Research Paper

"Pulse Pressure of Blood Flowing in the Lumen of Great Arterial Trunks Equals with Number of Concentric Elastic Rings Present in Transverse Sections of Their Tunica Media" –Theory of Interrelationship Between Pulse Pressure and Concentric Elastic Rings.

Medical Science

KEYWORDS : Ascending aorta, Pulmonary trunk, Pulse pressure, Elastic fibres.

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ABSTRACT

In order to create theory of interrelationship between pulse pressure and concentric elastic rings tissue of ascending aorta and pulmonary trunk was obtained immediately distal to their commencement from 300 human adults not suffering from any cardiovascular disease to be preserved in 10% formalin during autopsy. Wall thickness and lumen circumference of these arteries were measured to calculate pulse pressure of blood flowing in their lumen according to laws of arterial pulsation (Keshaw Kumar 1993, 2015)1,2. Paraffin sections of 10 micron thickness were cut to be stained with orcein and counterstained with haematoxyline and eosin.

It was observed that pulse pressure of blood flowing in the lumen of great arterial trunks equalled with number of concentric elastic rings present in transverse sections of their tunica media-Theory of interrelationship between pulse pressure and concentric elastic rings created by Dr. Keshaw Kumar.

INTRODUCTION:

Effect of ageing in tunica media elastic fibres of aorta was studied by Foster (1909)[3], Hass (1943)[4], Saxton (1942)[5] and Smith et. al (1951)[6], Gray et al (1953)[7] reported the effect of ageing in tunica media elastic fibres of aorta as well as pulmonary trunk. Ahmed (1967)[8] described the age and sex differences in tunica medial structure of human aorta. Laitinen (1963)[9] noticed the effect of experimental atherosclerosis in the elemental structure of aorta. Fischer (1971)[10] showed the effect of oestrogen on collagen and elastic dynamic in arterial wall. Keshaw Kumar (2002)[11] established the effect of tangential pressure of pulsation on tunica media of human arteries. Keshaw Kumar (2010)[12] observed elastic fibres in ascending aorta and pulmonary trunk of mammals. Keshaw Kumar (2011)[13] described interrelationship between pulse pressure and tunica medial concentric elastic rings in human great arterial trunks. Present study was conducted to create theory of interrelationship between pulse pressure and concentric elastic rings which is not available in the literature as yet.

MATERIAL AND METHODS

10mm long arterial segments of ascending aorta and pulmonary trunk were obtained immediately distal to their commencement from 300 human adults soon after their death due to accidents after knowing history from their relatives that they were not suffering from any cardiovascular disease. Arterial segments were preserved in 10% formalin. Lumen of each arterial segment was opened by cutting its wall longitudinally to measure lumen circumference and wall thickness. Mean of the wall thickness and mean of lumen circumference were calculated separately for ascending aorta and pulmonary trunk.

Paraffin sections of 10 micron thickness were cut to be stained with orcein and counterstained with haematoxyline and eosin. Each layer of arteries was graded as +, ++, +++, ++++ according to density of concentric elastic rings with + representing the minimum density and ++++ representing the maximum density of concentric elastic rings. Results were obtained as visual assessment by a single observer to record tunica medial density of elastic fibres per magnified field in each artery. Mean of total number of tunical medial concentric elastic rings counted in transverse sections of arterial segments was calculated separately for ascending aorta and pulmonary trunk. Pulse pressure, pulsatory power and volume of blood entering the lumen of ascending aorta and pulmonary trunk during each heart beat were calculated according to following laws of arterial pulsation created by Dr. Keshaw Kumar (1993, 2015) [1,2].

1. Pulsatory power of an artery is equal to pulse pressure multiplied by volume of blood entering the lumen of that artery during each heart beat.

2. Pulsatory power of an artery is directly proportional to wall (tunica media) thickness of that artery having 1mm wall thickness is reported as 2000 Joule per heart beat.

3. Arterial lumen circumference in millimeters equals with the volume of blood in milliliters entering the lumen of that artery during each heart beat.

OBSERVATIONS

Mean wall thickness of ascending aorta was 1.5 mm while in case of pulmonary trunk it was 0.5mm (Table-I). Mean lumen circumference of ascending aorta was 60mm which equalled with the mean lumen circumference of pulmonary trunk (Table-I). Mean pulse pressure in case of ascending aorta was 50mm Hg and in case of pulmonary trunk it was 17 mm Hg (Table-I and II).

Mean of total number of tunica medial concentric elastic rings in transverse sections of ascending aorta was 50 while the mean of total number of tunica medial concentric elastic rings in transverse sections of pulmonary trunk was 17 (Table-II). A ratio of 3:1 was existing between the number of tunica medial concentric elastic rings present in ascending aorta and pulmonary trunk (Table-III).

Density of concentric elastic rings in transverse sections of tunica media of ascending aorta as well as pulmonary trunk was ++++ per magnified field (fig. 1.2 and Table IV).

Table-I
Pulse pressure of blood in human great arterial trunks.

Great arterial trunk	Wall thickness	Pulsatory power	Lumen circumference	Blood volume entering lumen per heart beat.	Pulse pressure
Ascending aorta	1.5mm	1.5x2000= 3000 Joule per heart beat	60mm	60ml	3000/60= 50mm Hg.
Pulmonary trunk	0.5mm	0.5x2000= 1000 Joule per heart beat	60mm	60ml	1000/60= 17mm Hg

Table-II
Pulse pressure and tunica medial concentric elastic rings in transverse sections of great arterial trunks.

Great arterial trunks	Pulse pressure of blood	Number of concentric elastic rings in tunica media
Ascending aorta	50mm Hg	50
Pulmonary trunk	17mm Hg	17

Table-III
Ratio between pulse pressure and total number of tunica medial concentric elastic rings in transverse sections of great arterial trunks.

Pulse pressure/Elastic rings	Ascending aorta	Pulmonary trunk	Ratio
Pulse pressure	50mm Hg	17mm Hg	3:1
Number of concentric elastic rings in tunica media	50	17	3:1

Table-IV
Density of tunica medial concentric elastic rings in transverse sections of great arterial trunks.

Great arterial trunks	Density of tunica medial concentric elastic rings in transverse sections
Ascending aorta	+ + + +
Pulmonary trunk	+ + + +

Fig– 1 Transverse section of human ascending aorta showing ++++ density of concentric elastic rings in its tunica media. (Orceinx100)

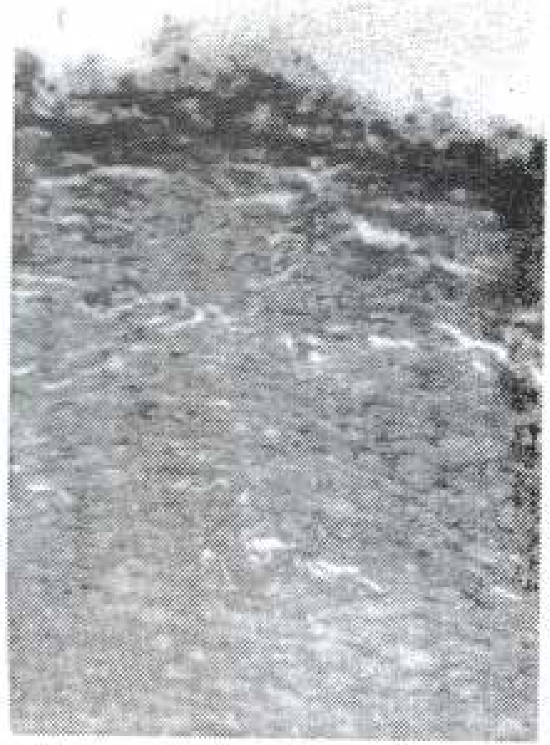

Fig – 2 : Transverse section of human pulmonary trunk showing ++++ density of concentric elastic rings in its tunica media (Orcein x100)

DISCUSSION

In case of ascending aorta wall thickness was 1.5mm, pulsatory power was 3000 Joule per heart beat, total number of concentric elastic rings in transverse section was 50 and pulse pressure of blood was 50mm Hg while in case of pulmonary trunk wall thickness was 0.5mm, pulsatory power was 1000 Joule per heart beat, total number of concentric elastic rings in transverse sections was 17 and pulse pressure of blood was 17mm Hg. In this way a ratio of 3:1 was existing between wall thickness, pulsatory power, pulse pressure of blood and total number of tunica medial concentric elastic rings of ascending aorta and pulmonary trunk. Regarding wall thickness, lumen circumference, pulsatory power and pulse pressure of ascending aorta and pulmonary trunk findings obtained in present study resemble with the finding of Keshaw Kumar (1993, 2002, 2007, 2011, 2015)[1,11,15,13,2] Pulse pressure of blood was 50mm Hg in ascending aorta which equals with the total number of tunica medial concentric elastic rings in transverse sections of ascending aorta i.e. 50. Similarly pulse pressure of blood was 17mm Hg in pulmonary trunk which equals with the total number of tunica medial concentric elastic rings in transverse section of pulmonary trunk i.e. 17. In this way ratio between pulse pressure and tunica medial concentric elastic rings in ascending aorta as well as pulmonary trunk was 1:1 which equalled with 1:1 ratio of lumen circumferences as well as volumes of blood entering the lumen of ascending aorta and pulmonary trunk during each heart beat i.e. 60ml. (Table I and II). Therefore pulse pressure of blood flowing in the lumen of great arterial trunks equals with number of concentric elastic rings present in transverse sections of their tunica media-Theory of interrelationship between pulse pressure and concentric elastic rings created by Dr. Keshaw Kumar.

Findings in the present study confirm the ascending aorta and pulmonary trunk as most elastic arteries and resemble with the finding of Foster (1909)[3], Hass (1943)[4], Saxton (1942)[5], Smith et. al. (1951)[6], Gray et. al. (1953)[7], Ahmed (1967)[8], Laitinen (1963)[9], and Fischer (1971)[10].

+ + + + density of tunica medial concentric elastic rings per magnified field observed in transverse sections of ascending aorta and pulmonary trunk in the present study resemble with the findings of Keshaw Kumar (2001, 2002, 2010, 2011)[14,11,12,13] Although density of tunica medial concentric elastic rings in transverse sections of ascending aorta and pulmonary trunk is same i.e. + + + + but total number of tunica medial concentric elastic rings in ascending aorta is thrice more than the pulmonary trunk due to thrice more wall (tunica media) thickness of ascending aorta in comparison of wall (tunica media) thickness of pulmonary trunk.

With the advancing age, pulse pressure increases due to increase in mental activity. Increase in tunica medial concentric elastic rings equals with the increase in pulse pressure to facilitate the arterial expansion during systole of heart to accommodate the extra volume of blood ejected by left and right ventricles in ascending aorta and pulmonary trunk respectively (Keshaw Kumar 2001, 2015)[11, 17]. This increase in tunica medial concentric elastic rings continues only up to the range of 50-60mm Hg pulse pressure. Fragmentation and breaking of tunica medial concentric elastic rings begins at the range of 60-70 mm Hg pulse pressure and tunica medial concentric elastic rings become converted into small particles of elastic tissue at the range of 70-80mm Hg pulse pressure (Keshaw Kumar 2005,2015) [16,18]. In case of pulmonary trunk pulse pressure of blood never reaches the range of 60-70mm Hg, therefore, question of fragmentation and breaking of tunica medial concentric elastic rings in pulmonary trunk does not arise. Normally pulmonary trunk pulse pressure remains thrice less than ascending aorta pulse pressure.

On the basis of findings observed in the present study following results are concluded as laws of interrelationship between pulse pressure and concentric elastic rings in human great arterial trunks.

1. "Pulse pressure of blood flowing in the lumen of ascending aorta and pulmonary trunk equals with the number of concentric elastic rings present in transverse sections of their tunica media"-Theory of interrelationship between pulse pressure and concentric elastic rings created by Dr. Keshaw Kumar.
2. Density of concentric elastic rings in transverse sections of ascending aorta is similar to density of concentric elastic rings in transverse sections of pulmonary trunk- "Keshaw concept of similarity in concentric elastic rings density."
3. Number of concentric elastic rings in transverse sections of ascending aorta is thrice more than the number of concentric elastic rings in transverse sections of pulmonary trunk.

REFERENCE

1. Keshaw Kumar. Pulsatory power of human arteries. Vijnana Parishad Anusandhan Patrika (1993) Vol. 36 (2): 155-120. 2. Keshaw Kumar. Laws of Arterial Pulsation. International Journal of Scientific Research (2015) Vol. 4(1) : 65-66. 3. Foster, L.L. Changes occuring in the elastic fibres of the aorta with advancing age. Journal of Medical Research (1909) Vol. 2 : 297-311. 4. Hass, G.M. Elastic tissue. Relation between the structure of the ageing aorta and the properties of the isolated aortic elastic tissue. Archives of Pathology (1943) Vol. 35 : 29-45. 5. Saxton, J.A. Elastic properties of the rabbit aorta in relation to age. Archives of Pathology (1942) Vol. 34 : 262-274. 6. Smith, C. Seitner, M.M. and Wang, H.P. Ageing changes in the tunica media of aorta. Anatomical Record (1951) Vol. 109 : 13-39. 7. Gray, S.M., Hardler, F.P. Blache, J.O., Zuckner, J. and Blumenthal, H.T. Ageing process of aorta and pulmonary artery in negro and white races. Archives of Pathology (1953) Vol. 56 : 238-253. 8. Ahmed, M.M. Age and Sex differences in the structure of tunica media of the human aorta. Acta Anatomica (1967) Vol. 66 : 45-58. 9. Laitinen, E. Changes in the elemental structure of the aorta in human and experimental atherosclerosis. Acta Pathologica Microbiologica Scandienevia (1963) 1671. 10. Fischer, G.M. Effect of oestrogen on collagen and elastin dynamic in arterial wall. Circulation (1971) Vol. 44 (Sup.11) : 21. 11. Keshaw Kumar. Effect of tangential pressure of pulsation on tunica media of human arteries. Journal of Anatomical Society of India (2002) Vol. 51 (1) : 35-38. 12. Keshaw Kumar. Elastic fibres in ascending aorta and pulmonary trunk of mammals. Journal of Anatomical Sciences. (2010) Vol. 18 (1) : 5-10. 13. Keshaw Kumar. Interrelationship between pulse pressure and tunica media concentric elastic rings in human great arterial trunks. Journal of Anatomical Sciences (2011) Vol. 19 (1) : 37-42. 14. Keshaw Kumar. Microstructure of human arteries. Journal of Anatomical Society of India (2001) Vol. 50 (2) : 127-130. 15. Keshaw Kumar. Vijnana Parishad Anusandhan Patrika (2007) Vol. 50 (4) : 307-316. 16. Keshaw Kumar. Anatomy of human arterial ageing. Indian Journal of Bioresearch (2005) Vol. 63 (2) : 125-135. 17. Keshaw Kumar. Laws of arterial elasticity or muscularity. International Journal of Scientific Research (2015) Vol. 4 (4) : 19-21. 18. Keshaw Kumar. Laws of arterial ageing International Journal of Scientific Research (2015) Vol. 4 (3) : 25-28.