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DEPARTMENT: NURSING 200L

MATRIC NO: 18/MHS02/048

COURSE: ANA 210

1A. IMPORTANCE OF VASCULATURE IN IMMUNE SYSTEM

Immune-mediated inflammation of peripheral tissues depends upon local recruitment of circulating leucocytes into an extravascular site. In most instances, leucocytes 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 leucocyte 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 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, microvessels(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 tha immune response. While much of this emphasis has been on the roles played by parenchymal cells in peripheral tissues, cells of the blood wall are also positioned to affect lymphocytes and recent observations have provide a deeper understanding of how blood vascular ECs, PCs and SMCs interact with infiltrating T cells in adaptive immune responses that occur near microvessels of inflamed peripheral tissues and within the wall of inflamed macrovessels. 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 against 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. Heterogenity 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.

1B. IMPORTANCE OF VASCULATURE IN RELATION TO COVID-19

An individual can survive with a single lung quite well, providing the lung is a top condition. Lungs are easily damaged, Covid-19, the disease at the centre of the current corona virus outbreak is a case in point. Patients in serious condition have inflamed lungs whose tiny alveoli fill with water and pus, and are unable to make the oxygen exchange effectively. The first two patients to die from the virus in China were healthy adults, but they were long-time smokers. Dr. Raymond Tso, a US-trained Hong kong specialist in respiratory medicine, streses that smoking is the single worst thing we can do for our lungs. Corona viruses cause acute and chronic respiratory, central nervous system (CNS) diseases in many species of animals, including humans. There had long been speculations about the association of human, coronaviruses with more serious human diseases such as multiple sclerosis, hepatitis, or enteric diseases in new-borns. However, none of these early associations had been substantiated. The recently identified covid-19, there have been reports of two new human coronaviruses associated with respiratory disease. This virus has been difficult to propagate in cell culture, and there is little information available about the biology of this virus. Covid-19 is associated with serious respiratory symptoms, including upper respiratory infection, bronchiolitis, and pneumonia. While primarily associated with infections of children, has been detected in immunocompromised adults with respiratory tract infections. That group has suggested that this virus is associated with Kawasaki’s disease in children; however, this has been disputed by two other reports. While little is known about the pathogenesis there have been detailed studies of the pathogenesis of some of the animal affected with coronaviruses, which may contribute to the understanding of the virus.

2. 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.

STRUCTURE

It is an intermuscular cleft situated on the medial aspect of the middle third of the thigh on anterior compartment of thigh, and has the following boundaries:

- Anteromedial wall- Sartorius

- Posterior wall- adductor longus and adductor magnus.

- Laterally – Vastus medialis.

It is covered in by a strong aponeurosis which extends from the vastus medialis, across the femoral vessels to the adductor longus and magnus.

- Lying on the aponeurosis is the sartoris (tailor’s) muscle.

CONTENTS

The canal contains the subsartorial aretery (superficial femoral aretery), subsartorial vein (superficial femoral vein), and branches of the femoral nerve (specifically, the saphenous nerve, and the nerve to the vastus medialis). The femoral artery with its vein and the saphenous nerve enter this canal through the superior foramen. Then, the saphenous nerve and artery and vein of genus descendens exits through the anterior foramen, piercing the vastoadductor intermuscular septum. Finally, the femoral artery and vein exit via the inferior foramen (usually called the hiatus) through the inferior space between the oblique and medial heads of adductor magnus.

BORDERS

The adductor canal is bordered by muscular structures:

Anteromedial: Sartorius

Lateral: Vastus medialis

Posterior: Adductor longus and adductor magnus

N:B- The adductor canal serves as a passageway for 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 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.

3. DESCRIBE THE EXTRAOCULAR MUSCLES AND INTRAOCULAR MUSCLES WITH THEIR NERVE SUPPLY

A. The exraocular 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- the levator palpebrae superioris, superior rectus, inferior rectus, medial rectus, lateral rectus, inferior oblique. Functionally, they can be divided into two groups:

LEVATOR PALPEBRAE SUPERIORIS

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

INNERVATION: The LPS is innervated by the oculomotor nerve (cn III). The superior tarsal muscle (located within the LPS) is innervated by the sympathetic nervous system.

MUSCLE OF EYE MOVEMENT

There are six muscles involved in the movement of the eyeball itself. They can be divided in two groups; the four recti muscles and two oblique muscles.

RECTI MUSCLES

There are four recti muscles; superior 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, he muscles pass anteriorly to attach to the sclera of the eyeball. The name recti is derived from the latin word ‘staight’- this represents the fact that the recti muscles have a direct path from the origin to attachment. This is in contrast with the oblique eye muscles, which have an angular approach to the eyeball.

- Superior rectus

Innervation: oculomotor nerve (CN III)

- Inferior rectus

Innervation: oculomotor nerve (CN III)

- Medial rectus

Innervation: oculomotor nerve (CN III)

- Lateral rectus

Innervation: abducens nerve (CN III)

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 rings. 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 sphenoid bone. Its tendon passes through a trochlear, and then attaaches to the sclera of the eye, posterior to the superior rectus.

Actions: Depresses, abducts and medially rotates the eyeball.

Innervation: Trochlear nerve (CN IV)

INFERIOR OBLIQUE

Innervation: Oculomotor nerve (CN III)

B. 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 Schlemn’s canal. The ciliary muscles are supplied by parasympathetic postganglionic myelinated nerve fibers from the ciliary ganglion.

- The iris sphincter muscle receives its parasympathetic innervation via the short ciliary nerves which leads to pupillary constriction and accommodation. The parasympathetic fibers that serve the sphincter muscles.

- The dilator muscle is innervated more specifically by postganglionic sympathetic nerves arising from the superior cervical ganglion as the sympathetic root of ciliary ganglion. From there, they travel via the internal carotid artery through the carotid canal to foramen lacerum.