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Literary Analysis of Neuroanatomy in Syurveda

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Abstract

Neuroanatomy deals with morphological study and organization of nervous system including brain, spinal cord, ganglia, Nerve etc which is formed basically by gray matter and white matter. Anatomical discussion in relation to neuroanatomy in Ayurveda bears limited consideration. Available references highlight neurological aspect mostly from functional and applied preview. The present research work elucidates all the available terminology which comes in relation to neuroanatomy with interpretation from much proximal entity.

"Sira" is the most common term used for head [brain]. It also indicates head [brain] and neck together and even sometimes brain with cranium in specific. While describing the "dasa pranayatan" and "siro roga", it indicates the head with brain but however in relation to regional anatomy i.e. sadaanga or disease related to eye, ENT etc are understood with morbidity of head and neck together. "mastaka" and "mastishka" are the exact terminology for Brain. "mastishkagata sneha" indicate brain matter including gray matter and white matter. "mastulanga," "mastiska majja" mentioned by Dalhan may incorporate with cerebral cortex and medullary core respectively. "Mastiska randhra" is better to understand for frontanalle specifically anterior frontanalle. Motor and sensory nerve identify with "sanga vaha" and "chesta vaha srota" respectively. Nadi in applied aspect incorporate with vessels in Ayurveda but in Yogic anatomy emphasis for nerve fibre, cord or tract. "Sira" specially "vata vaha sira" clearly indicate volitional action of extremity and autonomous activities of viscera.

The present work highlights all this aspects emphasizing histology and dissection point of view

Keywords: Neuroanatomy, Ayurveda, Sira, Mastiska, Vata vaha sira, Clinical importance. .

INTRODUCTION:

Neuroanatomy deals with morphological and organisation of central nervous system and peripheral nervous system which includes brain, spinal cord, ganglia, nerve, etc. It is structurally composed of gray matter and white matter. The fundamental components with morphological entities are present scattered in Ayurveda in different contexts. A wide range of terminologies are available in texts emphasizing structural entities, location and composition highlighting functional and applied approach.

Analysis of these components in above arena is essential for better understanding of human anatomy.

AIMS: The present study aims to elucidate the structural entities related to nervous system in Ayurveda.

OBJECTIVES:

1. Literary study of structural entities related to nervous system in Ayurveda.
2. Interpretation of the Ayurvedic components with the best possible correlated structures of nervous

system.

3. Clinical importance related to nervous system was studied.

MATERIAL METHODS:

The study is designed to evaluate the terminology used for nervous system in Ayurveda from the structural and functional preview. Emphasis was given in context relating to morphological identity with applied aspect. Histological interpretations were also tried with the available references.

REVIEW & DISCUSSION:

NERVOUS SYSTEM RELATED SPECIFIC TERMINOLOGIES:

- **SIRA (SHIRA):** It is the most widely used component. Sira includes

a. Head including brain & neck (collectively)
b. Head with brain
c. Brain and cranium [skull]

- **Head including brain & neck**:

a) In context of sadangam (sastha sira iti), the 6th division of the body is defined as sira[1].
b) Headache, hemi crania, disease of oral cavity, nose, eye and ear, facial paralysis. lockjaw etc are the morbidity of sira which indicate it as head & neck.[2]

- **Head with brain:**

a) It is mentioned in relation to dasa pranayatana[3].
b) Charaka includes sira as trimarma which indicates head with brain including various types of marma.[4]
c) While describing 5 types of siraroga imparts diseases of head.[5]
d) "Sirasi sambhutan" Head is the place for generation of disease.[6]

- **Brain and cranium:**

"Pranah pranabhrit yatrashritah sarvendriyanicha yadutamangamanganam sirastadabhidhiyate".[7]

The vital part of the body is defined as sira where prana along with all sensory organs sustain. This clearly indicates the brain with cranium which regulates and governs all the functions of human being.

MASTAK OR MASTISKA [BRAIN MATTER]:

a) It is widely used terminology for brain matter and it was mentioned in relation to anjali pramana where mastak is measured as ardhajali (1/2 anjali) and same with sukra & ojha[8].
b) Dalhana highlights 'panchamastika', parswamastak' and 'kalamastak' that represents occipital lobe, parietal lobe and temporal lobe respectively.[9]

- **Cranium:**

a) In context of discussion of different body parts (pratyanga) Susruta counted mastak as one which indicates cranium.[10]
b) Acharya Vagbhata mentioned in relation to adhipati marma which is present inside the mastak in upper part.[11] Indu used the term 'antarmastak'. Adhipati marma is sandhi marma.[12]

- **MASTAKA SNEHA**:

Mastiska is better understood as mastakasneha exhibiting 'ghrita' in appearance.[9] Here white colour is due to the presence of fatty materials. However a neurolema sheeth is absent here. This indicates the

outer gray matter and inner white matter studded with cell body and nerve fibre which is basically lipid predominant.

- **MURDHA** – It is synonym of sira.[7]
- **MASTAKA RANDHRA**- It is mentioned by "Sarangadhara" (pratham khanda) and "Bhavaprakash'. Commenting on it Acharya Adhmalla says- in human body 10 openings persist, 9 external passages and one internal passage. Mastaka randhra which is also defined as brahmarandhra can be understood with anterior fontanelle which is an unossified area present at the antero-superior angle of parietal with superior angle of frontal bone.
- **MASTAK MAJJA**: It is synonym of mastulunga which clearly indicates brain substance. In the treatment of 'talupat' i.e. depression of fontanelle which occurs due to diminish of "mastulunga"; ghrita prepared with madhudravya is beneficial.[13] Commenting on it Dalhana says mastulunga appears as masatak majja ("mastulungabilenghritakara mastakmajja"). The mastakmajja or mastulunga can be identified as 'brain matter'.
- **PACCHYAD GRIVA OR PARSWA MASTISKA**: Dalhana mentioned these 2 terms indicating occipital lobe or parietal lobe respectively.[9]
- **CUDASTHANAM:** while describing 'bhagna nidana' in 'Madhava nidana' Srikantha Dutta quoted this term which can be understood as synonym of sira (head).
- **URDHA HRIDAYA**: In "urdha dasamuliy adhyaya" Bhela mentioned Urdha hridaya, which can be understood with Brain.
- **SIRA HRIDAYA**: While describing treatment of krimiroga of sirahridaya, nose, ear, eye etc the allocation of anjana, nasya and avipidana were mentioned where sirahridaya indicates head[15].
- **URDHA KAPHASAYA**: Acharya Jeevaka mentioned that the provocated vayu produces "pratichya" (rhinitis) involving urdha kaphasaya which indicate head.

1. **UTTAMANG:** It is used for head or head & neck mentioned collectively by Susruta and Caraka.[9]
2. **SIRASTALU**: In Bhela Samhita it is used for 'brahmarandhra' indicating fontanelle.
3. **SANGYAVAHA SROTANGSI**: The terminology emphasizes sensory nerve or automonous nervous system. However in control of sleep[16] it exhibits reticular formation also.
4. **CESTABAHA SROTANGSI**: This can be understood with motor nerve.
5. **NADI**: Commonly used term available in different contexts which indicates vessel, cord, meatus, canal or tube. In relation to nerve following references may be highlighted

- Sabdavahinadya- Understood with cochlear nerve.
- Netra Nadi- Optic nerve.
- Medhyanadi- Dalhana mentioned in the context of sleep which can be understood with white fibres of Cerebral Cortex or Spinal cord.
- In 'Shiva Sanghita' Dr Dhirendranath Banerjee mentioned that among the 3,50,000 nadi, following 14 are important –

1. Ida- The left sympathetic chain
2. Pingala- The right sympathetic chain
3. Sushumna- The spinal cord
4. Gandanari- Sympathetic nerve to the left eye.
5. Hastijihwa- Left sympathetic spinal system of cervical, brachial and lumbosacral plexus on the left

side from left eye to left great toe.

6. Kuhu- Pudendal nerve
7. Saraswati- Sympathetic fibre of cervical plexus supplying the tongue.
8. Pusha- Sympathetic nerve to the right eye.
9. Sakhini- Left auricular branch of cervical plexus
10. Payaswini- Right auricular branch of cervical plexus
11. Baruni- Branch of sacral nerve
12. Alambusha – Coccygeal nerve to anus and urogenital organs.
13. Bisabara- Sympathetic nerve of lumber plexus.
14. Yasaswi – Stretching from right thumb to right leg, brachial and lumbosacral plexus.

Thus in Tantrayoga it clearly exhibits that the term nadi is emphasised for nerve.

Functions of vata correlated with nervous system[17]:

Though vata is all pervading and responsible for all activities in our body however based on the names, sites and functions sharira vata is divided into 5 categories which undertakes almost all the functions of vata explained separately in Vata kalakaliya chapter of Charaka samhita. These functions of vata can be correlated with as below

Functions of prana vata :

Types of vata	**Relation with nervous system anatomy.**
1. **Buddhi dharana:** • Mano buddhi (sensory knowledge): tattva gyana, dharana, grahana, indriya buddhi. • Smriti(memory): anubhava (knowledge through direct perception, inference, analogy, verbal testimony)	PFA (pre frontal area). Hippocampus, cerebral cortex, Wernicke's area, physical cortex, anterior thalamic group.
2. **Chitta dharana:** holds function of mana (indriabhigraha- initiates and withdraws indriyas, gyana-intellectual, karma-motor) from perceiving their objectives and sends information to atma (intellectual, motor, emotional). swatya nigraha (self-control)	Heschl's gyrus, post central gyrus, insural cortex, pre pyriform cortex, amygdala cerebellum, hypothalamus dorsomedial aspect of thalamus associating with prefrontal gyrus, primary motor area, pre motor area, basal ganglion.
3. **Hridaya dharana:** holds functions of hridaya (heart).	Neurons lying in dorsal motor nucleus of the vagus nerve in reticular formation of medulla, caudal hypothalamus, vasomotor centre in medulla.
4**. Swasa** (respiration)	Respiratory centre located in the reticular formation of brain stem, dorsal group of respiratory neurons of medulla, pneumotaxic centre and apneustic centre of pons
5. **Anna pravesana** (mastication, salivation, deglutition)	Nuclei of trigeminal, facial, glossopharyngeal, vagus, hypoglossal, located in pons, medulla, other parts of brain.

6. **Kshavadhu** (sneezing)	Sneezing centre of CNS
7. **Nishteeva** (spitting)	Nucleus of facial nerve located in caudal portion of Pons
8. **Udgara** (belching)	Medulla (a polysynaptic visceral reflex)

Functions of udana vata :

Type of vata	**Relation with nervous system anatomy.**
1. **Vakpravritti-** (speech), 2. **Prayatna** (motivation), 3. **Urja,** 4. **Balakara,** 5.**Varnakara,** 6.**Smritikaraka**(sensory adaptation)	Motor fibres of the cranial nerves- facial, glossopharyngeal, vagus, and accessory, hypoglossalas a whole can be compared to cervical plexus as it is formed by these along with nerves arising from vertebrae C1-C4

Functions of vyana vata :

Type of vata	**Relation with nervous system anatomy.**
1. **Gati –** Voluntary movements of muscles, **Prasarana**(extension),**akunchana/ akshepana** (flexion/withdrawal), **vinamana** (bending),**Unnamana** (upward movement) **tiryaggamana** (lateral movement)	CNS, All these movements are nothing but the functions of motor neurons regulated by the CNS based on the sensory information received.
2. **Rasa samvahana** (Circulation of rasa) - Circulation of rasa along with other dhatus like rakta (according to Gayadasa) to nourish all the dhatus.	Motor nerve supply to the cardiac muscle
3. **Sweda asrik sravana** (effecting the outflow of blood and sweat) – this depends on effective contraction of heart and caliber of vasculature.	Thoraco lumbar sympathetic division and Vasomotor centre of ANS and parasympathetic divisions in turn are regulated by CNS. Hypothalamus
4. **Yoni sukra pratipadana** (deposition of semen inside the vaginal cavity) - here only the act of intercourse can be considered as the actual ejection of semen is the function of Apanavata.	Sympathetic flow arising from inferior horn cells of the spinal cord regulated by the CNS.
5. **Sroto vishodhana** (clearing the channels)	Sympathetic division and Vasomotor centre of ANS

Functions of samana vata :

Type of vata	**Relation with nervous system anatomy.**
1. **Annam grihnati** (receiving and withholding it in annavaha srotas)	Vagal, glosso pharyngeal supply of the GIT (gastro intestinal tract) , ENT (enteric nervous system)
2. **Annam pacchati** (helps in proper digestion by regulating production of digestive juices,]	Sympathetic, para sympathetic supply of glands of digestive system, myo-enteric

	plexus.
3. **Annam bibhechayati** (discrimination of essence and waste products of digested food by the absorption of essence, water etc and forming solid wastes)	Myo- enteric plexus, vagus nerve innervation
4. **Munchati** (passing away the contents)	Parasympathetic innervation of colon, myo- enteric plexus

functions of apana vata :

Type of vata	**Relation with nervous system anatomy.**
1. Mutra nishkramana (emptying of bladder) the urine formed by Samana vata is excreted out by the coordinative function of the Apana-Prana- Vyana vata.	Sensory fibres of the pelvic nerves, motor branches of the pudendal nerve (Central control is by the centres in cortical, pontine, spinal regions which can be considered as indriya dharana of prana) .
2. **Sakrit nishkramana** (bowel evacuation/ defecation) A process of evacuation of solid wastes from guda by coordinative function of the Apana-Prana-Vyana vata..	Pudendal nerve, nervi erigentes which inturn are under the control of CNS.
3. **Sukra nishkramana** (ejection of semen) the movement of sukra from vrishana to sishnendriya and its ejection.	Parasympathetic supply, nervi erigentes, sympathetic supply in L1-L2 level, pudendal nerve
4**. Artava nishkramana** (menstrual flow)	HPO axis
5. **Garbha nishkramana** (bearing down the foetus during labour)	Nerve supply to the muscles of uterus and abdomen, hypothalamus

TERMINOLOGIES OCCASIONALLY REPRESENTING THE COMPONENTS OF NERVOUS SYSTEM:

- **SIRA [vein]:** The term sira is mainly used for vein but sometimes can refer to nervous function as it helps in smooth functioning of nerve. Dalhana commenting on the function of vatavahasira says it control voluntary action of limbs and involuntary function of viscera and organs. This can be understood with volitional and autonomous function of nervous system.
- **DHAMANI [artery]:** Dhamani another terminology used normally for vascular structure while sometimes collaborates with nerve due to its wide spread functional presentation. For example 10 dhamani that originates from hridaya are related to nervous system function like prana, apana, mana, buddhi, chetona, and mohabhutas i.e. prithvi, jala, agni, vayu and akash as spokes of a wheel are attached to the centre[18]

HRIDAYA [heart]:

1 Hridaya is the place of sadaka pitta and thus control buddhi, medha, mana, utsah, avipret. According to yogashastra, hridaya is the seat for anahata chakra, it is like red lotus with 12 branches. In Amarakosa, the words chitta, hridaya and manas have been used in the same sense. Hridaya is responsible of chetana and also helps in sleeping[19].

2 Acharya Charaka tolds that saguna atma, chitta (mana) and its arthas are sheltered or supported in Hridaya[20]. Astanga Samgraha notes that 'sadhaka pitta' located in Hridaya, is responsible for buddhi (intelligence), medha (memory and intellect), abhiman [ego], utsaha (enthusiasm) and the achievement of one's aspirations[21]

3 Describing the pathogenesis of apasmara, unmad, Charaka noted that the morbid dosha lodged in dhamani affecting Hridaya cause disturbance in its function and the person is affected with stupor and derangement of mind. Hridaya is responsible for sensory perception. Vyana vayu present is in hridayaand is responsible for different function in body like nimesh[closing], unmesha [blooming]. [22]

- **Common neurological disease in ayurveda and its correlations:**

Ayurvedic term	**Modern term**	**Ayurvedic term**	**Modern term**
• Ardit	Bell's palsy	• Kampavata	Parkinsonism
• Avabahuk	Frozen shoulder	• Katishool	Lumber spondylitis
• Apatantrak	Hysteric convulsion	• Khanja	Limping
• Apasmar	Epilepsy	• Manyastamba	Neck rigidity
• Akshepa	Convulsion	• Pangu	Poliomyelitis
• Biswachi	Brachial neuritis	• Pakshaghat	Hemiplsagia, Paraplagia
• Gridhrasi	Sciatic syndrome	• Pakwasayagata vata	Irritable bowel syndrome
Grivashool	Cervical spondylitis	Sirograha	Trigeminal neuralgia
Hanugraha	Lock jaw	Sukragata vata	Sexual neurosis
Jibha sthambha	Glossal palsy	Twachagata vata	Peripheral neuritis

CONCLUSION:

The morphophysiological description of nervous components that have been mentioned are scattered in the classics. Different terminologies are found elsewhere in different texts of Ayurveda during the description of functional aspect or clinical aspect, which gives a glimpse of neuroanatomial components. Often the higher functions are attributed to Hridaya where mana is located i.e. psychic function or autonomous nervous function. The functions of vata can be correlated with the nervous system activities. It is observed that the functions of above mentioned structures bear limited description, though they were emphasized in therapeutic approach while describing the different disease and its treatments.

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