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RESEARCH ARTICLE

Identifying the anatomical structures involved in Anantavata – A Neuroimaging based clinical study.

Dr. Sushama Ramdas Pakade[1], Dr. Vishal Wasudeorao Hend[2]*, Dr Sachin Rangrao Patil[3], Dr. Meera Subhashrao Solanke[4]

[1]M.S. Ph.D. Scholar, Assistant Professor, Shalyatantra Department , BSDT'S Ayurveda Mahavidyalaya Wagholi Pune
[2]MD, Assistant Professor, Department of Rachana Sharira, Mahesh Ayurved College, Ashti
[3]MD, Ph.D (Scholar), Associate Professor, Department of Rachana Sharira, College of Ayurved Pune Satara-Road Pune 43, Bharati Vidyapeeth Deemed to be University Pune
[4]MD, Ph.D (Scholar), Professor, Department Kayachikitsa, Yashwantrao Chavan Ayurved Medical College Nipani Bhalgaon, Chatrapati Sambhaji Nagar

*Corresponding Author
Dr. Vishal Wasudeorao Hend

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Abstract: Anantavata is recognized as a severe type of Tridoshaja Shiroroga. Although the classical literature describes the complex manifestations of this disorder, the anatomical and neuroanatomical substrates of this condition have not been elaborated yet.This study aimed at identifying the structural and neurovascular abnormalities associated with Anantavata as per clinical presentations in patients diagnosed with this condition using high resolution magnetic resonance imaging (MRI).***Methods:*** Cross-sectional observational study was conducted in 30 patients aged between 18 and 70 years with typical clinical presentation of Anantavata. Severity of Manya pida, Ghatasu ruja, Gandasya parshva kamp, Ashukari akshi/bhru pida, Shankha desha pida, Hanugraha, and ophthalmic manifestations of this syndrome (Lochan rog) was assessed using Visual Analogue Scale (VAS) and "Faces" Pain Rating Scale. Structural and neurovascular abnormalities were identified using Magnetic resonance imaging of the brain.***Results:*** Neurovascular conflict affecting the trigeminal nerve (5th cranial nerve) was observed in the majority of the subjects examined. Abnormal cerebellar arterial loops with impingement onto the trigeminal root entry zone accounted for the most frequently observed structural abnormality (36.66%, n=11), with dolichoectasia of the vertebrobasilar artery being the second (13.33%, n=4). Focal lesions of fat intensity in the pontine region, extra-axial mass lesions in the cerebellopontine angle, and deep white matter hyperintensities were found in 10%, 7%, and 23.33% (n=7) of patients, respectively. No structural abnormalities were found in 23.33% (n=7) of the subjects.***Conclusion:*** The typical clinical presentation of Anantavata corresponds to the modern concept of neurovascular compression syndromes including trigeminal and facial nerves. MRI offers essential information regarding the structural pathogenesis of this condition.

Keywords: Anantavata, Shiroroga, MRI Brain, Ayurveda, Trigeminal Neuralgia

INTRODUCTION

Acute Anantavata is Vata-Pitta Predominant Tridoshaj disease classifies among eleven types of Shirorogas by various Acharya. Anantavata represents a complex, debilitating cranial pain disorder. According to classical texts including the, Sushruta Samhita , and Ashtanga Hridaya , and various other. The pathogenesis (Samprapti) of Anantavata is driven by a predominant vitiation of Vata and Pitta doshas located within the posterior cervical region (Manya). Aggravated Vata, coupled with Pitta, travels along the vascular and neural channels (Siras) traversing the nape of the neck, radiating intensely toward the temporal region (Shankha), eyebrow (Bhru), and orbit (Akshi). Clinical manifestations frequently include localized muscle twitching or facial spasms (Ganda Spandana), eye pain, stiffness of the jaw (Hanugraha), and intense burning or throbbing sensations along the affected facial and cranial zones.

The shiras is the highest among the organs of the body and is considered as the center of all the sense organs including the netra (eyes), karna (ears), nasa (nose) and jihwa (tongue). According to Vagbhat, the body is considered as the tree which is upside-down in nature and shiras is considered as the root of the body (urdhvamoola) since any kind of injury to the shiras causes death just as any kind of injury to the root of the tree causes its death. The shiras is also considered as the adhistana for the prana vayu.

While traditional Ayurvedic literature provides comprehensive accounts of the clinical presentation and management of Anantavata, mapping these classical insights onto modern human anatomy remains vital for integrative clinical diagnosis and contemporary research. The symptom complex of Anantavata shares striking parallels with modern neurovascular pain syndromes, particularly trigeminal neuralgia, occipital neuralgia, and temporomandibular joint dysfunction accompanied by muscular spasm. Structures such as the Greater Occipital Nerve (C2 segment), the ophthalmic (V1) and maxillary (V2) divisions of the Trigeminal Nerve, the Superficial Temporal Artery, and suboccipital musculature mirror the classical descriptions of Manya, Shankha, Bhru, and Akshi involvement.

Trigeminal neuralgia previously termed as tic douloureux, is chronic condition that is characterized by recurrent episodes of electric shock like pain. The condition affects the structures that are innervated by

fifth cranial nerve (CN V). The nerve has three component or divisions: V1, V2, V3:

- V1 – Ophthalmic division – Innervates eye, upper eyelid, and forehead.
- V2 – Maxillary division – Innervates Lower eyelid, nostrils, upper lip, upper gingivae and cheeks.
- V3 – Mandibular division – Innervates Lower lip, Lower gingivae, muscles of mastication and jaw.

Trigeminal nerve compression followed by subsequent nerve demyelination is the cause of trigeminal neuralgia in most cases. Schwann cells, a type of glial cell, secrete neurotrophic factors that encourage axon regeneration and create the myelin sheath surrounding peripheral nerves.

MRI has proven to be essential in the clinical management of trigeminal neuralgia, being helpful in the identification of anatomical causes of the pain and distinction of classical, secondary and idiopathic TN cases. Using quantitative MRI it was possible to establish structural changes like demyelination and axonal injury in the affected trigeminal nerve, which are consistent with pathological findings and correlate with the treatment outcome.

The diagnosis of TN is made on the basis of the medical history. The use of imaging studies is beneficial in diagnosing classical and secondary TN (tumors, multiple sclerosis) as well as assisting in surgical decompression. High resolution T2-weighted MRI is the imaging study of choice in such case. CT is not sensitive enough to assess the brainstem and cisterns. However, when MRI cannot be used due to certain reasons, one should conduct a CT cisternogram in order to depict trigeminal nerves and cisternal vessels.

METHODOLOGY

Study Design and Ethical considerations: - A systematic cross-disciplinary framework was applied to evaluate classical Ayurvedic conceptualizations of Anantavata alongside contemporary human neurovascular and musculoskeletal anatomy. Presented study is evaluation of 30 Patients with classical sign and symptoms of Anantavta. Grossly the studyis conducted in two stages: Literature review and Observational clinical study.

Literature Review: Detailed study of Anantavata from samhitas and published articles. Study of related references from available texts online. Modern concepts of trigeminal neuralgia were studied and reviewed from authentic sources from PubMed, Research gate, Google scholar etc.

Observational clinical study: Thirty patients showing clinical symptoms of anantvata were selected randomly from OPD of Kayachikitsa, Shalakya and Rognidan departments in the hospital of Ayurveda Institute. Case papers of individual patients were prepared with information about Lakshana (symptoms) and M.R.I. Brain reports details and written consent of the patient. Data collected was analyzed and presented. Known cases were randomly enrolled for the study. Specialized performa of case paper and consent of the patient were taken. MRI was used for the method of radiological imaging to determine the involved structure and pathology.

Selection criteria

Inclusion criteria

- Patient with classical signs and symptoms of Anantavata as mentioned in classical literature.
- Age group between 18-70 Years.
- Patient were selected irrespective of religion, gender, and socio-economic status.

Exclusion criteria

- Patient not presenting with symptoms of Anantavata were excluded,
- Patients with a congenital, traumatic, functional, neoplastic pathology were excluded.
- Patients which are contra indicated for Radiological investigations like patients with cardiac pacemaker, intracranial aneurysm clip, cochlear implant.
- Non -cooperative patients.

Clinical Assessment

A grading scale was used to access the severity of symptoms of Anantavata that are Ghatasu ruja, manya sampeedana. Ashukari akshibhruvi peeda, ashukari sankhdesh peeda, gandasya parshve kampa, hanugraha, lochana roga.

Following scales were used for assessment of each sign and symptom. Lochana Roga was assessed as Present or Absent.

a) Pain Visual Analogue Scale

Patients were asked to grade their intensity of pain in number 0-10. Location, onset, duration, variation and quality of pain were record

Table 1: Description of VAS Scale in terms of intensity

0	No Pain
1–3	Mild Pain
4–7	Moderate Pain
8–10	Severe pain

(Over all grading for mild pain 1, moderate 2 and severe 3).

"Faces" Pain rating scale

Patient were asked to choose the face that best describes own pain. The associated rating was recorded.

Table 2: Rating description for Faces Pain Rating Score

Face 0	Very happy because he is not hurt at all.
Face 1	Hurt just a little bit
Face 2	Hurts even a little more
Face 3	Hurts even more
Face 4	Hurts a whole lot
Face 5	Hurts as mush as can't imagine

Neuroimaging Protocol

Magnetic Resonance Imaging was used for our study for interpretation.

Case Record

Form was divided in three sections:

1st – General information i.e., name, age, religion, education, occupation, marital status.

2nd – Data regarding symptoms of Anantavata

3rd – MRI findings were recorded.

Image 1: Wong-Baker FACES Pain Rating Scale

RESULTS

Literary Study

From the literature review, it can be concluded that the ideas regarding the disease Anantavata in the classical Ayurvedic literature are very close to the neurology concepts about the disease trigeminal neuralgia (TN).

Based on the information presented in the classical Ayurvedic literature, Anantavata is the severe form of Shiro-roga that is marked with the pain arising from the Manya (neck) and located in the Akṣi (eye), Bhru (eyebrow), Shankha (temple), Kapola (cheek), Karṇa (ear), and Hanu (jaw), which are the localization areas for V1 (ophthalmic), V2 (maxillary), and V3 (mandibular) branches of the trigeminal nerve. It is necessary to note that the disease is associated with the aggravation of Vata Dosha with the involvement of Pitta and Kapha Doshas, which causes acute radiating pain in the face. Therefore, the concept of Anantavata in the classical has some similarities with the TN that is described as the disease caused by the attacks of pain triggered by the stimulation of the trigeminal nerve.

According to the literature review, TN is to be the most suitable clinical manifestation of Anantavata because of the similarities in the symptomatology, localization of the disease, course, and treatment principles. The contemporary literature refers to Vata pacifying procedures including Nasya, Murdhni Taila, Shiro Pichu, Karnapuraṇa, Gandusha, and internal medicines as the basic approaches to treating the disease. However, it should be noted that there is no evidence regarding the effectiveness of Ayurvedic treatment of TN because of the lack of randomized controlled trials and case reports. Nonetheless, almost all articles state that the treatment results in the decrease in the intensity of pain, frequency of attacks, and usage of analgesics. It should be noted that the lack of evidence is caused by the absence of randomized controlled trials, standardized diagnostic, outcomes and mechanistic studies of both Ayurvedic concepts and neurophysiology.

Clinical Presentation

In this study, a total of 30 patients from Anantavata were enrolled. Following thorough clinical examinations, all thirty patients were registered, and their findings were recorded. Essential charts and graphs were made after the observations were documented. All the observations were recorded using a suitable statistical method.

Table 3: Showing Percentage of incidence of signs and symptoms of Anantavata with grading.

Manya Peeda	Nil	26.66
	Mild	44.66
	Moderate	13.33
	Severe	13.3
Ghatasu Ruja	Nil	16.66
	Mild	56.66
	Moderate	20
	Severe	6.66
Gandasya parshv kamp	Nil	0
	Mild	6.66
	Moderate	30
	Severe	63.33
Ashukari Akshi peeda	Nil	13.33
	Mild	63.33
	Moderate	23.33
	Severe	0
Ashukari bhru pida	Nil	0
	Mild	63.33
	Moderate	36.66
	Severe	0
Ashukari Shankha Peeda	Nil	0
	Mild	50
	Moderate	43.33
	Severe	6.66
Hanugraha	Nil	0
	Mild	6.66
	Moderate	46.66
	Severe	46.66
Lochana Roga	Present	70
	Absent	30

Table 4: Showing overall incidence of various MRI Findings

MRI findings	Number of cases	Percentage of incidence
Loop of cerebellar artery	11	36.66
Dolichoectasia of vertebral artery	4	13.33
Lipoma in Pons region	3	10
Extra-axial mass in cerebello-pontine angle	2	7
Hyperintense foci in deep white matter	7	23.33
No anomaly detectes	7	23.33

DISCUSSION

The integration of the classical principles of Ayurveda with the anatomy of neurovascular system provides an ideal anatomical correlation of the disease called Anantavata. As per the classical literature, Anantavata is a type of cranial pain disorder caused due to the vitiation of the Vata and Pitta in the Manya region of neck, which spreads to the craniofacial areas. Using the neuroimaging studies and nerve supply, it is possible to show that Anantavata is not just a localized muscle pain but the neuralgia of Trigeminal, Facial, and Cervical Nerves.

Manya Sampidan and Ghatasu Ruja (Cervical and Posterior Nuchal Pain)

Classic sources characterize the condition called Manya Sampidan by pain and tightness in the neck, intensified by swallowing. According to anatomy, these symptoms are caused by the spasm of deep cervical muscles and suboccipital muscles. Cervical branch of Facial Nerve

(CN VII) provides sensory innervation to platysma muscles and other surrounding tissues; thus, any local neuromuscular hypertonicity results in radiating pain in the neck. Additionally, Ghatasu Ruja is characterized by pain in the back of the neck and in the area of Krikatika. In this case, the pathology develops along the anatomical pathway of the Greater Occipital Nerve (C2) while it passes through the trapezius muscle, producing severe radiating pain that spreads to the vertex of the head.

Gandasya Parshva Kamp (Lateral Facial Twitching and Spasms)

Gandasya Parshva Kamp – one of the key symptoms of Anantvata – is defined as the twitching and trembling of muscles in the lateral areas of the cheeks. The symptoms develop because of the irritation or damage of the maxillary (V2) and mandibular (V3) divisions of the Trigeminal Nerve (CN V), as well as branches of Facial Nerve (CN VII). The maxillary nerve penetrates through the Infraorbital Foramen and supplies sensory innervation to the midface. Compressing of the neurovascular branches leads to the instability of innervation, causing the cheek twitching.

Akshi Pida, Bhru Pida, and Lochan Roga (Ophthalmic and Supraorbital Pain)

The development of sharp pain in the eye (Akshi Pida) and eyebrow region (Bhru Pida) indicates the involvement of the Ophthalmic Division (V1) of the Trigeminal Nerve. The largest branch of ophthalmic nerve is the frontalis nerve; it gives out Supraorbital nerve that provides sensory innervation to the eyebrow, upper eyelid and forehead. Classic symptoms of Lochan Roga, such as lacrimation, blinking and redness of the conjunctiva arise because of the hyperirritation of the V1 pathway, responsible for sensing mucosal and cutaneous stimuli of the cornea, eyelids and conjunctiva.

Shankhdesha Pida (Temporal Pain)

Temporal Pain (Shankhdesha Pida) involves both myofascial and neurovascular disorders. In the temporal fossa, there is fan-shaped temporalis muscle, which is the primary muscle of mastication and is innervated by deep temporal nerves, originating from mandibular division (V3) of the Trigeminal Nerve. Myofascial tensions, trigger points in the temporalis muscle, as well as neural conflict of V3 motor and sensory branches cause severe throbbing pain in the Shankha area.

Hanugraha (Jaw Lock and Trismus)

The mandibular nerve (V3) of the trigeminal nerve exits from the cranial cavity through the foramen ovale and divides into several motor nerves supplying the four chewing muscles: the masseter muscle, temporal muscle, medial pterygoid muscle, and lateral pterygoid muscle. Inflammation of the motor root of the V3 nerve disrupts the functioning of the temporomandibular joint (TMJ). It leads to restricted mouth opening along with severe pain during jaw movement, which is typical for Hanugraha.

Neuroimaging Findings

Abutment of Arteries and Arterial Loops: There is one major discovery seen on the MRI scan: the loop of cerebellar arteries (from the basilar artery) compressing the Root Entry Zone (REZ) of the Trigeminal nerve. Pulsating arterial pressure in the REZ causes localized demyelination and results in neuralgic pain.

Dolichoectatic Vertebrobasilar Syndrome: The stretching and dilatation of vertebro-basilar arteries leads to compression of brain stem and middle cerebellar peduncle; further mechanical stretching, thinning and displacement of Trigeminal (CN V) and Facial (CN VII) nerves occur in the process of exiting from the brain.

Pontine and Cerebellopontine Angle (CPA) Lesions: Fatty tissue deposits in pons (nuclei of trigeminal motor and sensory nerves) and extra-axial lesions in CPA cistern cause direct nerve distortion and give rise to various polyneuropathy syndromes.

Idiopathic Presentation: As far as 23% of clinically confirmed Anantvata patients do not show any abnormalities on the MRI, one may assume that dysfunction of Vata-Pitta and microvascular spasms and/or myofascial entrapment cause all the manifestations of the disease.

CONCLUSION

This integrative study proves the structural association between classical concepts of Anantavata and modern neurovascular anatomy. Based on the correlation of classic descriptions of the clinical signs, such as Manya Sampidan, Shankhdesha Pida, Akshi/Bhru Pida, Gandasya Parshva Kamp, Hanugraha, with the corresponding anatomical structures, Anantvata proves to be a syndrome of peripheral nerves and vessels causing craniogenic headache and neuralgias. The Samprapti, which traditionally explained Vata-Pitta disorder originating in the neck region (Manya), corresponds to the pathology of suboccipital nerve entrapment and cranial neuralgias. Irritation of the Greater Occipital Nerve (C2) leads to the pain in the posterior part of the head (Ghatasu Ruja). In addition, the spread of pain to temples (Shankha), eyebrows (Bhru) and eyes (Akshi) coincides with the functional regions of the nerve divisions of the Trigeminal Nerve (CN V): Ophthalmic (V1), Maxillary (V2) and Mandibular (V3). Neuromuscular symptoms, such as facial twitching (Ganda Spandana) and jaw tightness (Hanugraha), indicate the impairment of both sensory and motor functions of peripheral nerves. Facial twitching may happen due to the damage of facial (VII) nerve, and jaw tightness – because of the irritation of the V3 nerve that supplies the chewing muscles. Neuroimaging studies show the presence of the structural abnormalities in the vascular loops of the cerebellar arteries, vertebrobasilar dolichoectasia, and pontine lesions in the proximity of the trigeminal root entry zone in the cases of severe Anantavata. However, the presence of the typical signs

in the patient with the normal MRI results proves the significance of the functional disorders of peripheral nerves, which includes microvascular spasm, soft tissues entrapment, and neuromuscular hypertonicity. The correlation of classical symptomatology with modern gross anatomy gives an explanation for the usage of traditional therapeutic methods. Nasya Karma affects the neural structures located in pterygopalatine fossa, whereas Marma stimulation and local Snehana-Swedana treatments help to relieve the myofascial trigger points and peripheral nerve entrapments in the suboccipital and temporofacial regions. Integration of the classical information about Ayurveda with modern neuroanatomy provides the improved diagnostic pattern of the disease and creates a background for the further integrative medical research. Clinical trials with neuroimaging and electrophysiological examination will help to develop the integrative treatment protocol for patients with craniogenic pain disorders.

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