

Review of Anatomical and Physiological Changes of Ageing

Tawalare Kiran^{1*}, Tawalare Kalpana², Pawar Jatved³, Sharma Gopal⁴, Sharma Mrityunjay⁵ and Ramteke Rachana⁶

✱

¹Department of Kriya Sharir, Shri Ayurved College, Nagpur, Maharashtra, India

²Department of Rachana Sharir, Shri Ayurved College, Nagpur, Maharashtra, India

³Department of Kriya Sharir, Govt. Ayurved College, Nanded, Maharashtra, India

⁴Department of Rachana Sharir, Govt. Ayurved College, Nagpur, Maharashtra, India

⁵Dept. of Panchkarma, Shri Ayurved College, Nagpur, Maharashtra, India

⁶Dept. of Balrog, Shri Ayurved College, Nagpur, Maharashtra, India

Received: 9th June 2014/Accepted: 26th June / Published: 8th August 2014



Greentree Group

©International Journal of Ayurveda and Pharmaceutical Chemistry, 2014

Tawalare et al

 drkirantawalare@gmail.com

Int J Ayu Pharm Chem Vol. 1, Issue 1, 2014

Abstract

Aging is the process of life that includes progressive physiological and anatomical changes in various systems of body. The proposed study aims to describe various anatomical and physiological changes that occur in old age. Aging process brings about various changes in every system of the body such as cardiovascular, respiratory, gastrointestinal, urinary, nervous, endocrine, reproductive and musculoskeletal. Through the critical analysis of the literature it is found that Ayurveda has given remedies to avoid *jara* (old age) state of life in the form of *rasayan* (rejuvenation) *drugs*, adopting *dincharya* (daily routine follow up), by avoiding suppression of various *adharniya vegas* (urges), yogic process and *pranayama*.

Keywords

Aging, Ayurveda, Jara, Rasayana

INTRODUCTION

Acharya Charaka mentioned that the normal life span of humans is one hundred years^[1], though life span is plummeting alarming; now a days it is considered as 70 years. Aging can be defined as the normal process of life which is characterized by degeneration of organs of various systems, and consequently losing their anatomical and physiological functions^[2]. Today the study of aging is based on model of pathology i. e., how to diagnose the diseases and chronic disabilities afflicting the elder people to give probable remedies. Before 1980's the scientist regarded aging as vexed issue of mortality. Since then, researcher have taken effort to reinterpret aging as a normal, healthy and

positive feature of the life span, but till date they are facing avalanches of difficulties. Treating older adults can be challenging, because they have age-related anatomical and physiological changes. Older people may respond differently to regular medications and interventions than adult persons.

There is no convincing evidence available which shows that administration of any specific drug can slow aging process^[3], but Ayurveda gives special emphasis on the care of *jara* (aging) and *jara vyadhi* (disease of elder) by including special branch '*Rasayana*' in *Ashtang* Ayurveda. This branch of Ayurvedic science deals with promotion of physical and mental health of person. Proper use of *rasayana* at proper

time provides physical and mental strength, longevity, memory, intelligence. Beside that *shodhana karma*, *yogic* procedures, proper *ahar* (diet), *dincharya* (daily routine follow up), avoiding suppression of natural urges can also help to maintain the health of body.

Proposed article aims to discuss normal anatomical and physiological changes that occur with aging. To enlighten the preventive measure describe in Ayurveda to minimize the increased risk related to normal physiological process of aging and increased prevalence of coexisting systemic diseases.

MATERIALS AND METHODS

Classical texts of Ayurveda viz. *Charaka*, *Sushruta* and *Vagbhata Samhita* with commentaries were consulted as references of *jara*, *rasayana* to state the remedies. Literature available regarding anatomical and physiological changes from various journals, books and internet were collected. These references from both the streams of knowledge were compared and analyzed critically.

CLINICAL CHANGES OCCURRING DURING OLD AGE

Cardiovascular System

Blood vessels become stiff and less responding to hormones which relax the valve of vessel and thus result in increasing systolic blood pressure. Due to lipid deposition and collagen degeneration, valve in the chamber of heart becomes thick and stiff^[4]. Cardiac muscle becomes stiff due to changes in connective tissue, thus decreases response to catecholamine, the barrow receptors which monitor blood pressure and results in hypertension.

Respiratory system

Mobility of the ribs decreases due to calcification of ribs and thus chest wall becomes stiff along with larynx and trachea in the elder people. Cilia lining the trachea helps to push up dust, debris and mucus in to pharynx also becomes less effective. Lungs become rigid due to loss of elasticity. As a result of which ventilation and gas exchange is affected, and results in decreasing respiratory flow. The functional unit of lung alveoli enlarges in size and the vital capacity decreases^[5].

Gastrointestinal system

In old age, stomach shrinks with inflammation of the mucosa called as atrophic gastritis. Due to lack of vitamin B₁₂, stomach produce insufficient amount of

acid which may lead acid deficiency called as achlorhydria. The colon becomes hypotonic, which leads to increased storage capacity of food and stool, longer stool transit time and greater stool dehydration. All these all factors lead to chronic constipation. Constipation also occurs due to decrease in gastric secretion and slowing of peristalsis movement. Loss of control of the internal and external anal sphincters in the old age is one of the worst traumatic experiences^[6].

Urinary system

Kidneys are the principal organs which are responsible for the regulation of the chemical composition of blood and fluid volume of the body by formation of urine. The size and function of the kidney begins to decrease in forty year of age and significantly decreases by sixty years^[7]. Decrease in the secretion of vasopressin declines the ability to conserve salt which may lead to dehydration. The urinary bladder with age is characterized by a decrease in storage capacity and urinary flow, increase in residual urine and frequency. These changes contribute to an increase in nocturia. It is one of the causes of higher rate of urinary tract infections among the elderly. Difficulty occurs in

urination or urinary retention. Renal impairment may lead to a reduced ability to excrete or conserve fluids, electrolyte imbalance and a reduction in the clearance of renal excreted drugs.

Nervous system and sense organs

The aging of the central nervous system results in irreversible loss of functions and decrease in ability of doing normal functions. Memory problems are increased after the age of 40 years^[8]. Reflexes, sensory and motor responses of the body become slow. Visual and hearing impairment are very common in elderly people. Iris becomes more rigid with reduced tear formation causing dry eyes. With the reduced pupil size and decrease in cone number vision hampered in night. Tympanic membrane become thick, ossicles undergoes degenerative changes. The labyrinth and vestibule begins to degenerate with age and older individuals may complain loss of balance. Sensation of smelling is lost gradually due to decrease in smell receptor. Taste diminishes with the age because of atrophy of taste buds. In old age sense of touch is also diminished.

Endocrine system

The endocrine system is a complex network of glandular tissues that secrete hormones

directly into the blood which are used by target organs of the body. Insulin resistance may prohibit the conversion of glucose into energy in elderly. Metabolic activity reduces after the age of 50 years, fasting glucose level rises by 6 to 14 milligrams per deciliter every 10 years ^[9]. The basal endocrine metabolic rate falls by 1% per year after the age of 30^[10].

Reproductive system

In female menopausal age is considered as 51 years. At menopause ovulation ceases and estrogen levels falls by 90% ^[11]. Women are more susceptible for osteoporosis after menopause. Vaginal wall becomes thin due to delicate epithelium. Women experience decrease in lubrication of vagina. After menopause FSH and LH levels falls down slowly this causes loss of muscular tone of breast. Male reproductive glands are called as testes, located in the scrotum. Rate of sperm production and size of testes is decreases with aging. There may be reduction in sex drive and erectile dysfunction affecting 42% of the adults between the ages of 40 and 60 years ^[12].

Musculoskeletal System

Arthritis is common painful condition that occurs with age and leads to reduced

mobility of joint. Osteoporosis occurs especially in females with a history of use of steroid drugs. According to Jacobs (1981) and Lamb (1996) one person loses one and half to 3 inches or 1.2 cm of height every 20 years as aging occurs. Long bones appear to be disproportionate in size due to decrease in the stature. Shortening of the trunk may occur due to thinning of vertebral disk. Many old persons assume forward bending with flex knees and bending of arm at elbow. These structural changes occur because of calcium loss from bone. Bone losses the strength, so that minor trauma can cause fracture of bone akin to egg shell.

Skin

Elder persons generally have thin skin. Atrophy of the epidermis occurs with age and it is predominantly found in exposed areas of neck, face, upper part of the chest, and outer parts of the hands and forearms. Dermal collagen becomes stiff. These changes cause the skin to lose its tone and elasticity, resulting in wrinkling. Hair becomes gray because of the decrease in melanin production. Nails develop striations and grow slowly ^[13].

BEST PREVENTIVE MEASURES

Avoiding suppression of *vega* (urges)

Suppression of impending *adharaniya vega* (urges), *purish* (faeces), *shukra* (semen), *vata* (flatus), *chhardi* (vomiting), *kshavathu* (sneezing), *udgar* (eructation), *jrunbha* (yawning), *kshudha* (hunger), *trushna* (thirst), *ashru* (tears), *nidra* (sleep) and *shramaja shwas* (breathing after exercise)^[14] causes so many disorders as following.

- Suppression of the urine urge leads to dysuria, pain in bladder, head ache.
- Suppression of defecation causes colic pain, head ache, pain in calf muscle.
- Retention of semen causes body ache, pain in cardiac region.
- Suppression of sneezing gives rise to migraine, weakness of sense organs.
- Suppression of hunger leads to disorder of complexion.
- Suppression of tears leads to eye diseases, heart diseases.
- Suppression of sleep leads to head disorders.
- Suppression of *vega* breathing due to exercise leads to heart disease and fainting^[15].

Person who desires to avoid these diseases should not hold up the natural urges mentioned above. But today's lifestyle

changed drastically which hamper daily routine of human being and tends to develop disorders of those particular organs. By avoiding suppression of impending urges can prevent the major disorders in future.

***Shodhan karma* (evacuative therapy)**

Shodhan (evacuative therapy) maintains the *dosha* in balance state and avoids the re-appearance of diseases^[16]. *Shodhan* is eliminative method employed when *doshas* accumulate to an extreme level. This therapy includes *Vaman*, *Virechana*, *Nasya*, and *Basti* (*niruh* and *anuvasan*). Toxin accumulated in the body channels due to vitiated *doshas* are expelled out of the body through the *bahirmukh strotasa* (external orifices) by using this evacuative therapy. Eliminative methods can be used by normal individual also to clean the body. Out of these *panchkarma*, *Basti* material is introduced through anus which reaches up to colon and come out with stool after some time. This procedure greases the whole body, thus preventing accumulation of constipated waste in colons. Blood can be purified by avoiding absorption of toxins generated by stool in constipated bowel. Thus taking *basti* in every *varsha rutu* (rainy season) would help to avert constipation of old age by providing oleation to rectum, anal

canal and by improving function of colon for long period. *Vaman* (emesis), *Virechan* (purgative) is carried out to clean vitiated *kapha* and *pitta dosha* of body, respectively. *Nasya* is procedure in which drug is administered through nasal route. *Nasya dravya* spreads through vascular pathway and sometimes act as counter irritant. *Tarpan karma* with *gogrita* can provide strength to the eye ball.

Aahara (diet)

One should take food in proper quantity; this quantity of food depends on the *agni* (power of digestion). Quantity of food taken gets digested in time without disturbing normal function of the body, should be regarded as the measure of proper quantity. The food in proper quantity provides the strength, complexion and happy life to the person^[17].

Dincharya (Follow-up daily routine)

The daily routine like *anjana* (collyrium), *gandush* (medicated oil gargling), *dhumpan* (medicated smoking), *abhyanga* (oil massage) should be done strictly. All measures play major role in maintaining health. Collyrium protects eyes from *kaphaj vyadhi*, oil gargling provide strength in jaw and voice^[18]. Medicated smoking provides strength to hair, skull and sense organ and prevents the diseases of *jatru* (head).

Acharya Charaka mentioned the qualities of *abhyanga* as person who when endowed with *abhyanga* (oil massage) becomes strong and are least affected by old age^[19]. According to modern science *abhyanga* is application of oil substances through the external route. Toxic substances are mainly fat soluble, because cell membrane provide barrier for water molecules, toxins get dissolved in cell membrane. Thus by oleation therapy the absorbed toxins are removed from body.

Pranayama and Yoga

Pranayama is a breathing exercise that balances our nervous system and encourages creative thinking by increasing amount of oxygen to our brain. It improves mental clarity, alertness and physical well being. It helps to release tension and develop a relaxed state of mind. *Pranayama* also increases parasympathetic activity and lowers systolic blood pressure as well as respiratory rate^[20]. Because it charges the body with an increased supply of oxygen through the lungs, this oxygen oxidizes the waste impurities, chiefly carbon, in the venous blood. This process of purification is enhanced by an accompanying huge increase in expulsion of waste carbon dioxide from the lungs during exhalation. As

a consequence, very little of the tissue remains in the blood as waste material. The consumption of oxygen decreases resulting in low blood flow to the heart. The heart and lungs are given extraordinary rest. Different types of *asana* create certain pressure on body parts especially on abdominal organs. When *yogic kriyas* are performed under breathing patterns, the oxygen availability increase in the body and the area under pressure shows enhanced activity with secretion of digestive enzymes. Unnecessary toxic deposition gets destroyed by the digestive enzyme and there is improvement in digestion. Thus *yogic kriyas* maintain normal anatomic physiological status of body.

Rasayana

Rasayana (promotive treatment) means the way for attaining excellent *rasadi dhatu*. Promotive treatments provide longevity, memory, intelligence, prevention of diseases, youthful age, excellent luster and complexion with voice, optimum strength of physique and sense organs ^[21]. Various *rasayana* drugs are mentioned in Ayurveda such as *Guduchi* (*Tinospora cardifolia*), *Amalki* (*Emblica officinalis*), *Haritaki* (*Terminalia chebula*), *Vacha* (*Acarus calamus*) etc. Many *rasayana* drugs have

antioxidant properties as *Haritaki*, *Amalki* ^[22] ^[23]. Extract of *Vacha* proved as neuroprotective ^[24]. *Guggulu* (*Commifera mukul*) has proved as antiarthritic and antiobesity agent ^[25]. *Gokshur* (*Tribulus terrestris*) and *Dhanyaka* (*Coriandrum Sativum*) has a diuretic property ^[26]. *Shankhapushpi* (*Convolvulus pluricaulis*) and *Brahmi* (*Centella asiatica*) are *medhya rasayana* can sustain the memory ^[27]. Use of *rasayana* drugs in childhood and adult age help to prevent the various geriatric problems.

CONCLUSION

Different anatomical and physiological changes occur by age. These changes often lead to health problems and even death in elderly. In order to ensure health and well-being of this growing age group, it is important that health care professionals, the government, the community, their families and the elderly themselves understand the changes that are happening and adapt the preventive measures to avoid the suppression of natural urges, follow the *dincharya* practice of regular *yogic* exercise, *shodhana* according to *ritu* and consumption of *rasayana* drugs at proper

time. All these things will help to avoid increased risk related to aging.

REFERENCES

- [1] Agnivesha, Charaka, Dridhabala, Charak Samhita, Sharir Sthana, Sharirvichaya sharir Adhyaya, 6/29. In: Sharma P, editor. Reprint. Varanasi: Chaukhambha Orientalia; 2011. p. 454.
- [2] American Geriatrics Society Expert Panel on the Care of Older Adults with Multimorbidity. Guiding principles for the care of older adults with multimorbidity: An approach for clinicians. *J Am Geriatr Soc* 2012;60:E1–E25.
- [3] International Longevity Center. Workshop Report: Is There an Antiaging Medicine? New York: Canyon Ranch Series; 2002. Butler R et al. *J Gerontol.* 2002;57:B333-338.
- [4] Brandfonbrener M, Landowne M, Shock NW: Changes in cardiac function with age. *Circulation* 12:567-57
- [5] Muresan G. Sorbini CA, Grassi V: Respiratory function in the aged. *Bull Physio-Pathol Respir* 7:973-1007, 1971.
- [6] Boss GR, Seegmiller JE: Age-related physiological changes and their clinical significance, In *Geriatric Medicine.* West J Med 135:434-440, Dec 1981
- [7] Dunnill MS, Halley W: Some observations on the quantitative anatomy of the kidney. *J Pathol* 110:113-121, 1973 13. Moore RA: Total number of glomeruli in the normal human kidney. *Anat Rec* 48:153-168, 1929
- [8] Available from: <http://www.webmd.com/brain/news/20120105/memory-loss-may-occur-40s> [Last cited on 2014 June 23].
- [9] A service of the U.S. National Library of Medicine NIH National Institutes of Health. <http://www.nlm.nih.gov/medlineplus/ency/article/004000.htm> Update Date: 9/2/2012. [Last cited on 2014 June 23].
- [10] Anatomy and Physiology of Ageing Endocrine / Metabolic Available from: <http://www.frca.co.uk/article.aspx?articleid=100697/> Reena, Hacking Royal. [Last cited on 2014 June 1].
- [11] Shilpa Sapre and Ratna Thakur. Lifestyle and dietary factors determine age at natural menopause. *J Midlife Health.* 2014 Jan-Mar; 5(1): 3–5.

- [12] Sai Ravi Shanker, Phanikrishnab Bhaktha, Vatsala Reddy. Association between erectile dysfunction and coronary artery disease and it's severity. Indian heart journal 2013;65: 180-186.
- [13] <http://www.nlm.nih.gov/medlineplus/magazine/issues/winter07/articles/winter07pg10-13.html/> [Last cited on 2014 June 15].
- [14] Agnivesha, Charaka, Dridhabala, Charak Samhita, Sutra Sthana, Navegannadharaniya Adhyaya 7/4. In: Sharma P, editor. Reprint. Varanasi: Chaukhambha Orientalia; 2011. p. 47.
- [15] Agnivesha, Charaka, Dridhabala, Charak Samhita, Sutra Sthana, Sharirvichaya sharir Adhyaya 7/6-24. In: Sharma P, editor. Reprint. Varanasi: Chaukhambha Orientalia; 2011. p. 48-49.
- [16] Vagbhata, Ashtang Hrudaya Samhita, Sutra Sthana, Roganuutpadaniya Adhyaya 4/26. In: Shrikantha Murthy KR. editor, (8th ed.). Varanasi: Chowkhambha Krishnadas Academy, 2011; p. 50.
- [17] Agnivesha, Charaka, Dridhabala, Charak Samhita, Sutra Sthana, Matrashitiya Adhyaya, 5/4. In: Sharma P, editor. Reprint. Varanasi: Chaukhambha Orientalia; 2011. p. 32.
- [18] Agnivesha, Charaka, Dridhabala, Charak Samhita, Sutra Sthana, Matrashitiya Adhyaya, 5/14. In: Sharma P, editor. Reprint. Varanasi: Chaukhambha Orientalia; 2011. p. 33.
- [19] Agnivesha, Charaka, Dridhabala, Charak Samhita, Sutra Sthana, Matrashitiya Adhyaya, 5/89. In: Sharma P, editor. Reprint. Varanasi: Chaukhambha Orientalia; 2011. p.40.
- [20] Upadhyay Dhungel K, Malhotra V, Sarkar D, Prajapati R (March 2008). "Effect of alternate nostril breathing exercise on cardiorespiratory functions". Nepal Med Coll J 10 (1): 25–7. PMID 18700626.
- [21] Agnivesha, Charaka, Dridhabala, Charak Samhita, Chikitsa Sthana, Rasayana Adhyaya, Pratham pada 1/8. In: Sharma P, editor. Reprint. Varanasi: Chaukhambha Orientalia; 2011. p.4.
- [22] S. M. S. Samarakoon, H. M. Chandola, V. J. Shukla. Evaluation of antioxidant potential of *Amalakyas Rasayana*: A polyherbalAyurvedic formulation. Int J Ayurveda Res. 2011 Jan-Mar; 2(1): 23–28.
- [23] Naik GH1, Priyadarsini KI, Satav JG, Banavalikar MM, Sohoni DP, Biyani MK, Mohan

- H. Comparative antioxidant activity of individual herbal components used in Ayurvedic medicine. *Phytochemistry*. 2003 May;63(1):97-104.
- [24] Dr. Jina Pattanaik, Yogesh Kumar, Ravi Shankar Khatri. *Acorus calamus* Linn.: A herbal tonic for central nervous system. *Journal of Scientific and Innovative Research* 2013; 2 (5): 950-954.
- [25] Bharat B. Aggarwal, Sahdeo Prasad, Simone Reuter, Ramaswamy Kannappan, Vivek R. Yadev, Byoungduck Park, Ji Hye Kim, Subash C. Gupta, Kanokkarn Phromnoi, Chitra Sundaram, Seema Prasad, Madan M. Chaturvedi, and Bokyung Sung. *Curr Drug Targets*. Identification of Novel Anti-inflammatory Agents from Ayurvedic Medicine for Prevention of Chronic Diseases. Oct 1, 2011; 12(11): 1595–1653.
- [26] Shreyas G Bhalodia, Chaturbhuj Bhuyan, Sanjay Kumar Gupta, Tukaram S Dudhamal. Gokshuradi Vati and Dhanyaka-Gokshura Ghrita Matra Basti in the management of Benign Prostatic Hyperplasia. 2012; 33(4): 547-551.
- [27] Reena Kulkarni, K. J. Girish, Abhimanyu Kumar. Nootropic herbs (*Medhya Rasayana*) in Ayurveda: An update. *Pharmacogn Rev*. 2012 Jul-Dec; 6(12): 147–153.

Tawalare et al *Int J Ayu Pharm Chem Vol. 1, Issue 1, 2014*

✉ drkirantawalare@gmail.com