



Conceptual Studies on Cellular Aging and Programmed Cell Death in Light of *Swabhavoparama Vada* and *Kshanabhangura Vada*

Bijita Majumder ¹ , Sukalyan Ray ²

- 1- Assistant Professor, Dept. of Ayurved Samhita & Siddhanta, Kalawati Ayurvedic Medical College & Research Centre & Hospital, Gorha, Kasgunj, Uttar Pradesh
- 2- Associate Professor & H.O.D., Dept. of Roga Nidan Avum Vikriti Vigyan, Raghunath Ayurved Mahavidyalay & Hospital, Contai, West Bengal

Article Info

Article history:

Received on: 22-04-2022

Accepted on: 13-06-2022

Available online: 30-06-2022

Corresponding author-

Sukalyan Ray Raghunath Ayurved Mahavidyalay and Hospital, Raghunath Sarani, Central Bus Stand, Contai, Purba Medinipur, West Bengal,

Email:

vaidya.sukalyan.ray@gmail.com

ABSTRACT:

In this universe, no living being is eternal. Birth and death are the two terminal point of life. Where we can point out to many causes of genesis, there is no absolute reason behind the annihilation of beings as it becomes certain once a creature is born, it will go to die one day. Every biological cycle has its own causes for its start-up but it has come to end one moment with no absolute cause behind for its cessation. Cells are the structural and functional unit of every living beings. Cells normally maintain a steady state called homeostasis in which the intracellular milieu is kept within a fairly narrow range of physiologic parameters. But every cell under goes aging and ultimately death. Cell death is one of the most crucial events in the evolution of disease in any tissue or organ. Cell death also is a normal and essential process in embryogenesis, the development of organs, and the maintenance of homeostasis. A number of cellular functions decline progressively with age. Cellular aging is the result of a progressive decline in the life span and functional capacity of cells. Although many theories have been propounded why the cell attains senescence and death, we still actually don't know why these senescence and death cannot be avoided and these become certain for every cell. In absence of proper explanation, the need of the hour is to study both the phenomenon i.e. cellular aging and apoptosis in comparison with the *Ayurvedic* doctrine of *Swabhavoparama Vada* (doctrine of natural destruction) and *Buddhist* doctrine of *Kshanabhangura Vada* (doctrine of momentariness). The proper understanding of these eternal theories may help us to find answers of many unsolved questions regarding cell's life cycle and can open the doors of possibilities for new research and discoveries.

Key Words : Programmed cell death, apoptosis, cellular aging, *Swabhavoparama Vada*, *Kshanabhangura Vada*.

INTRODUCTION

Cells are the basic membrane-bound structural and functional units that contain the fundamental molecules of

life and of which all living things are composed. Cells are active participants in their environment, constantly



adjusting structure and function to accommodate changing demands and extra cellular stresses. Cells normally maintain a steady state called homeostasis in which the intracellular milieu is kept within a fairly narrow range of physiologic parameters¹. As cells encounter physiologic stresses or pathologic stimuli, they can undergo adaptation, achieving a new steady state and preserving viability and function. The principal adaptive responses are hypertrophy, hyperplasia, atrophy, and metaplasia². If the adaptive capability is exceeded or if the external stress is inherently harmful, cell injury develops. Within certain limits, injury is reversible, and cells return to a stable baseline; however, if the stress is severe, persistent and rapid in onset, it results in irreversible injury and death of the affected cells³. Cell death is one of the most crucial events in the evolution of disease in any tissue or organ. Cell death also is a normal and essential process in embryogenesis, the development of organs, and the maintenance of homeostasis. Individuals age because their cells age⁴. In *Ayurveda*, *Jara* (senility) has been regarded as one of the *Swabhavika Vyadhi* i.e. natural ailment which means it cannot be avoided⁵. Although public attention on the aging process has traditionally focused on its cosmetic manifestations, aging has important health consequences, because age is one of the strongest independent risk factors for many chronic diseases, such as cancer, Alzheimer disease, and ischemic heart disease⁶. A number of cellular functions decline progressively with age. Cellular aging is the result of a progressive decline in the life span and functional capacity of cells. Although there are many theories, it is clear that cellular senescence is multifactorial. It involves the cumulative effects of both an intrinsic clock of cellular aging and the extrinsic stressors of the cellular environment (wear and tear phenomenon)⁷. The intrinsic cellular aging theories hold that cell senescence occurs because of predetermined genetic programming⁸ - such events can be compared with the *Ayurvedic* concept of '*Swabhava Uparama*' i.e. natural annihilation.

Programmed cell death - commonly called as 'apoptosis' is a distinctive and important mode of cell death different from necrosis⁹. Rather than the cellular homicide that occurs in necrotic cell death, apoptosis is a pathway of cellular suicide¹⁰. Apoptosis is a pathway of cell death in which cells activate enzymes that degrade the cells' own nuclear DNA and nuclear and cytoplasmic proteins. Fragments of the apoptotic cells then break off, giving the appearance that is responsible for the name (apoptosis, "falling off"). The plasma membrane of the apoptotic cell remains intact, but the membrane is altered in such a way

that the cell and its fragments become avid targets for phagocytes. The dead cell and its fragments are rapidly cleared before cellular contents have leaked out¹¹. Apoptosis is responsible for the programmed cell death in several important physiologic as well as pathologic processes. Apoptosis occurs in many normal situations and serves to eliminate potentially harmful cells and cells that have outlived their usefulness¹². It also occurs as a pathologic event when cells are damaged beyond repair, especially when the damage affects the cell's DNA or proteins; in these situations, the irreparably damaged cell is eliminated. Death by apoptosis is a normal phenomenon that serves to eliminate cells that are no longer needed and to maintain a constant number of cells of various types in tissues¹³. Cell death in many situation is caused by apoptosis. It has two distinct pathways - intrinsic pathway (mitochondrial pathway) and extrinsic pathway (death receptor pathway)¹⁴. The mitochondrial pathway seems to be the pathway that is responsible for apoptosis in most situations. In this pathway many factors trigger cell death like - growth factor withdrawal, DNA damage, protein misfolding (ER stress) etc.¹⁵. Both the phenomenon i.e. cellular aging and apoptosis can be studied in comparison with the *Ayurvedic* doctrine of *Swabhavoparama Vada* (doctrine of natural destruction) and *Buddhist* doctrine of *Kshanabhangura Vada* (doctrine of momentariness).

The doctrine of *Swabhavoparama Vada* was propounded by sage *Atryea Punarvasu* in *Charaka Samhita*, *Sutrasthan*, chapter 16 (*Chikitsa Prabhritiyam Adhyaya*)¹⁶. The terminology consists two distinct words - '*Swabhava*' means natural and '*Uparama*' means destruction or annihilation¹⁷. So, this theory (*Vada*) tells us about phenomenon of natural destruction or destruction as part of nature's own healing process, apparently without having any cause. Disturbance in the equilibrium of the causative factors causes imbalance of *Dhatu*s (tissue elements) of the body. Conversely, the maintenance of the former's equilibrium maintains the latter's balance. However, the *Dhatu*s come to normalcy automatically irrespective of any external causative factor, that is to say both the imbalanced and balanced *Dhatu*s tend to fade away immediately after they caused¹⁸. *Atryea Punarvasu* also mentions that, there is a causative factor for manifestation of *Bhava* (existing things / beings) but no causative factor as such exists for their annihilation¹⁹. According to him, some scholars opine that annihilation of beings is caused by non-effectiveness of the causative factors²⁰. While commenting on the relevant verses, the great commentator of *Charaka Samhita*, *Chakrapani Dutta* mentions that²¹, all beings do

have a cause in so far as their creation is concerned, but they have no cause in relation to their annihilation; that is to say, annihilation or destruction of beings is automatic. So if this view is accepted, the disturbance of equilibrium caused in the *Dhatus* by certain causative factors will be automatically done away without the help of any therapeutic device. That is to say, the natural state of equilibrium of *Dhatus* is automatically restored without the help of any other causative factor like treatment etc. So, any deviation from the state of equilibrium of the *Dhatus* may be treated as a momentary one²². In this connection, *Chakrapani Dutta* has correlated the theory of *Swabhavoparama Vada* with the *Buddhist* theory of momentariness i.e. *Kshanabhangura Vada*²³.

Kshanabhangura Vada is one of the important theory of early *Buddhism*²⁴. According to this theory everything in this universe is not static and eternal. Instead everything is momentary. Everything will be destructed in a moment. Everything is produced in the first moment, exists in the second moment and gets destructed in the next moment. Similarly all the matters get changes in every moment²⁵. *Buddhist* opine that the present is not related with the past and future. The object existed at a particular place and time gets destructed at the same time²⁶. *Yadriccha* controls the activities of *Karana* and *Karya*. The *Karana Dravya* destroys immediately after producing the *Karya Dravya* or production. Mutual and actual relation between two moments never exists. Thus the existence of one object is momentary²⁷. *Buddhist* philosophy further states that, some cause is there for creation and production of matter. But there is no such cause for its destruction²⁸. Destruction is natural. The objects produced get changes in every moment very fast which cannot be visible. Hence it looks like that it is in previous form, but it is not true. All the objects created in the universe are momentary. The production, existence and destruction of all the objects is a continuous process forever²⁹. *Acharya Charaka* represents this view of *Kshanabhangura Vada* in *Charaka Samhita, Sharirasthan*, chapter 1 as³⁰ - "there are no permanent entities as such. They appear to be so because they are similar. As a matter of fact, they are produced afresh each time, consecutively. It is merely the combination of these ephemeral elements devoid of any permanent controlling agent as such that are known a living beings". So, according to this view, different living beings are nothing but the combination of the various momentary phases of consciousness etc., bound with the chains of momentary causality. Later *Acharya Charaka* upholds that, apart from the body which is in the process of constant decay, there is

a factor called *Purusha* (*Atma* / soul) which is eternal and responsible for the manifestation of actions³¹.

In the above context this study has been carried out keeping the following aims and objectives:

1. To study *Swabhavoparama Vada* (theory of natural annihilation) & *Kshanabhangura Vada* (theory of momentariness) elaborately with relevant application in *Ayurveda*.
2. To understand the process of cellular aging and programmed cell death (apoptosis) in light of the above two doctrines.

MATERIALS AND METHODS:

The literary information regarding the doctrine of *Swabhavoparama Vada* & *Kshanabhangura Vada* has been taken from various classical texts of *Ayurveda* (mainly *Charaka Samhita*) and philosophy and the information related with cellular aging and apoptosis has been taken from various reputed books of modern pathology like Textbook of Pathology by Harsh Mohan (7th edition), Robbin's Basic Pathology (9th edition) among others. All the literary information has been verified and validated through this study.

DISCUSSION:

As per the theory of *Swabhavoparama Vada*, there is a causative factor for *Pravritti* (manifestation) of *Bhava* (existing things / beings) but no causative factor as such exists for their annihilation³². Imbalance between the factors responsible for equilibrium between *Dhatus* (should be taken for *Dosha*, *Dhatu* and *Mala*) leads to disequilibrium between them. All the *Dhatus* gets nourishment from *Ahara Rasa* which consists all the six *Rasas*. So, naturally the *Rasa* which has been taken acts as an increment factor for those *Dhatus* which have similar properties with the respective *Rasa* and the same *Rasa* act as a declining factor for those *Dhatus* which have opposite properties of that respective *Rasa*. Apart from this, there is always a continuous decaying of all the *Dhatus* without having any specific reason and to compensate that loss, the process of *Dhatu Paka* (formation of different *Dhatus* from *Ahara Rasa*) is also going on continuously³³. Thus it can be said that, the process of building up (wear phenomenon) and process of decaying (tear phenomenon) is always going on simultaneously within human body. Wear phenomenon needs several causative factors but there is no such factor needed for tear phenomenon. Thus the state of homeostasis within our body is maintained.

Cellular ageing mechanisms involve both programmed events and the consequences of progressive environmental injury³⁴. Programmed aging assumes a pre-determined sequence of events, including the repression and depression of specific genetic programmes, leading ultimately to senescence. All normal cells have a limited capacity for replication, and after a fixed number of divisions cells become arrested in a terminally non dividing state, known as replicative senescence³⁵. Aging is associated with progressive replicative senescence of cells. Cells from children have the capacity to undergo more rounds of replication than do cells from older people³⁶. Such theories are supported by the long standing observation that normal human fibroblasts in culture have a finite life span, they stop dividing and become senescent after about 50 doublings whereas fibroblasts from neonates go through about 65 doublings before they cease dividing³⁷. Although many theories have been proposed how the cell attains programmed aging but it is not still clear why cells and organisms should have evolved to have a finite number of replications³⁸. This is where we can apply the understanding of the theories of *Swabhavoparama Vada* and *Kshanabhangura Vada*. *Swabhavoparama Vada* explains that although there are many reasons for cell sustenance and their replication, but there is no such finite cause for the cessation of their replication after a certain number of times. That is why every type of cells has their own number of pre-determined replications after which they attain senescence. This is part of natural destruction - '*Swabhava Uparama*'. According to the theory of *Kshanabhangura Vada*, everything is produced in the first moment, exists in the second moment and gets destroyed in the next moment. The objects produced get changes in every moment very fast which cannot be visible. Hence it looks like that it is in previous form, but it is not true. All the objects created in the universe are momentary. This very concept can be applied to understand the process of replication of fibroblasts - where every fibroblast is continuously replicated for a certain number of times - each time producing a new fibroblast which looks like the previous one but actually different from the previous one. And after a certain number of times it attains senescence. So it can be said from the perceptive of *Buddhist* that, the existence of fibroblasts like any other cells are momentary, not permanent. This very concept has also been accepted by *Acharya Sushruta* where he accepts *Jara* or the state of senescence as *Swabhavika Vyadhi* - a condition which is not desirable but comes naturally to everyone³⁹. Several mechanisms are thought to be responsible for

cellular aging, among them some important mechanisms are as follows :

1. Damage to nuclear and mitochondrial DNA : DNAs are the most important component for cellular division. A variety of metabolic insults that accumulate over time may result in damage to nuclear and mitochondrial DNA. Although most DNA damage is repaired by DNA repair enzymes, some persists and accumulates as cells age⁴⁰. Some aging syndromes are associated with defects in DNA repair mechanisms. This particular mechanism can be correlated with a specific aspect of *Swabhavoparama Vada*. *Acharya Charaka* while describing the doctrine has mentioned that, according to some scholars, annihilation of beings is caused by non-effectiveness of the causative factors which are responsible for its well-being⁴¹. To explain it further, *Acharya Chakrapani Dutta* has given an example of flame of a lamp which requires a cause, that is oil etc. for its continuance but it does not need any cause as such for its extinction which is automatic⁴². When the oil etc. become void the flame also comes to an end naturally. From above perspective this phenomenon can be explained in a way that, the absence of oil makes the extinction of flame a natural event without having any visible cause. The absence of a normal functioning DNA and its failure of self-repairing leads to imbalance of homeostasis which ultimately leads to cellular aging and programmed cell death - without having any other specific causative factors.

2. Decreased cellular replication: Aging is associated with progressive replicative senescence of cells⁴³. Cells from children have the capacity to undergo more rounds of replication than do cells from older people. In human cells, the mechanism of replicative senescence involves progressive shortening of telomeres, which ultimately results in cell cycle arrest⁴⁴. Telomeres are short repeated sequences of DNA present at the ends of linear chromosomes that are important for ensuring the complete replication of chromosome ends and for protecting the ends from fusion and degradation. When somatic cells replicate, a small section of the telomere is not duplicated, and telomeres become progressively shortened. As the telomeres become shorter, the ends of chromosomes cannot be protected and are seen as broken DNA, which signals cell cycle arrest⁴⁵. This mechanism can be compared with theory of natural destruction where there is progressive annihilation without having any specific cause. This mechanism can also be understood through the example of Lamp and its flame as described by *Acharya Chakrapani Dutta*, where progressive decaying of the oil and thread leads to extinction of flame.

3. Defective protein homeostasis: Protein homeostasis is essential for sustenance and replication of cells. Over time, cells are unable to maintain normal protein homeostasis, because of increased turnover and decreased synthesis caused by reduced translation of proteins and defective activity of chaperones (which promote normal protein folding), proteasomes (which destroy misfolded proteins) and repair enzymes⁴⁶. Abnormal protein homeostasis can have many effects on cell survival, replication, and functions. In addition, it may lead to accumulation of misfolded proteins, which can trigger pathways of apoptosis⁴⁷. This mechanism of cell aging can be understood from the perspective of the theory of *Swabhavoparama Vada* as discussed earlier.

Programmed cell death or apoptosis as it is generally called, is a regulated mechanism of cell death that serves to eliminate unwanted and irreparably damaged cells, with the least possible host reaction⁴⁸. It is characterized by enzymatic degradation of proteins and DNA, initiated by caspases; and by recognition and removal of dead cells by phagocytes⁴⁹. This phenomenon can be again compared with *Acharya Sushruta's* concept of *Mrityu* or death as *Swabhavika Vyadhi* - a condition which is not desirable but comes naturally to everyone without having any real cause. That is to say, as per *Acharya Sushruta*, death does not require any causative factors as such, as it becomes certain after birth. So, it cannot be avoided. Here we can see the reflection of the basic concept of *Swabhavoparama Vada* and *Kshanabhangura Vada*. Programmed cell death can be seen in both physiologic and pathologic processes. Some of the physiologic process where apoptosis can be seen are :⁵⁰

1. The programmed destruction of cells during embryogenesis as occurs in implantation, organogenesis and developmental involution.
2. Hormone dependent physiologic involution such as involution of endometrium during menstrual cycle or the lactating breast after weaning.
3. Cell deletion in proliferating populations such as intestinal crypt epithelium or cell death in tumour.
4. Deletion of auto reactive T cells in the thymus, cell death of cytokine starved lymphocytes. Apoptosis is initiated by two major pathways:

1. Mitochondrial (intrinsic) pathway: it is triggered by loss of survival signals, DNA damage and accumulation of misfolded proteins (ER stress); associated with leakage of pro-apoptotic proteins from mitochondrial membrane into the cytoplasm, where they trigger caspase activation; inhibited by anti-apoptotic members of the Bcl family, which are induced by survival signals including growth factors⁵¹.

2. Death receptor (extrinsic) pathway: it is responsible for elimination of self-reactive lymphocytes and damage by cytotoxic T lymphocytes; is initiated by engagement of death receptors (members of the TNF receptor family) by ligands on adjacent cells⁵².

Whatever the pathways may be, we can understand the purpose of programmed cell death by applying the theory of *Swabhavoparama Vada*. It is a highly regulated process of cellular destruction like what is described under the theory of natural destruction. The natural destruction of every beings should not be an irregular and isolated phenomenon, rather this is regulated by the law of nature. Programmed cell death serves to eliminate unwanted and irreparably damaged cells - where the cell is no longer needed and its utility comes to an end. So its destruction occurs as a part of maintaining body homeostasis. The above mentioned various example of physiologic instances indicates that whenever the functionality of any particular cell ceases or to say it is no more needed by the body, the body eliminates these cells without having any particular causative factors. This happens as part of natural destruction of cells to maintain body homeostasis. This particular point can be studied in light of *Swabhavoparama Vada* which tells us about the destruction of beings (here cells) without having any cause or when destruction of beings does not depend upon any particular cause. Again this phenomenon can be correlated with *Buddhist* view of *Kshanabhangura Vada* which tell us about the momentary nature of all beings in this universe. Nothing is permanent in this universe, so as the cells. They are created at one moment, sustained for one moment and on next moment they got destructed as part of nature's rule - without having any cause. As time is moving forward and as such automatically destroying itself due to its fickleness and it does not need any other cause for its destruction. Such is the case of the destruction of all beings⁵³. It is caused automatically without any causative factor as such. *Acharya Chakrapani Dutta* opined that, "if an occurrence is not caused by another causative factor, it will be automatic and it will be taken for granted for all times to come. Destruction of beings comes to this category. If destruction were also dependent on some other causative factor, it would not occur automatically. Destruction of beings occurs only after its production. After production, all beings are momentary and as such they go on destroying themselves automatically. So, all beings perish exactly as they were produced such as the time"⁵⁴. Here we can notice the inter relation between the two stipulated doctrines of *Swabhavoparama Vada* and *Kshanabhangura Vada*. We

can apply the same understanding for further analysis of cellular aging and programmed cell death.

CONCLUSION:

With the progression of scientific studies we have now become able to know many 'how's but still we could not know many 'why's. Origin and destruction are the two terminal point of life cycle. There are many theories proposed for genesis of beings but we still cannot found any satisfactory answer to why there is continuous decaying of living beings and why there is at one point of time ultimate cessation comes. Cellular aging is the result of a progressive decline in the life span and functional capacity of cells. Although there are many theories, it is clear that cellular senescence is unavoidable and part of normal phenomenon. The intrinsic cellular aging theories hold that cell senescence occurs because of predetermined genetic programming - such events can be compared with the *Ayurvedic* concept of natural annihilation. Apoptosis occurs in many normal situations and serves to eliminate potentially harmful cells and cells that have outlived their usefulness. It also occurs as a pathologic event when cells are damaged beyond repair. Cell death by apoptosis is a normal phenomenon that serves to eliminate cells that are no longer needed and to maintain a constant number of cells of various types in tissues, which helps to maintain cellular homeostasis. In Ayurveda, *Jara* (aging), *Mrityu* (death) have been considered as *Swabhavik Vyadhi* (natural disease) and these cannot be stopped. Tear and wear is the law of nature. This means the *Dosha, Dhatus and Malas* of the body are destructed naturally and this cannot be stopped by any process, which is supported by the theory of *Swabhavoparama Vada*. *Dhatus* are originated at one moment, sustain for next moment and subsequently start decaying on the next moment. So the cycle of *Utpatti* (origin), *Sthiti* (sustenance) and *Vinasha* (destruction) continues uninterruptedly with the passage of *Kala* (time). This phenomenon of momentariness is supported by the theory of *Kshanabhangura Vada*. In absence of proper reasons which indicate why cellular aging and programmed cell death occurs and cannot be avoided, we can find the possible answers through the theories of *Swabhavoparama Vada* (theory of natural annihilation) & *Kshanabhangura Vada* (theory of momentariness) which are well accepted and validated by Ayurveda. The proper understanding of these eternal theories may help us to find answers of many unsolved questions in biological science and can open the doors of possibilities for new research and discoveries.

Acknowledgement:

We want to sincerely acknowledge our revered preceptor Dr. Debasis Maity, MS, Mch (Urology) for his valuable inputs on cell injury and cell death.

Source of Funding -Nil

Conflict of Interest-Nil

ORCID

Bijita Majumder , <https://orcid.org/0000-0003-4980-0095>

REFERENCES:

1. Kumar V, Abbas Abul K., Aster Jon C., Robbins Basic Pathology, 9th Ed., Philadelphia, Elsevier Saunders, 2013.pp.02
2. Kumar V, Abbas Abul K., Aster Jon C., Robbins Basic Pathology, 9th Ed., Philadelphia, Elsevier Saunders, 2013.pp.02
3. Kumar V, Abbas Abul K., Aster Jon C., Robbins Basic Pathology, 9th Ed., Philadelphia, Elsevier Saunders, 2013.pp.02
4. Kumar V, Abbas Abul K., Aster Jon C., Robbins Basic Pathology, 9th Ed., Philadelphia, Elsevier Saunders, 2013.pp.02
5. Shastri AD, editor. Sushrut Samhita of Maharshi Sushrut. Reprint. Vol. 1. *Sutrasthan, chapter 24, verse -8*. Varanasi: Chaowkhamba Sanskrit Sansthan, 2015. Page. 131
6. Kumar V, Abbas Abul K., Aster Jon C., Robbins Basic Pathology, 9th Ed., Philadelphia, Elsevier Saunders, 2013.pp.26
7. Kumar V, Abbas Abul K., Aster Jon C., Robbins Basic Pathology, 9th Ed., Philadelphia, Elsevier Saunders, 2013.pp.29
8. Kumar V, Abbas Abul K., Aster Jon C., Robbins Basic Pathology, 9th Ed., Philadelphia, Elsevier Saunders, 2013.pp.29
9. Kumar V, Abbas Abul K., Aster Jon C., Robbins Basic Pathology, 9th Ed., Philadelphia, Elsevier Saunders, 2013.pp.26
10. Kumar V, Abbas Abul K., Aster Jon C., Robbins Basic Pathology, 9th Ed., Philadelphia, Elsevier Saunders, 2013.pp.26
11. Kumar V, Abbas Abul K., Aster Jon C., Robbins Basic Pathology, 9th Ed., Philadelphia, Elsevier Saunders, 2013.pp.18
12. Kumar V, Abbas Abul K., Aster Jon C., Robbins Basic

- Pathology, 9th Ed., Philadelphia, Elsevier Saunders, 2013.pp.18
13. Kumar V, Abbas Abul K., Aster Jon C., Robbins Basic Pathology, 9th Ed., Philadelphia, Elsevier Saunders, 2013.pp.18
 14. Kumar V, Abbas Abul K., Aster Jon C., Robbins Basic Pathology, 9th Ed., Philadelphia, Elsevier Saunders, 2013.pp.19
 15. Kumar V, Abbas Abul K., Aster Jon C., Robbins Basic Pathology, 9th Ed., Philadelphia, Elsevier Saunders, 2013.pp.19-20
 16. Sharma R.K., Dash Bhagwan, editor. Charaka Samhita of Agnivesh : commentary Ayurveda Dipika of Chakrapani Dutta. Reprint Ed. Vol. 1. *Sutrasthan, Chapter 16, Verse - 27 - 33*. Varanasi : Chaowkhamba Sanskrit Series Office, 2004 Page. 305 - 307
 17. Sharma R.K., Dash Bhagwan, editor. Charaka Samhita of Agnivesh : commentary Ayurveda Dipika of Chakrapani Dutta. Reprint Ed. Vol. 1. *Sutrasthan, Chapter 16, Chakrapani Dutta's commentary on Verse - 27*. Varanasi : Chaowkhamba Sanskrit Series Office, 2004 Page. 305
 18. Sharma R.K., Dash Bhagwan, editor. Charaka Samhita of Agnivesh : commentary Ayurveda Dipika of Chakrapani Dutta. Reprint Ed. Vol. 1. *Sutrasthan, Chapter 16, Chakrapani Dutta's commentary on Verse - 27*. Varanasi : Chaowkhamba Sanskrit Series Office, 2004 Page. 305
 19. Sharma R.K., Dash Bhagwan, editor. Charaka Samhita of Agnivesh : commentary Ayurveda Dipika of Chakrapani Dutta. Reprint Ed. Vol. 1. *Sutrasthan, Chapter 16, Chakrapani Dutta's commentary on Verse - 27*. Varanasi : Chaowkhamba Sanskrit Series Office, 2004 Page. 305
 20. Sharma R.K., Dash Bhagwan, editor. Charaka Samhita of Agnivesh : commentary Ayurveda Dipika of Chakrapani Dutta. Reprint Ed. Vol. 1. *Sutrasthan, Chapter 16, Chakrapani Dutta's commentary on Verse - 27*. Varanasi : Chaowkhamba Sanskrit Series Office, 2004 Page. 305
 21. Sharma R.K., Dash Bhagwan, editor. Charaka Samhita of Agnivesh : commentary Ayurveda Dipika of Chakrapani Dutta. Reprint Ed. Vol. 1. *Sutrasthan, Chapter 16, Chakrapani Dutta's commentary on Verse - 27*. Varanasi : Chaowkhamba Sanskrit Series Office, 2004 Page. 305
 22. Sharma R.K., Dash Bhagwan, editor. Charaka Samhita of Agnivesh : commentary Ayurveda Dipika of Chakrapani Dutta. Reprint Ed. Vol. 1. *Sutrasthan, Chapter 16, Chakrapani Dutta's commentary on Verse - 27*. Varanasi : Chaowkhamba Sanskrit Series Office, 2004 Page. 305
 23. Sharma R.K., Dash Bhagwan, editor. Charaka Samhita of Agnivesh : commentary Ayurveda Dipika of Chakrapani Dutta. Reprint Ed. Vol. 1. *Sutrasthan, Chapter 16, Chakrapani Dutta's commentary on Verse - 27*. Varanasi : Chaowkhamba Sanskrit Series Office, 2004 Page. 305
 24. Radhakrishnan S., Indian Philosophy, 2nd edition, vol. 1, New Delhi, Oxford University Press, 2013, 314 page
 25. Nimbal AA., Concept of Kshanabhangur Vada and its application in Ayurveda, slideshare.net, Januray 23, 2019, available from: <https://www.slideshare.net/DrashwiniNimbal1/concept-of-kshanabhanguravada-and-its-application-in-ayurveda-by-dr-ashwini-a-nimbal>
 26. Nimbal AA., Concept of Kshanabhangur Vada and its application in Ayurveda, slideshare.net, Januray 23, 2019, available from: <https://www.slideshare.net/DrashwiniNimbal1/concept-of-kshanabhanguravada-and-its-application-in-ayurveda-by-dr-ashwini-a-nimbal>
 27. Nimbal AA., Concept of Kshanabhangur Vada and its application in Ayurveda, slideshare.net, Januray 23, 2019, available from: <https://www.slideshare.net/DrashwiniNimbal1/concept-of-kshanabhanguravada-and-its-application-in-ayurveda-by-dr-ashwini-a-nimbal>
 28. Kolarkar RS, Appraisal of Swabhavaparamvada in the light of the Buddha's teaching, International Journal of Complementary and Alternative Medicine, 2018, October 9 ; 1(5): 271-273
 29. Kolarkar RS, Appraisal of Swabhavaparamvada in the light of the Buddha's teaching, International Journal of Complementary and Alternative Medicine, 2018, October 9 ; 1(5): 271-273
 30. Sharma R.K., Dash Bhagwan, editor. Charaka Samhita of Agnivesh : commentary Ayurveda Dipika of Chakrapani Dutta. Reprint Ed. Vol. 2. *Sharirasthan, Chapter 1, Verse - 46-47*. Varanasi : Chaowkhamba Sanskrit Series Office, 2004 Page. 323
 31. Sharma R.K., Dash Bhagwan, editor. Charaka Samhita of Agnivesh : commentary Ayurveda Dipika of Chakrapani Dutta. Reprint Ed. Vol. 2. *Sharirasthan, Chapter 1, Verse - 51*. Varanasi : Chaowkhamba Sanskrit Series Office, 2004Page. 324
 32. Sharma R.K., Dash Bhagwan, editor. Charaka Samhita of Agnivesh : commentary Ayurveda Dipika of Chakrapani Dutta. Reprint Ed. Vol. 1. *Sutrasthan, Chapter 16, Chakrapani Dutta's commentary on Verse - 28*. Varanasi : Chaowkhamba Sanskrit Series Office, 2004Page. 305
 33. Sastri K, Chaturvedi Gorakhnath editor. Charaka Samhita

- of Agnivesh : Hindi exposition Vidyotini, Reprint Ed. Vol. 1. *Sutrasthan, Chapter 16, Hindi exposition on Verse 27*. Varanasi : Chaowkhamba Sanskrit Series Office, 2004 Page. 324
34. Kumar V, Cotran Ramji S., Robbins Stainley L., Robbins Basic Pathology, 7th Ed., Mitchell Richard N., Cotran Ramzi S. (chapter author), Philadelphia, Elsevier Saunders, 2005.pp.30.
35. Kumar V, Cotran Ramji S., Robbins Stainley L., Robbins Basic Pathology, 7th Ed., Mitchell Richard N., Cotran Ramzi S. (chapter author), Philadelphia, Elsevier Saunders, 2005.pp.26
36. Kumar V, Cotran Ramji S., Robbins Stainley L., Robbins Basic Pathology, 7th Ed., Mitchell Richard N., Cotran Ramzi S. (chapter author), Philadelphia, Elsevier Saunders, 2005.pp.26
37. Kumar V, Cotran Ramji S., Robbins Stainley L., Robbins Basic Pathology, 7th Ed., Mitchell Richard N., Cotran Ramzi S. (chapter author), Philadelphia, Elsevier Saunders, 2005.pp.29
38. Kumar V, Cotran Ramji S., Robbins Stainley L., Robbins Basic Pathology, 7th Ed., Mitchell Richard N., Cotran Ramzi S. (chapter author), Philadelphia, Elsevier Saunders, 2005.pp.26
39. Shastri AD, editor. Sushrut Samhita of Maharshi Sushrut. Reprint. Vol. 1. *Sutrasthan, chapter 24, verse -8*. Varanasi: Chaowkhamba Sanskrit Sansthan, 2015. Page. 131
40. Kumar V, Cotran Ramji S., Robbins Stainley L., Robbins Basic Pathology, 7th Ed., Mitchell Richard N., Cotran Ramzi S. (chapter author), Philadelphia, Elsevier Saunders, 2005.pp.26
41. Sharma R.K., Dash Bhagwan, editor. Charaka Samhita of Agnivesh : commentary Ayurveda Dipika of Chakrapani Dutta. Reprint Ed. Vol. 1. *Sutrasthan, Chapter 16, Verse - 28*. Varanasi : Chaowkhamba Sanskrit Series Office, 2004Page. 305
42. Sharma R.K., Dash Bhagwan, editor. Charaka Samhita of Agnivesh : commentary Ayurveda Dipika of Chakrapani Dutta. Reprint Ed. Vol. 1. *Sutrasthan, Chapter 16, Chakrapani Dutta's commentary on Verse - 27& 28*. Varanasi : Chaowkhamba Sanskrit Series Office, 2004Page. 305
43. Kumar V, Cotran Ramji S., Robbins Stainley L., Robbins Basic Pathology, 7th Ed., Mitchell Richard N., Cotran Ramzi S. (chapter author), Philadelphia, Elsevier Saunders, 2005.pp.27
44. Kumar V, Cotran Ramji S., Robbins Stainley L., Robbins Basic Pathology, 7th Ed., Mitchell Richard N., Cotran Ramzi S. (chapter author), Philadelphia, Elsevier Saunders, 2005.pp.26-27
45. Kumar V, Cotran Ramji S., Robbins Stainley L., Robbins Basic Pathology, 7th Ed., Mitchell Richard N., Cotran Ramzi S. (chapter author), Philadelphia, Elsevier Saunders, 2005.pp.26-27
46. Kumar V, Cotran Ramji S., Robbins Stainley L., Robbins Basic Pathology, 7th Ed., Mitchell Richard N., Cotran Ramzi S. (chapter author), Philadelphia, Elsevier Saunders, 2005.pp.27-28
47. Kumar V, Cotran Ramji S., Robbins Stainley L., Robbins Basic Pathology, 7th Ed., Mitchell Richard N., Cotran Ramzi S. (chapter author), Philadelphia, Elsevier Saunders, 2005.pp.27-28
48. Kumar V, Cotran Ramji S., Robbins Stainley L., Robbins Basic Pathology, 7th Ed., Mitchell Richard N., Cotran Ramzi S. (chapter author), Philadelphia, Elsevier Saunders, 2005.pp.22
49. Kumar V, Cotran Ramji S., Robbins Stainley L., Robbins Basic Pathology, 7th Ed., Mitchell Richard N., Cotran Ramzi S. (chapter author), Philadelphia, Elsevier Saunders, 2005.pp.22
50. Kumar V, Cotran Ramji S., Robbins Stainley L., Robbins Basic Pathology, 7th Ed., Mitchell Richard N., Cotran Ramzi S. (chapter author), Philadelphia, Elsevier Saunders, 2005.pp.26
51. Kumar V, Cotran Ramji S., Robbins Stainley L., Robbins Basic Pathology, 7th Ed., Mitchell Richard N., Cotran Ramzi S. (chapter author), Philadelphia, Elsevier Saunders, 2005.pp.19
52. Kumar V, Cotran Ramji S., Robbins Stainley L., Robbins Basic Pathology, 7th Ed., Mitchell Richard N., Cotran Ramzi S. (chapter author), Philadelphia, Elsevier Saunders, 2005.pp.19
53. Kolarkar RS, Appraisal of Swabhavaparamvada in the light of the Buddha's teaching, International Journal of Complementary and Alternative Medicine, 2018, October 9 ; 1(5): 271-273
54. Sharma R.K., Dash Bhagwan, editor. Charaka Samhita of Agnivesh : Reprint Ed. Vol. 1. *Sutrasthan, Chapter 16, Chakrapani Dutta's commentary on Verse - 31 & 32*. Varanasi : Chaowkhamba Sanskrit Series Office, 2004 Page. 306 – 307

How to cite this article: Majumder B, Ray S "Conceptual Studies On Cellular Aging And Programmed Cell Death In Light Of Swabhavoparama Vada And Kshanabhangura Vada" IRJAY. [online]2022;5(6): 92-99. Available from: <https://irjay.com> DOI link-<https://doi.org/10.47223/IRJAY.2022.5614>