrous facial nerve is mobilized, giving more exposure of the carotid canal and middle ear cavity. In the third step, a total petrosectomy is achieved with sacrifice of the cochlea, giving access to the petrous apex and to the whole course of the intrapetrous carotid artery. Using the same dissection of the soft tissues from a lateral trajectory, these three approaches bring solutions to the radical removal of distinct tumor extensions. While the first step preserves the facial nerve and intrapetrous neurootologic structures, the third one offers a wide but more aggressive exposure of the JF and related structures ¹²⁾.

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