Research Paper

Volume : 4 | Issue : 3 | March 2015 • ISSN No 2277 - 8179

Laws of Arterial Ageing

Medical Science

KEYWORDS : Physical Activity, Mental Activity, Pulse Pressure, Elastic Fibres.

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ABSTRACT

In order to create laws of arterial ageing condition of radial arterial wall was examined, pulse pressure of blood was recorded and changes in tunica medial elastic fibres of ascending aorta were observed in physically active persons and mentally active persons of different age groups not suffering from any cardiovascular disease to compare atherosclerotic and ageing changes in these arteries interrelating with their pulse pressure of blood.

From 50 to 79 years of age pulse pressure ranged from 42 to 57 mm Hg in persons having increased physical and decreased mental activity while in persons with decreased physical and increased mental activity pulse pressure ranged from 50 to 80 mm Hg. Ageing and atherosclerotic changes in tunica medial elastic fibres of ascending aorta and radial arterial wall were absent in all the persons with pulse pressure ranging from 50 to 60 mm Hg. while at the range of 60 to 70 mm Hg pulse pressure ageing and atherosclerotic changes were progressive in the form of high fragmentation of tunica medial elastic fibres in ascending aorta and firm radial arterial wall but at the range of 70 to 80 mm Hg pulse pressure ageing and atherosclerotic changes were observed establishing in the form of loss of tunica medial elastic fibres in ascending aorta and hard radial arterial wall.

On the basis of results obtained in the present study following laws of arterial ageing were created by Dr. Keshaw Kumar.

(1) Process of arterial ageing can be controlled but it can not be reversed from old age to young age.

(2) Arterial ageing can not occur without arterial atherosclerotic changes exact cause of which is increasing pulse pressure of blood.

(3) Decreased physical activity with increased mental activity results into rise in pulse pressure which can be controlled by increased physical activity with decreased mental activity.

INTRODUCTION:

In the past ageing changes in elastic fibres of aorta have been studied by Foster (1909)[1], Gray, et al. (1953)[2], Hass, (1943)[3], Laitinen (1963)[4], Ahmed (1967)[5], Margaret and Harkness (1957)[6], Saxton (1942)[7] and Smith et al. (1951)[8]. Keshaw Kumar (1993, 1996, 2003, 2005)[9,10,11,12] described controlled pulse pressure of blood, increased pulse pressure of blood, atherosclerosis and ageing in arteries. Secret of prolonged young age of arteries which can control ageing changes in arterial elastic fibres was unknown as yet and inter relationship between pulse pressure of blood and structural changes in tunica media of arterial wall was not available in the literature, therefore, present study was conducted to compare ageing changes in elastic fibres of tunica media of ascending aorta and atherosclerotic changes in wall of radial artery interrelating with systemic pulse pressure of blood in individuals of different age groups because prevention of ageing changes in arterial elastic fibres can control the process of ageing in arteries towards old age.

MATERIAL AND METHODS

This study was conducted in the North Indian persons not suffering from any cardiovascular disease and belonging to Allahabad District of U.P. by following methods.

- Measuring systemic pulse pressure of blood in the individuals of different age groups of people with increased physical and decreased mental activity and also in the people with decreased physical and increased mental activity.
- Examining the condition of wall of radial artery for atherosclerotic changes in the different ranges of systemic pulse pressure of blood in the same population.
- Observing the ageing changes in tunica medial elastic fibres of ascending aorta in the different ranges of pulse pressure of blood in the same population.

Lawyers, Doctors, Engineers, Professors who were not doing any physical exercise were classified into the category of the individuals with decreased physical activity and increased mental activity, while Farmers Labourers, Rikshaw pullers who were not doing any mental exercise were classified in the category of individuals with increased physical activity and decreased mental activity.

These objective parameters to classify individuals into the two categories were within physiological limits. Following objective parameters were applied to classify the individuals into two categories during sampling of postmortem cases.

- Whether the individual belonged to intellectual class or labourer class?
- Was the individual doing regular physical work/ Physical exercise?
- Was the individual doing regular mental work/ mental exercise?
- Was the individual exposed to hurry, worry tension and anxiety?

These objective parameters were recorded by taking history of dead individuals from their relatives. In living individuals all necessary investigations were carried out to rule out any cardiovascular disease.

Measurement of pulse pressure of blood:

Pulse pressure was taken in the individuals of age ranging from 50 to 79 years which was divided into the age groups of (50-54), (55-59), (60-64), (65-69), (70-74) and (75-79). 100 males and 100 females of each group were selected for this study from the population which belonged to the class of the individuals with increased mental activity and decreased physical activity and the same number was selected from population belonging to the class of individuals with decreased mental activity and increased physical activity. In this way (total 2400) cases were studied.

Systolic and diastolic pressure of blood were recorded by sphygmo-manometer. Later on by subtracting the diastolic pressure from systolic pressure the pulse pressure of blood was obtained.

200 people (100 males and 100 females) were studied in each group. Sum of the pulse pressure of 100 males was divided by 100 to obtain mean pulse pressure of males in a group. Similarly the mean pulse pressure of females in a group was obtained.

Examination of condition of wall of radial artery:

While taking the pulse pressure of blood the wall of radial artery was observed by palpating it against the underlying radius bone in all the 2400 individuals for atherosclerotic changes interrelating with pulse pressure of blood ranging from 50 – 60 mm Hg, 60-70 mm Hg and 70-80 mm Hg.

Observation of ageing changes in elastic fibres of tunica media of ascending aorta:

Tissue of ascending aorta was obtained immediately distal to its commencement from postmortem cases of 10 males and 10 females of the mentioned age groups belonging to the population with increased physical and decreased mental activity and also belonging to the population with decreased physical and increased mental activity. In this way total 240 cases were studied. Tissue was preserved in 10% formalin. Paraffin sections of 10 micron thickness were cut with the help of rotary microtome and stained with orcein to observe ageing changes in elastic fibres of tunica media interrelating with pulse pressure of blood ranging from 50-60 mm Hg., 60-70 mm Hg and 70-80 mm Hg.

OBSERVATIONS

Pulse pressure of Blood (table-I)

In males belonging to population with increased mental and decreased physical activity pulse pressure ranged from 50-58 mm Hg. between the age group of 50-64 years and it ranged from 63-68 mm Hg. between the age group of 65-74 years and at the age group of 75-79 years it ranged from 68-73 mm Hg.

In females belonging to population with increased mental activity and decreased physical activity pulse pressure ranged from 51-60 mm Hg between the age group of 50-59 years. It ranged from 63-72 mm Hg between the age group of 60-69 years and it ranged from 72-80 mm Hg between the age group of 69-79 years.

Table -I

Pulse pressure of blood in the Individuals of different age groups.

Age Groups in year	People with increased mental and decreased physical activity				People with decreased mental and increased physical activity			
	Male		Female		Male		Female	
	Total number	Mean pulse pressure in mm Hg	Total number	Mean pulse pressure in mm Hg	Total number	Mean pulse pressure in mm Hg	Total number	Mean pulse pressure in mm Hg
50-54	100	50	100	51	100	42	100	43
55-59	100	54	100	60	100	46	100	45
60-64	100	58	100	63	100	49	100	50
65-69	100	63	100	72	100	52	100	51
70-74	100	68	100	76	100	54	100	55
75-79	100	73	100	80	100	56	100	57

In males belonging to population with increased physical and decreased mental activity between the age group of 50-59 years pulse pressure ranged from 42-46 mm Hg. Between the age group 60-69 years it ranged from 49-52 mm Hg and between the age group of 70-79 years it ranged from 54-56 mm Hg.

In females belonging to population with increased physical and decreased mental activity between the age group of 50-59 years pulse pressure ranged from 43-45 mm Hg. Between the age group of 60-69 years it ranged from 50-51 mm Hg and between the age group of 70-79 years it ranged from 55-57 mm Hg.

Condition of wall of radial artery (table II)

Between the range of pulse pressure from 50-60 mm Hg wall of radial artery was not palpable due to being soft. Between the range of 60-70 mm Hg pulse pressure wall of radial artery was palpable due to being firm and between the range of 70-80 mm Hg pulse pressure it was felt like a whip cord due to being hard indicating atherosclerotic changes in it.

Table- II

Condition of Radial Arterial wall in Relation with Pulse Pressure of Blood

Pulse Pressure of Blood	Condition of Radial arterial wall
50-60 mm Hg	Soft
60-70 mm Hg	Firm
70-80 mm Hg	Hard

Firm and Hard feeling of the wall of radial artery while recording blood pressure of the individuals was due to ageing changes and not due to any cardiovascular disease. Atherosclerotic change due to ageing in human arteries was a normal physiological phenomenon as a result of rise in pulse pressure (Keshaw Kumar 1993, 1996, 2003)[9,10,11].

Elastic tissue in tunica media of ascending aorta (Table III, Fig. 1, 2 and 3)

Ageing changes were absent between the range of 50-60 mm Hg pulse pressure. Tunica media of ascending aorta was full of elastic fibres arranged in the form of concentric laminae. Elastic laminae were widely separated and remained evenly spaced. These appeared wavy quite thick and stained variably (Fig.1).

Ageing changes were towards progress between the range of 60-70 mm Hg pulse pressure. In tunica media of ascending aorta elastic laminae were less wavy and were much thicker staining less deeply and were interrupted in their course showing signs of heavy fragmentation in which elastic fibres were broken into small pieces in the entire tunica media (Fig. 2).

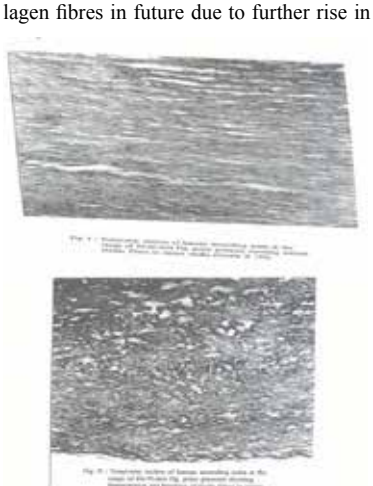
Ageing changes were towards establishment between the range of 70-80 mm Hg pulse pressure. Tunica media of ascending aorta showed atrophy of smooth muscle fibres and complete loss of elastic fibres because fragmented/broken elastic fibres were further broken into small particles and the entire tunica media was full of condensed small particles of elastic tissue (Fig. 3).

Table III

Ageing changes in tunica medial elastic fibres of ascending aorta in relation with pulse pressure of blood

Pulse Pressure of Blood	Ageing changes in tunica medial elastic fibres of ascending aorta
50-60 mm Hg	Ageing changes were absent
60-70 mm Hg	Ageing changes were towards progress
70-80 mm Hg	Ageing change were towards establishment

Ageing changes towards progress means fragmentation or breaking of elastic fibres into small pieces. Ageing changes towards establishment means conversion of small pieces of elastic fibres into small particles of elastic tissue which will convert into collagen fibres in future due to further rise in pulse pressure.



Volume : 4 | Issue : 3 | March 2015 • ISSN No 2277 - 8179

DISCUSSION

A person is as aged as aged are his arteries therefore concluding the controlled pulse pressure of blood as a secret of prolonged youth on the basis of above mentioned observations Dr. Keshaw Kumar created following laws of arterial ageing.

- Process of arterial ageing can be controlled but it can not be reversed from old age to young age.
- Arterial ageing can not occur without arterial atherosclerotic changes exact cause of which is increasing pulse pressure of blood.
- Decreased physical activity with increased mental activity results into rise in pulse pressure which can be controlled by increased physical activity with decreased mental activity.

In the individuals with decreased mental and increased physical activity the range of pulse pressure was from 42-57 mm Hg in the range of age from 50-79 years while in the individuals with decreased physical and increased mental activity the range of pulse pressure was 50-80 mm Hg in the range of age from 50-79 years proving that pulse pressure rises due to increased mental activity coupled with decreased physical activity and it can be controlled by increased physical activity coupled with decreased mental activity.

Within the range of 50-60 mm Hg pulse pressure the wall of radial artery was soft showing absence of atherosclerotic changes in it. Within the range of 60-70 mm Hg pulse pressure it was firm and at the range of 70-80 mm Hg pulse pressure it became hard indicating atherosclerotic changes in it and thus proving that increasing pulse pressure of blood is the exact cause of atherosclerosis without which ageing can not occur.

Within the range of 50-60 mm Hg pulse pressure elastic fibres in tunica media of ascending aorta were not showing ageing changes but it showed progressive ageing changes at the range of 60-70 mm Hg pulse pressure in the form of splitting of internal elastic lamina and fragmentation of elastic fibres and at the range of 70-80 mm Hg pulse pressure loss of elastic fibres and fibrosis of tunica media indicates that ageing can not occur in elastic fibres of arteries without atherosclerotic changes exact cause of which is increasing pulse pressure of blood.

After the fibrosis of tunica media elasticity of ascending aorta is lost and it can not be replaced by elastic fibres proving that ageing can be controlled but it can not be reversed from old age to young age to proceed in an opposite direction.

Hass (1943)[3], Smith et al. (1951)[8] and Ahmed (1967)[5] noted that after 4th decade elastic laminae became wavy, stained variably and showed signs of fragmentation here and there. After 6th decade the laminae were only slightly wavy in the majority of cases and even flat in a few of them. These lost most of their staining property and showed signs of high fragmentation and atrophy. In the present study the finding at the range of 60-70 mm Hg pulse pressure resemble with the findings of 4th 6th decade of above mentioned authors indicating that pulse pressure of individuals of 4th to 6th decade must be ranging between 60-70 mm Hg. Similarly finding of present study at the range of 70-80 mm Hg pulse pressure resemble with the findings of 6th to 8th decade must be ranging between 70-80mm Hg.

Foster (1909)[1] pointed out that elastic element of aorta begins to atrophy around 50th year. In present study atrophy starts above 70 mm Hg pulse pressure. It seems that individuals used for the study by Foster must be having pulse pressure above 70 mm Hg at the age of 50 years. Saxton (1942)[7] maintained that after 25th year there is graded but progressive loss of elasticity indicating that the individuals used for the study by Saxton must be having pulse pressure above 70 mm Hg after 25th year according to present study.

Gray et al (1953)[2] found that in both white and negro Americans elastic fibres of aortic media are thick undulating and closely packed from birth to 20 years of age, after which the majority of aorta became elastoid while a minority became atrophic in type. The elastoid type seemed to be more prone to calcification in old age. According to present study atrophic changes observed by Gray et al $(1953)_2$ in minority of aortae seems to be due to pulse pressure above 70 mm Hg and elastoid type of aortae seemed to be more calcification in old age due to pulse pressure above 80 mm Hg.

Ahmed (1967)[5] observed fall in the elastic fibres of tunica media in males and females after the 4th decade indicating pulse pressure of blood in the individual studied by him must be more than 60 mm Hg according to present study.

Findings of Harkness (1957)[6] and Hass (1943)[3] that wall of ascending aorta is full of concentric elastic laminae indicates that pulse pressure of the individuals studied by above workers must be between the range of 50-60 mm Hg according to present study.

Finding of Laitinen (1963)[4] regarding changes in elemental structure of aorta in human indicates that the pulse pressure of blood must have reached between the range 70-80 mm Hg during experimental atherosclerosis produced by him according to present study.

Pulse pressure of blood flowing in the lumen of an artery is directly proportional to tunica intimal density of lipid of that artery (Keshaw Kumar, 1996, 2003)[10,11]. Aging changes in the arteries are due to increasing pulse pressure of blood flowing in their lumen (Keshaw Kumar, 1993)[9]. Pulse pressure increases due to increase in mental activity, therefore, in mentally active persons the physical activity should be increased to control the increasing pulse pressure.

It is concluded that ageing changes can not occur without atherosclerotic changes in the arteries exact cause of which is increasing pulse pressure of blood which increases due to increased mental activity with decreased physical activity. Increasing pulse pressure can be controlled by increasing physical activity in mentally active persons.

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