



“PULSE PRESSURE” A NEW DIAGNOSTIC TOOL TO RULE OUT NADI KATHINYA AND IT’S MANAGEMENT IN AYURVED

DAHILEKAR SG^{*1} AND DAHILEKAR HS²

1: M.D. (Rognidan Avam Vikritivigyan), Ph.D. (Scholar) Professor, Parul Institute of Ayurved, Parul University, Limda, Vadodara, 391760

2: M.D. (Rognidan Avam Vikritivigyan), Ph.D. (Scholar) Asso. Professor, Parul Institute of Ayurved & Research, Parul University, Ishwarpura, Vadodara, 391760

*Corresponding Author: Dr. Sandeep G. Dahilekar: E Mail: sandeep_dahilekar@rediffmail.com

Received 12th Dec. 2021; Revised 14th Jan. 2022; Accepted 7th Feb. 2022; Available online 5th March 2022

<https://doi.org/10.31032/IJBPAS/2022/11.3.1045>

INTRODUCTION

Pulse pressure (PP) is a new way to assess Cardiac function & blood vessels diseases in early old age as a “Pre diagnostic tool”. Rather to refers “Higher investigation” like 2D echo sonography, Angiography, Color doppler, Magnetic resonance angiography (MRA) etc. which is time consuming as well as cost effective in late diagnosis. Pulse pressure is just a simple calculation of “Systolic blood pressure (SBP)” subtracted by “Diastolic blood pressure” = PP. Normal value = 40 to 60 mm of Hg.¹

As a pre diagnosis of multiple pathological condition like “Cardiac valvular disorder, Stenosis and stiffness, Regurgitation and most important part is “Vessel wall elasticity.” Wide pulse pressure (> 60mm of

Hg) can be seen in many more cardiovascular, Cardio valvular, hormonal & anemic diseases and Narrow pulse pressure (< 40 mm of Hg). Probably in Kidney failure person. Pulse pressure with aging in association of many more Cytokine Releasing Syndrome with several infectious diseases, sedentary lifestyle induced obesity and addiction in time & hormonal changes with aging or its replacement end in Raised Arterial stiffness. As per in Ayurved text, it is called as “Dhamani Kathinya”. This Dhamani Kathinya should be observed cleanly in routine Ayurved OPD to avoid cardiovascular diseases as well as many more Systemic Involvement diseases too. So, this Dhamani Kathinya can be observed in routine OPD. with the help of

Naditarangini Yantra (Photoplethysmography principle-based machine.) As well as there is role of Nitric Oxide (NO) secreting drugs in Ayurved which can reverse Arterial stiffness to survive patient to healthy longer lives. These both pathological ranges have most significant regarding aging and loss of elasticity of blood vessels wall, oxidant injury to collagen of the vessels and loss of its elasticity which stand for Arterial stiffness index (ASI.) with several cause of lifestyle induced disorder, hormonal diseases as well as obesity by the means of atherosclerosis and addiction especially to Nicotine induced arteriosclerosis.²

Significance of PP: - It's have most significant and different than Hypertension condition. Person with its BP as 120/60 mm of Hg will also stand for Wide pulse pressure. Modern medicine has limitation regarding Wide & Narrow pulse pressure because Antihypertensive, Antiarrhythmic drugs with Diuretics doesn't apply for this typical condition.³

Definition: - Pulse pressure is the difference between Heart in contractile position exerted pressure (Systolic pressure) deducted by heart in relax position with still exerting some pressure (Diastolic pressure) is called Pulse pressure.

Normal range of Pulse pressure = 40- to 60-mm Hg. The PP is rises after age 50yrs. due to raised arterial stiffness. It is having two

types.⁴

1. Low pulse pressure is also considered as "Narrow" pulse pressure. When Pulse Pressure is less than ≤ 40 mm of Hg. Often seen in "Heart failure".⁴

2. High pulse pressure is also considered as "Wide" pulse pressure. When Pulse Pressure is more than ≥ 60 mm Hg. A high pulse pressure is often associated with increased risk of Heart attack or stroke, particularly in men found overall mortality to 10 – 20 %.

Seen in High blood pressure, Atherosclerosis, Aortic regurgitation, aortic sclerosis (both heart valve conditions), arteriosclerosis (less compliant arteries), Fatty deposits that build up in arteries (atherosclerosis), Iron deficiency anemia (reduced blood viscosity), and hyperthyroidism (increased systolic pressure) causes high Pulse pressure.

Increased pulse pressure is associated with increased mortality among those with severe kidney disease.⁴

3. Exception for High Pulse pressure: - Some retrospective study shows that people admitted to a hospital for Sepsis found that pulse pressure greater than 70 mm Hg (High pulsepressure) was actually associated with a decrease in mortality.

Difference between Pulse pressure & Hypertension: - High pulse pressure is more than 60mm of Hg. It can be seen in a normal range Systolic pressure to lower

value of Diastolic pressure. E.g., 120 / 60 mm of Hg can be in range of High pulse pressure than HTN condition.⁴ There is no as such literature available in Ayurved regarding High pulse pressure while Hypertension get entertained in Ayurveda with multiple choice of medicine against Dhamani pratichaya, Dhamani Uplepa, Uccha-rakta chap, Vyanavrutta apan vata and so on.⁵

Narrowing pulse pressure (Low pulse pressure) causes: - It can be seen in...

1. Dengue fever. It lowers systolic Blood pressure by 20 mm of Hg result in Narrow pulse pressure. **2. Patent ductus arteriosus (PDA) in infant.** It is one of the factors that leads to diastolic hypotension because of the diastolic run off of blood flow into the pulmonary vascular system from left-to-right shunt. Hypotension with is often difficult to treat.⁶

3. In Aortic stenosis, there is a narrowing of the aortic valve, which interferes with the ejection fraction of blood from the left ventricle into the aorta, which results in a decrease in stroke volume and a subsequent decrease in pulse pressure.⁶

High pulse pressure and its causes: - It is associated with loss of elasticity of blood vessels. Increases with aging, connective tissue hardening due to oxidant in dietary, Nicotine addiction, long term hypertension, Aortic regurgitation, aortic valves sclerosis (both heart valve conditions), arteriosclerosis

(less compliant arteries), fat deposition in arteries (atherosclerosis), hyperthyroidism (increased in systolic pressure), iron deficiency anemia (due to reduced blood viscosity).⁶

1. Mitral valve stenosis: - The high resistance across the stenotic mitral valve causes blood to back up into the left atrium, thereby increasing Left Atrium pressure, which raised in 25 mm Hg pressure. (normally ~10 mmHg). This results in the Left Auricular pressure being much greater than the Left Ventricle pressure during diastolic filling.⁶

2. Mitral regurgitation: - There is a large increase in left ventricular end-diastolic pressure and left atrial pressure. The ventricle and atrial function on a stiffer portion of their compliance curves so that the increased volume results in a large rise in pressure.⁶

3. Old Aged: - Pulse pressure tends to increase after the age of 50. This is due to the stiffening of arteries and blood vessels as the age grows older.⁶

Novelty in the Pulse pressure study in Ayurved Perspective: - Modern medicine has some limitation regarding Wide & Narrow pulse pressure. Bcz, Antihypertensive, Antiarrhythmic drugs with Diuretics doesn't apply for this typical condition or after some extent to no use.⁷



Naditarangini Instrument for diagnosis of "Dhamani-Kathinya" 8

Understanding Pathophysiology of PP: -

Pulse Pressure.

Bigger difference between Systolic Blood pressure and Diastolic blood pressure.



Regarding Aging with

Loss of elasticity of blood vessels wall.



Sedentary life with Obesity & Addiction in time.

Atherosclerosis with Obesity &

Arteriosclerosis due to use of Nicotine.



Increased Arterial stiffness Index (ASI.)

Oxidant injury to collagen of the vessels wall.



High Pulse Pressure.

Due to high pumping activity of heart with Multiple Cardiac & Cardiovascular diseases.



Nadi Pareeksha can diagnosed - Dhamani kathinya.⁹

Cytokinin Releasing Syndrome (CRS) in many diseases with aging.

Lifestyle Induced disorder with time, hormonal changes & Addictions

As per Ayurved, **Dhamani-kathinya.**

Hopes in correction for ASI in Ayurveda:

It's hopes in Ayurveda's with Rejuvenating, Anti-oxidant, lifestyle correction as well as Pre-diagnostic tool in Asthavidha pareeksha explained by Yogratarakar. Latest newly developed instruments in Ayurveda in Photoplethysmography plays crucial Pre-diagnostic role in Arterial stiffness index. New era in the scope of Ayurved medicine as well in development of manual Nadi examination skill with latest technological of Pulse wave velocity in ASI. with Bio-inflammatory markers in laboratory tests too.

Novelty: - [Pulse Pressure, Arterial Stiffness, and Drug Treatment of Hypertension | Hypertension \(ahajournals.org\)](#) NO (Nitric oxide) Donor medicine can increase diameter in arteries. Study shows 40 mg Sinitrodil given in single dose increases brachial artery diameter by 27% whereas this value was only 8% after ISDN 20 mg.⁹

NO donor Sinitrodil are presumably good candidates to decrease PP, thereby **decreasing SBP and not decreasing Pulse pressure (PP), but perhaps even increasing DBP.**¹⁰

Apart from NO (Nitric oxide) donors, enhancers of NO production and/or release might be of interest. Recent studies suggest that some compounds, like the diuretic agent cicletanine⁵⁵ and the selective β 1-blocker nebivolol,^{56,57} may act as enhancers of NO production and/or release with resulting

decrease in arterial stiffness.^{11.}

Status of the study – In progress with trial of 10 cases studied with inflammatory markers in laboratory with Naditarangini examination in diagnosed COPD patients with different causes. We found many cases with old history of allergen with asthma, even COPD due to chronic smoking, cardiac valvular diseases with old infection related complication, Post Covid19 complication, lungs fibrosis etc. In those cases, we found significant percentage (more than 40 %) Nadi kathinya as well as Nadi sthulata, Guruta too. Ultimately stand to arterial stiffness with mostly significant raised CRP values. Even there are 4 cases out of 10 COPD with Non Hypertensive still possess wide pulse pressure in those nadi Kathinya patients with raised inflammatory markers too.

What's the treatment in ASI? –

“Kinlay *et al*” used a modification of this technique and determined that **Nitric oxide (NO)** is a regulator of **Arterial stiffness.**¹⁰

“NO” have an interplay between Endothelial-derived factors that alter tone and structural properties of the arterial walls. **Collagen stiffness** with age factors and several infectious insults in lungs field raised Arterial stiffness with end results to High Pulse pressure can be reverse with drugs secreting “NO” i.e., nitric oxide. “NO” opposes the actions of potent endothelium-

derived contracting factors such as angiotensin-II and endothelin-1. In addition, NO serves to inhibit platelet and white cell activation and maintain the vascular smooth muscle in a non-proliferative state. Nitric oxide (NO) signaling drugs in Ayurved which repairs endothelial of vessels wall.^{11,12.}

Ginseng Root is one of strongest drug.^{13.}

“**Bhramari Pranayam**” is the most occurrence literature that produces NO in nose breathing exercise.¹⁴ (We found many studies on it). Citrulline drugs like Gingers.^{15, 16.} Ashwagandha is the strongest remedy against ASI.^{15, 16.} Green Tea Extract, Saffron, Hibiscus, Black cumin.^{15, 16.} All “Vajikarana” drugs used in Erectile dysfunction (ED) are good one in NO signaling drugs in ASI. (Ashwagandha, kapikacchu, shilajeet, Kavachbeej etc.)^{17, 18.} With that Lifestyle correction, De-addiction, Habit of Good exercise with Pranayam, habit of brisk walk with Achar-Rasayana, Nitya-Rasayana with Chyavanprash, Madhumalini vasant, Vasant-Kusumakar rasa are some more steps against Arterial stiffness and Cardio-valvular as well as cardiovascular diseases.^{19,20.}

Investigation: -

1. **Inflammatory Markers in Vasculitis:** – **C-reactive protein (CRP)** test may be done to check for a protein linked to inflammation of the arteries. **ESR** – Erythrocytes sedimentation rate to checked

long term changes in vasculopathy related globulin secretion may results to higher values in chronicity.^{21,22.} **Micro and Macro urine** albumin ratio in compare with Creatinine (UACR) which is most significant in arterial stiffness related vasculitis.^{23.}

2. **Cardiac Level Investigations:** - **Electrocardiogram (ECG or EKG)** is simple and painless test records for the electrical signals in the heart. **Treadmill stress test, 2D- echo, Colour Doppler Ultrasound, Coronary calcium scan, Angiography and magnetic resonance angiography (MRA) or positron emission tomography (PET)** etc. These tests can show hardening and narrowing of large arteries.²⁴
 3. **Other Lab Test:** - High levels of Blood sugar and Sr. Cholesterol, hyperthyroidism raise the risk of atherosclerosis.²⁴
 4. **Ankle-brachial index (ABI):** - A “Blood pressure” difference in the arms and in the foot towards ankles gives an idea about atherosclerosis. This instrument is costly one as well as availability is less hence, we recommended “Naditarangini” as ground level screening tool for Arterial stiffness in routine practices to rule out “**Nadi / Dhamani Kathinya**”.²⁵
- Nadi Kathinya In Ayurved:** - (The significance of Nadi Pariksha is well understood and effectively used by Ayurveda practioners for assessing

Tridoshas and various physiological and psychological states of the patient. The traditional texts Sharangdhara Samhita, Yoga Ratnakara, Basavarajeeyam and Bhavaprakasha have discussed the details of Nadi Pariksha in succinct set of slokas. Ayurveda has thousands of years of rich experience in Nadi Pariksha with strong literature support but is subjective in nature and the need for studying nadi with a scientific approach is well understood. Recently, pulse wave velocity has gained significant research interest as it is considered to be a strong indicator of cardiovascular disease; however, the relevance of pulse wave analysis to Nadi Pariksha has not been studied. In this review, traditional methods of Nadi Pariksha as defined in Ayurveda classics and the recent advances in pulse wave analysis are discussed. As per classical texts, qualities or properties of pulse such as pulse movement (Gati), speed of the pulse (Vega), stability of the pulse (Sthiratva) and hardness of the artery (Kathinya) play major role in Nadi Pariksha and in the current review these properties were analyzed and compared with the modern pulse parameters namely pulse wave velocity, pulse rate variability and arterial stiffness. The significance of pulse wave velocity in cardiovascular studies is discussed and the need for extending these studies to Ayurveda is highlighted.)²⁶

Recent advances in pulse wave analysis to Nadi Pariksha which underlines the need for a comprehensive review of Nadi Pariksha.

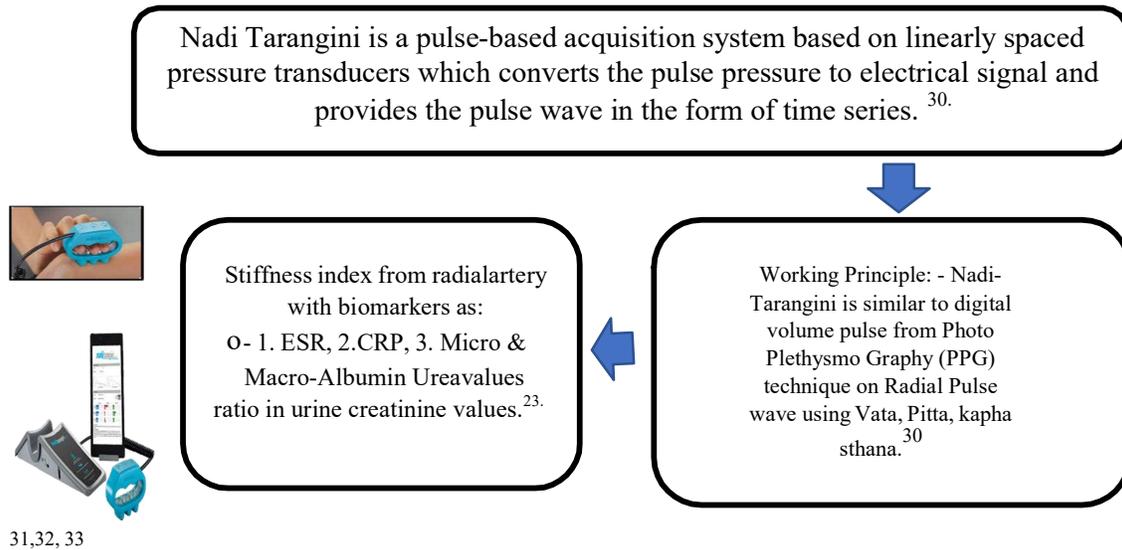
The texts have used the term kathinya to explain the hardness of the artery and reference to kathinya is available only in Basavarajeeyam. In dviteeya prakarana of Basavarajeeyam while explaining the signs of **Mrityu nadi** the term kathinya has been used and in triteeya prakarana of Basavarajeeyam the term kathinya is used to explain the nature of kapha²⁷. The term **kathina** (hard)²⁸ represented as kathinya corresponds to hardness of the artery and can be closely associated to modern pulse parameter arterial stiffness. Vasant has used the term consistency of the vessel wall to explain kathinya whereas Upadhyaya has used the term condition of the vessel wall for the same. In this review the term hardness of the artery is used to represent kathinya and is associated to arterial stiffness which is measurable and has research significance.²⁹

Stiffness index (SI): - It is measured as the ratio of height of the person to the time difference between systolic and diastolic peaks. The pulse wave measured from radial artery is closely associated to the digital volume pulse measured from PPG and is related to it by a transfer function. Hsein-Tsai have demonstrated the significant correlation between the stiffness index measured using PPG and radial artery. Initial studies have shown promising results with

radial artery but the significance of arterial stiffness measured from radial artery yet to be established. As per ayurveda kathinya is closely associated to arterial stiffness and there is a need to extend the studies on arterial stiffness to Tridosha analysis.^{30,31.}

Stiffness index from radial artery: - The sensor and semiconductor technologies have advanced further and precise pulse acquisition systems are available to measure the pulse at radial artery which resulted in resurgence of traditional Tridosha analysis in a more scientific manner. Nadi Tarangini, Nadi Yantra and Nadi Pariksha Yantra are some of the instruments available to acquire the pulse at Tridosha locations simultaneously. Nadi Tarangini is a pulse-based acquisition system based on linearly spaced pressure transducers which converts the pulse pressure to electrical signal and provides the pulse wave in the form of time series. The pulse wave acquired using Nadi Tarangini is similar to digital volume pulse from PPG with clear systolic and diastolic peaks in place.^{30,31,32.}

How to diagnose Dhamani Kathinya (ASI) in Ayurved Nadi examination as an unbiased result: -



CONCLUSION

Multiple causes with lifespan may trigger **CRS disorders to arterial stiffness(AI) i.e., “Dhamani kathinya”** in early old age group.

The aging with **Cardiovascular diseases** may be in early 40 than late in 70 yrs. Hence, **Pulse pressure** have more significant in early old age (Middle age) than senile disorder in late old age.

Many patients with history of Pulmonary infection (Pranavaha Srotodushti) in present study shows Nadi Kathinya / Dhamani kathinya in significant values on Naditarangini.

Ayurved Rasayana Chikitsa will be beneficial in **Pulse pressure** as well as **Naditarangini**

will be a pre diagnostic tool in early old age for assessing **Arterial stiffness Index**.

REFERENCES: -

- [1] <https://www.ncbi.nlm.nih.gov/books/NBK482408/> dated 14.12.2021, 2.15pm
- [2] <https://www.statpearls.com/ArticleLibrary/viewarticle/28072> dated 14.12.2021, 2.35pm
Rangacharya V. Basavarajeevam, Central council of research in ayurveda and siddha, NewDelhi. (2007) (Google Scholar).
- [3] <https://www.sciencedirect.com/topics/medicine-and-dentistry/pulse-pressure> dated 14.12.2021, 2.15pm
- [4] <https://www.healthline.com/health/pulse-pressure#high-pulse-pressure>
- [5] Acharya Agnivesha, Charaka samhita. Vaidya jadavaji trikamji Acharya, editor, varanasi: Chaukhambha orientalia, reprint, 2009. p.150, pp.738
- [6] <https://www.healthline.com/health/wide-pulse-pressure#causes>
- [7] <https://www.jacc.org/doi/full/10.1016/j.jacc.2009.10.061> dated. 15.12.21. 4.30pm.

- [8] https://www.google.com/imgres?imgurl=https%3A%2F%2Fwww.naditarangini.com%2Fwp-content%2Fuploads%2F2018%2F04%2Fabout_naditarangini_with_typo.png&imgrefurl=https%3A%2F%2Fwww.naditarangini.com%2Fsection%2F&tbid=TadHEi2Kqa0M&vet=12ahUKEwi9wIqNzeX0AhWe2XMBHcELBOEQMygBegQIARAY..i&docid=8udSdjnJt5YvzM&w=620&h=445&itg=1&q=Nadi%20tarangini%20Athreya&hl=en&safe=active&ved=2ahUKEwi9wIqNzeX0AhWe2XMBHcELBOEQMygBegQIARAY dated. 15.12.21. 4.40pm.
- [9] <https://www.ahajournals.org/doi/full/10.1161/hy1001.095773> dated. 15.12.21. 4.45pm.
- [10] <https://www.ahajournals.org/doi/10.1161/hy1001.095773> dated. 15.12.21. 4.50pm.
- [11] <https://www.sciencedirect.com/topics/medicine-and-dentistry/endothelium-derived-constricting-factor> dated 15.12.21 19.20pm.
- [12] <https://www.sciencedirect.com/science/article/pii/S1347861315001954> dated. 15.12.21.19.50pm
- [13] <https://onlinelibrary.wiley.com/doi/full/10.1046/j.1440-1681.2003.03885.x> Ginseng root a strong NO signaling drug. dated 16.12.21 12.10pm.
- [14] <http://lifspa.com/nitric-oxide-humming-brahmari-pranayama/> Bhramari pranayama raises NO in body. dated 16.12.21 12.20pm.
- [15] Ginger as NO booster <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3210006/> dated 16.12.21 12.30pm.
- [16] Green Tea Extract as a NO secretor <https://healthyfocus.org/vasodilator-herbs/> dated 16.12.21 12.30pm.
- [17] <https://healthyfocus.org/vasodilator-herbs/> dated 16.12.21 12.40pm.
- [18] <https://morningsteel.com/supplements-that-boost-nitric-oxide/> Most of Vajikarana drugs in Erectile dysfunction. dated 16.12.21 12.45pm.
- [19] <https://www.ayurvedinfo.com/2020/08/15/madhu-malini-vasant/> especially in allergic condition and Asthma related CRS. dated 16.12.21 03.30pm.
- [20] <https://www.chandigarhayurvedcentre.com/blog/vasant-kusumakar-ras/> in diabetic vasculopathy and hypotension. dated 16.12.21 03.40pm.
- [21] <https://arupconsult.com/content/vasculitis> for CRP. dated 16.12.21 03.50pm.
- [22] <https://www.frontiersin.org/articles/10.3389/fneur.2019.00591/full> for ESR. Dated 04.10pm.
- [23] <https://jasn.asnjournals.org/content/18/6/1942> for UACR in Arterial stiffness. Dated 16.12.21 04.20pm.
- [24] <https://www.healthline.com/health/pulse-pressure#high-pulse-pressure> Cardiac pathology in Pulse pressure. dated 17.12.21, 11.15 am.
- [25] <https://www.webmd.com/heart-disease/ankle-brachial-test> Ankle brachial index, dated 17.12.21, 11.25 am.

- [26] Dt. Upadhyay GP. Nadi Pariksha Vigyan. Varanasi: Choukhamba Surbarti Publication; 2009. (Whole book with multiple scattered references)
- [27] Basavaraju, Basava rajeeyam, edited by Puvvada Surya narayana Rao, Published by A.B.S publication, Rajahmundry, A.P. (1999)
- [28] <https://www.researchgate.net/publication/24898384> Some important aspects of nadi pariksha from basavarajiyam dated 17.12.21, 11.35am.
- [29] <https://www.sciencedirect.com/science/article/pii/S0975947617302620> nadi kathinya in ayurved. dated 17.12.21, 11.45am.
- [30] Reference for Mrityu-Nadi & Kathinya - Sastri L, Yogaratnakar with Vidyotini Hindi commentary edited by Sastri B. B. 5th edition 1993, Chaukhambha Sanskrit Sansthan, Varanasi, Shloka 13,14,16,17,18,23,25,39,40 41; pages 7,8,9.
- [31] A. Joshi, A. Kulkarni, S. Chandran, V.K. Jayaraman, B.D. Kulkarni, Nadi Tarangini: a pulse based diagnostic system, Conf. Proc. IEEE Eng Med Biol Soc [Internet], 2007 (2007 Jan), pp. 2207-2210, Available from: <http://www.ncbi.nlm.nih.gov/pubmed/18002428> View Record in Scopus, (Google Scholar.) dated 17.12.21, 11.55am.
- [32] Sareen M. Abhinav, M. Kumar, S. Anand, A. Salhan, J. Santhosh, "Nadi Yantra: a robust system design to capture the signals from the radial artery for non-invasive diagnosis," 2nd Int Conf. Bio. Informa Biomed Eng. ICBBE 2008, 2009 (November) (2008), pp. 1387-1390. Cross Ref. View Record in Scopus. (Google Scholar.)
- [33] N. Roopini, "Design & development of a system for Nadi Pariksha". 4 (6) (2015), pp. 465-470, View Record in Scopus, (Google Scholar.)
- [34] H.T. Wu, C.H. Lee, A.B. Liu, W.S. Chung, C.J. Tang, C.K. Sun, *et al.* Arterial stiffness using radial arterial waveforms measured at the wrist as an indicator of diabetic control in the elderly, IEEE Trans Biomed Eng., 58 (2) (2011), pp. 243-252, View Record in Scopus, (Google Scholar.)