

Project Report

History of Neurodegenerative Diseases and its Impact on Aged Population in India: An Assessment*

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1. INTRODUCTION

The present project focused on a comprehensive historical account on the devastating neurodegenerative diseases and their impact on aged population in India. In the Indian context, the conception of neurodegenerative diseases could be traced back to the Vedic age and more specifically the medical corpus known as the *Atharvaveda*. In our ancient medical system of *Āyurveda*, the three concepts of *dhi* (intelligence), *dhṛti* (retention) and *smṛti* (memory) are the central assertive areas which guide treatment of neurodegenerative disorders. The 1st Chapter of *Caraka Samhitā* 'Sūtrasthāna' deals with long life, retention of memory and cognition.

प्रथमो दीर्घजीवितीयमध्यायः

prathamō dīrghajīvitīyam-adhyāyaḥ

अथातो दीर्घजीवितीयमध्यायः व्याख्यास्यामः॥1॥

athāto dīrghajīvitīyam-adhyāyaḥ

vyākhyāsyāmaḥ 1

[*athāto=atha+ataḥ; atha - so; ataḥ-hence,*

therefore, *dīrghajīvitīyam-long; jīvitīyam-life,*

adhyāyaḥ-chapter;

Another important *śloka* in *Caraka Cikitsāsthāna* -

दीर्घमायुःस्मृतिं मेधामारोग्यं तरुणं वयः।

प्रभावर्णस्वरौदार्यं देहेन्द्रियबलं परम्॥7

वाक्सिद्धिं प्रणतिं कान्तिं लभते ना रसायनात्
लाभोपायो हि शस्तानां रसादीनां रसायनम् ॥8॥

(चरक संहिता चिकित्सास्थानम् प्रथमोऽध्यायः)॥

(Source: *Caraka Cikitsa* 1/7-8)

From promotive treatment, one attains longevity, memory, intelligence, freedom from disorders, youthful age, excellence of lusture, complexion and voice, optimum strength of physique and sense organs, successful words, respectability and brilliance. *Rasāyaṇa* (promotive treatment) means the way for attaining excellent *rasa* etc. (*dhātus*).

Caraka Samhitā – Priyavrat Sharma p.4 *śloka* no. 7-8.]

It is evident from the above mentioned 'ślokās' that since ancient times good memory and intelligence was very much associated with long life. Therefore it was embedded that a long life must be free from degeneration *vis-à-vis* neurodegeneration. Although a single specific term for neurodegeneration was not available in the ancient medical texts of India, equivalent terminology like *dhātukṣhay*, *dhātusaithilyo*, *smṛti- buddhi bhramsa*, *vatik unmāda*, *vikṛtovat* were mentioned in different major and minor texts. The study also reveals that there existed specific concept of neurology, neurological diseases and more specifically the notion of neurodegenerative diseases in the ancient medical texts. Therefore, for a comprehensive understanding about nerve related disorders prevailing in ancient India, it is important to know about the nature of neurological problems and its affected areas mentioned in the different major and minor texts of *Āyurveda*. In this context, it has been observed that either *śiro* or *hrdaya* has been identified as the major cause of all kinds of neurological problems mentioned.

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However it is to be noted that the Āyurvedic concept of *śiro* or *hṛdaya* was completely different from the Western medical concept of head or heart. In Āyurveda *hṛdaya* is considered as a meeting point and five *hṛdayās* such as *ura hṛdaya*, *śiro hṛdaya*, *navi hṛdaya*, *amara hṛdaya* and *tala hṛdaya* are mentioned. A comprehensive classification of major neurological problems and the areas affected are also mentioned in these texts. Therefore, it cannot be an overstatement that the notion of degeneration or neurodegeneration was not unknown in ancient Indian medical system of Āyurveda.

In the Western medical texts, up to the early part of the nineteenth century, historical notions regarding neurodegeneration were relatively scanty. The medical identification of neurodegeneration in old age was first reported by Pinel in his book *Philosophical Nosography* (1816). But a somewhat simplistic theory on vascular pathogenesis of dementias began to rise in Germany, in Alzheimer's (1907) classical papers and in Kraepelin's famous textbook (1910). Since then the histopathological study of the senile brain was the object of several contributions.

In spite of all historical concepts on neurodegenerative diseases available in different Western medical texts, no such medical texts or writings were available in Indian medical journals even in the colonial period of India. Rather it had been found that neurological problems were less prioritized in the context of public health in colonial India. Both neurological and neurodegenerative diseases were identified symptomatically and commonly treated as psychiatric problems during 17th or 18th century colonial India. As a consequence of these phenomena, establishment of lunatic asylums were essential in different parts of colonial India where both European soldiers and native Indians were treated for their mental problems. For this reason, it seems that the history of neurodegenerative diseases was not properly chronicled in the medical history of British

India. Rather the history of psychiatry had been considered as the comprehensive beginning in this regard. The inadequacy of this kind of study and immensity of these degenerative diseases instill the present researcher to think over the issue of historical genesis of this disease particularly in this subcontinent and the present project has been visualized in this regard. The research account is placed under six chapters as follows -

- I: Concept of Neurology and Neurodegenerative Diseases in Ancient Medical Texts of India
- II: Concept of Neurodegenerative Diseases in Western Medical Texts
- III: Neuroscience in India and in the West
- IV: History of Neurodegenerative Diseases
- V: Ayurvedic Expertise about Neurodegenerative Disease
- VI: Discussions and Concluding Remarks

2. DETAILED DISCUSSION OF THE WORK

The present research has been started with 'Introduction' followed by six chapters. Chapter I begin with the concept of neurology in the ancient Indian medical texts followed by the concept of degeneration *vis-à-vis* neurodegeneration in different major and minor texts of Āyurveda, starting from Caraka to Bhāvamishra. The history of Indian Medicine dates back to Vedic Age (around 1500 BCE). The first descriptions of medical disorders and their proposed treatments through herbal prescriptions are found in the *Atharvaveda* (c. 2000-1000 BCE). *Atharvaveda* was one of the four original Vedas (sacred texts of the ancient India) and as with most contemporary medical literature, it discussed medicine in the realm of magical spells and exorcism of demons. Later, around the middle of 1st millennium BCE emerged the traditional Indian system of Medicine "Āyurveda" (literally meaning "the knowledge of life") with a more scientific approach towards medicine. Just like modern allopathic medicine,

Āyurveda distinctly classified medical practice into *kāyācikitsā* (internal medicine), *śalyacikitsā* (surgery including anatomy), *śālākyacikitsā* (eye, ear, nose and throat diseases), *kaumārabhṛtya* (pediatrics), *bhūtavidyā* (spirit medicine), *manasrogracikitsā* (psychiatry), *agada tantra* (toxicology), *rasāyaṇa* (science of rejuvenation) and *vājīkaraṇa* (aphrodisiacs/virility). The Āyurvedic System of Medicine stresses the balance of three elemental energies or humors *tridoṣas* namely: *Vāyu vāta* (air and space – “wind”), *pitta* (fire and water – “bile”) and *kapha* (water and earth – “phlegm”). A disturbance in this balance results in disease with its attendant ailments.

Neurological disorders are classified under humor -*Vāta rogas* (diseases) in Āyurveda. *Vāta* is the energy that moves throughout the body, including brain and thus controls both voluntary and involuntary functions. The pathogenesis of neurological disorders is due to deranged humor *vāta* which enters the tissues (*dhātu*) such as muscles (*mans*), ligaments (*snāyu*), etc. The exacerbation or deficiency of this energy (*vāta*) can cause disturbance in the form of hyperactivity or weakness of the nervous system. Within Āyurvedic texts, over eighty neurological disorders are described, such as *apasmara/apasmṛti* (Epilepsy), *kampavāta* (Parkinson’s Disease) etc. For each category, a detailed clinical profile is presented and medical treatments are proposed.

In the present report, the Āyurvedic concept of *śiro* and *hṛdaya* has been described in a compressed manner. Besides, a detailed classification of neurological problems along with affected area mentioned in the different major and minor texts of Āyurveda (from Caraka to Bhāvamishra) has also been made. However, by the end of the 19th century, Āyurveda along with other indigenous systems of medicine such as Unāni (Graeco-Arabic medicine) and Siddha (South Indian Tamil traditional medicine) were

profoundly influenced by their encounters with Western medicine. This basically led to the formation of different medical lineages with specific tradition and teaching. As a result several schools of Āyurveda were developed all over the country. Chapter I also encompasses the conceptual developments related to neurodegenerative diseases in Āyurveda particularly in the 20th century India as mentioned by different eminent physicians from different Āyurvedic schools of India. The Chapter ends with the concept of *smṛti* and *smṛtibhramsa* in Āyurvedic perspective and management of *smṛtibhramsha* in Āyurveda. Āyurvedic literatures reveal that *smṛtibhramsha* occurs mainly due to old age and due to impairment of *buddhi*. Management by *rasāyaṇa* drugs would be the appropriate line of treatment. Furthermore, prior to *rasāyaṇa* therapy, *pañcakarma* is very essential for *deha śuddhi*. Also, as *smṛtibhramsha* can be considered as an *urdhwajatrugata vikara*, *nasya karma* can be performed. Hence, the line of treatment comprises of *nasya* and administration of *rasāyaṇa* and *medhya* drugs orally.

Chapter II discusses the Western medical history regarding origin of neurology or neurodegenerative diseases which is quite impressive and has a distinct chronological order. Prunier’s announcement in 1873 of the discovery at Lozères of trephined Neolithic skulls activated an interest in the history of neurology. This was an epoch making discovery followed by finding of such skulls in France, Switzerland, Great Britain, Denmark, Germany, Sweden, Austria, Poland, Italy, Russia, Spain and Portugal. Such specimens have also been found in China, Japan and Afghanistan. For the next important contribution we may look at the Nile Valley civilization and the ancient Egyptian traditions. The first written description of the cerebral cortex and the first indications that the site of brain injury could determine the nature of neurological symptoms were found in the Edwin Smith surgical papyrus written in about 1700 BCE. It was a copy

and gloss of much older treatise dating back to about 3000 BCE. Legend ascribed the original treatise to Inhotep, Grandvizier of the 3rd Dynasty of Faraoh, Zozer, and later deified as an Egyptian god of medicine. The most important Pre Socratic neuroscientist was Alcmaneon of Croton. He was the first writer to declare that the senses and the central organ of intellect was the brain. However, the most famous Greek neuroscientist was Hippocrates (460 – 375 BCE) and his important treatise was titled '*On the Sacred Disease*'. The so called sacred disease was epilepsy and the author was clear about its natural origin that is brain. Aristotle (384 BCE – 322 BCE) was the other remarkable Greek Philosopher who was a great biologist and the founder of comparative anatomy. However he dismissed brain as wet and cold and devoid of sensation.

For us the next important school of neuroscientific thought was the great museum at Alexandria where Hesophilos and Erasistratos worked on brain and neural function (3rd Century BCE). But the most important neuroscientist was Claude Galen (129 CE – 199/217 CE). His views on body and brain dominated western neurological thoughts for more than 1500 years. His studies on cranial nerves and spinal cord were outstanding. The first person who broke this strong hold of Galen and rekindled the concepts of neurological science was Andreas Vesalins (1514 – 1564). He was the founder of modern anatomy and with Nicholas Copernicus (1473 – 1543) initiated the scientific revolution in the realm of neuroscience. Renedescarpes (1596 – 1650) combined the Galenic physiology with a conception of the body as a machine that provides the first idea of reflex action. Thomas Willis (1621 -1675) an anatomist and a Physician took this idea and related it to actual brain structures. The first actual experiments on neural mechanisms of reflexes were carried out by Robert Whytt (1714 – 1766) of Edinburgh. The modern concept of reflex largely began with the English Physiologist and Physician Marshall Hall

(1790 – 1857). In between, Luigi Galvani (1737 – 1798) produced muscle contraction by stimulation with an electrostatic machine run by atmospheric electricity. Next we come to the great Spanish anatomist Salvadore Ramon Y Cajal (1852 – 1936) who was able to demonstrate that each nerve cell with its dendrites and axon was an independent unit. This extension of Cell theory is now known as 'neural doctrine'. Thus the dominant trend since 1861 was established by Paul Broca (1824 – 1880) through his example of cortical localization to try to divide all major brain parts into progressive smaller units. The history of modern neurology, neuropsychology and related disciplines are closely associated with the theory that different parts of the brain serve different function.

In colonial India, development of neurology did not follow an uniform pattern. Even in the 18th century and the beginning of the early 19th century, there was no sharp distinction between neurological and psychiatric diseases and a common neural basis for both was suspected. British medical practitioners in India reflected this approach in different medical journals during colonial period. Colonial discourses on asylums for lunatics in British India as a part of the new discipline of mental science took prominence in mid nineteenth century. However, development of lunatic asylums was apparent in the early colonial period from 1745 to 1857 till the first movement for Indian Independence was started. The mid-colonial period from 1858-1918 witnessed a steady growth in the development of mental asylums. This period was significant for the enactment of the first Lunacy Act in the year 1858. New asylums were established in different parts of India. The first psychiatric outpatient service, precursor to the present-day general hospital psychiatric units (GHPU), was set up at the R.G. Kar Medical College, Calcutta in 1933 by Ghirinder Shekhar Bose. This was followed by a surge of such units with Masani opening at JJ Hospital, Bombay in 1938 and Dhunjibhoy opening one day weekly

clinic at Prince of Wales Medical College (now Patna Medical College) in 1939. The World War II saw a separation of military psychiatry from psychiatry in general. It is at this juncture of time the history of modern psychiatry in India seemed to have returned to its origin.

Chapter III highlights the conceptual developments in the field of neurology specifically in the post independent India. While doing so an attempt has also been made to chronicle the systematic development of neuroscience in India and also the early history of neuroscience in the western medical context. The first account of a neurosurgical procedure in India is of a transphenoidal hypophysectomy in 1935, which was performed by Lt. Col. Frederick Jasper Anderson in Madras. However, the neurologists/neurosurgeons at that time were not trained in India. Instead, they went abroad to acquire specialized training. Therefore, it was a tremendous achievement when India offered graduate training in Neurology starting in the last quarter of the 20th century.

Initially, the field of Neurosciences was dominated by neurosurgeons. The first Neurological training facility was established in 1948 when the Director of Christian Medical College, Vellore extended an invitation to Dr. Jacob Chandy to start the Department of Neurosurgery at the college. Following the establishment of the neurosurgery Department at the CMC, Vellore, numerous neuroscience departments were set up throughout the country. In 1950, Dr. B Ramamurthi initiated the second neurosurgery at Government General Hospital in Madras. In 1951, the third neurosurgery department was initiated at Seth GS Medical College, Mumbai. In 1962, a Department of Clinical Neurosciences was established at the Postgraduate Institute, Chandigarh. Later, a Department of Neurology was established at the Institute of Medical Science BHU in 1966. In 1974, the All India Institute of Mental Health was converted to an autonomous National Institute of Mental Health and Neurosciences. In 1976, the Sree Chitra Thirunal Institute of Medical

Sciences and Technology added its neurological center of excellence. Furthermore, the Sanjay Gandhi Post Graduate Institute was established to focus on specialized education and research in various fields of medicine, which included neurology, in 1983. As a result of this progress in Neurology in India, there are currently over 1,100 qualified clinical neurologists working in the country. Also, there are about 59 MD programs instructing nearly 169 students annually and 39 DNB programs with 51 positions providing a form of postgraduate training in Neurology in a private practitioner based setting. Interestingly, the idea of establishment of neurosciences in India stemmed from the minds of clinicians in neurology.

Modern neuroscience has roots deep in the history of Western biology, medicine and Philosophy. The most important Pre-Socratic (6th – 5th Century BCE) contribution to the history of neuroscience was by Alcmaeon of Croton. He was the first writer to champion brain as the seat of the senses and the central organ of intellect. Perhaps the most famous treatise of Hippocrates (460 – 375 BCE) and certainly the most relevant one for neuroscience is “*On the sacred disease*”. The so called sacred disease is epilepsy, but the author is clear about its natural origins. The influence of Plato (428 – 347 BCE) and Aristotle (384 – 322 BCE) on the development of neuroscience was essentially negative but in different ways. Plato thought that the superior part of the soul resides in the head. On the other hand, Aristotle dismissed the brain as wet and cold and devoid of sensation.

Alexandrian Neuroscience (3rd Century BCE) at Alexandria, where two neuro anatomist Herophilos and Erasistratos, worked on brain function and neural function, carried out experiments on the living brain perhaps the human brain. Galen (129 – 199 CE) was the most important figure in classical medical science. He attempted to attribute particular nervous diseases to dysfunctions of specific brain regions.

The advances in understanding of the brain in medieval Europe are very easy to summarize – *there were none*. Thus the central feature of the medieval view of the brain was the localization of the mental faculties in the ventricles of the brain. But the first person to break the stronghold of Galen and rekindle neuroscience was Andreas Vesalius – the founder of modern anatomy and with Nicholas Copernicus, the initiator of neuro science. But the first actual experiments on neural mechanisms of reflexes were initiated by Robert Whytt (1714 – 1766). The modern concept of reflex was started by Marshall Hall (1790 – 1857). By the middle of the 18th century the stage was set for Galvani and the beginning of electrophysiology. R A Von Kolliker (1817 – 1905) demonstrated the origin of nerve fibers from nerve cells. The Spanish anatomist Salvadore Ramon Y Cajal (1852 – 1936) demonstrated the independent nature of each nerve cells. K.S. Lashley (1890-1958) searched for the neural components of memory, which he called engrams. Wilder Penfield (1891-1976) was one of the great neurosurgeons of all times, and a leading authority on epilepsy. His localizationist views profoundly affected modern neurology and other scientific fields. Modern Day (2000- onwards) - The communication of discrete neurons (brain cells) using electrical and chemical signals (neurotransmitters) is well established and accepted (Neuron Doctrine).

In comparison with the Western world, the scientific development of this discipline in India dates back to much later period. In the Indian subcontinent, neuroscience as a distinct discipline was initiated only after colonial period (after independence). Some isolated examples of work could be found earlier. Over the years, the contributions of neurosciences in the country have a subject of several reviews. Tribute must be paid to some of the pioneers who laid the foundation of this edifice. Mention will be made of- Dr. Jacob Chandy, B. Ramamurthi, R.G. Ranade, R.N. Chatterji, Ashok Bagchi in Neurosurgery, Baldev

Singh, T.K. Ghosh in Neurology, B.K. Bacchawat in Neurochemistry, D.K. Dastur in Neuropathology, B.K. Anand and A.S. Paintal in Neurophysiology, K.P. Bhargava in Neuropharmacology. Some other important contributions find detailed reference in the comprehensive volume like – *Neurosciences in India : Retrospect and prospect* by Sunil K Pandya (1989), *Mental Health : An Indian Perspective* (1946 – 2003) edited by S.P. Agarwal (2004), *Evolution of Neurosciences in India* by Prof. K. Rajsekharan (1998), uphill all the way.

However, the scientific study of the nervous systems underwent a significant increase in the second half of the 20th century, principally due to revolutions in molecular biology, neural networks and computational neuroscience. Neuroscience comprises a large number of distinct disciplines, fortunately now seamlessly merging into one another. Unlike the West, the seeds for their development in India were laid by clinicians, neurologist, neurosurgeons and psychiatrist. Therefore, it cannot be an overstatement that with the passage of time, this multidisciplinary discipline has witnessed a progressive evolution of all major disciplines of neurosciences in the country.

Chapter IV chronicles the historical origin of dementia disease in the Western medical context. The chapter also highlights the ageing population's perspective towards these kinds of neurodegenerative disorders not only in the Indian context but also in the Asian perspective. Neurodegenerative disease is an umbrella term for a range of conditions which primarily affect the neurons in the human brain. Neurons are the building blocks of the nervous system which includes the brain and spinal cord. Neurons normally donot reproduce or replace themselves, so when they become damaged or die they cannot be replaced by the body. Neurodegenerative diseases include a number of diseases, such as - Alzheimer's disease (AD) and other dementias, Parkinson's disease (PD) and PD-related disorders,

Prion disease, Motor neurone diseases (MND), Huntington's Disease (HD), Spinocerebellar ataxia (SCA), Spinal muscular atrophy (SMA).

Without a doubt, the history of vascular dementia is a history of progress. This is the history of past great doctors and scientists making great doctors and scientists for the present – all sharing the aim of unraveling the mysteries of the disease and discovering ways for their prevention and cure. In the case of dementia, this produces a historical narrative that begins with Esquirol's first scientific description in 1829. Up to the first half of the nineteenth century, historical notions regarding dementias were relatively scanty. Brief accounts can be traced in the ancient medical literatures. In particular, Babylonian, Egyptian, Hebrew, Chinese and Indian ancient medicine did not deal with mental illness as such. The medical identification of neurodegeneration in old age was first performed by Pinel in his book *Philosophical Nosography* (1816). But Esquirol (1829) tackled the clinical problem of dementias on a scientific basis evaluating the age of patients, etiology of different types, various clinical patterns (acute, chronic and senile) the causes of death and their pathological picture. But somewhat simplistic theory of a purely vascular pathogenesis of dementias began to rise in Germany, in Alzheimer's (1907) classical papers and in Kraepelin's famous textbook (1910). Since then the histopathological study of the senile brain was the object of several contributions (Comte, 1925). Lastly, it can be said that, dementia of old age was associated to cerebral vascular disease until the end of the eighteenth century. After Kraepelin's and Alzheimer's papers in the beginning of the twentieth century, students' attention was drawn by histopathological alterations to degenerative causes.

In India, the colonial period was marked by a rapid increase in the variety of diseases that were known to European practitioners. But the diseases of the nervous system offer nothing special prominent mention. Medical History of British

India reveals that the case of 'dementia' was reported among the insane (both Europeans and Indian) in different lunatic asylums of India. Even after independence, 'dementia' was not clinically identified. *Indian Medical Gazette* reported that in the mid 70s, the case of 'dementia' was clinically identified in military hospital at Delhi. After clinical identification, researches on 'dementia' started from different discipline. Dementia had not been a frequent topic for publication even in *Indian Journal of Psychiatry*. However, this does not reflect the progress made in the field of dementia research. There had been many studies in India and their findings were published in different journals. The past decade witnessed active dementia research and networking of researchers. India's contribution in dementia research has increased from thirty five papers in 2002 to 261 papers during 2011, witnessing an annual average growth rate of 25.58%. The average citation per paper registered by India's research in dementia during 2002-11 was 5.11. India has contributed 24.53% international collaborative papers share in dementia research during 2002-11. However, demographically all over the world there are one Billion people who are battling from the aforementioned neurodegenerative problems. Of these people, approximately 7.5 percent belong to the 60+ generation. India is the home of more than eighty million people older than sixty years as per the 2011 Census. The unprecedented growth of this age specific group (60+) is expected to grow dramatically in the coming decades. With the increasing number of aged persons affected by neurodegenerative disorders, the problem of dementia cases surfaces. According to World Health Organization (WHO), the rate of growth will be the highest (around 336%) in India, followed by China, South Asia, and western Pacific regions, 235-393% in Latin America and Africa, and the lowest (100%) in developed regions. The number of persons with dementia double every five years of age and so. India will have one of the largest numbers of elders with this degenerative problem.

Chapter V provides a comprehensive discussion about the revival of Āyurveda and conceptual understanding of *Smṛ'tinasa* by different Āyurvedic specialists from different Āyurvedic schools of India. The discussion highlights that by the end of the 19th century, Āyurveda along with other indigenous systems of medicine were profoundly influenced by their encounters with Western medicine. The result was revealed through the books of Āyurveda in vernacular languages (such as English) as the proponents of Āyurveda. Besides, it was also a response to the colonial Government's decision in 1835 to suspend the teaching of Āyurveda in Calcutta Medical College (CMC). In the first half of the 19th century, British Health and Education Policy in India began to emphasize support for the new medical knowledge and methodology which was then emerging in Europe. This resulted in patronage of new medical colleges and hospitals and ultimately produced a number of practitioners with a medical reputation superior to that of traditional practitioners. To meet the competition of the new system and to show the value of their science, traditional practitioners needed to articulate the theoretical foundations of their medical system and to establish their professional identity. In the case of Āyurveda, this meant the birth of a new era, the beginning of modern Āyurveda. This would lead to the organization of Āyurvedic practitioners into uniform body. This basically leads to the formation of different medical lineages with specific tradition and teaching. As a result several schools of Āyurveda were developed all over the country. For example – Bengal school of Āyurveda, South Indian School of Āyurveda, Rajasthan school of Āyurveda, Banaras school of Āyurveda, Bombay School of Āyurveda and Gujarat school of Āyurveda. The discussion includes the conceptual understanding of *Smṛtinasa* by different Āyurvedic specialists from different Āyurvedic schools of India, namely Bengal, Kerala, Gujarat, Banaras and so on. Besides, a detailed classification of neurological

problems along with affected area mentioned by different Āyurvedic specialists from different Āyurvedic schools have also been made. It has been observed that West Bengal, Banaras, Gujarat Schools mainly follow *rasouśadhi gharana* (Herbo-mineral mixed preparation) whereas Kerala follows mainly *Kasthouśadhi gharana* (mainly Herbal preparations). Regarding treatment, Bengal, Banaras and Gujarat thus follow the integrated approach comprising of both Āyurveda and modern science, but Kerala follows the traditional Āyurvedic approach. An effort has also been made to understand *Smṛti* in Āyurvedic perspective.

Chapter VI is the concluding chapter which encompasses the whole gamut of the discussion in a compressed manner and with a wider perspective.

3. CONCLUSION

The study reveals that the ancient Indians had clear and deep understanding of human neurology as shown by the large volume of Vedic and post Vedic literatures. In the Indian context, the conception of neurodegenerative diseases could be traced back to the Vedic age and more specifically the medical corpus known as the *Atharvaveda*. In Āyurveda, the term neurodegeneration was not available but equivalent terminology like *dhātukṣaya*, *dhātusaithilyo*, *smṛti- buddhi bhramsa*, *vatic unmada*, *vikritovat* were mentioned in different major and minor texts of Āyurveda. The study also highlights that the ancient medical texts contains specific concept of neurology, neurological diseases and more specifically the notion of neurodegenerative diseases. From Āyurvedic perspective either *śiro* or *hṛdaya* has been identified as the major cause of all kinds of neurological problems mentioned in different major and minor texts of Āyurveda. The Āyurvedic concept of *śiro* or *hṛdaya* was completely different from the Western medical concept of head or heart.

During colonial period even at the early part of the 18th century and the beginning of the early 19th century, as mentioned earlier there was no sharp distinction between neurological and psychiatric diseases. A common neural basis for both was suspected. Neurological diseases were not highlighted. For treatment of the mental patients, lunatic asylums were established in different parts of the colonial India. Specific concept of neurology was started at the mid 20th century in India. The systematic study of neurology and neurosciences were started in Post independent India. It should be mentioned here, that the chronological continuity of neurology and neurodegeneration were found more systematically chronicled in the Western medical treatises. The major difference between eastern and western lies in the fact that, in India, the process of diagnosis was more individualistic whereas Western perspective gave more emphasis to generalization. Besides, clinical researches and technological advancement were more pronounced in the Western perspective than its eastern counterpart. However, preventive strategies were the backbone of Indian ancient medical tradition. As a consequence, we found number of examples of neuroprotection in Indian ancient medical texts than its Western counterpart.

Since 19th century onwards the concept of *smṛitibhramsha* and other neurological diseases mentioned by different Āyurvedic specialists took a different connotation. This perspective was clearly revealed in their identification of the disease and affected organs of the body. Changing conceptual development may be the close impact of Western medical system. But in spite of having a basic perception on neurology, development of neurology or neuroscience or clinical identification of neurodegenerative diseases took much longer time in India. After clinical identification of neurodegenerative diseases, like dementia, systematic research on this disease gradually increased in India. Here it should be mentioned that while tracing the

historical origin of neurology or neuroscience, in the Western medical treatises, since ancient times it has been observed that the facts are more chronicled and well documented than its Indian counterpart. This is also true in the historical origin of two important neurodegenerative diseases like Alzheimer's and vascular dementia.

Therefore, it may not be an overstatement that the history of the concept of neurodegenerative diseases developed as an interaction among biological, clinical, historical and social views. Only the scientific and historical study of neurodegenerative diseases can provide an evolutionary understanding of the complex mechanisms through which such diseases develop. Finally, it can be said that historical research and epistemological reflection can make a constructive contribution towards progression and current theoretical understanding of this age old disease to a great extent. It is expected that nature and magnitude of the present research has tried to throw enough light for a comprehensive understanding of the history of neurodegenerative diseases and its impact on aged population in India to a great extent.

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The Academy has instituted an **INSA Young Historian of Science Award** with the aim of recognizing young historians of science of extraordinary promise and creativity who have made notable research contributions in areas related to History of Science. This award, considered to be the highest recognition of promise, creativity and excellence, is made annually to those historians of science who are distinguished for these attributes as evidenced by their research work carried out in India or abroad. Only those born on or after **January 1, 1982** are eligible for consideration in the year 2017.

The awardee shall receive a **certificate**, a **bronze medal**, cash award of **Rs. 25,000/-** and seed amount to initiate research project and further scope for overseas training for advancement of career.

A candidate may be nominated by a Fellow of the Indian National Science Academy and other National Scientific Societies, Vice Chancellors of Universities and Heads of Research Institutions.

Nomination proforma can be downloaded from website www.insaindia.res.in or contact for a copy from Assistant Executive Director –II (History of Science), Indian National Science Academy, Bahadur Shah Zafar Marg, New Delhi-11000; email- ijhs@insa.nic.in. One hard copy and a soft copy (in MS-Word only) of the nomination, along with all supporting documents, must reach the Academy latest by June 30, 2017.