

## A CRITICAL REVIEW OF AYURVEDIC LITERATURE ON HYPERTENSION

**Dr. Poonam Khyalia<sup>1\*</sup>, Dr. Ravi Sharma<sup>2</sup>, Dr. Om Prakash Sharma<sup>3</sup>**

\*<sup>1</sup>PG Scholar, Dept. of Kayachikitsa MMM Govt. Ayurveda College, Udaipur, Rajasthan India.

<sup>2</sup>Professor & HOD, Dept. of Kayachikitsa MMM Govt. Ayurveda College, Udaipur, Rajasthan India.

<sup>3</sup>Associate Professor, Department of Panchkarma Govt. Ayurvedic College Pratap Nagar, Jaipur, Rajasthan.

Article Received on 15 Dec. 2025,  
Article Revised on 05 Jan. 2026,  
Article Published on 15 Jan. 2026,  
<https://doi.org/10.5281/zenodo.18255210>

### \*Corresponding Author

**Dr. Poonam Khyalia**

PG Scholar, Dept. of Kayachikitsa  
MMM Govt. Ayurveda College,  
Udaipur, Rajasthan India.



**How to cite this Article:** Dr. Poonam Khyalia<sup>1\*</sup>, Dr. Ravi Sharma<sup>2</sup>, Dr. Om Prakash Sharma<sup>3</sup> (2026). A CRITICAL REVIEW OF AYURVEDIC LITERATURE ON HYPERTENSION "World Journal of Pharmaceutical Research, 15(2), 23-33.

This work is licensed under Creative Commons Attribution 4.0 International license.

### ABSTRACT

Numerous theoretical frameworks have been suggested within *Ayurveda* to clarify the occurrence of hypertension, yet a cohesive conceptual model has yet to be formed. To tackle this uncertainty, modern researchers are working to reinterpret the applied physiology and causes of hypertension through foundational *Ayurvedic* principles. In *Ayurveda Acharya Yadunandan Upadhyay* has equated the term "*Raktagata Vata*" for hypertension. When *rakta* gets vitiated it leads to *Shoshana* of *rakta dhatu*. It is also called as "*Uchcha Raktachapa*". Concepts such as *Shadkriyakala* (the sequential phases of *doshika* imbalance) and *Avarana* (the functional blockage of *doshas*) were methodically linked with contemporary pathophysiological frameworks of hypertension to produce integrative understandings. It is suggested that the *Prasara-Avastha* or spread of vitiated *Doshas* from their respective sites

specifically *Vyana Vata*, *Prana Vata*, *Sadhaka Pitta* and *Avalambaka Kapha* coupled with *Rakta* in their disturbed states should be interpreted as hypertension. *Ayurvedic* treatment methods based on *Samprapti* (pathogenesis) effectively target all three elements simultaneously, which include *Ahara* (diet), *Vihara* (lifestyle), and *Aushadha* (medications). Adjustments in *Pathya-Apathya* (healthy-unhealthy food and lifestyle practices), along with

modifications in *Ahara* and *Vihara*, as well as *Shamana* (pacifying) and *Shodhana* (cleansing) therapies, can assist in managing hypertension. Ayurvedic texts reference the use of *Sarpagandha churna*, *Ashwagandha churna*, and other therapeutic remedies. *Shodhana chikitsa* employs bio-cleansing strategies such as *Basti*, *Virechana Karma*, and *Shirodhara*, using medicinal solutions to remove impurities from the body.

**KEYWORDS:** Hypertension, *Raktagata Vata*, *Uchcha Raktachapa*, *Shodhana*, *Shamana*.

## INTRODUCTION

According to World Health Organization, as of 2025, there are approximately 1.28 billion adults (aged 30–79 years) living with hypertension worldwide. It is a leading risk factor for heart disease and stroke, and nearly half of these individuals are unaware of their condition.<sup>[1]</sup> The incidence of hypertension and its consequences is rising at a startling rate. In India, hypertension is directly to blame for 24% of all deaths from coronary heart disease (CHD) and 57% of all stroke deaths.<sup>[2]</sup>

Hypertension is one of the most prevalent lifestyle disorders in the modern era. Every fifth individual is diagnosed with hypertension. It usually appears in the latter portion of an adult's life. Numerous variables, including stress, obesity, genetics, excessive salt intake, and other factors, can lead to hypertension. Because it rarely shows signs before causing damage to the kidney, heart, or brain, hypertension is known as a silent killer. *Acharya Charaka* states that when a condition is unknown, the doctor should first attempt to determine its nature by determining its *Dosha*, the place of manifestation, and its aetiology before starting treatment.<sup>[3]</sup> Therefore, in order to properly comprehend the condition and its *Samprapti*, plan its *Samprapti Vighatanameva Chikitsa* and avoid it, it becomes necessary to examine a variety of components, such as *Dosha Vriddhi*, *Dhatu Dushti*, involved *Srotas* and their function in the cause of hypertension.

## AIM AND OBJECTIVE

To understand hypertension through the principles of *Ayurveda*, with the intention of supporting both therapeutic and preventive approaches.

## MATERIALS AND METHODS

To study *Ayurveda* prospective on hypertension classical books on *Ayurveda*, Morden literature, available research updates, scientific information and papers available on internet

etc. were searched and analysed.

## LITERATURE REVIEW

**Hypertension:** The tension exerted on the wall of arteries by the strength of the contraction of heart is called blood pressure.<sup>[4]</sup> In adult's hypertension is condition which the systolic blood pressure is higher than 140 mm of hg and diastolic is more than 90 mm of hg on three separate readings recorded several weeks apart.<sup>[5]</sup>

### Types of hypertension

There are 2 types of hypertension,

1. Primary or essential hypertension
2. Secondary hypertension.

Factors affecting blood pressure

These include,

1. Vessel elasticity
2. Blood volume
3. Cardiac output
4. Peripheral resistance

Several other factors and condition may play role in development of hypertension such as smoking, obesity, lack of physical activity, excessive salt intake, alcohol consumption, stress and family history of hypertension.

### Ayurvedic perspective

Hypertension cannot be consider as *vyadhi* as per *Ayurveda* but it can be understood by assessing the involved *Doshas*, *Dushyas* (entity which affected by morbid *dosha*) *strotas* etc.

Now first important thing to understand is physiological aspect of high blood pressure in *Ayurveda* which is based on the theory of *Tridosha*.<sup>[6]</sup>

Looking at hypertension from this perspective we can assume that vitiation of *Vata Dosha* is the main entity of disease, as the *Dhatu gati* or *Vikshepa* is achieved by *Vata* itself. *Rakta Dushti* correlates with essential, or primary, hypertension.

*Srotorodha* is comparable to hypertension caused by arterial stiffness.

## RISK FACTORS

Essential hypertension is classified as idiopathic, meaning the precise cause of elevated blood pressure remains unclear. Several contributing factors to hypertension include excessive alcohol consumption, high salt intake, a sedentary lifestyle characterized by excessive indulgence in sweet foods, daytime sleeping, mental stress from anger, fear, and grief, physical exertion, seasonal changes, and genetic predispositions. Additionally, related diseases such as diabetes, obesity, heart disease, and kidney disorders are also implicated.<sup>[7]</sup>

## PATHOGENESIS OF HYPERTENSION<sup>[8]</sup>

Genetic + Environmental Factors



Renal sodium retention → ↑ Blood volume → ↑ Cardiac output



↑ Sympathetic activity → Vasoconstriction → ↑ Peripheral resistance



RAAS activation → Angiotensinogen II & Aldosterone → ↑ BP



Vascular remodeling → ↑ Peripheral resistance → HYPERTENSION

## SAMPRAPTI

*Nidana Sevana*



*Vata-Pradhana Tridosha Prakopa*



*Prana Vata Dushti (affecting Hridaya)*



Vitiation of *Hridaya* & its factors (*Vyana Vata, Sadhaka Pitta, Avalambaka Kapha, Shonita*)



*Prakupita Avalambaka Kapha* → ↑ Cardiac contractility

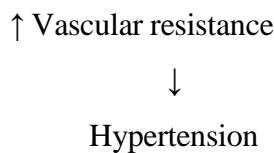


Aggravated *Vyana Vata* → ↑ *Gati* (force of blood ejection)



Forceful expulsion of blood through *Dhamanis*





### **SAMPRAPTI GHATAKAS**

- *Dosha- Prana, Udana, Vyana Vata, Sadhaka pitta and Avalambaka Kapha*
- *Dhatu- Rasa, Rakta, Mamsa and Medha*
- *Upadhatu- Dhamani and sira*
- *Agni- Dhatwagni Mandya and Jatharagni*
- *Srotas- Rasa, Rakta, Manovaha Strotas and Pranavaha strotas*
- *Srotodustiprakara- Sangha and Vimargagamana*
- *Udbhavasthana- Pakwashaya and Amashaya*
- *Sancharasthana- Sarva Sharira*

### **SIGNS & SYMPTOMS**

**Shirahshoola (Headache):** According to *Sushruta*, pain cannot arise without *Vata* vitiation,<sup>[9]</sup> and *Charaka* includes *Shirahshoola* among the *Nanatmaja Vatavyadhis*. When aggravated *Vatadi Dosha* causes *Rakta Dushti* and localizes in the head region (*Shira*), it produces *Shiroroga*, of which *Shirahshoola* is a manifestation.

**Nidranasha (Insomnia):** Insomnia occurs due to vitiated *Vata*, *Pitta* and mental distress (*Manasa Santapa*). *Charaka* lists *Nidranasha* as a *Nanatmaja Vata Vikara*, and because the *Laghu Guna* of *Vayu* becomes predominant, both diminished sleep (*Nidraalpata*) and complete loss of sleep (*Nidranasha*) appear as features of *Vata-Pitta* aggravation.<sup>[10]</sup>

**Bhrama (Giddiness):** *Sushruta* describes *Bhrama* as resulting from the vitiation of *Raja*, *Pitta*, and *Vata*.<sup>[11]</sup> When the *Chala Guna* of *Vata* becomes excessive due to aggravated *Raja*, the individual experiences a sense of revolving or giddiness.<sup>[12]</sup>

**Tamodarshana (Black flashes):** *Charaka* classifies *Tamodarshana* under *Rakta Pradoshaja Vyadhis*, indicating that obstruction in the *Rakta-vahinis* of the head leads to compromised blood flow, resulting in the perception of dark flashes before the eyes.<sup>[13]</sup>

**Daurbalya (Weakness):** Weakness is considered a *Shonitaja Vyadhi* and arises when *Vata*-induced *Rasa-Rakta Dushti* impairs proper *Dhatu* formation. This eventually leads to

depletion of *Ojas*, causing marked physical debility.<sup>[14]</sup>

**Hridadravata (Palpitation):** *Gangadhara*<sup>[15]</sup> explains *Hridadravata* as an increased speed of cardiac activity. *Charaka* mentions “*Hridayam Tamyati*” during *Rasakshaya*, and commentators clarify that aggravated *Vyana Vata* with its *Chala Guna* produces the sensation of palpitations.<sup>[16]</sup>

**Swasakashtata (Breathlessness):** Breathlessness results from *Kapha* obstruction in the *Pranavaha Srotasa*, which vitiates *Prana Vata*. In such cases, *Agnivaishamya* produces *Sama Rasa* that transforms into *Malarupa Kapha*, causing *Srotorodha* and leading to *Swasakashtata*.

**Akshiraga (Redness of Eyes):** *Akshiraga* is described under *Shonitaja Rogas*, and *Sushruta* states that ocular redness occurs due to *Raktavridhhi*.<sup>[17]</sup> Conditions like *Raktagata Vata* and *Rakta-avruta Vata* show similar symptomatology, correlating these features with eye congestion and inflammation.

### **CHIKITSA SIDDHANT**

Management of hypertension in *Ayurveda* is planned according to the vitiated *Doshas* and affected *Dushyas* involved in its pathogenesis. Psychological factors such as *chinta* (worry), *krodha* (anger), *bhaya* (fear) significantly contribute to the onset, progression, and prognosis of hypertension. These mental states also influence therapeutic outcomes; therefore, the treatment must emphasize interventions that pacify disturbed *mansika bhavas*.

**1. Nidana Parivarjana:** *Nidana parivarjana* refers to eliminating etiological factors responsible for the disease. The following causative influences of hypertension should be strictly avoided:<sup>[18,19]</sup>

Excessive consumption of salt, refined oils, and junk foods

Alcohol intake and smoking

Daytime sleeping (*diwaswapa*)

Mental triggers such as excitement, anxiety, and constant worry

**2. Lifestyle Modification;** Essential lifestyle corrections include:

Achieving and maintaining optimal body weight

Consuming a balanced and wholesome diet

Engaging in regular physical exercise.

**3. Samana Chikitsa:** Single as well as compound *Ayurvedic* formulations are used for

the prevention and management of hypertension. Commonly employed medicines include:

### ***Shamana Yoga***

**Single Drugs:** *Sarpagandha, Ashwagandha,<sup>[20]</sup> Jatamansi, Arjuna, Rasona, Punarnava, Amalaki.*

**Compound Formulations** *BramhiVati, Prabhakara Vati, Arjunarishta, Hridayavarana Rasa, Sarpagandha vati, Brahmi vati, Puskar Bramhi Guggulu, Pancha Tikta Ghrita Guggulu.*

### ***Shodhana Chikitsa***

*Shodhana Chikitsa* is a specialized Ayurvedic therapeutic approach aimed at eliminating aggravated *Doshas* (toxins) from the body through *Panchakarma* or bio-cleansing procedures.

- Basti Karma:*** Recommended for *Vata*-dominant disorders, therefore it can be applied in the management of hypertension where *Vata* imbalance is involved.
- Virechana Karma:*** Indicated in conditions related to vitiated *Rakta* (blood), hence beneficial in managing hypertension.
- Shirodhara:*** Using medicated oils, buttermilk (*Takra*), or herbal decoctions (*Kwatha*) can help in reducing high blood pressure by inducing relaxation and calming the mind.
- Raktamokshana:*** As it is specifically indicated for *Raktaja* disorders, this procedure is considered useful in reducing hypertension.

### ***Diet (Aharya Dravya)***

Diet plays an important role both in the development and management of diseases, including hypertension. A balanced diet is essential for its prevention and control. Limiting excessive salt (*Lavana Rasa*) and adopting a diet rich in fruits, vegetables, whole grains, and low-fat dairy products is beneficial for individuals with high blood pressure.

***Yoga:*** Practice of yoga, meditation, and other relaxation techniques helps reduce stress, which in turn can lower blood pressure.<sup>[21]</sup> Regular performance of postures such as *Shavasana, Dhanurasana, Makarasana, and Vajrasana*, along with *Pranayama*, has been found effective in decreasing blood pressure levels. Therefore, yoga serves as a supportive therapy in the management of hypertension.<sup>[22]</sup>

### ***PATHY-APATHYA***

***PATHYA AAHAR:*** Changes in lifestyle, such as eating a balanced diet on time and using

more fruits and vegetables. *Yava, Godhum, Carrot, Apple, Pineapple, Shigru, Mudga, Kulatta, Karavellaka, Amalaki, Draksha*, and so on.

**PATHYA-VIHAAR:** Regular light exercise (walking, yoga, pranayama), meditation, deep breathing, maintain regular daily routine (*Dinacharya*), avoid excessive physical or mental strain, controlled screen time; mental calmness, avoid suppression of natural urges, rest after fatigue, staying in peaceful environment and avoiding conflict.

**APATHYA AAHAR:** Overconsumption of fatty, salty, sour, and spicy foods, increased use of tea, coffee, pickles, *dadhi*, butter, fried food, greasy food, and chilies, etc.

**APATHYA VIHAAR:** Mental stress, anger, anxiety, night-awakening (insufficient sleep), daytime sleeping, irregular daily routine, lack of exercise, smoking, alcohol, excessive tea/coffee, suppression of natural urges (urine, stool, flatus), excessive physical exertion.

**PREVENTION:** Practicing *Dinacharya* and *Ritucharya* getting regular exercise, giving up alcohol and tobacco, chewing tobacco, limiting salt in food, changing one's diet and losing weight.

## DISCUSSION

*Prakrit Vata* carries out work of every organ; it maintains *Gati* (flow) of every organ. In Hypertension due to vitiated *Vata*, blood circulation get disturbed.<sup>[23]</sup> In the patient giddiness, burning sensation, sweating. Pain, these mixed types of symptoms were present. According to *Samprapti*, *Dosha* is *Pitta* and *Rakta* and main *Dushta Dosha* is *Vata*. So according to, treatment:

**Ashwagandha Churna:** it works on Central nervous system i.e., treats stress, overthinking, insomnia, anxiety etc.

**Punarnava:** it works as diuretics.

**Puskar Bramhi Guggulu:** Puskar Bramhi Guggulu work as a veno-dilator, hypolipidemia due to its effect it works on ischemic heart disease. The drug action have been consider which include risk of cardiac events associated with the anti-ischemic therapy through the cardio protective action of Guggulu and post exercise restoration and PGE2.

**Pancha Tikta Ghrita Guggulu** - as it contains Tikta Ausadhi having properties like Lekhana

as well as Bhedan Karma so it works as hypolipidemia and anti-arthrosclerosis.

Arogyavardhini Vati is a good appetizer, digestive, relieves constipation and purifies blood. Amalaki - is Rasayan and work as anti-oxidant and Mukta Sukt, Abhraka Bhasma is also work as antioxidant.<sup>[24]</sup>

## CONCLUSION

According to *Ayurveda*, health is maintained when the *Doshas*, *Dhatus*, *Malas*, and *Agni* remain in a state of balance. While interpreting hypertension from an *Ayurvedic* perspective, several factors must be taken into account:

1. Pathophysiological alterations, such as vitiation of *Doshas* (*Vata*, *Pitta*, *Kapha*), disturbance in *Dhatus*, and impairment of *Malas*.
2. Psychological factors, involving disturbances at the level of the mind (*Manovaha Srotas*).
3. Structural changes that develop as long-term complications of hypertension, affecting organs such as the heart, blood vessels, and kidneys.

After reviewing classical *Ayurvedic* texts and modern scientific concepts, it becomes evident that the *Ayurvedic* method of treating diseases based on their *Samprapti* (pathogenesis) is logical and effective. This review highlights that, when administered according to *Ayurvedic* guidelines, appropriate therapies can successfully manage blood pressure without harmful side effects. Furthermore, hypertension can be effectively controlled by adopting *Pathya*–*Apthyā* (dietary regulations), proper lifestyle habits, and practicing Yoga as prescribed in *Ayurveda*. These measures help restore and maintain the body's homeostasis, thereby preventing the development and progression of hypertension.

## REFERENCES

1. <https://share.google/DDZRI89xtXAiHANmn>
2. Gupta R. Trends in hypertension epidemiology in India. *J Hum Hypertension*, 2004; 18: 34.
3. Charaka. (ca. 1000 BCE–200 CE). *Charaka Samhitā* (Sūtrasthāna 18/15) [Classical Ayurvedic text]. In P. V. Sharma (Trans. & Ed.), *Charaka Samhitā* (Vol. 1). Chaukhamba Orientalia.
4. Tabers cyclopedic Medical Dictionary, 20th edition, 2005; 268.
5. Ibid-9: 1039.
6. The History of Discovery of Blood circulation: unrecognized contributions of Ayurveda

masters. K.Patwardhan. *Adv Physiol Edu.*, 2012; 36: 77-82.

7. Jameson, J. L., Fauci, A. S., Kasper, D. L., Hauser, S. L., Longo, D. L., & Loscalzo, J. (Eds.). (2018). *Harrison's Principles of Internal Medicine* (20th ed.). McGraw-Hill.
8. Hall JE, Guyton AC. *Guyton and Hall Textbook of Medical Physiology*. 14th ed. Philadelphia: Elsevier; *Pathophysiology of Hypertension*.
9. Sushruta. (n.d.). *Suśruta Samhitā* (Sūtrasthāna 17/7; Y. T. Acharya, Ed.).
10. Sushruta. (n.d.). *Suśruta Samhitā* (Sūtrasthāna 15/14; Y. T. Acharya, Ed.). Chaukhambha Sanskrit Sansthan.
11. Sushruta. (n.d.). *Suśruta Samhitā* (Sūtrasthāna 4/56; Y. T. Acharya, Ed. Chaukhambha Sanskrit Sansthan).
12. Sushruta. (n.d.). *Suśruta Samhitā* (Sūtrasthāna 1/20; Y. T. Acharya, Ed.). Chaukhambha Sanskrit Sansthan.
13. Charaka. (n.d.). *Charaka Samhitā* (Sūtrasthāna 20/14; Y. T. Acharya, Ed.). Chaukhambha Sanskrit Sansthan.
15. Charaka. (n.d.). *Charaka Samhitā* (Sūtrasthāna 20/14; Y. T. Acharya, Ed.). Chaukhambha Sanskrit Sansthan.
16. Charaka. (n.d.). *Charaka Samhitā* (Sūtrasthāna 24/13; Y. T. Acharya, Ed.). Chaukhambha Sanskrit Sansthan.
17. Charaka. (n.d.). *Charaka Samhitā* (Sūtrasthāna 17/64; Y. T. Acharya, Ed.). Chaukhambha Sanskrit Sansthan.
18. Sushruta. (n.d.). *Suśruta Samhitā* (Sūtrasthāna 15/19; Y. T. Acharya, Ed.). Chaukhambha Sanskrit Sansthan.
19. L.J. Appel et al. "A clinical trial of the effects of dietary patterns on blood pressure." *New England Journal of Medicine*, 1997; 336(16): 1117-24.
20. R.J. Padwal et al. "The 2010 canadian hypertension education program recommendations for the management of hypertension: Part 2- Therapy." *The Canadian journal of cardiology*, 2010; 26(5): 249-258.
21. J.L.N.shastray, "Dravyaguna VIjnana" Chaukambha orientalia Publications, Varanasi, vol II, 2nd ed-2005; 75-380.
22. M.V. Rainforth et al. "Stress reduction programs in Patients with Elevated Blood pressure: A Systematic review and Meta analysis." *Current hypertension*, 2007; 9(6): 520-8.
23. ([http://nopr.niscair.res.in/bitstream/123456789/8524/1/IJPK%204\(4\)%20367-372.pdf](http://nopr.niscair.res.in/bitstream/123456789/8524/1/IJPK%204(4)%20367-372.pdf))
24. Charaka, Charaka Samhita, Acharya Y.T. (editor), Chaukhamba Surbharati Prakashana,

Varanasi. Reprint 2008, Sutrasthana 12/08, 79.

25. Anonymus, Rasatantrasar and Siddhaprayoga Sangraha Pan 1, Krishnagopal Ayurved Bhavan, Kaleda Krishnagopala, 23rd edition, 2014; 250.
26. Ambulkar P, Chand T, Rao S, Dwivedi L. (2010) Makardhwaj as a Boon in Hypertension (Vyana Bala Vaishamya): A Clinical Evaluation, Proceedings in National Seminar on Preventive Cardiology in Ayurveda. Rashtriya Ayurveda Vidyapeeth Publication, New Delhi, India, 295-300.
27. WHO report of Prevention and control for Cardio vascular diseases, 2001-2002, available from <http://www.sld.cu/./pdf/./international cardiovascular disease statistics>. Page 2
28. Gupta R. Trends in hypertension epidemiology in India. *J Hum Hypertension*, 2004; 18: 73-8.
29. Charaka Samhita, Yadavaji Trikamji, Reprint edition, Chaukhamba Sansrit Sansthana, Varanasi, 2009, Sutrasthana, 18/46: 108.
30. Gupta R. Trends in hypertension epidemiology in India. *J Hum Hypertension*, 2004; 18: 73-8.
31. Charaka Samhita, Yadavaji Trikamji, Reprint edition, Chaukhamba Sansrit Sansthana, Varanasi, 2009, Sutrasthana, 18/46: 108.
32. Dhamle Madhumati. Post Graduate Thesis on the study of Yojana Chatushka of Charaka and Yojana for the management of Raktashrita Vyadhi (hypertension). Department of Basic Principles, Institute of Post Graduate Teaching and Research in Ayurveda; 2001.
33. Patwardhan K. The history of the discovery of blood circulation: unrecognized contributions of Ayurveda masters. *Adv Physiol Educ* 2012; 36: 77e82. <https://doi.org/10.1152/advan.00123.2011>
34. Tripathy Brahmananda, editor. Caraka Samhita of Agnivesha, Charaka Chandrika Hindi commentary. 1st ed. Varanasi: Chaukhamba Orientalia; 1999. p. 558. Chikitsa Sthana; Grahanidosha chikitsa, Chapter-15, Verse 36.
35. Murthy Srikantha KR, editor. Asthanga Samgraha of Vaghbata. 9th ed. Varanasi: Chowkhamba orientalia; 2012. p. 368. Sutra Sthana, Doshabhedeeyya Adhyaya, Chap 20, Verse 2.
36. Gordan R, Gwathmey JK, Xie L-H. Autonomic and endocrine control of cardiovascular function. *World J Cardiol*, 2015; 7(4): 204e14. <https://doi.org/10.4330/wjc.v7.i4.204>.
37. Sembulingam, Sembulingam Prema. Properties of cardiac muscle. Essentials of medical physiology. 5th ed. New Delhi: Jaypee brothers medical publishers (P) Ltd., 2010; 509.