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A REVIEW ARTICLE ON NEELAA AND MANYA MARMA WITH RESPECT TO INTERNAL CAROTID ARTERIAL DEFICITS

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ABSTRACT

Introduction: *Mookata* (Complete loss of voice), *Swaravaikrita* (Defective voice) and Arasagrahita (Loss of taste sensation) are *Abhighata Lakshanas* (symptoms of injury) of *Neelaa Manya marma*. They are mentioned as *Vaikalyakara Marmas* (deformity) of the head & neck region. They are also included as *avedya sira* (vessels to be avoided during surgical procedure), as injury will lead to either deformities or death. In a comprehensive study done on *Shiromarma Abhinaya Lakshanas in 100 patients with intracranial neurological disorders at SDMACH, Udupi, Karnataka (2014-2017), eight individuals were observed with the incidence of Mookata, Swaravaikrita and Arasagrahita having notable pathological changes in the calibre* and patency in the Doppler study of the carotid arteries[1,2]. **Aims and objectives**: To understand *Neelaa Manya Marma Abhinaya Lakshanas and to localise the structures involved in the lesions of neurological origin from the CT, MRI scan of the brain & Doppler imaging study of the* carotid artery in the *marma* region.

Materials and methods: Concerned Literary works, books, journals, and CT MRI scans and Doppler imaging studies collected from patients suffering from intracranial diseases were reviewed, and related information was collected and analyzed scientifically.

Results and Discussion: In the pathogenic sequel of injury to any *Marma sthana*, aggravated vayu diffuses into the surrounding areas and spreads throughout the body via *siras* (vessels). Both Neela and many are included among the Vaikalyakara Marmas as well as they come under the category of *Madhya siras* (vessels supplying to trunk area). Here the vitiation of *Dhamanis* (vessels) such as *Vatavaha* (vessel carrying life force), *Rasanagrahana*

(vessels responsible for taste sensation), *Bhashya* (vessel accountable for speech), *Gosh* (vessel responsible for voice artriculation) located in the neck region near the *Marma Sthana*, may be one of the reasons for the symptoms such as *Mookata, Swaravaikrita* and *Arasagrahita.* The branches of the internal carotid artery supply to the cortical, sub-cortical, as well as the thalamic & sub-thalamic areas of the brain. Any occlusion of these vessels will undoubtedly result in the ischemia or infarct of the areas of its supply, causing functional deficits such as Aphasia, dysphonia, dysphagia, etc.

Conclusion: This was a review article based on the observational study representing the fact that it was possible to clinically assess the *Neelaa Manya marma abhinaya lakshanas* on patients diagnosed with intracranial lesions with internal carotid arterial deficit, especially notable pathological changes in the calibre and patency in the Doppler study of the carotid arteries.

Keywords: *Neelaa and Manya marma abhighata lakshanas, intracranial lesions, internal carotid artery, CT, MRI, Doppler imaging study*

INTRODUCTION

Background for the Study: *Mookata* (Complete loss of voice), *Swaravaikrita* (Defective voice) and *Arasagrahita* (Loss of taste sensation) are *abhighata lakshanas* (symptoms of injuy) of *Neelaa* and *Manya marma*. *Neelaa* and *manya* are mentioned as *vaikalyakara marma* (debilitating vital points) of the *urdwajatru pradesha* (head & neck region). Any injury to a *vaikalyakara marma* leads to deformities. In the pathogenic sequel of the injury to any *marma sthana*, *vayu* gets aggravated first. Then it gets diffused into the surrounding areas and later spreads throughout the whole body via the *siras* (vessels) traversing through the *marma sthana*. By gaining momentum, the *vayu* causes various kinds of severe pain. When the pain becomes unbearable, the functioning apparatus of the body slowly collapses, i.e. there will be the destruction of *shareera dhathu*, and the person loses orientation and becomes unconscious, finally resulting in the death of the person. Owing to the predominance of *soma tatva* (water element) in the *vaikalyakara marma sthana*, the life is supported because of its *sthiratva guna* (firmness) and *shaitya guna* (coldness). Still, even then the injured person sustains some deformity. Both *Neelaa* and *Manya* are mentioned, where *sira vasthu* is predominant. Vitiation of *sira* by the aggravated *vayu* will result in many diseases. Also, there are *dhamanis* such as *vatavaha* (vessel carrying life force), *rasanagrahana* (vessels responsible for taste sensation), *bhashya* (vessel responsible for speech), *gosh* (vessel responsible for voice artriculation) located in the neck region, which when vitiated by the *vayu* may be one of the reasons for the symptoms such as *mookata, swaravaikrita* and *arasagrahita*[1].

In a comprehensive study done on *Shiro marma abhinaya lakshanas in 100 patients with intracranial neurological disorders at SDMACH, Udupi, Karnataka (2014-2017), eight individuals who were observed with the incidence of Mookata, Swaravaikrita and Arasagrahita having notable pathological changes in the calibre* and patency in the Doppler study of the carotid arteries. The carotid artery- internal carotid artery is one of the main blood vessels for the brain in the anterior aspect. This artery divides into anterior and middle cerebral arteries, which supply the cortical, subcortical, and thalamic areas of the brain. Any occlusion or stenosis will certainly result in the ischemia or infarct of the areas of its supply. The possibility of correlating the carotid artery with these two *marma* could have been verified if the analysis of the Doppler studies of the carotid artery were available in more patients[2].

AIMS & OBJECTIVES:

To Screen for *Neela* and *Manya abhighata lakshanas* in patients suffering from neurological lesions of the brain.

To localise the area of the lesion with the aid of a CT scan, MRI Scan & Doppler Imaging study.

To compare the Neurological defects with *Neela* and *Manya abhighata lakshanaa* and to localise the structures involved in the lesions of neurological origin including the carotid artery pathologies.

MATERIALS & METHODS

- Literary works, books, and journals, including all published on the concept related to the subject, were reviewed, and related information was collected and analysed scientifically.
- CT MRI scans and Doppler imaging studies collected from patients suffering from intracranial diseases such as Cerebrovascular accidents, Injuries, tumors, etc. were reviewed, and related information collected during the study period (2014-2017) was analyzed scientifically.
- Inclusion criteria included all patients, irrespective of age and gender, who were diagnosed with intracranial pathology. Patients with identifiable with *Neelaa* and *Manya marma abhighata lakshanas* such *Mookata* (Complete loss of voice- Aphasia), *Swaravaikrita* (Defective voice- Dysarthria, Slurred speech, Inappropriate usage of words, Failure to voice common words etc.) and *Arasagrahita* (Loss of taste sensation- Ageusia).
- Exclusion criteria included patients not presenting any *Neelaa* and *Manya marma abhighata lakshanas*.
- Assessment criteria included to enlist the *Neelaa* and *Manya marma abhighata lakshanas.* A standard & detailed neurological examination Proforma was designed. Also, Glasgow coma scale was used for assessment of unconscious patients or those with impaired consciousness.
- Investigations included CT; MRI & Doppler imaging studies collected from patients.

LITERATURE REVIEW:

NEELAA & MANYAA MARMA

The word "*Neelaa*" means blue or dark blue color & the word "*Manya " refers* to 'honor' due to its connection with the voice also it refers to the name of a vein in neck. These are *Sira vasthu* predominant *marma* located on either side of *kanthanadi* (on both sides of the windpipe), thus there are 4 numbers (2 *neelaa & 2 manya*) one on each side[1]. The *pramana* (measurement) of these marma are mentioned to be as *swa-panitala pramana* (size of palm of the person) for each *marma*. The *vidha lakshana* or effect of injury is said to be *VAIKALYAKARA* – producing symptoms such as *MOOKATA* (loss of speech), *SWARAVAIKRITA* (defective voice) & *ARASAGRAHITA* (loss of taste sensation). Acharya Susrutha has used the term '*dhamani*' for describing the character of these 2 *marma*[1]. Acharya Vagbhata in Ashtanga Sangraha as well as Ashtanga hridaya follows the same way of description[3]. Here the *marma* are said to be located near the lower jaw.

Table No: 1. Comparison of *sthana* and *viddha lakshana* of *Neela manya marma*[1].

Sl. No	*Name of marma*	*Location of marma*	*Number of marma*	*Predominant Marma vasthu*	*Pramana of marma*
1.	*Neela*	On either side of *kanthanadi*	2	*Sira*	*Swa-panitala*
2.	*Manya*	On either side of *kanthanadi*	2	*Sira*	*Swa-panitala*

Table No: 2 Regional anatomical structures related to shirogata marma sthana[2]:

Name of marma	*Mamsa vasthu*	*Sira vasthu*	*Snayu vasthu*	*Sandhi vasthu*	*Asthi vasthu*

Neela and Manya	Posterior belly of digastric muscle Superior belly of Omohyoid muscle	Common carotid arteries & its bifurcation into external & internal carotid arteries	Deep cervical fascia, Glossopharyngeal, Hypoglossal, Superior Laryngeal nerves	Trachea, Cartilaginous rings	Cartilage, Cervical vertebrae

NEELA AND MANYA AS AVEDYA SIRA

Acharya Susrutha mentions the concept of *Avedhya Sira* (vessels which should be avoided while doing surgeries in the 7th chapter of *Shareera Sthana*[4]. Injury of these vessels leads to either death due to excessive bleeding or other functional deficits and structural deformities due to lack of blood supply resulting from severe hemorrhage. Among the 96 *Avedhya sira*, 8 are located in the neck region and *neela manya* are 4 such vessels to be protected from any surgical instruments[4].

Anatomy of neck region and internal carotid artery[6,7]:

The neck is the bridge between the head and the rest of the body. It is located in between the mandible and the clavicle, connecting the head directly to the torso, and contains numerous vital structures. It contains some of the most complex and intricate anatomy in the body and comprises numerous organs and tissues with essential structure and function for normal physiology[5]. Structures contained within the neck are responsible for breathing, speaking, swallowing, regulation of metabolism, support and connection of the brain and cervical spine, and circulatory and lymphatic inflow and outflow from the head[6].

The carotid arteries are the primary vessels supplying blood to the brain and face. The right common carotid artery (RCCA) originates in the neck from the brachiocephalic artery while the left common carotid artery (LCCA) arises in the thorax from the arch of the aorta. Furthermore, both right and left common carotid arteries bifurcate in the neck at the level of the carotid sinus into the internal carotid artery (ICA), which supplies the brain, and the external carotid artery (ECA), which supplies the neck and face[7].

The internal carotid artery, being one of the most clinically relevant and vital arteries, supplies oxygenated blood to crucial structures such as the brain and eyes. The internal carotid arteries are branches of the common carotid arteries that bifurcate into the internal and external carotids at the level of the carotid sinus[8]. After this bifurcation, the internal carotids traverse through the base of the skull to reach the vital organs that they supply.

After the bifurcation of the common carotid, the internal carotid continues through the carotid sheath to enter the carotid canal of the temporal bone. It does not have any branches in the neck. Within the cranial cavity, the two internal carotid arteries anastomose with the two vertebral arteries to form the circle of Willis, which supplies the brain with oxygenated blood. The internal carotid artery gives off its first branch, the ophthalmic artery, just distal to the cavernous sinus. The ophthalmic artery is the primary blood supply to the eye, extraocular muscles, lacrimal gland, upper nose, and parts of the forehead. Following this the internal carotid artery branches into the middle cerebral artery and the anterior cerebral artery. The middle cerebral arteries primarily supply the motor and sensory cortices for the upper limb and face, in addition to supplying Broca's area in the dominant frontal lobe and Wernicke's area in the dominant temporal lobe, whereas the anterior cerebral arteries supply the regions of the brain primarily responsible for motor and sensory of the lower limbs[9].

The internal carotid has been described by the Bouthillier classification to consist of seven distinct parts based on angiographic appearance. This classification includes the entire internal carotid artery using a numerical scale based on the direction of blood flow and describes the segments anatomically and based on the compartments through which they travel. Each segment branches into different vessels; these branches are generally small, inconstant, and can often be not present[10]. The classification system goes as follows[7]:

- C1, Cervical: From the common carotid bifurcation to the entrance of the carotid canal
- C2, Petrous: From the entrance to the carotid canal to the posterior edge of the foramen lacerum.
  - Branches include the caroticotympanic artery and the vidian artery.
- C3, Lacerum: From the posterior edge of the foramen lacerum to the superior margin of the petrolingual ligament
- C4, Cavernous: From the superior margin of the petrolingual ligament to the proximal dural ring (anterior clinoid process)
  - Branches include the meningohypophyseal trunk and the inferolateral trunk.
- C5, Clinoid: From the proximal dural ring (anterior clinoid process) to the distal dural ring (cavernous sinus roof)
- C6, Ophthalmic: From the distal dural ring (cavernous sinus roof) to just proximal to the origin of the posterior communicating artery
  - Branches include the ophthalmic artery and the superior hypophyseal trunk.
- C7, communicating: From the proximal origin of the posterior communicating artery to the internal carotid bifurcation
  - Branches include the posterior communicating artery, anterior choroidal artery, anterior cerebral artery, and the middle cerebral artery.

A branch of the internal carotid arteries, the ophthalmic artery, provides oxygenated blood supply to the extraocular muscles, some facial muscles, as well as the intrinsic muscles of the eye. The extraocular muscles of the eye include the superior rectus, inferior rectus, lateral rectus, medial rectus, superior oblique, and inferior oblique. The facial muscle that is mostly covered by the ophthalmic artery is the levator palpebrae superioris, a muscle that functions to elevate the superior orbit. Some examples of intrinsic muscles of the eye that are supplied by ophthalmic artery include ciliary muscle, iris sphincter, and the radial pupillo dilator muscles[7].

DISCUSSION

Anatomical features of the internal carotid artery and its origin from the carotid bifurcation are of particular surgical importance. Characteristics such as the height of the carotid bifurcation, morphometric values of the internal carotid artery, aberrant or torturous courses, and detailed anatomy of the carotid sinus require consideration[7]. These features play an essential role in pathological mechanisms such as carotid atherosclerosis, which is usually most severe within 2 cm of the bifurcation; these plaques can encroach on the lumen of the internal carotid artery and extend caudally into the common carotid artery[11].

These characteristics can be analyzed pre-operatively using diagnostic modalities such as computerized tomographic angiography (CTA), magnetic resonance angiography, and ultrasound. Deciding upon which modality to use can depend upon applicability to a specific disease, availability, and patient characteristics such as metal implants, renal function, and allergy to contrast. However, the gold standard modality is currently the three-dimensional CTA[7].

The carotid bifurcation is an anatomically and surgically important landmark as it is involved in a variety of physiological and pathological processes. The height of the carotid bifurcation is highly variable, and extreme variations are important in determining appropriate surgical techniques such as the decision for carotid endarterectomy and carotid stenting. Additionally, the geometry of the carotid bifurcation is an important factor in blood hemodynamics and wall shear stress, which can commence or promote atherogenesis. The carotid bifurcation is also the location of chemoreceptors and baroreceptors

detecting blood oxygen and pressure levels to help regulate homeostasis. Surgical denervation of the carotid bifurcation can be a treatment of carotid sinus syndrome[7].

The internal carotid arteries are of vital importance for oxygenated blood supply to the brain, and so they are of major importance in clinical evaluation. They are susceptible to atherosclerosis, which can cause stenosis and embolization of plaque distally towards the brain. Particular pathologies in which the internal carotid artery should undergo evaluation include, but are not limited to, stroke, transient ischemic attack, penetrating neck trauma, and hypovolemic shock[12].

Several physical exam maneuvers, such as the carotid pulse check and carotid auscultation, can be done to assess the carotid arteries. The carotid pulse is palpable at approximately 60 to 70 mmHg systolic blood pressure; loss of carotid pulse can be an indication of severe hypovolemic shock or cardiac arrest. While an unequal carotid pulse check can indicate atherosclerosis, aortic dissection, arteritis, or embolus[13]. Carotid auscultation can elicit a carotid bruit, which can indicate turbulent, non-laminar blood flow through a stenotic artery, arteriovenous connections, or flow disturbances transmitted from the aortic valve or subclavian artery. In addition to the auscultation of bruits, these sounds are occasionally palpable as a thrill. It is important to be aware that these sounds may occasionally be normal, such as the venous hum in a child[14].

Penetrating neck trauma is another important pathology that warrants carotid investigation. Current literature advises to use the 'no zonal approach' due to superior patient outcomes; however, this still can vary by the institution[15]. Any patient with a penetrating neck trauma that is unstable, including patients with stable vitals who present with hard signs, should be taken to the operating room for surgical evaluation. Hard signs that represent an unstable patient with penetrating neck trauma include stridor, apnea, gurgling, expanding hematoma, pulsatile bleeding, frank shock, stroke, and frank mediastinitis. In a stable patient with only soft signs, it is advisable to conduct a CTA for evaluation. If the patient is stable and lacks soft signs, then just observation is indicated. Soft signs can include the following: dysphonia, subcutaneous air, non-expanding hematoma, oozing vessels, and dysphagia[7].

Occlusion of middle cerebral artery: The occlusion of middle cerebral artery occurs commonly. It produces the following signs and symptoms)

- *Contralateral hemiplegia and hemianaesthesia* involving mainly the face and arm, due to involvement of most of the primary motor and sensory areas.
- *Aphasia,* if left dominant hemisphere is involved—due to involvement of motor and sensory speech areas.
- *Contralateral homonymous hemianopia* due to involvement of optic radiation.

Severe stenosis of the carotid artery is a significant cause of stroke and transient ischemic attacks, and it is one of the most common causes of death worldwide and the most common cause of long-term disability[17]. The presence of severe impending occlusion of the internal carotid arteries due to atherosclerosis with associated neurological symptoms can necessitate surgical intervention. Carotid endarterectomy was found to be of some benefit for participants with 50% to 69% symptomatic stenosis, and highly beneficial for participants with 70 to 99% stenosis without near-occlusion. However, data showed no benefit in participants with carotid near-occlusion. In patients who are unable to undergo an open surgical procedure due to contraindications, carotid angioplasty and stenting may be potential options[16].

Mookata (Complete loss of voice), *Swaravaikrita* (Defective voice) and *Arasagrahita* (Loss of taste sensation) are *abhighata lakshanas* (symptoms of injury) of *Neelaa* and *Manya marma*. *Neelaa* and *manya* are mentioned as *vaikalyakara marma* of the *urdwajatru pradesha* (head & neck region). Any injury to a *vaikalyakara marma* leads to deformities. In the pathogenic sequel of the injury to any *marma sthana*, *vayu* gets aggravated first, and then it gets diffused into the surrounding areas and later spreads throughout the whole body via the *siras* (vessels) traversing through the *marma sthana.* By gaining

momentum, the *vayu* causes various kinds of severe pain. When the pain becomes unbearable, the functioning apparatus of the body slowly collapses i.e. there will be destruction of *shareera dhathu* and the person loses orientation and becomes unconscious finally resulting in the death of the person. Owing to the predominance of *soma tatva* (water element) in the *vaikalyakara marma sthana*, the life is supported because of its *sthiratva guna* (firmness) and *shaitya guna* (coldness), but even then, the injured person sustains some kind of deformity. Both *Neelaa* and *Manya* are mentioned as *marma* where *sira vasthu* is predominant. Vitiation of *sira* by the aggravated *vayu* will result in associated diseases. Furthermore, both *neela* & *manya* are named as *avedhya sira* (vessel which should be avoided during surgical procedures). Injury to these vessels itself are considered as either life threatening and or loss of functional integrity. Acharya Susrutha mentions that the neck region is also related to structures such as *vagvaha and rasavaha sira* (vessels responsible speech and taste sensation respectively). Injury of both results in affliction of *vayu* leading to the symptoms such as *mookata, swaravaikrita* and *arasagrahita*[17]. Under the category of *urdwagata dhamanees*, Acharya Susrutha quotes about 6 vessels namely *dhamani* related to *rasa grahana* (taste related), *bhashana* (speech related) and *kosa* (related to scat). Their trauma also leads to impairment of their respective functions[18]. All these are consistent with the various signs and symptoms mentioned for occlusion of internal carotid artery and its branches. Functional deficits such as aphasia, dyphonia, dysphagis etc few of the signs mentioned. This is due to the fact that area of supply is related to these functions.

When in case *Neela* & *manya* are taken as *sira marma vastu* then the concept of *samaya sira marma abhighata lakshanas* mentioned by Acharya Vagbhata[19] are consistent with the hard signs of penetrating neck trauma.

CONCLUSION

This was an observational study representing the fact that it was possible to clinically assess the *Neelaa* and *Manya marma abhighata lakshanas* on patients diagnosed with intracranial lesions with arterial deficit.

Statistical analysis of the clinical symptoms and the pathological findings obtained from the CT, MRI scan & Doppler imaging study, gave a gross idea about the probable area of lesion corresponding to the *Neelaa* and *Manya marma abhighata lakshanas*, which is the carotid artery.

Scope of the study:A study can be taken up for collecting sufficient data to clarify and clinically assess *Neelaa* and *Manya marma abhighata lakshanas* on patients diagnosed with intracranial lesion with carotid arterial deficit.

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