ORIGINAL RESEARCH PAPER

Anatomy

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CORONARY TORTUOSITY & ITS CLINICAL SIGNIFICANCE

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ABSTRACT

Coronary arteries are the vasa vasorum of the heart. They supply oxygen rich blood to myocardium during diastole. Normally these vessels are not tortuous ,sometimes the branches of the right and left coronary arteries show tortuousity that have impact on the blood supply to the heart during exercise. The present study was done on 40 hearts that were removed during undergraduate teaching of medical students. All the branches of the coronary arteries were traced to find out the tortuous vessels. Tortuosity was observed in the branches of coronary arteries of three hearts, mostly involving the left anterior descending branch. The degree of tortuousity varied from mild to moderate depending on the curves of the vessel. Normally the tortuous vessel may not affect the coronary supply at rest but may compromise during exercise .It was common in elderly female and hypertensive individuals due to lack of elastin in the wall of the vessel. The coronary tortuousity is associated with high incidence of spontaneous coronary artery dissection. Normally tortuous coronary vessels are identified in coronary angiography and serve as a marker for arterial dissection which may lead to complications like stent loss or vessel block during angioplasty. It may be related to autosomal recessive disease where there is generalized tortuousity involving the skin and joints as arterial tortuousity syndrome.

Introduction

Coronary arteries are the vasavasorum of the heart. They supply this vital organ during diastole. Normally these vessels are straight but sometimes they show tortuosity and will compromise the flow during exercise. Coronary tortuosity (CT) is defined as ≥ 3 consecutive curves of 90 to 180 in a major epicardial artery measured at end diastole. The degree of tortuosity varies from mild to severe depending on the number and degree of curves. Severe tortuosity is defined as ≥2 consecutive curvatures of ≥180° and mild tortuosity is defined as either ≥3 consecutive curvatures of 45° to 90° in a major epicardial coronary artery or ≥3 consecutive curvatures of 90° to 180° in an artery <2 mm in diameter.(1,2)

Coronary tortuosity leads to flow alteration resulting in a reduction in coronary pressure distal to the tortuous segment of coronary artery leading to ischeamia.It is associated with reversible myocardial perfusion defects and chronic stable angina. The person with CT often suffers with exercise induced chest pain that typically disappear at rest. (3,4). Coronary tortuosity is an angiographic finding and can be seen in major branches of coronary arteries. The present study was taken to identify the tortuous branches of coronary arteries and their clinical significance.

Materials & Methods:

The study was conducted on 40 human hearts that were removed during dissections of undergraduate medical students .All the branches of coronary arteries were traced by removing the epicardial fat. The vessel that was showing two or more coils was identified as tortuous vessel and all the branches of coronary arteries were studied for tortuosity.

Observations:

Normally arteries are straight for their efficient transport .Due to remodelling they show tortuosity.(fig.1)

Fig.1 Normal & Tortuous coronary arteries

In two hearts ,Right coronary artery after its origin from ascending aorta passed in the right atrioventricular groove.It gave a ventricular branch and tortuous right marginal artery that passed along the inferior border. Left coronary artery gave a tortuous left anterior descending artery(LAD) that had a course along the anterior interventricular groove.(fig.2)

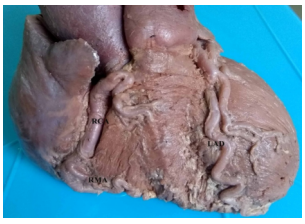

Fig.2 Tortuous Left anterior descending branch

In another specimen, The branches of coronary arteries showed tortousity.Right coronary artery after its origin formed a loop in the atrioventricular groove. At the inferior border it gave a tortuous right marginal artery(RMA) .The further course of right coronary artery(RCA) was tortuous and at the inferior border posterior interventricular artery(PIVA) took origin from RCA and it reached the posterior interventricular groove. The left anterior descending branch showed a tortuous course.

Fig.3 showing tortuous left anterior descending branch, right coronary artery and posterior interventricular artery

Discussion:

Coronary arteries deliver oxygen rich blood to myocardium. Blocked arteries will decrease blood supply and cause angina.Coronary tortuosity(CT) is one of the reason for decreased blood flow. Under resting conditions ,the influence of tortuosity on the blood flow is negligible but during exercise the blood flow will reduce notably.(5) . So individual with CT often complain of exercise induced chest pain due to insufficient perfusion pressure that disappears at rest through auto regulation effect.

Tortuosity was most often observed in left circumflex artery, followed by left anterior descending and right coronary artery. It is a common angiographic finding and described as -intravessel symmetry,multi vessel symmetry and corkscrew sign based on the pattern of coiling of the vessels.(6)

Arterial tortuosity is associated with age, atherosclerosis, hypertension &diabetes mellitus(7,8) Its incidence is higher in female, hypertensive patients(1) .Tortuosity is more common atherosclerotic arteries(9) and these patients have increase calcium levels.

Haemodynamic forces are vital modulators of vascular structure. Traction and Pressure in the lumen are two forces that tend to lengthen the vessel and it was opposed by retractive force. Retractive force was generated by elastin in the arterial wall and degeneration of elastin leads to aneurysmal dilatation.(10)

Coronary tortuosity in childhood is related to malformation of arterial wall with prolongation of vessels and it may be a cause for early death due to coronary insuffiency. Arterial tortuosity syndrome,an autosomal recessive disorder occur in babies of closely related parents.(5) Sharp bends in vessel tortuosity result in fluid separation and disruption of laminar flow ,resulting in energy loss and increased stress on the vessel wall that may weaken the vessel predisposing to spontaneous coronary artery dissection(SCAD), a leading cause of acute coronary syndrome affecting young individuals.(2) CT is associated with a high risk of recurrent SCAD and SCAD is associated with extravasculopathy including fibromuscular dysplasia. CT is a useful marker for SCAD(6)

CT in coronary angioplasty may lead to complications like vessel dissection ,stent loss and acute arterial obstruction.There may be chance of failure of thrombus aspiration during angioplasty and recanalization in chronic occlusions.(11) To treat occlusions in these tortuous segments adequate preparation and more delicate catheters are needed. (12)

Conclusion:

Tortuous coronary arteries compromise the blood flow to heart during exercise. Sharper coronary bends leads to higher the energy loss and subsequent pressure loss in the coronary arteries .This is due to decrease in elasticity of vessels that cause differences in traction and refraction forces of the vessel leading to decreased perfusion to the heart that cause angina during exercise and it disappears by rest.. It is common in hypertensive and female individuals. It is a coronary angiographic finding and may lead complications like stent loss and vessel dissection in angioplasty procedures.

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