Anatomico physiological aspects of siravedha W.S.R to neuromuscular disorders

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Abstract
Siravedha/bloodletting is a worldwide favoured medical practice having its origin from the prehistoric era. Among many of its accomplished functions, Sushruta (the father of surgery) has also prescribed it in some Vatavyadhi (i.e., diseases predominantly causing pain/Shula due to Vata predominance). Vagbhat advised Raktamokshana/bloodletting as a treatment modality that relieves pain & redness immediately (Sadya Raga Ruja Samana). Throwing some light on the anatomical & physiological considerations lying behind the effectiveness of therapeutic bloodletting in neuromuscular conditions (Vatavyadhi) is of immense value for sustenance of para-surgical procedures in modern day medical practices.

Keywords: Vatavyadhi, Raktamokshana, Siravedha, Phlebotomy, Neuromuscular disorders.

Introduction
Siravedha or Bloodletting, the taking of blood from a patient with therapeutic intent, was a practice carried out over millennia (AFI, 2003). It is an important part of treatment protocols prescribed under Unani, Ayurveda, and traditional Chinese & Hildegard medicine. According to G. Greenstone-2010. Egyptian history tracing back to 3000 years ago cites practicing of venesection/therapeutic phlebotomy, then continued with the Greeks & Romans, the Arabs & Asians, then spread through Europe during the Middle Ages & the Renaissance. It reached its peak in Europe in the 19th century but subsequently declined & today in Western medicine is used only for a few selected conditions (hemochromatosis, polycythemia vera, porphyria cutanea tarda, etc). Acharya Sushrut. The Father of Surgery have given immense value to the anatomical & functional aspects of Sira and described it under two chapters in Sharir Sthana of Sushrut Samhitaa as “Sira Shariram” & “Sira Vedhyavidhi Shariram”. His compendium is regarded as one of the oldest treatise dealing with surgery. As such he have emphasized on specific areas where venesection should/shouldn’t be done. The treatise’s insight, accuracy & details of the regions allotted for venesection in different neurological disorders should be analysed by both literary & clinical studies. Although speculations are raised on the efficacy of Siravedha in combating different types of diseases; but till date many clinical studies claim reduction in pain/numbness, etc with cases like sciatica, migraine, low backache, rheumatic conditions, etc. Thus, the sole purpose of this study is to propose the anatomical entities involved in Siravedha for different neuromuscular disorders & physiological changes that could be attributed to its actions in pain management, etc in these cases.

Review of literature
In Ayurveda, Siravedha is prescribed for many types of diseases including neuromuscular disorders like Avabahuka (Frozen shoulder/Brachialgia), Visvachi (Brachial neuralgia or neurtitis), Bahusosha (Muscular wasting of arm/forearm), Gridhrasi (Sciatica), Khanja (Limping), &Pangu (Paraplegia). Siravedha as such implies puncturing of Sira for bloodletting. It is a type of Raktamokshana (bloodletting), which is described under the Sodhana/purification processes of body in Ayurveda. Sushruta considers Raktamokshana as

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a regimental therapy in the months of autumn for purification of body humour (Dosha) & is also advocated as Ardhachikitsa or half of the treatment for surgical cases. Ayurvedic Acharya’s have used the word Sira for different vessels of body in different contexts. As such, it becomes a necessity to come to a common conclusion for which vessels to be punctured while performing Siravedha.

Sira: the word originates from the Vedic word Hirā, which means blood carrying channel towards heart (Kumar, 2013).

Etymology:
‘Sira’, word derived from “सू+क+टप्प” meaning ‘Rakta Vahini Nadi’ (T. Sharma)
“सर्वपल्लिदेशीयनामानानात्मवत्सुयते” by Kaviraj Gagndhara (T. Sharma)
“स दि यह निरिः करिलस गिंते कंठाल तथा। स्रावेण्या वा बहुतेवा आत् सर्वनामः स्नूता।” by Sushruta (Murthy, 2004).

From the aforesaid descriptions given by different Acharyas about Sira, it seems to be a tubular structure where movement occurs and it is capable of transmission of Rakta, Dosha & Dhatu. There is also different views regarding the origin of Sira, Sushruta have accepted Sira to start from Nabhi or Umbilicus and Vagbhat opines it to origin from Hriday/Heart.

“तस्य नामचेतुः, ततः प्रसरणसप्नथस्थितेऽवक्तः” by Sushruta (Murthy, 2004).
“नामोष्णस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यস्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यस्यs
Vyadha Pramana (size of puncture) according to place:

In Mamsala Sthana: लम्बाय (0.24cm) (AFI, 2003)
Rest of the places: अधमयमत्र (0.12cm) (AFI, 2003)

or ब्रह्म प्रशार्य 

Over Asthi (bones): अधयमत्र by कुटाकायन 

In muscular areas, puncturing should be the size of Yava (barley grain), in other areas it shall be half Yava or one Vrihi (paddy/rice) using a Vrihimukha Shastra (trocar or puncturing needle). Veins over the bones should be punctured to the size of half Yava by using a Katharika (small surgical axe). From the above descriptions, it can be concluded that the depth of puncturing shouldn’t exceed 0.24cm or 2.4mm (thus, venesection should only be performed on superficial veins which becomes prominent with application of pressure). For proper bloodletting of a place, Sushruta opines that it should be done for 1 Muhurta (AFI, 2003) & maximum blood flow to be allowed is limited upto 0.24cm (AFI, 2003)

Veins to be punctured in different neurological disorders: The specific veins described for puncturing in different parts of body have special affinity to decongest the organ or part & stimulate it to reorganize due to its closed proximity to the affected areas.

Avabahuka (Frozen Shoulder or Brachialgia): Frozen Shoulder or Adhesive capsulitis causes pain & stiffness in shoulder. Pain is usually located over the outer shoulder area & sometimes upper arm. Process: done by Brihimukha Yantra: 2Angul above Kshipra Marma (Padasyaangusthaangulyo Madhye) or Asmyo Antare: The first place described above lies 2Angul above the midpoint of the angle formed between thumb & index finger towards the dorsum of palm. The major superficial vein present in this area is cephalic vein. The second place to be punctured is advised as a place in between the two scapulas, thus the vein to be punctured may be probably a cutaneous vein (as dorsal scapular vein is deep seated in this area).

Visvachi (Brachial Neuralgia or Brachial Neuritis): In case of Brachial neuralgia the lower motor neurons of the brachial plexus (C5 to T1) &/or individual nerves or nerve branches are involved. It is characterised by unilateral shoulder pain, followed by paralysis of shoulder & parascapular muscles. It is thought to be an immune-system mediated inflammatory reaction against nerve fibres of the brachial plexus.

Process: venesection is to be done at 4 Angul above and below elbow joint. The major vein that is superficial in this region & becomes prominent with application of pressure is median cubital vein. Two sites for puncturing were advised may be due to the fact that: median cubital vein which is a superficial vein overlying bicipital aponeurosis in the roof of cubital fossa shows variable forms in pattern of joining the cephalic vein to basilic vein (H-type or M-type). Hence, its exact location can’t be assessed.

Bahusosha (Muscular wasting of shoulder/forearm): Muscle wasting in hand is multifactorial, viz., stroke, spinal cord injury, injury of shoulder or hand, rheumatoid arthritis, poliomyelitis, etc. Mostly muscles supplied by brachial plexus are affected in these cases.

Process: venesection to be done in between two scapulas (“अंसोसं: अंजने”). The main vessel to be punctured in these cases may be cutaneous blood vessels as dorsal scapular vein that accompanies dorsal scapular artery is deep seated in this area.

Gridhrasi (Sciatica): Sciatica, a condition of leg pain, alongwith tingling, numbness or weakness of leg that originates in the lower back & travels through the buttock & down the large sciatic nerve in the back of each leg. Nerve roots compressed in this case mostly are L4 – L5 & S1- S3.

Process: venesection to be done 4Angul above & below Janu Sandhi (knee joint). The major vein present here are branches to great saphenous vein (superficially) & femoral vein (deep) above knee and tributaries to great saphenous vein (superficial) & anterior tibial vein (deep) below knee. Thus, most probably great saphenous vein is to be punctured in cases of sciatica.

Khanja (Limping) and Pangu (Paraplegia): Limp is a type of asymmetric abnormality of the gait mainly due to pain, weakness, neuromuscular imbalance, or a skeletal deformity. Paraplegia is the impairment in motor or sensory function of the lower extremities. It is usually caused due to spinal cord injury, congenital conditions, CVA, etc. The area of spinal cord mainly affected in paraplegia is thoracic, lumbar or sacral regions.

Process: Venesection to be done 4 Angul above Gulpha (ankle joint) in the Jangha (crus). The
superficial vein to be punctured in these cases is tributary to great saphenous vein.

**Physiological changes due to bloodletting:**
Bloodletting works according to the principle of Tanqiya-e-Mavad, i.e. evacuation of morbid matters from the affected area. It also improves circulation to the area & provides better nutrition to the area, where it is applied. A study by Ma et al., 2006, showed that Acupuncture (a type of Chinese bloodletting process) in mice with focal cerebral ischemia could reduce the release of Tumor Necrosis factor-α/TNF-α. It also showed an increase of HSP70 (heat shock protein in brain) messenger ribonucleic acid (mRNA) expression in the cortex & hippocampus. This indicates that acupuncture can boost HSP70mRNA expression in the brain through regulation of calcium channels by HSP70 to achieve nerve protection. It also promotes human metabolism & increases heart rate, systolic blood pressure, & blood supply to brain. Through the nerve-body fluid regulation, it improves microcirculation & vascular function, which helps to remove harmful free radicals from the blood. It also causes increase in partial O₂ pressure & a decrease in H⁺ concentration in regions of ischemia. It further eases hypoxia & acidosis due to ischemia (He et al., 2002), adjusts homeostasis of K⁺ & Na⁺ in ECF, & reduces the development of cytotoxic edema (Ma et al., 1997).

Pricking to draw blood can reduce nitric oxide (NO) concentration, improve nitric oxide synthase (NOS) activity, & reduce damage caused by free radicals on tissue. It also decrease the malondialdehyde (MDA) concentration, increase super oxide dismutase (SOD) activity, clear free radicals, & reduce lipid peroxidation. Acupuncture is one of the induced physiological stresses that can stimulate HPA axis, by triggering hypothalamus to secrete CRH (corticotropic-releasing hormone) that then stimulate anterior pituitary pelvic to release ACTH (adrenocorticotropic hormone). ACTH in turn stimulates adrenals to release glucocorticoids. Glucocorticoids enhance immune functions & inhibit the production of pro-inflammatory cytokines.

**Results and Discussion**
Neuropathic pain is a complex, chronic pain state that usually accompanied by tissue injury. It is the result of disease or injury to peripheral or central nervous system & the lesion may occur at any point. These types of pain are than characterized by humans as spontaneous pain, allodynia (increased response of neurons), & causalgia (severe burning pain). Spontaneous pain includes sensations of ‘pins & needles’, shooting, burning, stabbing & paroxysmal pain often associated with dysesthesias (abnormal unpleasant sensation) & paresthesias (abnormal dermal sensations). A normal pain circuituaries involve activation of nociceptors (noxious substances like K⁺, H⁺, S-HT, bradykinin induces pain stimuli in free nerve endings)→ Na⁺ influx & K⁺ ion outflow causing depolarization of first order neurones→ which ends in trigeminal nucleus of brainstem or dorsal horn of spinal cord→ voltage gated Ca²⁺ channels activates & release glutamate→ glutamate binds to NMDA (N-methyl-D-asparate) receptors on the second order neurones causing depolarization→ these go upto third order neurones in thalamus, which in turn connects to limbic system & cerebral cortex. The clinical expression of spinal segmentation sensitization includes hyperalgesia, pain at mild touch, referred pain, & dysfunction of motor & autonomic nerve function. Sustained CNS sensitization caused by pain enhances the excitation of neurons & enlarges the receptor pool of neurons, thus inducing intractable referred pain (Coderre, 1993). The inhibitory pathway prevents pain signal transmission in the dorsal horn. Anti-nociceptive neurons originate in brain stem & travels down the spinal cord synapsing with short interneurons in the dorsal horn by releasing serotonin & norepinephrine (mood elevators or antidepressants). The interneurons modulate the synapse between the first-order neuron & second-order neuron by releasing gamma amino butyric acid (GABA), an inhibitory neurotransmitter.

Based on the previous stated facts neuropathic pain can be relieved by blocking neurotransmission at 3 levels: the local periphery, the spinal segment, & the CNS:

**At periphery level:** bloodletting therapy expels the blood with a high concentration of pain producing substances, improving local circulation, & helping to repair damaged tissue.

**At spinal segment:** when noxious stimulation & stimulations initiated by puncturing signalare are sent to the same or nearby spinal segments,
puncturing or pricking significantly reduces pain, thus reversing spinal segmental sensitization. **At CNS level:** The puncturing or pricking signal can be sent into the cerebrum through the ventrolateral funiculus. In the frontal abdominal side of the medulla oblongata, periaqueductal gray matter of midbrain & the thalamus, noxious stimulation & puncturing/pricking signal gathers in the same cells & nuclear groups. When they take effect at the same time, noxious stimulation will be depressed by puncturing/pricking signal, thus reversing CNS sensitization (Parapia, 2008).

HSP70 are normal intracellular proteins produced in greater amounts when cells are subjected to stress or injury (Morang, 2005). These proteins are assumed to protect cells from thermal or oxidative stress by inducing protein folding. Therefore, as bloodletting increases the level of HSP70 protein in body it ensures neural protection by initiating cell protection machineries. Moreover TNF-α is not only a proinflammatory mediator but also a pain mediator. It is involved in the generation & maintenance of inflammation-related pain & is released by numerous nociceptors (Schaible, 2010). Bloodletting results in decrease in production of TNF-α thus further accentuating neural protection along with hindering pain signal transmission. From the above depicted experimental evidences it may be deduced that *Siravedha* or bloodletting can prove as an effective modality in cases of neuropathic pain (*Vatavyadhi*) management & associated sensory or motor features. These anatomical & physiological considerations along with other unknown factors may be responsible for clinical evident management of *Vatavyadhi* through *Siravedha* as proposed by our classics.

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