

Ocularizing the cavernous sinus: A teleologic tale

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Teleology is an urge to see meaning in whatsoever *Mother Nature* does. It is a search for poetry in what seems prosaic. It can't be utilitarian, but if you were to allow a pun, teleology is beautilitarian, for when rightly taken it can help you and your patients, too. Teleology is philosophy to be intellectually enjoyed without the urge to 'scientifically' verify it by hurting an animal.

To the pooh-poohers of the teleological treatise, it may benefit to listen to two physiologists, starting with the Austrian von Brucke: "Teleology is a lady without whom no biologist can live. Yet he is ashamed to show himself with her in public". Cannon, the American physiologist, who mused masterly over *The Wisdom of Human Body*, is down to earth: "My first article of belief is based on the observation, almost universally confirmed in present knowledge, that whatever happens in our bodies is directed towards a useful end."

The vertebrate head is literally filled with venous sinuses. At one spot a sinus has chosen to be cavernous even before Adam was born. The two Corpora Cavernosa Cranii, polarly matching the two Corpora Cavernosa Caudii in both Adam and Eve, lodge themselves bang behind the eye to allow it to merrily drain its veins into the cavernous sinus. The cranial and caudal are cavernous-look-alikes, raising the distinct possibility that the enormously expanded endothelial surfaces therein leave enough room for cells that secrete heparin-like substances that stall any intravascular thrombosis even when these turn turgid over extended periods of time.

The whole biological kingdom bears out a comprehensible truth: In Nature, functional necessity is the mother of structural innovation. The vertebrate eye is a series of fluid chambers held under ideal pressures to inflate the chambers optimally, but preventing any excess of pressure therein. Towards that end, the eye would need the veins to drain into a large lake, a sump or a sluice, so that at no times the veins throw a back-pressure into the eye. The cavernous sinuses themselves heighten this assurance by interconnecting themselves round the sella turcica to create the 'Venous Circle of Relief', matching the 'Arterial Circle of Willis.'

Each cavernous sinus thus becomes the integral tail of the eye, as important to it as the tail is to a whale or a monkey. The interconnection between the two cavernous sinuses mimics the

optic chiasma by uniting the two eyes into a common venous pool and allowing the venous circle of relief to be also seen as the venous chiasma.

The most beautiful eye in the animal kingdom is of the squid or loligo, as beautiful as the human eye, but measuring as much as a foot in diameter (Nobel prizes have been won by working on the giant neurons of the squids). One can postulate that the squid-head must be having mechanisms parallel to Corpora Cavernosa Cranii, which must be helping the squid as the fastest swimmer in ocean, surpassing even a whale.

This fascinating sinus that is the arch protector of all the pasclean systems of the eye- anterior chamber, lens, posterior chamber, the whole eyeball itself- deserves an acronym that sums up its *raison d'être*. We have chosen to call it the ocular pasclean stability assuring system/sump/sluice (OPSAS), in short. A shorter acronym would be ocular-venous access lake (OVAL). Cavernous sinus stands ocularized, as an integral structural and functional part of the eye.

The OPSAS or OVAL has chosen to be in good company for several reasons. The contained internal carotid artery imparts its throb ceaselessly to the sinus, providing its contents with the *vis-a-latere* that helps the sinus drain itself into the jugular with the vigor, if not the speed of an arterial system. The ocular sensory/motor nerves-III, IV, V, VI are contained and caressed by the sinus assuring their decongestion in states of heightened venous pressure.

OPSAS not only subserves the ocular pasclean systems, but also the nerves that work for the eye and hence all the intrinsic and extrinsic muscles, not to miss the whole orbit and its other contents, including the retro-orbital pad of fat that serves as an articular cup in which the eyeball has the free-est movements.

The liver gets 80% of its oxygen from the portal vein, a mere 20% from the hepatic artery. Hepatic artery ligation - once upon a time a practiced move for combating ascitis accompanying cirrhosis - is compatible with survival of the liver (and its owner). Ligating the portal vein assuredly promises massive liver necrosis and death. So for the eye. The thrombosis of the retinal artery leads to retinoplegia, leaving the rest of the eye intact. Cavernous sinus thrombosis knocks out the whole eye -ophthalmoplegia-to

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throw out of action even the extrinsic eye muscles, to give the face that frightening steady stare of the swollen, edematous, waxy eyes. Here, too, the vein scores over the artery, lock, stalk and barrel.

William Boyd, the poetic pathologist, mused over the fact that despite the microbial biomass outweighing the total animal biomass by a factor of 100, most of us sail through life unbothered by the microbial ocean (They are the host; we the pampered and tolerated guest). The human nose has over 200, the mouth has over 400 species of microbes; sinusitis is universal, bad teeth a rule, conjunctivitis and the like rampant. And yet none of these manage to go up to the cavernous sinuses. Ergo, they must be somehow resisting the microbial onslaught. It must be too powerful a microbe and too poor immunity of the patient that must be giving rise to the dreaded cavernous sinus thrombosis that so very often fails to infect the opposite sinus and the eye despite the intercommunicating venous circle of relief. *Viva le cavernous sinus.*

If the cavernous sinus serves the eye; eye-to-the-sinus, it plays equally significant role, chest-to-the-sinus, seeing to it that the highest intrathoracic (and hence intracaval) pressure as during a deep Valsalva maneuver or an Olympian lifting a weight of 400 Kg fails to be transmitted to the eye. In the foregoing, the face swells up, the neck veins are manifestly turgid, the sweat pours from the face, but the eyes remain serenely unbloated and functionally totally fidel. There could be a valve (like the saphenous valve) protecting the cavernous sinus from the pressure build-up in the chest and the venae cavae.

A coronal view of the sinuses, as is very colorfully available in all texts especially the *Gray's Anatomy*, shows them to be strategically placed just above the sphenoid sinus which opens into the attic of the nose. While the human body may be dressed from head-to-foot, this is one area that cannot be shielded from the temperature of the incoming air. The cavernous sinuses sense this temperature, balance it with the venous (their own) and arterial (carotid) temperature to guide the anterior pituitary into releasing optimum quantum of hormones to mediate, among many other things, the thermostasis of the individual; Nature has made full use of the juxtapositioning of pituitary, veins, artery and an air sinus into closest structural and therefore functional proximity. May be that this symphony also carries thermal messages to the rest of the brain to allow it to regulate its blood flow and to divert its conscious

and autonomic areas towards the well-being and survival of the individual.

Some years ago, a review of embryology over the past 200 years opined that we understand precious little of this miracle, worm to whale (The hackneyed terms ecto-meso-and entoderm have been declared persona non grata, by Gray, Romer and others). There is trite statement that the cavernous sinus develops from the anterior head vein. This learned statement explains away the development of cavernous sinus, without explaining it at all. The student of embryology needs to be encouraged as to why, amongst veins known to be erratic in their embryogenesis manage to be precisely formed into a sinus on either side of sella turcica, drain the eyes and chose to be, unlike any other intracranial sinus, cavernous on the one hand and widest amongst the sinuses on the other.

Some semantic clarification is in order. Skinner, in his *The Origin of Medical Terms* bemoans he fact that the magnificent intracranial venous sinuses have been wrongly named, for, a sinus clearly means a pocket or sail that is inherently a cul-de-sac. Each intracranial venous sinus can be renamed as an intracranial vena magna. The cavernous sinus is this *cavernous vena magna*.

The cranial caverna venae magna differ from their caudal counterpart in the sense that the latter do become, during sexual excitement in both sexes, cul-de-sac to provide to the individual recurrent, reversible, cavernous hemangiomas. Such lake-like arrangement of vascular spaces is to be found in the palm and sole where a very well-defined arterial capillary hemangiomas enriches the palmar/plantar surface to form a pasclean system that bears all the pressure-shocks that these two surfaces are heir to. It's a visual treat to squeeze-out blood from them to render the palm/sole pale and then to see them refill under your vision. They also explain why the darkest skin may have the pinkest palm. Any 'abnormal' hemangioma anywhere else in the body is a mere ectopic variation of what normally prevails in the body from head-to-foot.

Ravindranath Tagore poetized that 'in the kingdom of my lord, a blade of grass is no less than the stars in heaven'. In the kingdom called the vertebrate body, the non-descript cavernous vena magna holds the key to the well-being of the body's 'most noble' (Ramon Y Cajal) sense organ-retina - on the one hand and the panoply of many important metabolic, vascular and thermostatic functions on the other.

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