



Integrated Approach of Yoga Therapy (IAYT) has an ability to treat cancer patients through electrophysiological mechanisms: Advantages & disadvantages.

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Abstract: Integrated Approach of Yoga Therapy (IAYT) is a holistic healing approach to maintain optimum health using simple, safe, and doable practices. These practices include breathing & physical exercise, asanas, pranayama, kriyas, meditation, science of emotion culture, special yogic techniques and sattvic food. Yogic counselling, diet and lifestyle modification is an integral and essential component of IAYT. Subject must get up early in the morning, must go for walking, running & jogging, must go for pranayama, yoga asanas, must take balanced and natural food, must attend evening prayer, and must stop taking alcohol, must be kept away from cigarette smoking, and keeping tobacco in their mouth and must think for sound sleep regularly. Therefore, blood circulation gets improved, cells will get adequate nutrition including vitamins & oxygen regularly resulting normal functions of the organs would be maintained which is most essential to combat cancer. People do not want to spend time for their health, busy with running for money. People know about stress, can understand anxiety, obesity but never try to follow the principle of healthy life. We have many organs, made up by millions and millions of cells which are controlled by the nervous system and endocrine systems but sometimes these control systems are unable to regulate all cells in our body due to lack of taking exercise, yoga, pranayama, meditation, and lack of taking bad food (unhealthy diet). We must know ourselves, must follow yogic life, must do the work according to time and must respect others may be juniors or may be seniors. Hence, Tobacco use, alcohol consumption, unhealthy diet, physical inactivity, and air pollution are risk factors for cancer. If so, all electrophysiological mechanisms will work normally, metabolic homeostasis will be maintained, mitochondrial injury would be less, production of ROS will be also minimum, and we will have healthy life. All cells will start working normally, no single cell will be functioning & multiplying rapidly, no mutation with the cell takes place and we can survive long. Positive attitude will bring happiness in our life, never be threatened with cancer or can be long peaceful life with cancer also. Advantages are many rather than disadvantages.

Keywords: Integrated Approach of Yoga Therapy, Cancer, Stress, Metabolic homeostasis

Introduction: Cancer is one of the most feared diseases, a leading cause of death worldwide, considering for nearly 10 million deaths in 2020 and most common were breast, lung, colon & rectum, prostate, skin, cervical & stomach. In 2022, as many as 14,61,427 cancer cases were registered compared to 14,26,447 in 2021 in

India. The corresponding figure for 2020 was 13,92,179,” the data showed. Among states, Uttar Pradesh topped with 2.10 lakh new cases – up from 2.01 lakh in 2020. Around one-third of deaths from cancer are due to *tobacco use, high body mass index, alcohol consumption, low fruit and vegetable intake and lack of physical activity*.

Adverse effects of its treatment (chemotherapy, radiation & surgery) and diagnostic procedures (biopsies & radiological diagnostic scans) can cause financial, physical, psychological, and emotional problems affecting patients’ quality of life. Despite the availability of powerful technology, strong and targeted medicines the desired therapeutic success in cancer care remains an elusive goal for the modern medicine. Cancer survivors will continue to increase or will not be affected, will have long peaceful life, if IAYT or complementary and alternative medicine (CAM) is taken as an important part in life. Not much financial burden is there to accept this as an important & essential tool in our life. About 38% persons in USA are using CAM for managing pain, arthritis, cardiovascular diseases, cancer, emotional problems like stress, anxiety, depression. Yoga, the mind-body medicine of CAM, is comprised of a wide range of techniques, which gradually harmonizes the body and mind as compiled by Patanjali in his yoga sutras. Yoga has been used by Hindus and Buddhists for thousands of years for maintaining good health as well as spiritual practice. Yoga is now practiced worldwide by millions of people irrespective of their age, gender, race, religion, and nationality. The main purpose of this review is to familiarize cancer patients and their caregivers (oncologists, nurses, family members and patients) with the research evidence of the beneficial effects of yoga and to encourage more scientifically focused research so that yoga therapy (IAYT) is fully recognized and integrated into cancer therapeutic programs.

Life depends on continuous input of energy because living cells require continuous assembly, maintenance, and selective destruction (turnover) of complex structures. These include both molecular (RNA, DNA, and proteins, etc.) and physical structures (membranes, organelles, etc.), as well as maintenance of non-equilibrium distributions of small molecules and ions(1-6). Energy input is needed to overcome both the negative entropy associated with making and maintaining order and the positive free energy associated with synthesis of the many required molecules. Providing and maintaining a robust, stable source of energy for doing chemical and physical work is the first and most essential requirement for the existence of life. Step-1 to 5 shall be important to understand the role of IAYT on treating cancer individuals and description of positive aspect of IAYT is based on electrophysiological mechanisms. Some risk factors (Step-1) are mentioned which can affect both parasympathetic and sympathetic nervous system. Metabolic homeostasis (Step-3) if fully maintained (adequate) through mitochondria with the presence of oxygen to parasympathetic stimulation (Step-2). If delivery of oxygen is less, mitochondrial injury occurs, metabolic homeostasis would be poor. Ionic environment in the cell remains normal with parasympathetic and opposite with sympathetic (Step-4). Exchange of ions across the cell membrane (Electrophysiological processes) gets normal and more powerful with parasympathetic but not with sympathetic. Mitochondrial injury leads to inflammation, concentration of ROS increases, mutation in the cell takes place and even cell can be multiplied uncontrolled ways which leads to cancer (Step-5) but with proper ionic concentration both inside and outside the cell will lead to powerful healthy life in the individual.

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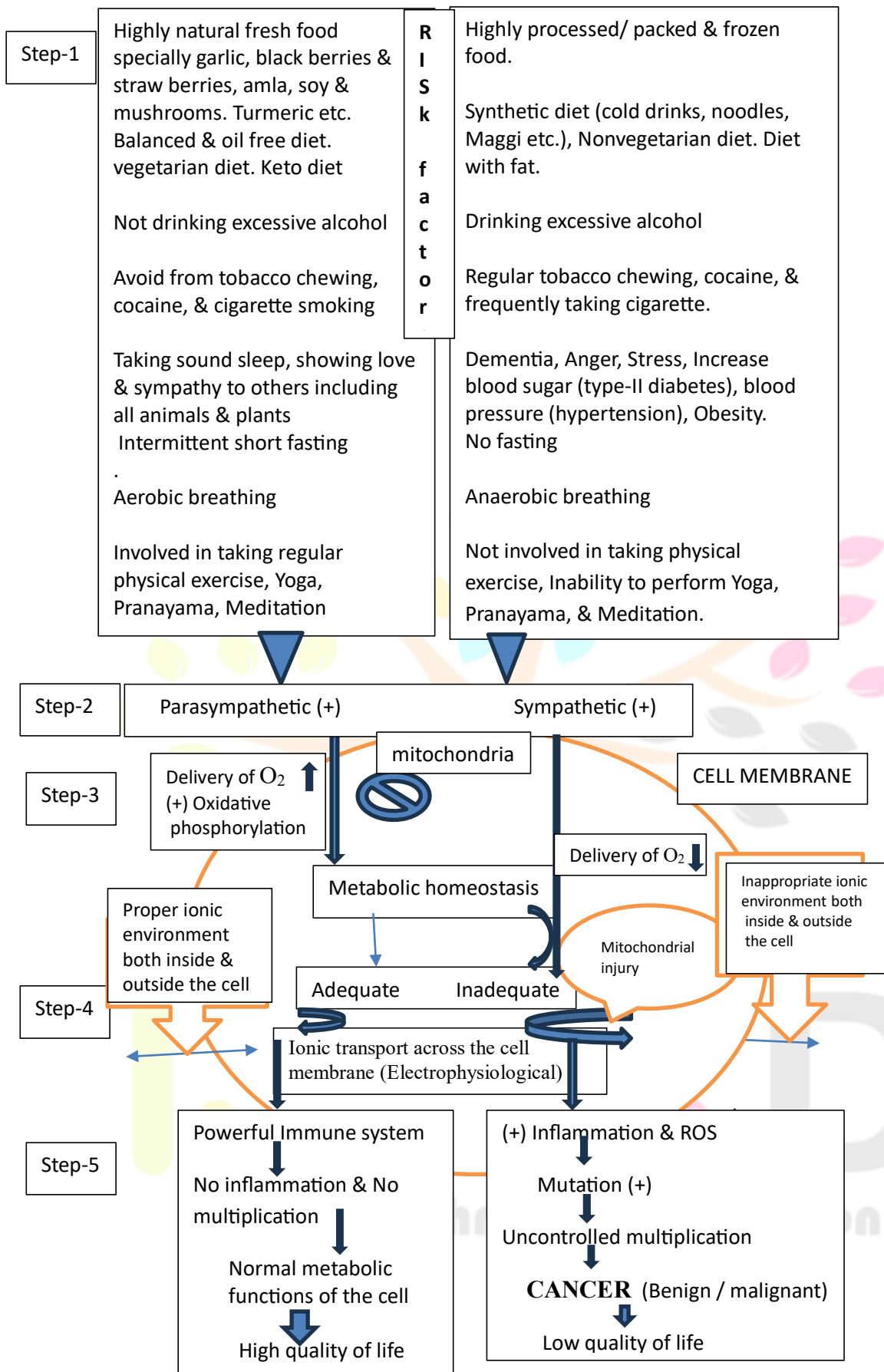


Figure-1: Step-1-5, A flow chart showing characteristics of a cell to various risk factors.

The IAYT model is based on *Pancha Kosa* concept; various yogic practices are incorporated at each level to help subjects as therapeutic interventions with different disorders deal with their problems. IAYT bring the central nervous system (CNS), autonomic nervous system (ANS) into healthy balance by stimulating the parasympathetic nervous system (Figure-1). When our body & mind are threatened or perceives being stressed

(+ve or -ve stress), sympathetic nervous system is stimulated (Figure-2), blood sugar level is gone up (Hyperglycaemia). In contrast, opposite responses are observed when subject is at rest/relaxation or no stress (Figure-2).

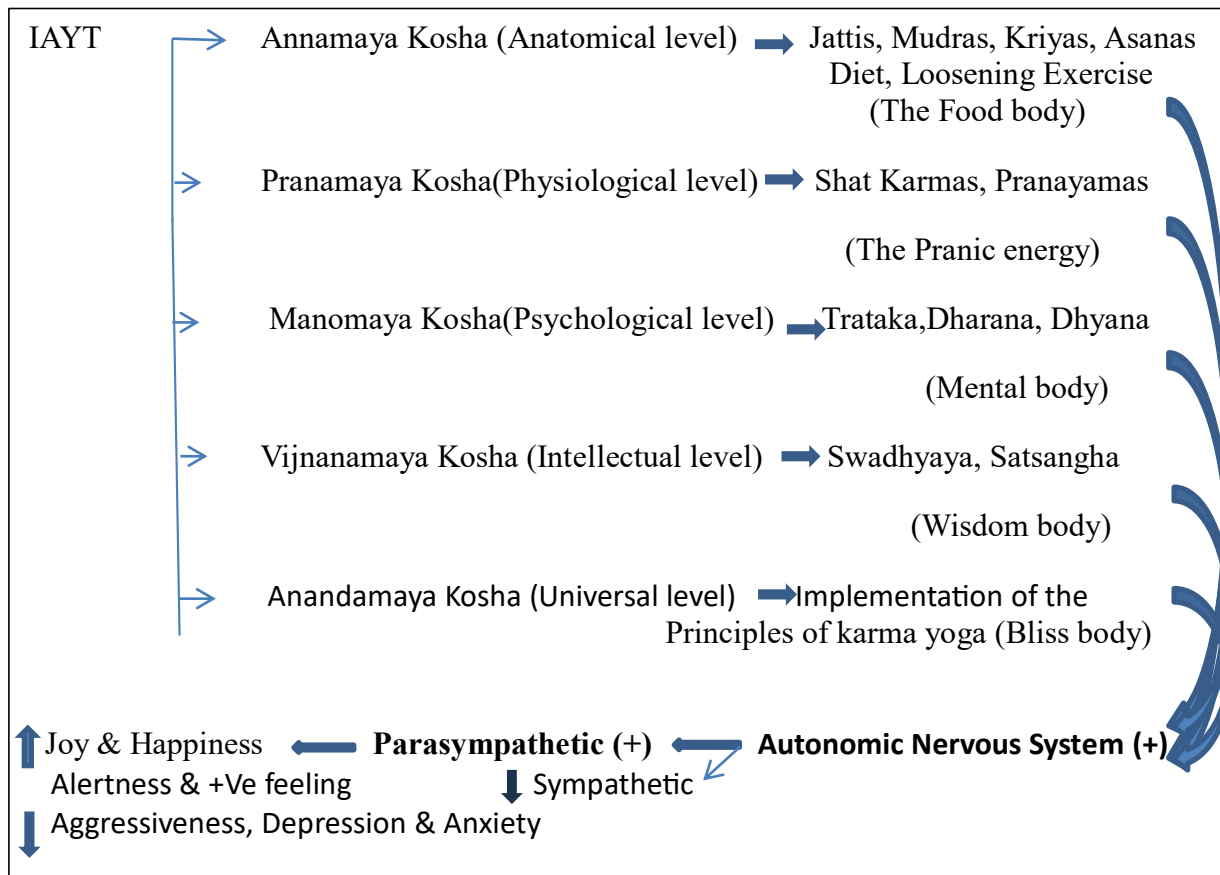


Figure-2: Implementation of IAYT based on *Pancha kosha* where involvement/stimulation of autonomic nervous system (ANS) especially parasympathetic nervous system (PNS).

Basic regulatory pathways in IAYT: -

Formal meditation practice can change both brain structure & function (7). Continuous practice can increase thickness of prefrontal cortex (PFC), amygdala, insular cortex (INSULA) & left hippocampus which have an active role in long term memory formation, emotional regulation & cognition (7). This is done through stimulating autonomic nervous system (ANS). Regular Surya namaskar, yoga also can bring awareness & joy by stimulating parasympathetic nervous system (figure 2). ANS, both sympathetic (SNS) & parasympathetic (PNS) can act on endothelial cell (EC), vascular smooth muscle cell (VSMC), nodal & contractile cell in heart (Figure-3). Metabolic activity in these cells starts from binding with either adrenergic or cholinergic receptors. There may be a contraction & relaxation depends upon metabolic activity in the cells. Arterial compliance depends upon availability of gas transmitters (H_2S , CO, & NO) which regulate the metabolic activities in these cells resulting vasoconstriction or vasodilation (9-10). As a result, myocardial contractility, heart rate (HR), respiratory rate (RR) are altered and accordingly changes on blood pressure is also notified (Figure-3).

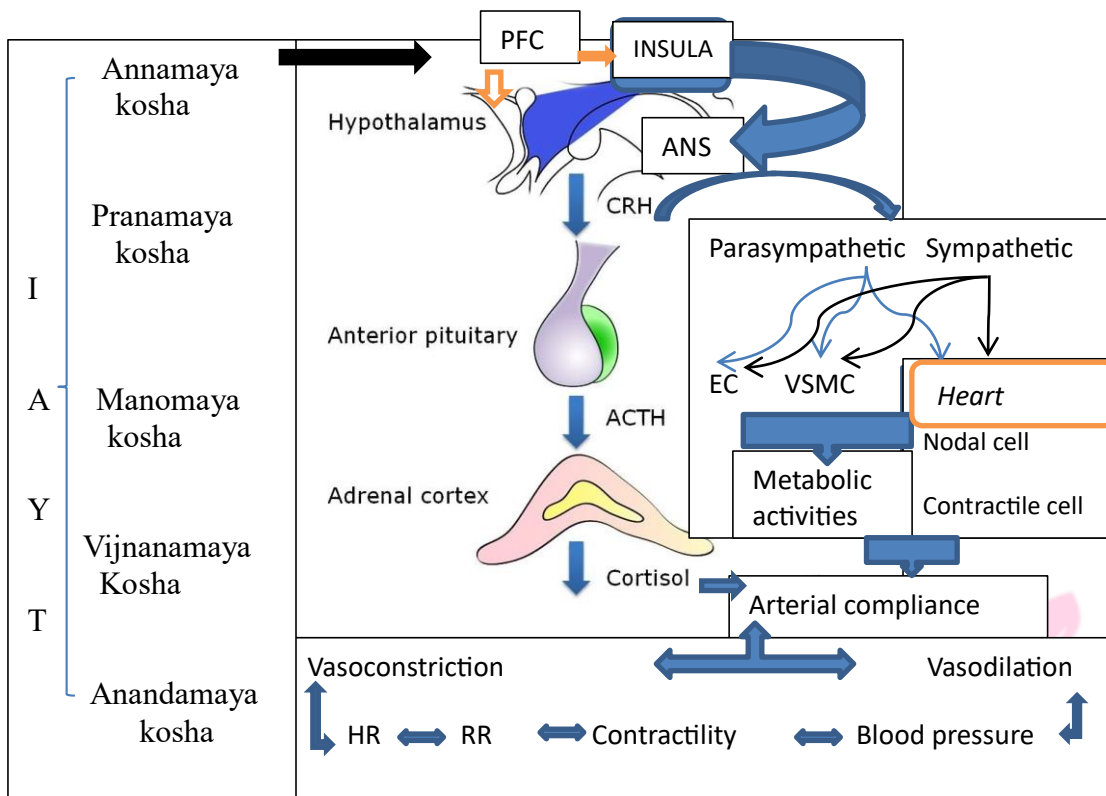


Figure-3: Possible neuroendocrine pathways involved in IAYT.

Several important alterations are noted while following 'Pancha kosha' (7). These are (1) Stimulation of muscle spindle & Golgi tendon organ (receptor for balance and tone), (2) Stimulation of vasomotor centre, (3) Stimulation of central nervous system (CNS). All these together can involve autonomic nervous systems (PNS or SNS) (Figure-3). Endothelial cells (EC), Vascular smooth muscle cell (VSMC), nodal & contractile cell in heart are come into operation and the finale output depends upon either sympathetic (SNC) or parasympathetic (PNC) (Figure-3).

Hypothalamic-pituitary –adrenal (HPA) axis is also affected due to stimulation of limbic system (amygdala, hippocampus), Vascular responses depends on the secretion of corticotrophin- releasing factor (CRF), which act on pituitary for adrenocorticotrophic hormone (ACTH) which subsequently stimulates the adrenal cortex for cortisol (7). Effect of cortisol includes increase blood sugar level leading to deterioration of balance between collagen and elastin- a main and important component for arterial compliance (12). In case of parasympathetic stimulation, less or no cortisol, hence vasodilation and blood pressure come down (Figure-3).

Basic functions of autonomic nervous system in IAYT:-

- Sympathetic (flight or fight response):** Stress is part of our lives. Responses of stress includes 1) Stimulation of sympathetic nervous system which can increase blood pressure, heart rate, respiratory rate, 2) Blood glucose concentration in increased due to more secretion of cortisol which can increase blood glucose level, even more increase leads to hyperglycaemia, 3) Body immune system is inhibited due to hyperglycaemia. Graphical representation (Figure-4) is given below. Subject has a chance to develop both hypertension and hyperglycaemia. These responses (flight & fight response) can be corrected after following IAYT (7).

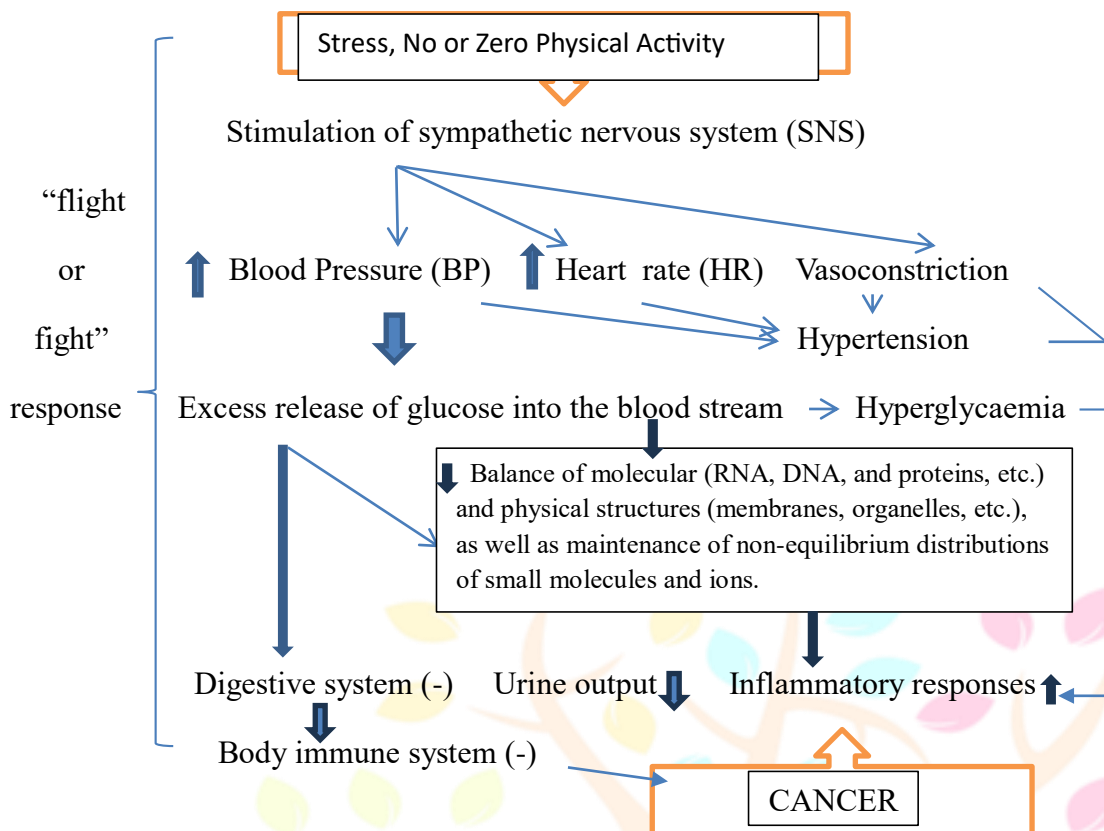


Figure-4: Response of sympathetic nervous system to stress/zero physical activity.

b) Parasympathetic (rest & digest response): The parasympathetic nervous system is stimulated when one relaxes (Figure-5). Blood flow to the digestive system, brain, extremities & sexual organs is increased. metabolic activity in vascular tissues is adjusted, resulting blood pressure (BP), heart rate (HR) & respiratory rate are reduced or becomes normal (signs of improved parasympathetic tone). No sign and symptoms of both hypertension & hyperglycaemia (7). Subjects with all age groups feel joy, happiness, can decrease negative feeling of aggressiveness, depression, and anxiety (7). Yoga practices can increase multiple neurotransmitters and hormones such as GABA, serotonin & dopamine-all natural anti-depressants (7). These neurotransmitters and hormones can increase the level of melatonin, helping to initiate sleep, improving sleep quality and also can help to secrete more oxytocin, the “bonding hormone”, thus helping with feeling of connectedness (Figure-5) (7).

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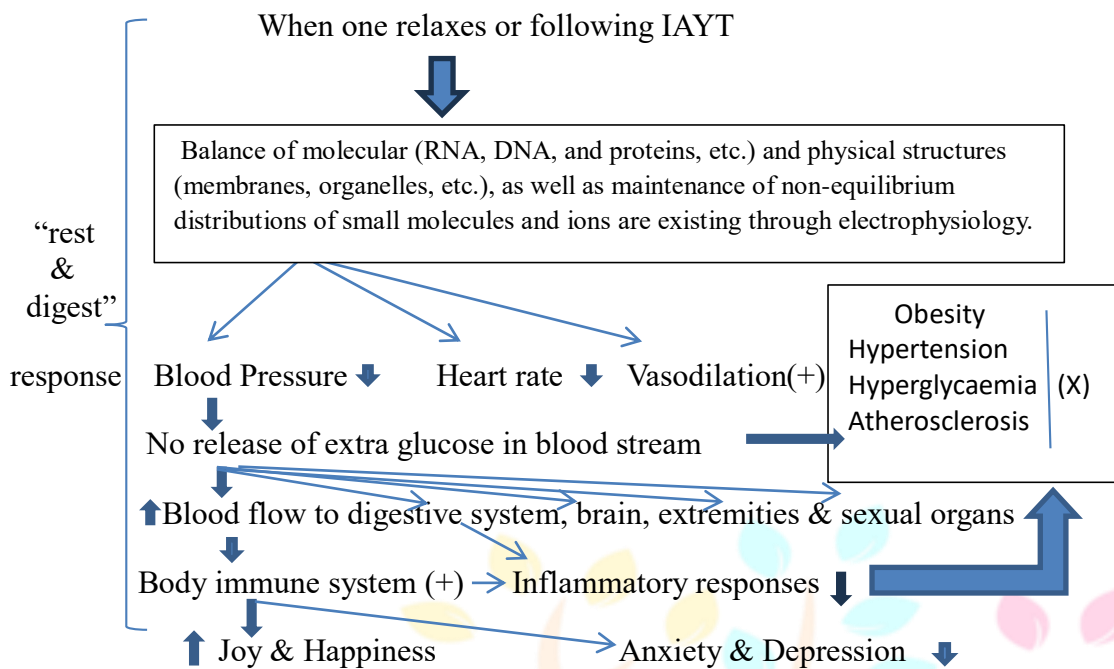


Figure-5: Response of parasympathetic nervous system to a state of relaxation/IAYT

- c) *Co-relation between the function of autonomic and various vascular cells in following IAYT :-* Endothelial dysfunction and autonomic nervous system dysfunction are both risk factors for cancer. There is a close interrelationship between these two systems. In hypertension, endothelial dysfunction affects the pathologic process through autonomic nervous pathways, and the pathophysiological process of autonomic neuropathy in diabetes mellitus is closely related with vascular function (11-14). However, detailed mechanisms of this interrelationship have not been clearly explained. In this review, we summarize findings concerning the interrelationship between vascular function and the autonomic nervous system may provide more comprehensive risk stratification and a new effective therapeutic strategy against atherosclerosis, hypertension and hyperglycaemia leading to cancer (7,11-14). Following important findings are noted. 1) Endothelial cell (EC) function is affected against ANS. Endothelial cells, vascular smooth muscle cells & nodal cells get hyperpolarized when there is a stimulation of PNS, resulting heart rate decreases, blood pressure goes normal, respiratory rate is also reduced. 2) HPA axis is inhibited, less cortisol can reduce blood sugar level, hyperpolarization process in these vascular tissues will be operated, resulting normal arterial compliance. 3) More release of GABA, serotonin, dopamine, dehydroepiandrosterone (DHEA) can control emotion & behaviour (7, 11-19). 4) Less secretion of inflammatory markers would reduce inflammation. 5) Vascular function is nicely maintained, means process of contraction and relaxation of vascular smooth muscle, cardiac muscle would be proper with parasympathetic dominance (Figure-6). 6) Telomerase enzymatic activity is increased which can protect cell deterioration and cell death (Figure-6) (7). Synaptic density and volume of prefrontal cortex left hippocampus which can increase the long-term memory through increased release of neurotropic protein (BDNF). 8) Concentration of inflammatory markers is decreased, resulting no inflammation which again will help in maintaining blood pressure, atherosclerosis, and hyperglycaemia (7).

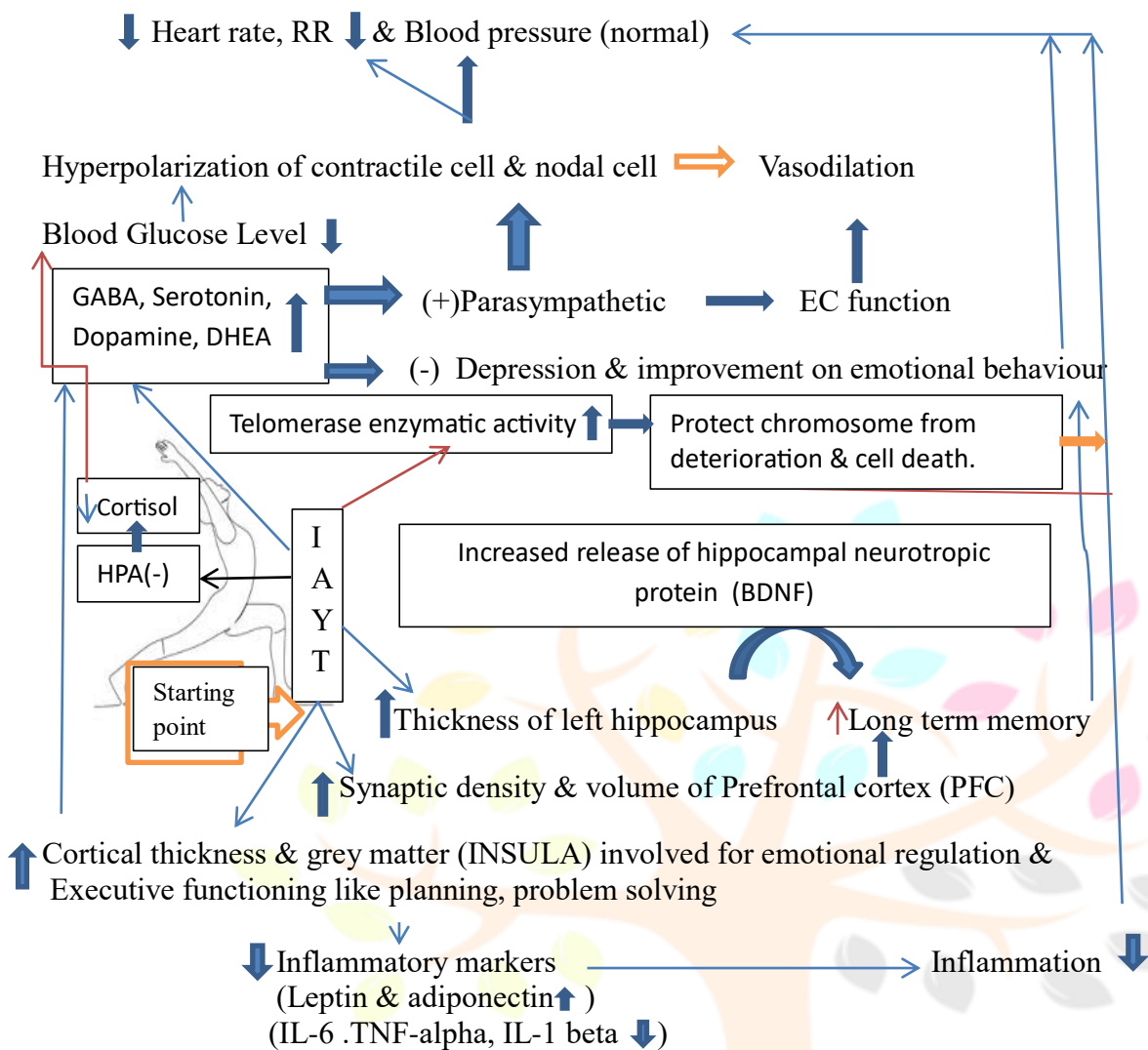
Electrophysiological involvements:

Figure-6: Co-relation between the function of autonomic and various vascular cells to following IAYT.

- 1) *Basic molecular controlling mechanism of sympathetic (SNS) and parasympathetic (PNS) in vascular system:* Resting Membrane Potential (RMP) in nodal fibre (pacemaker fibre) is -60 mv & -90 mv in contractile fibre in the heart (Figure-7). With the help of “funny Na^+ channel”, ‘T’ type Ca^{++} channel and ‘L’ type Ca^{++} channel, K^+ channel, electrical event goes on rhythmically, making nodal cell & contractile cell active till death. Some additional voltage gated Na^+ channels are also operated in contractile cell to make resting membrane potential -90 mv during resting condition. Neurotransmitters like acetylcholine (Ach) or adrenaline/noradrenaline (Epi / NE) play an active role during the process of depolarization, repolarization and hyperpolarization expect only one plateau phase in contractile fibre present in heart. Hence, neuroendocrine process to IAYT cannot be overruled.

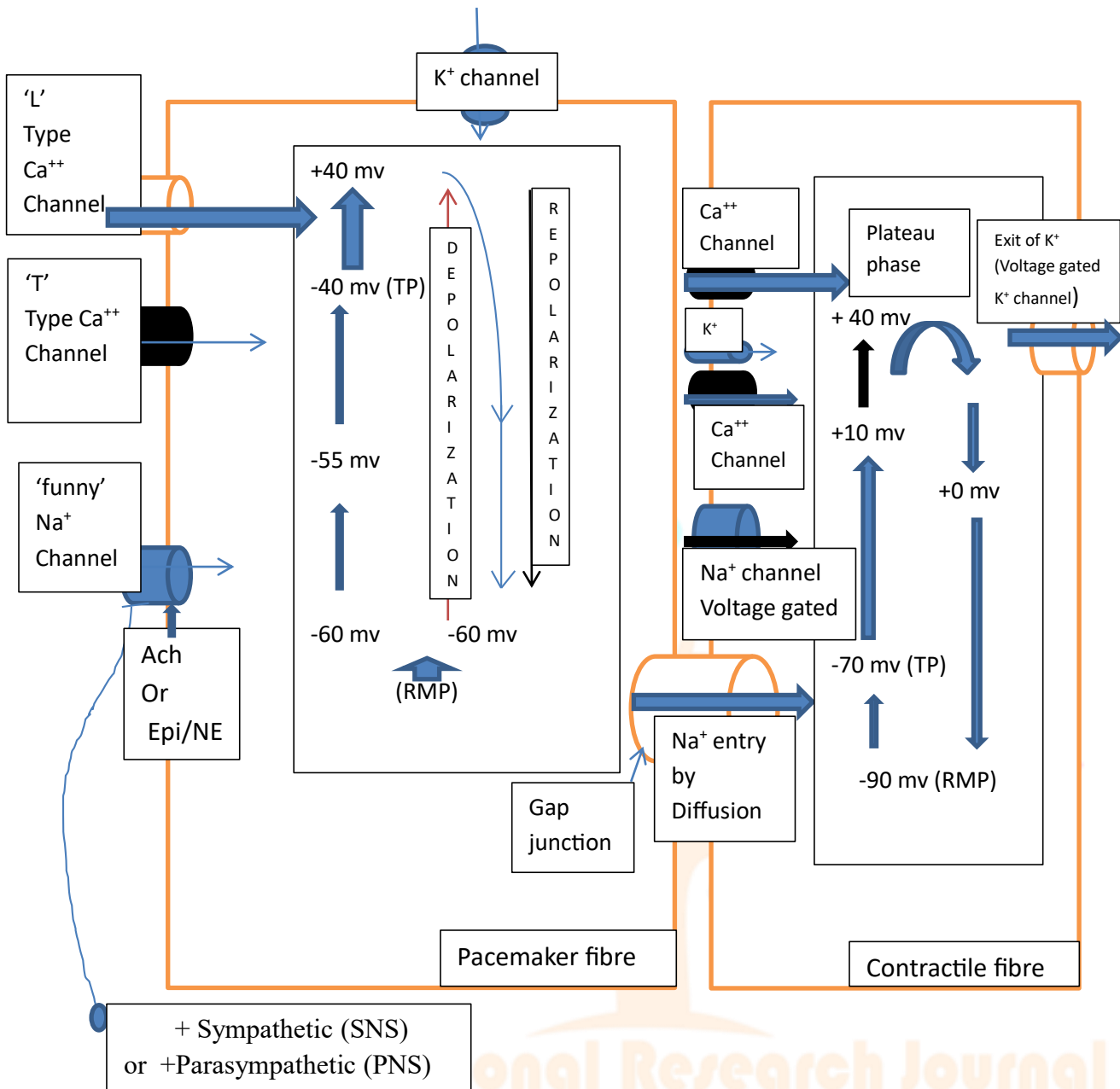


Figure-7: Basic mechanism of sympathetic and parasympathetic in vascular system

2) Responses from general basic extrinsic innervation of vascular system: - a) Sympathetic Nervous System (SNS)- In this, stimulatory G protein (GS) after binding with adrenergic neurotransmitter (Epi/NE) in the membrane can convert GTP to GDP as soon as adrenergic receptors are stimulated. GDP can form cAMP from ATP which stimulates protein kinase A. Protein kinase has a big role to stimulate voltage gated Ca⁺⁺ channel, quick depolarization takes place. Cardiac output, stroke volume and heart rate are increased which can increase blood pressure (Figure-8).

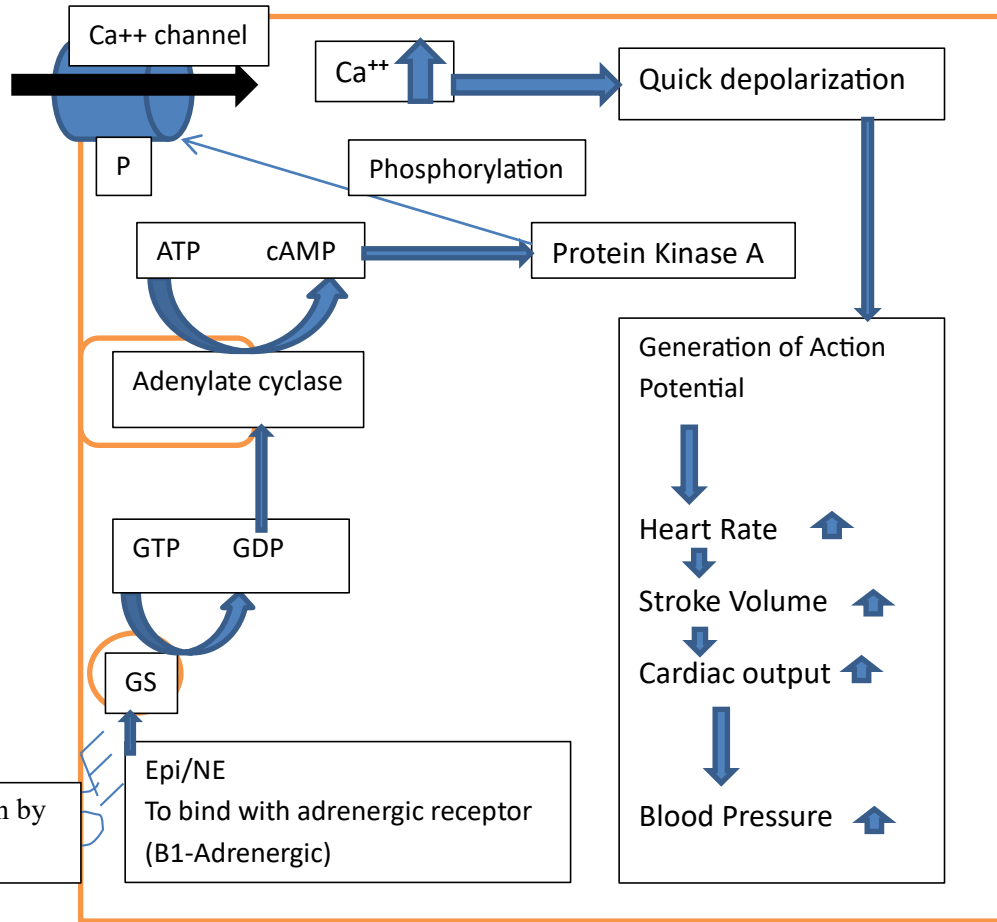


Figure-8: General basic extrinsic innervation of vascular system (Sympathetic response)

3) Responses from general basic extrinsic innervation of parasympathetic only on nodal cell (pacemaker fibre):
 - Parasympathetic (vagal) activation, which releases acetylcholine onto the SA node that binds to muscarinic receptors having three units (α , β & γ), decreases pacemaker rate by increasing potassium conductance and decreasing the pacemaker currents. Cyclic adenosine monophosphate (cAMP) is less produced due to stimulation of alpha unit of muscarinic M2 receptor (Figure-9).

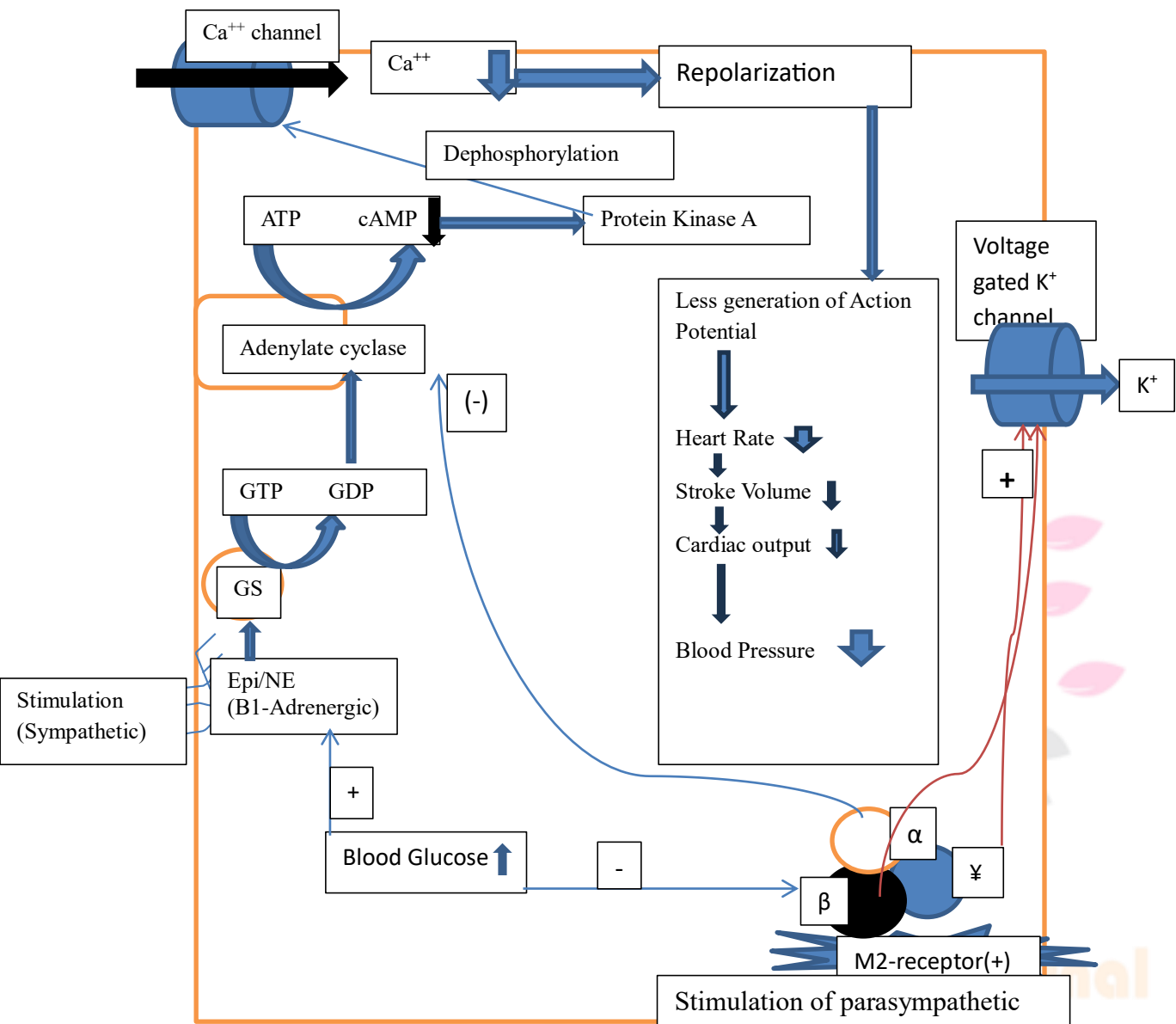


Figure-9: General basic extrinsic innervation of parasympathetic only on nodal cell (pacemaker fibre)

These changes in ion currents decrease the slope of phase 4 of the action potential, thereby increasing the time required to reach threshold. Voltage gated potassium channel is directly inhibited by β and γ unit of muscarinic receptor (Figure-9). Vagal activity also hyperpolarizes the pacemaker cell during Phase 4, which contributes to the longer time to reach threshold voltage. Heart rate & blood pressure are reduced.

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4) Response of sympathetic on contractile cell & possible mechanism to IAYT: As per earlier

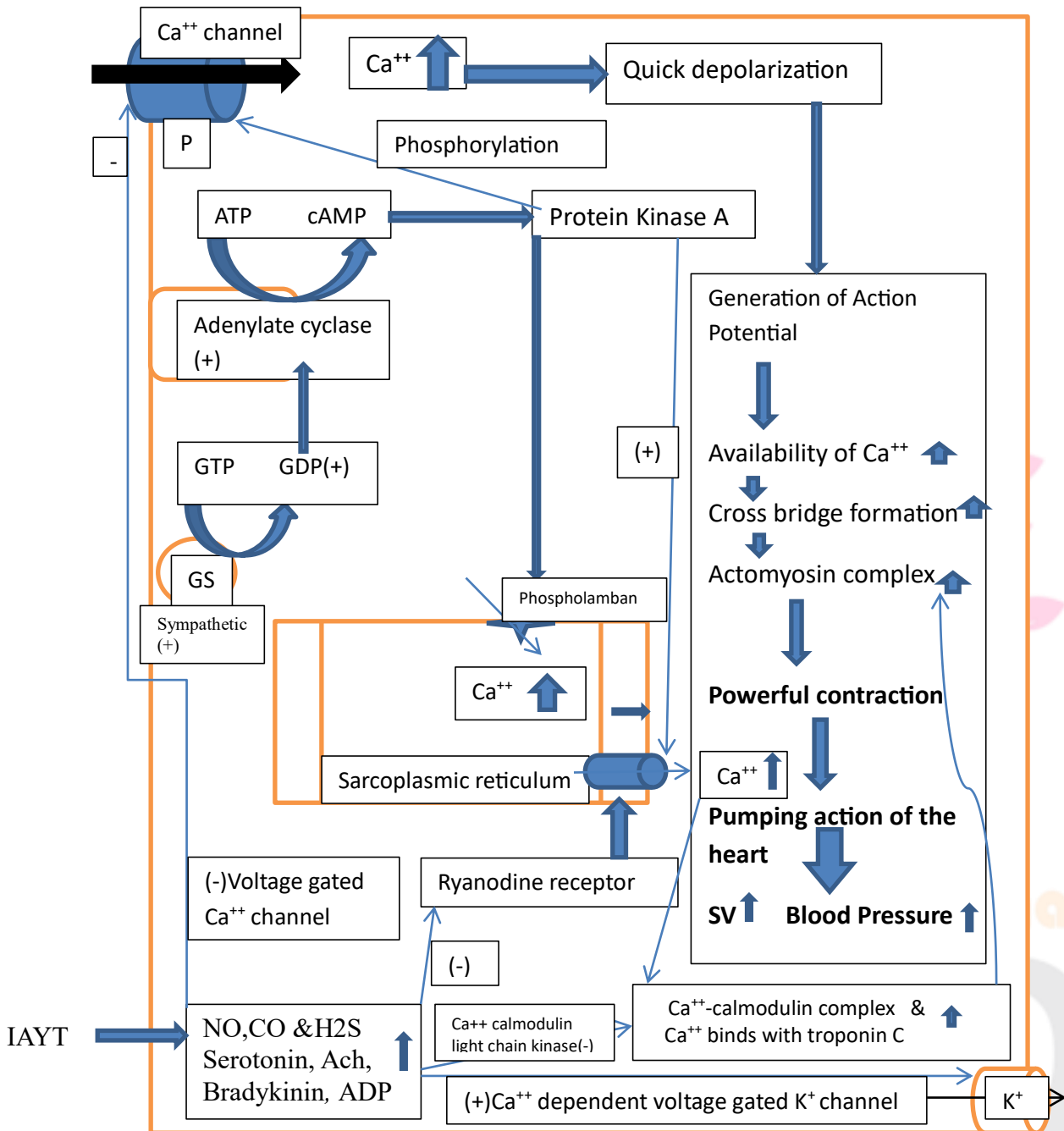


Figure-10: Response of sympathetic on contractile cell & possible mechanism to IAYT

Discussion: Sympathetic on contractile is stimulatory. Following IAYT, few important changes are noted. 1) Concentration of gaso transmitters (NO, CO, H₂S) is increased (15-17), resulting inhibition of ryanodine receptors which reduce the transport of Ca⁺⁺ from sarcoplasmic reticulum to cytosol, hence formation of Ca⁺⁺-calmodulin complexes. Less amount of formation of cross bridges takes place. Concentration of Ca⁺⁺ in the contractile fiber decreases, but concentration in the sarcoplasmic reticulum is increased. 2) Concentration of serotonin, acetylcholine, bradykinin, and ADP are increased, have inhibitory effect of ryanodine receptor, has an inhibitory effect on Ca⁺⁺-calmodulin light chain kinase, resulting formation of less amount of Ca⁺⁺-calmodulin complex. 3) Gasotransmitter along with serotonin, bradykinin and ADP has a stimulatory effect of Ca⁺⁺ dependent voltage gated K⁺ channel, and hence this is again inhibitory, allow fibre to relax (Figure-10).

Conclusions: Electrophysiological mechanism is being operated in every cell in our body and which has been regulated by nervous system and endocrine system. Regulation will decide the responses of a cell. World Health

Organization (WHO) estimates that 80% of non-communicable diseases (NCD) deaths are due to four main disease types: cardiovascular disease, cancer, diabetes, and respiratory diseases. Unfortunately, lifestyle is the major causative factor on NCDs, including tobacco use, sedentary lifestyle, and lack of regular exercise, unhealthy diets, and chronic psychological stress. Chronic inflammation and stress are a common factor of many of the NCDs, and an area where IAYT has been found to be extremely beneficial. IAYT can reduce stress with increased *parasympathetic* and reduced sympathetic activities respectively. Yoga practices (IAYT) can help to lower blood pressure, increase lung capacity, improve respiratory function, and heart rate, improve circulation and boost muscle tone.

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