Nadis in Yogic Science and their Correlation with Modern Neuroanatomy

Dr. Deepali Gautam[1*], Dr. Ram Mohan Singh Kushwah[2], Dr Bharat Bhushan[3]

[1]MD Scholar, P.G. Dept. of Rachana Sharir, RGGPG Ayurvedic College & Hospital Paprola.

[2] H.O.D. and Professor, P. G. Dept. of Rachana Sharir, RGGPG Ayurvedic College & Hospital Paprola.

[3]Assistant Professor, Department of Agada Tantra, Shiva Ayurvedic Medical College & Hospital Bilaspur (H.P.).

[*]Corresponding Author

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ABSTRACT

In Yogic philosophy, Nadis are considered subtle channels for the flow of Pranic energy, with Ida, Pingala, and Sushumna regarded as the most significant. While their spiritual and physiological roles are emphasized in classical texts, their structural correlation with human anatomy remains less defined. This study aims to explore the structural perspective of Nadis and correlate Ida, Pingala, and Sushumna with relevant anatomical structures of the nervous system. A narrative review was conducted using classical Yogic texts, Samhitas, and Swasthavritta treatises, alongside contemporary scientific literature in neuroanatomy and physiology. Comparative analysis was applied to align Yogic descriptions of Nadis with modern anatomical structures and autonomic nervous system functions. Yogic texts describe Sushumna as a central channel extending from the Mooladhara to the Brahmarandhra, comparable to the spinal cord. Ida and Pingala, arising from the Mooladhara and spiraling around Sushumna to converge at the Ajna Chakra, were correlated with the left and right sympathetic trunks, respectively. Functional attributes also paralleled autonomic regulation: Ida was associated with parasympathetic activity and a calming influence, whereas Pingala aligned with sympathetic activation and stimulation. Evidence from physiological studies, such as unilateral nostril breathing practices, supported these correlations by demonstrating specific autonomic responses. Structural analogies were further observed between the Chakras and autonomic plexuses. The review highlights a significant correspondence between Yogic concepts of Nadis and modern neuroanatomy. Nadis may symbolically represent neural pathways, particularly the spinal cord and sympathetic chains, thus bridging traditional Yogic philosophy with contemporary scientific understanding.

Keywords- Ida, Pingala, Sushumna Nadi, Nervous System

INTRODUCTION

Nadis, vessels, or nerves are considered the structural pathways for the flow of energy within the body. Among them, *Sushumna* is regarded as the supreme channel and is most revered by *Yogis*, while other *Nadis* are considered subordinate. These principal *Nadis* are oriented downward, supported by the vertebral column, and symbolically represent the Sun, Moon, and Fire. [1] The innermost of these, the *Chitra Nadi*, is believed to contain the subtle hollow known as *Brahma Randhra,* which is described in the scriptures as a divine pathway. It is said to bestow the bliss of immortality, and through deep contemplation on it, a *Yogi* is believed to transcend worldly limitations and destroy all sins. The *Shad-Chakras* and *Nadis* described in *Yoga Samhitas* primarily highlight their physiological and spiritual dimensions. Therefore, the present attempt focuses on exploring their structural aspects and correlating these *Nadis* with human body organs.

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MATERIALS & METHODS

- Classical Yogic texts, Samhitas, and Swasthavritta textbooks were reviewed.
- Contemporary scientific literature and journals were consulted for interpretation.
- As Tantra Sharir in Rachana Sharir texts focuses mainly on functional and spiritual aspects, this study was undertaken to:

    1) Emphasize the structural perspective of Nadis.
    2) Correlate Ida, Pingala, and Sushumna with anatomical structures.

OBSERVATIONS AND RESULTS

A Nadi is defined as a channel through which energy flows. [2] It serves as the medium for the movement of Pranic energy (vital force). The practice of Pranayama helps regulate this flow of Prana, which often becomes disturbed due to improper diet and lifestyle.[3] [4] Among the numerous Nadis, Ida, Pingala, and Sushumna are considered the most important, functioning in association with the Shad-Chakras to maintain essential physical, mental, and autonomic functions.[5] A relational hypothesis may be drawn here, suggesting that the movement of axoplasm within the axon and the endoplasm within the neuronal cell body can be compared to the concept of the Nadi.

In Yogic texts, Nadis are symbolically described as lotus stalks, directed downward and located along the vertebral column.[6] In Ayurveda, the term Nadi is often equated with arteries, as seen in the context of Nadi Pariksha, whereas in Yoga it is explained in relation to the nervous system. The Trishikhi-Brahmana Upanishad describes Nadis as delicate, like lotus filaments, and when stimulated they are said to resemble an electric current. Among them, the Sushumna Nadi runs through the vertebral column along its central axis. It is described as lying between the two hemispheres (Kanda), like the stalk of a lotus, directed upwards to connect with the Brahma-Vivara (foramen magnum). When impulses ascend through it to the Brahmarandhra, they are said to produce a sensation similar to a subtle electric current. On either side of Sushumna lie the two subsidiary Nadis: Ida (also called Chandra Nadi), located to the left of the Kanda and associated with the left nostril, and Pingala (also called Surya Nadi), located to the right of the Kanda and traced to the right nostril.[7] [8]

Although Sushumna Nadi is subtle and concealed, together with Ida and Pingala it converges at the Triveni point, located at the Ajna Chakra behind the midpoint between the two eyebrows.[9] Normally, Ida and Pingala function alternately. Both Nadis arise from the Mooladhara Chakra, course upward alongside Sushumna, and unite at the Ajna Chakra. From this point, they separate again to establish their association with the left and right nostrils. Sushumna Nadi originates from the Mooladhara and extends continuously up to the Brahmarandhra at the base of the skull. It is considered stable, and the dormant Kundalini Shakti, often described as a coiled serpent, resides at the Mooladhara Chakra. When Sushumna is activated, the activities of Ida and Pingala are subdued. As Prana ascends through the awakened Sushumna, both Ida and Pingala become inactive, and respiration through both nostrils occurs simultaneously. When the awakened Kundalini reaches the Sahasrara Chakra, it is said to unite the Jiva (individual soul) with Brahman, which is regarded as the ultimate goal of Yoga. [10]

According to the Darshana Upanishad, all Nadis are distributed around Sushumna, while the Prashna Upanishad states that 72,000 Nadis originate from the Nabhi (umbilicus) through the Moola Kanda (central root) and spread throughout the body. Out of 24 principal Nadis, 10 are considered vital for carrying Prana within the body. Among these:

1) Ida Nadi – Inspiration through this channel produces a cooling effect, even in a hot environment.
2) Pingala Nadi – Transmits the solar (heat) energy and helps regulate body temperature.

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3) Sushumna Nadi – Flanked by Ida and Pingala, which spiral around it, leading to the formation of the Shad-Chakras.[11]

Based on the review of *Yogic* literature and *Svara Shastra*, it may be inferred that the functioning of *Ida Svara* corresponds to parasympathetic dominance, whereas *Pingala Svara* correlates with sympathetic dominance of the autonomic nervous system (ANS).[12] [13]

Table 1*:* Trividha Nadi - Indication of work to be followed and other details

Ida Nadi	**Pingala Nadi**	**Sushumna Nadi**
All auspicious & easy work	Hard & difficult activities	Activities related to God
Chandra-Nadi, Ganga	Surya-Nadi, Yamuna	Mahapath, Sarsvati
Left Side of Kanda & Sushumna	Right Side of Kanda & Sushumna	Sushumna is hidden
Traced at left nostril	Traced at right nostril	Situated between Ida & Pingala, Chief among major 10 Nadis.
Act alternately	Act alternately	Meet with Ida & Pingala at Triveni point which lies at the site of Adnya Chakra.
Runs upwards surrounding Sushumna to join with Adnya Chakra	Runs upwards surrounding Sushumna to join with Adnya Chakra	Originates from Mooladhar & continue to Bramharandhra
Get separated to establish association with left nostril	Get separated to establish association with right nostril	Usually stable - if activated, the functions of Ida and Pingala are impaired
It helps in maintaining the cold and anabolic activity of the body	Sun factor (heat) is streamed through this Nadi and maintains the body temperature. (Catabolic)	Respiration through both nostrils is initiated upon activation

The two cerebral hemispheres function in distinctly different ways. When energy flows through the left hemisphere, abilities such as logical thinking, calculations, vocabulary, grammar, and technical concepts become more prominent. In contrast, when the right hemisphere is more active, skills related to acting, music, and poetry emerge with ease, while emotions, faith, and beliefs take precedence. [14]

DISCUSSION

The term “Nadi” is derived from the Sanskrit root Nad Dhatu, which signifies “to flow within a structure.” It refers to a tubular channel, and in Ayurvedic literature, the term appears in various contexts such as Dhamani, Vansi, Bhagandara, and vessels [15]. In Sharira Sthana, Sushruta has distinctly described Sira, Dhamani, and Srotas; hence, the Nadis mentioned in Yoga Shastra are different from these. From the perspective of modern anatomy, the tubular or cord-like structures within the body that lie in close relation to vessels can be correlated with nerves, according to Yogic philosophy. Thus, the Nadis described in Tantra Sharira may be compared to the nervous system.

In the Trishikhi-Brahmana Upanishad, the lotus analogy highlights not only the consistency but also the color of the Nadis, as the hue of the lotus filament resembles that of a nerve. It is well known that any external or internal compression on a nerve produces tingling sensations both in the nerve itself and in surrounding tissues. Hence, the description of an “electric current-like feeling” and tingling in Yogic texts may be interpreted as the same phenomenon. Therefore, the concept of Nadis as described in Yogic literature closely parallels the nerves of modern science. The mechanism of action potential generation should be studied in greater depth by scholars to validate this hypothesis precisely.

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A detailed study of the literature on Sushumna Nadi reveals several noteworthy points: It is said to remain hidden, like the river Sarasvati, and is also known by synonyms such as Brahmarandhra, Mahapatha, and Yogavallabha. It is located between the two Kanda (hemispheres) and resembles the stalk of a lotus bearing a flower. It originates from the Mooladhara and ascends upward to connect with the Brahma-Vivara (Randhra). On either side of the Sushumna lie Ida and Pingala; Ida extends along the left side of the Kanda and terminates at the left nostril, whereas Pingala runs along the right side and connects to the right nostril. From the anatomical standpoint, the spinal cord represents not only the lower part of the central nervous system (CNS) but also serves as a center for reflex activity. The spinal cord extends through the upper two-thirds of the vertebral canal, beginning at the upper border of the atlas and terminating most commonly at the lower border of the first lumbar vertebra, though in some cases it may reach the upper border of the second lumbar vertebra. It maintains connections with the cerebrum and cerebellum through the brainstem, which consists of the medulla oblongata, pons, and midbrain [16].

When references from Yogic and contemporary sciences are compared, it becomes evident that the Sushumna Nadi described in Yoga closely resembles the spinal cord, as both represent the central axis of the nervous system and remain protected within the vertebral column. If the upper expanded part of the central nervous system is likened to a lotus flower, then the spinal cord may be envisioned as its stalk.

Yogic texts state that “When Ida and Pingala flow in equilibrium, they converge into Sushumna, and at this stage the Kundalini Shakti begins its ascent.” This phenomenon may be better understood by drawing parallels with the process of respiration, which is primarily regulated by the autonomic nervous system (ANS). During Pranayama, voluntary control is exerted over respiratory functions, and with prolonged practice, practitioners may achieve partial voluntary regulation of ANS activity. This ultimately results in a relative reduction of autonomic dominance and enhancement of central nervous system (CNS) activity, particularly that of the spinal cord.

Bhargava R, Gogate MG, and colleagues have observed that Pranayama breathing exercises appear to modify autonomic responses to breath-holding, most likely by enhancing vagal tone and reducing sympathetic discharge [15]. Thus, the Yogic concept of Nadi or Swara regulation can be interpreted in terms of autonomic nervous system activity. Detailed characteristics of Ida and Pingala Nadis are summarized in Table 2.

Table 2: Comparison of *Ida* and Pingla Nadi

Ida Nadi	**Pingala Nadi**
Chandra-Nadi, Ganga, Left Side of Sushumna	Surya-Nadi, Yamuna, Right side of Sushumna
Traced at left nostril	Traced at right nostril

Ida & Pingala both runs upwards surrounding Sushumna to join with Adnya Chakra

From the perspective of contemporary science, the structural components of these *Nadis* can be correlated with neural pathways. It is described that *Ida* and *Pingala* encircle the *Sushumna* in a curved or spiral manner. A comparable example in modern anatomy is seen in the course of sympathetic nerve fibers supplying the upper limb, which follow a curved path around vascular structures.

Sympathetic Innervations of Upper Limbs: The sympathetic nerves supplying the upper limb originate from spinal segments T2–T6. Their preganglionic fibers arise from the lateral horn cells of the spinal cord and emerge through the ventral nerve roots. These fibers pass via the white rami communicantes to enter the sympathetic chain, where they ascend and terminate in the middle cervical, inferior cervical, and first thoracic ganglia. From these ganglia, the postganglionic fibers exit through the grey rami communicantes to join the corresponding spinal nerves and supply the upper limb. The spinal cord thus serves as the primary pathway and source for autonomic activity, while the sympathetic chain and its ganglia provide secondary routes and distribution. Collectively, the chains unite to form a single structure known as the sympathetic trunk. The superior cervical ganglion, the highest in this trunk, extends from the transverse process of the atlas to the tip of the greater cornua

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of the hyoid bone [16].

The spinal cord also originates at this level, which is noteworthy as *Yogic* texts describe the meeting of *Ida, Pingala,* and *Sushumna* at the *Triveni* point, corresponding to the *Ajna Chakra* located behind the midpoint of the eyebrows. A physiological interpretation of *Ida* and *Pingala Nadis* reveals parallels with the autonomic nervous system (ANS). The concept of body lateralization, as described in *Yogic* texts, finds some anatomical support in modern neuroanatomy. Structural variations in the branching of the sympathetic chain also offer points of comparison. In the abdominal autonomic nervous system (ANS), for example, preganglionic vagal fibers forming the celiac plexus arise from the posterior vagal trunk, which contains contributions from both the right and left vagus nerves—although fibers from the right vagus are usually predominant. Similarly, in the parasympathetic division, fibers from the pelvic splanchnic nerves ascend to the superior hypogastric plexus through the inferior hypogastric plexus, typically coursing along its left side [17].

According to the *Yoga Samhitas, Ida* and *Pingala* are described as encircling the *Sushumna* in a spiral manner, thereby giving rise to the *Mooladhara, Swadhisthana, Manipura, Anahata*, and *Vishuddha Chakras*, in association with the *Shadchakra* system. This concept can be correlated with the course of the autonomic nervous system (ANS), where the ganglia of the sympathetic chain provide both lateral and medial branches. In the lumbar sympathetic chain, the lateral branches are distributed to all five lumbar nerves via the grey rami communicantes, whereas the medial branches, known as the lumbar splanchnic nerves (usually four in number), are arranged such that the upper two contribute to the celiac and aortic plexuses, while the lower two join the superior hypogastric plexus. This structural arrangement may provide an anatomical analogy for understanding the formation of the *Shadchakra*. *Ida Nadi* is described as being located on the left side of the *Sushumna*. A comparative study of the ANS suggests that a major portion of its contribution arises from the left sympathetic trunk. Considering the inferior region of the sympathetic trunk, one finds that it lies along the medial margin of the sacral foramina. The location of the filum terminale between the paired sympathetic trunks helps explain the *Yogic* view of *Ida* and *Pingala* lying on either side of the *Sushumna.* At the terminal end of the sympathetic trunk lies the ganglion impar, situated over the coccyx. Its coiled, nodular appearance closely resembles the Kundalini, often described as a “serpent-like energy” in *Yogic* literature.

Furthermore, *Ida* and *Pingala* are associated with the left and right nostrils, respectively, and their activity is referred to as *Swara* in *Yogic* texts. This concept can be related to the superior cervical ganglion (SCG), which represents the uppermost part of the sympathetic trunk. The SCG, located opposite C2–C3 vertebrae and lying deep to the sheath of the internal carotid artery, provides sympathetic innervation to several structures of the head. Moreover, sympathetic fibers from the superior cervical ganglion (SCG) innervate the carotid body. Postganglionic axons from the SCG also form the internal carotid plexus, which distributes fibers to the eye, lacrimal gland, nasal and oral mucosa, and pharynx [18].

Modern physiological studies provide further support for this correlation. Evidence suggests that right nostril-initiated *Pranayama* exerts sympathomimetic effects, whereas left nostril-initiated *Pranayama* produces parasympathomimetic (or sympatholytic) effects. The effect of unilateral nostril breathing (UNB) or alternate nostril breathing (ANB) is determined primarily by the nostril used for inspiration, rather than the one used for expiration. These findings align with the traditional concept of *Swara Yoga*, which states that airflow through the right nostril (*Pingala Swara*) has an activating effect, while airflow through the left nostril (*Ida* or *Chandra Swara*) produces a calming effect [19].For instance, *Chandra Nadi Pranayama* (left unilateral forced nasal breathing) has been shown to reduce heart rate and systolic blood pressure in hypertensive patients undergoing standard medical management. This effect is attributed to normalization of autonomic cardiovascular rhythms, enhanced vagal modulation, reduced sympathetic activity, and improved baroreflex sensitivity [20].

The sympathetic component of the autonomic nervous system (ANS) in the abdominal region functions as vasomotor, motor to sphincters, inhibitory to peristalsis, and sensory to the supplied viscera. *Suryanadi Pranayama*, which involves right unilateral forced breathing, along with certain *Asanas*, was introduced as an intervention in subjects with diarrhea-predominant irritable bowel syndrome. Both loperamide therapy and yogic intervention led to a significant improvement in bowel symptoms and state anxiety over a period of two months. Conventional therapy was associated with increased gastric activity as recorded electrophysiologically, whereas

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Yogic intervention demonstrated enhanced parasympathetic reactivity, as indicated by heart rate parameters [21]. These findings suggest the sympathomimetic activity of *Suryanadi* or *Pingala Nadi.* Following the discussion on various components of the ANS in relation to Ida and Pingala Nadis, the structural correlation of these *Nadis* can be illustrated with the help of a figure adapted from Tortora G. J., Vol. 1, p. 550 (Fig. 1).

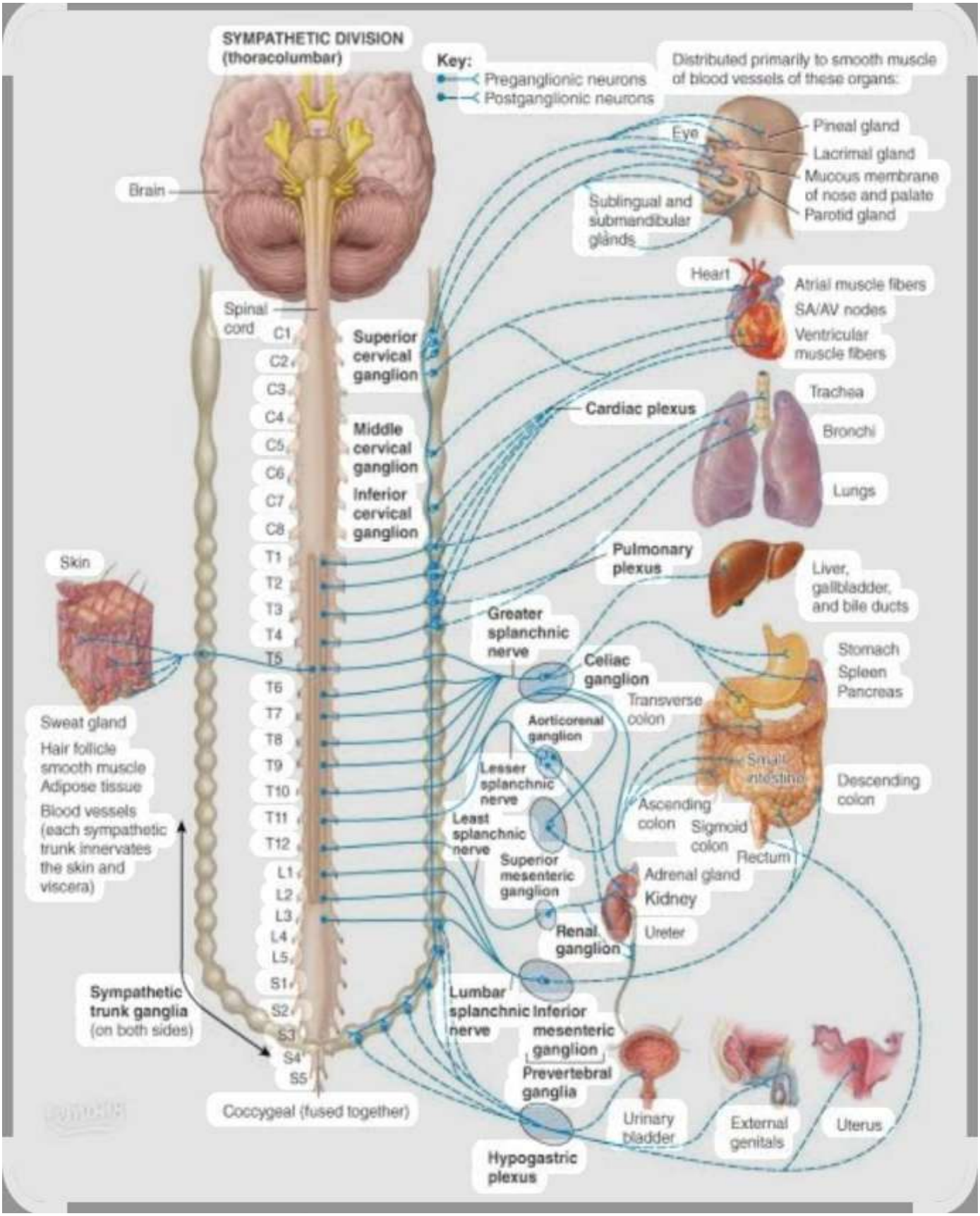

Fig.1: Structural correlation of with nervous system *Ida, Pingla Nadi*

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Table 3: Correlation between *Chakra* and plexus along with their effect on meditation

Sr. No	Name of Chakra	Place	Plexus	Effects on Meditation (balance & healthy)
1	Muladhar	Between the root of reproductory organ and anus	Pelvic Plexus (sacro - coccygeal plexus)	Courage, strong will, confident, humanistic, spo- ntaneous and honesty
2	Swadhishthana	The origin of the reproductory organ	Hypogastric	Sociable, independent, constructive, energetic and enthusiastic
3	Manipura	Navel of Nabhi Sthana	Coeliac or Solar	Confidence, humorous, practical, intellectual, Alert and Optimistic
4	Anahata	Heart (chest)	Cardiac	Compassionate, generous, romantic, self-controlled, adaptable, sympathetic and loving
5	Vishuddha	At the base of the throat of Kantha Mula Sthana	Carotid & pharyngeal	Loyal, trustworthy, affection at e, caring, tactful and calm
6	Adnya	At the space between the two eyebrows or Bhru Madhya	Cavernous	Orderly, clear sighted, faithful, fearless, practical, idealistic and highly intuitive

As described in the table outlining the features of Ida and Pingala Nadis, these are located on the left and right sides of the Sushumna, respectively. They ascend upward, encircling the Sushumna, and ultimately converge at the Ajna Chakra. When this description is compared with anatomical structures, it can be interpreted that the Sushumna corresponds to the spinal cord, Ida to the left sympathetic trunk, and Pingala to the right sympathetic trunk. Although the structural components of both sympathetic trunks are similar, the two cerebral hemispheres exhibit functional differences upon activation. Consequently, activation of the respective cerebral hemisphere may influence the functioning of the corresponding sympathetic trunk, providing a possible anatomical basis for the Yogic classification of Ida and Pingala Nadis.

CONCLUSION

A comprehensive review of Yogic texts and modern anatomical references highlights significant correlations between the concept of Nadis and the structures of the human nervous system. Yogic descriptions portray Nadis as subtle tubular channels conducting Pranic energy, with Sushumna, Ida, and Pingala regarded as the most vital. The Sushumna is described as a central pathway extending from the Mooladhara to the Brahmarandhra, symbolically compared to a lotus stalk. Structurally, this aligns with the spinal cord, which forms the central axis of the nervous system and is protected within the vertebral column. Ida and Pingala Nadis, situated on the left and right sides of Sushumna respectively, spiral around it to converge at the Ajna Chakra. This arrangement can be correlated with the left and right sympathetic trunks in modern neuroanatomy. Moreover, their functional attributes align with the autonomic nervous system, wherein Ida is associated with parasympathetic dominance and produces a cooling, calming influence, while Pingala corresponds to sympathetic dominance and exerts a stimulating effect. Evidence from physiological studies supports these parallels, as unilateral nostril breathing produces specific autonomic responses. These observations suggest that the Yogic concept of Nadis represents a symbolic yet accurate reflection of neural pathways, particularly the spinal cord and sympathetic chains, thereby bridging ancient Yogic philosophy with modern neuroanatomical understanding.

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