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IMPORTANCE OF VASCULATURE IN RELATION TO IMMUNE SYSTEM AND OUTBREAK OF PANDEMIC COVID-19 ON THE HUMAN BODY

Vasculature means blood vessels or the arrangement of blood vessels in an organ or part of the body. Immune system is the body's defense against infections. The lymphatic system is a major part of the immune system and is a network of lymph nodes and vessels. Lymphatic vessels carry a fluid called lymph containing tissue fluid, waste products and immune system cells. Lymph nodes are bean-shaped clumps of immune system cells connected by lymphatic vessels. They contain white blood cells that trap viruses and other invaders. White blood cells are cells of the immune system referred to as soldiers of the body. They are made in the bone marrow which is a lymph organ.

Covid-19 spreads by droplets from the mouth and nose and can be contracted by touching someone who is infected, touching a contaminated surface or by breathing in an infected person's respiratory secretions. When the virus enters the body, it binds to 2 cells in the lungs(goblet cells) which have hairs on them and normally prevent the lungs from filling up with debris and fluid. The virus starts to kill them hence the lungs begin to accumulate fluid causing difficult breathing.

Covid-19 cases progress through three stages. The first two are when the body attacks the virus while the third is the problematic stage where the immune system goes haywire attacking the virus with ferocity that it does far more damage than the virus itself.

In the first stage, which most patients remain in, the virus SARS-COV-2 attacks by latching onto a protein called ACE2 receptor which are mostly found in the lungs. As the virus replicates the immune system tries to stop it responding with virus-specific antibodies and T-cells. A high fever will be developed by the body to create a hostile environment for the virus. Coughing and runny nose will also be observed to expel mucus from the body. But in some people, the immune system can go into overdrive killing the virus along with healthy cells. The heightened immune response can trigger a "cytokine storm" whereby white blood cells activate a variety of chemicals that can leak into the lungs which along with the attack on the cells damages them even further. Bacterial infection can also take place at this point and weakened immune system will struggle to fight them off. More severe symptoms arise as the immune system really ramps up its response and that is when breathlessness increases and progresses to hypoxiaor low oxygen levels and even progressive things much more severe like pneumonia or acute respiratory distress syndrome.

The second stage(occurs in about 20% of patients) occurs when the virus replicates so fast the immune system cannot control it. This causes inflammation of the lungs and can happen if a large amount of virus enters the body.

The third stage is called the hyperinflammatory phase. This is when the body's immune system starts attacking itself. At this phase the virus is not as active. It's still there but the inflammation and the body's response starts to limit the organ system thus causing the heart and kidneys to start becoming dysfunctional. This leads to a stage of multisystem organ failure eventually resulting in death.

2. EXTRAOCULAR AND INTRAOCULAR MUSCLES OF THE EYE AND THEIR INNERVATION

Extraocular muscles of the eye

They are located within the orbit but are extrinsic and separate from the eyeball itself. They act to control the movement of the eyeball and superior eyelid. They are seven in number- the levator palpebrae superioris, superior rectus, inferior rectus, medial and lateral rectus, inferior and superior oblique.

1. Levator palpebrae superioris- the only muscle involved in raising the superior eyelid. It is innervated by the oculomotor nerve. It originates from the lesser wing of the sphenoid bone and attaches to the superior tatsal plate of the upper eyelid. It contains the superior tarsal muscle innervated by the sympathetic nervous system.

Recti muscles(4): originate from the common the common tendinous ring surrounding the optical canal at the back of the orbit. The muscles pass anteriorly to attach to the sclera.

2. Superior rectus- originates from the superior part of the tendinous ring and attaches to the superior and anterior aspect of the sclera. Innervated by oculomotor nerve.

3. Inferior rectus- originates from the interior part of the common tendinous ring and attaches to the inferior and anterior aspect of the sclera. Innervated by oculomotor nerve.

4.Medial rectus- originates from the medial part of the common tendinous ring and attaches to the anteromedial aspect of the sclera. Innervated by oculomotor nerve.

5. Lateral rectus- originates from the lateral part of the common tendinous ring and attaches to the anterolateral aspect of the sclera. Innervated by abducens nerve.

Oblique muscles(2)- they do not originate from the common tendinous. From their origin the oblique muscle take an angular approach to the eyeball. They attach to the posterior surface of the sclera.

6. Superior oblique- originates from the body of the sphenoid bone. Its tendin passes through a trochlear then attaches to the sclera of the eye posterior to the superior rectus. Innervated by trochlear nerve

7. Inferior oblique- originates from the anterior aspect of the orbital floor and attaches to the sclera of the eye posterior to the lateral rectus. Innervated by oculomotor nerve.

Clinical Significance

The Extraocular muscles are innervated by three cranial nerves. Damage to any of the cranial nerves will cause paralysis of its respective muscles. A lesion of each cranial nerve has its own characteristic appearance:

- Oculomotor nerve: A lesion of the oculomotor nerve affects most of the extraocular muscles. The affected eye is displaced laterally by the lateral rectus and inferiorly by the superior oblique. The eye adopts a postion known as 'down and out'.

- Trochlear nerve: A lesion of CN iv will paralyze the superior oblique muscle. There is no obvious effect of the resting orientation of the eyeball however the patient will complain of double vision and may develop a head tilt away from the sight of the lesion.

- Abducens nerve: A lesion of CN vi ill paralyze the lateral rectus muscle. The affected eye will be adducted by the resting tone of the medial rectus.

Horner's syndrome: refers to a triad of symptoms produced by damage to the sympathetic trunk in the neck.

- Partial ptosis(dropping of the upper eyelid)- due to denervation of the superior tarsal muscle.

- Miosis(pupillary constriction)- due to denervation of the dilator pupillae muscle.

- Anhydrosis(absence of sweating) on the ipsilateral side of the face- due tp denervation of the sweat glands.

Intraocular Muscles of the Eye

Intraocular muscles include the ciliary muscle, sphincter pupillae and dilator pupillae.

The ciliary muscle is a smooth muscle ring that conyrols accommodation by altering the shape of the lens as well as controlling the flow of aqueous humor into Schlemm's canal. Upon its contraction, the twnsion on the lens is lessened which causes it to adopt a more spherical shape to focus on near objects. Relaxation of the ciliary muscle has the opposite effect optimising distant focus.

Innervation: the ciliary ganglion is made up of postsynaptic parasympathetic nerve cell bodies associated with the ophthalmic nerve. The short ciliary nerve originates from the ciliary ganglion and carry parasympathetic and sympathetic fibres to the iris and ciliary body. The long ciliary nerves branch iff the nasociliary nerve and carry postsynaptic sympathetic fibres to the dilator pupillae and afferent fibres from the cornea and iris.

The sphincter pupillae and dilator pupillae are also composed of smooth muscle. The sphincter pupillae encircles the pupil and is responsible for the constriction of its diameter while the dilator muscle is arranged radially and increases the pupillary diameter.

Innervations: the sphincter pupillae is parasympathetically stimulated while the dilator pupillae is sympathetically stimulated.

There are three primary axes of ocular movement- vertical, transverse and anteroposterior. Rotation around the vertical axis result in either adduction or abduction of the eye. Rotation around the transverse axis result in either elevation or depression. The anteroposterior axis enables movement of the superior pole of the eye medially(intorsion) or laterally (extorsion). Its rotation allows the eye adjust to tilting of the head.