***NAME: OGUNDUN OPEOLUWA DAMILOLA***

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***DEPARTMENT: NURSING***

***COURSE: GROSS ANATOMY***

***ASSIGNMENT***

1. ***Describe the importance of vasculature in relation to immune system and outbreak of pandemic COVID-19 in the human body***

When COVID - 19 enters your body it binds to two cells in the lungs - goblet cells that produce mucus and cilia cells which have hairs on them and normally prevent your lungs filling up with debris and fluid such as virus and bacteria and particles of dust and pollen. The virus attacks these cells and starts to kill them - so your lungs begin to fill with fluid making it hard for you to breathe. This phase of the disease is thought to last about a week.

At this point your immune system will start to kick in and fight off the invaders. You will develop a fever and your high body temperature will create a hostile environment for the virus. You will start to get rid of the mucus in the form of coughing and a runny nose but in some people - particularly the elderly and those with other health conditions - the immune system can go into overdrive. As well as killing the virus it also starts to kill healthy cells.  This heightened immune response can trigger a “cytokine storm” - 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. Scans of the lungs show “ground-glass” opacity and then “crazy paving” patterns, as they fill with mucus making it harder and harder to breathe.

Bacterial infections can also take hold at this point and your weakened immune system will struggle to fight them off. This heightened immune response can lead to organ failure and death. Some people who recovered from severe acute respiratory syndrome (Sars) which swept the world in 2002 to 2003 had long-term respiratory problems as their lungs were permanently damaged. Covid-19 is similar to Sars in some respects, although is much less lethal, so those who have recovered from more serious symptoms may also suffer some long-term effects.

While people with weakened immune systems and the elderly are more likely to become critically ill the younger and healthy in China and elsewhere have also succumbed to the virus - this is because none of us have any immunity to this new disease. However, one interesting factor is that children do not seem to be falling victim to Covid-19 - just 2.4 per cent of all those who have contracted the disease are 18 and under and the vast majority have mild symptoms. In other respiratory diseases such as flu children are key disease transmitters.

Immune-mediated inflammation of peripheral tissues depends upon local recruitment of circulating leukocytes into an extravascular site. In most instances, leukocytes are recruited across the wall of post-capillary venules, which are composed of a continuous, one cell thick inner lining of endothelial cells (ECs) supported by an incomplete outer layer of pericytes (PCs) located within the basement membrane to which the ECs are attached . Larger vessels are not directly involved in leukocyte trafficking into tissues, but may themselves be a target of inflammation, for example when arteries become involved by cell-mediated immune responses as occurs in atherosclerosis. In the arterial wall, the EC lining of the vessel is completely covered by vascular smooth muscle cells (SMCs), some of which are located within the vessel intima, consisting of the EC lining and the anatomic space immediately beneath the basement membrane of the ECs. However, most SMCs are densely concentrated in a multilayered, circumferentially oriented array within the vessel media, which surrounds and is separated from the intima by the internal elastic lamina. The arterial adventitia is external to the media and separated from it by the external elastic lamina. The adventitia contains fibroblasts, nerve endings, micro vessels (known as vasa vasorum) and vascular stem cells. Some mononuclear leukocytes may also be present in each of these compartments that can increase dramatically in number with inflammation. It is increasingly appreciated that resident cell populations within the environment in which an immune response develops can play a major role in shaping the form of that immune response. While much of this emphasis has been on the roles played by parenchyma cells in peripheral tissues, cells of the blood vessel wall are also positioned to affect lymphocytes and recent observations have provided a deeper understanding of how blood vascular ECs, PCs and SMCs interact with infiltrating T cells in adaptive immune responses that occur near micro vessels of inflamed peripheral tissues and within the wall of inflamed macro vessels. In this review we consider how these interactions impact the nature of the immune response, with focus on observations made with human cells and tissues. We discuss the issues surrounding the cell source in these experiments, and, when possible, emphasize conclusions based on in vivo observations. We caution against generalizing about the immunological functions of vascular cells, as in “ECs do the following but SMCs do something else.” While each vascular cell type displays specific characteristics that define it as an EC, PC or SMC, each of these populations may vary significantly in both phenotype and function depending on the anatomic location; i.e. their most defining feature is simply their anatomic position within the vessel wall. Heterogeneity among vascular cells arises from several causes . Additionally, major species differences in vascular cell immunological functions have led to much confusion in the literature. We also caution that conclusions from experiments with cultured cells often ignore the profound phenotypic alterations that result from removing cells from their natural context and exposing them to tissue culture conditions.

1. ***Subsartorial canal is an important area in the lower limb, Discuss.***

The adductor canal (subsartorial or Hunter’s canal) is an aponeurotic tunnel in the middle third of the thigh extending from the apex of the femoral triangle to the opening in the adductor magnus, the adductor hiatus.

The **adductor canal** (Hunter’s canal, subsartorial canal) is a narrow conical tunnel located in the thigh. It is approximately 15cm long, extending from the apex of the femoral triangle to the adductor hiatus of the adductor magnus. The canal serves as a **passageway** from structures moving between the anterior thigh and posterior leg. It transmits the**femoral artery,** femoral vein (posterior to the artery), nerve to the vastus medialis and the saphenous nerve – the largest cutaneous branch of the femoral nerve. As the femoral artery and vein exit the canal, they are called the**popliteal artery**and **vein**respectively.

1. ***Describe the extraocular and intraocular muscles with their nerve supply.***

  The **extraocular muscles** are located within the orbit, but are extrinsic and separate from the eyeball itself. They act to control the movements of the **eyeball** and the **superior eyelid.** There are seven extraocular muscles which include the levator palpebrae superioris, superior rectus, inferior rectus, medial rectus, lateral rectus, inferior oblique and superior oblique. There are two groups which are:

1) Responsible for eye movement: Recti and oblique muscles. 2) Responsible for superior eyelid movement: Levator palpebrae superioris.

*Levator Palpebrae Superioris*

The levator palpebrae superioris (LPS) is the only muscle involved in raising the superior eyelid. A small portion of this muscle contains a collection of smooth muscle fibres – known as the superior tarsal muscle. In contrast to the LPS, the superior tarsal muscle is innervated by the sympathetic nervous system.

* Attachments:Originates from the lesser wing of the sphenoid bone, immediately above the optic foramen. It attaches to the superior tarsal plate of the upper eyelid (a thick plate of connective tissue).
* Actions: Elevates the upper eyelid.
* Innervation:The levator palpebrae superioris is innervated by the occulator nerve. The superior tarsal muscle (located within the LPS) is innervated by the sympathetic nervous system.

### *Recti Muscles*

There are four recti muscles; superior rectus, inferior rectus, medial rectus and lateral rectus. These muscles characteristically originate from the **common tendinous ring**. This is a ring of fibrous tissue, which surrounds the optic canal at the back of the orbit. From their origin, the muscles pass anteriorly to attach to the sclera of the eye

***Superior Rectus***

* **Attachments**: Originates from the superior part of the common tendinous ring, and attaches to the superior and anterior aspect of the sclera.
* **Actions:** Main movement is elevation. Also contributes to adduction and medial rotation of the eyeball.
* **Innervation:** Oculomotor nerve

*Inferior Rectus*

* Attachments: Originates from the inferior part of the common tendinous ring, and attaches to the inferior and anterior aspect of the sclera.
* Actions: Main movement is depression. Also contributes to adduction and lateral rotation of the eyeball.
* Innervation: Oculomotor nerve.

*Medial Rectus*

* Attachments: Originates from the medial part of the common tendinous ring, and attaches to the anteromedial aspect of the sclera.
* Actions: Adducts the eyeball.
* Innervation: Oculomotor nerve.

*Lateral Rectus*

* Attachments: Originates from the lateral part of the common tendinous ring, and attaches to the anterolateral aspect of the sclera.
* Actions: Abducts the eyeball.
* **Innervation**: Abducens nerve.

### *Oblique Muscles*

There are two oblique muscles – the superior and inferior obliques. Unlike the recti group of muscles, they do not originate from the common tendinous ring.

From their origin, the oblique muscles take an **angular** approach to the eyeball (in contrast to the straight approach of the recti muscles). They attach to the posterior surface of the sclera.

***Superior Oblique***

* **Attachments**: Originates from the body of the sphenoidbone. Its tendon passes through a trochlear, and then attaches to the sclera of the eye, posterior to the superior rectus.
* **Actions**: Depresses, abducts and medially rotates the eyeball.
* **Innervation**: Trochlear nerve..

***Inferior Oblique***

* **Attachments**: Originates from the anterior aspect of the orbital floor. Attaches to the sclera of the eye, posterior to the lateral rectus
* **Actions**: Elevates, abducts and laterally rotates the eyeball.
* **Innervation**: Oculomotor nerve.

*Intraocular muscles*

The intraocular muscles include the ciliary muscle, the sphincter pupillae, and the dilator pupillae. The ciliary muscle is a smooth muscle ring that controls accommodation by altering the shape of the lens, as well as controlling the flow of aqueous humor into Schlemm's canal. The ciliary muscle is attached to the zonular fibers which suspend the lens. Upon contraction of the ciliary muscle, the tension 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. 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.

There are three primary axes of ocular movements: vertical, transverse, and anteroposterior. Rotation around the vertical axis results in either adduction (medial movement) or abduction (lateral movement) of the eye. Rotation around the transverse axis causes elevation (superior motion) or depression (inferior motion). The anteroposterior axis enables movement of the superior pole of the eye medially (intorsion) or laterally (extorsion). The rotations around the anteroposterior axis allow the eye to adjust to tilting of the head. The medial rectus muscle is responsible for medial rotation around the vertical axis, and the lateral rectus lateral rotation. The superior rectus muscle primarily elevates the eye and contributes to adduction and intorsion. The inferior rectus depresses and laterally rotates the eye and contributes to adduction and extorsion. The superior oblique abducts, depresses, and medially rotates the eye, while the inferior oblique abducts, elevates, and laterally rotates the eye.