CASE REPORT

IMPACT AND BIOMECHANICAL MECHANISMS OF TORTUOSITY OF ABDOMINAL AORTA- A CASE REPORT

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ABSTRACT

Abdominal aorta is the major arterial avenue to supply oxygenated blood to human body.Its luminal diameter,thickness and tortuosity are predisposing factors for variation of blood pressure. We report a case where there is buckling of the abdominal aorta in an elderly female.In the present cadaveric study we have analysed the possible factors that might produce such deformity. The knowledge of anatomic characteristics of abdominal aorta , and early detection by clinical symptoms and radiological diagnosis can prevent catastrophe.

Keywords: Abdominal aorta, tortuosity, aneurysm

INTRODUCTION

Abdominal aorta is the largest elastic artery to provide blood to systemic circulation. The caliber diminishes from above downwards. The cadaveric superior and inferior calibers are between 9-14mm and 8-12 mm respectively [1] .The relation between aortic size and shape is a possible causative factor in the developement of abdominal aortic aneurysm. [1,2]

We report a case where there is buckling of the abdominal aorta in an elderly female.The present study have analysed the possible factors producing such deformity. Knowledge of tortuosity of abdominal aorta with danger of aneurysm and rupture is of immense importance to clinicians and vascular surgeon.

CASE REPORT

Routine abdominal dissection of an elderly female cadaver around 65 yrs age revealed a curved course of the abdominal aorta.At the upper pole of the left kidney the aorta deviated to the left described a sinuous course, turned to the right 2cm below the lower pole of left kidney and continued below to the right side of the midline till its bifurcation into common iliac arteries.As a result,inferior vena cava was further pushed to the right.

The diameter of the abdominal aorta progressively reduced from the point of deviation as shown in the Table 1.The maximum convexity to the right was 2cm below origin of superior mesenteric artery where the wall was found to be thickest. Just before bifurcation into common iliac arteries the wall thickness was minimal.

Table 1: Dimensions of Abdominal Aorta at different levels

Site	Diameter(Cm)
Upper pole of left kidney	7
2cm below origin of SMA	**7.2***
Lower pole of left kidney	5.8
At the origin of IMA	5.5
Just before bifurcation	**5.3****

* Thickest; ** Thinnest

Right hepatic,left hepatic and right gastric arteries arose separately from the common hepatic artery.Splenic artery was found to originate from the superior mesenteric artery.Rest of the ventral branches were according to normal anatomical configuration.Among the lateral branches,left inferior phrenic was a branch of abdominal aorta ,but right inferior phrenic arose from the coeliac trunk.There were two renal arteries on the left side.Upper renal artery arose from the level of origin of superior mesenteric artery(SMA) and entered the hilum.Lower artery arose below the SMA and also entered the hilum separately.Renal artery on the right side was normal in disposition .Both the gonadal arteries were extremely slender and arose below the renal arteries. Great saphenous vein drained into the external iliac vein just below the inguinal ligament on both sides.A cystic lesion was found on the anterior surface of the right kidney.

DISCUSSION

Abdominal aorta is formed by the fusion of the two dorsal aortae in a caudo-cranial fashion.Congenital narrowing or coarctation of aorta is primarily a defect of the tunica media,followed by proliferation of the tunica intima.Most of the changes in caliber of abdominal aorta occur in later ages and are acquired.Tortuosity may be considered as a geometrical risk factor in the development of the disease.Midline straight vessels like the abdominal aorta, have a tendency to develop tortuosity with increasing age due to loss of longitudinal stiffness. The exact mechanism of development of tortuosity of a blood vessel is not very clear.Carotid artery tortuosity have been shown to be associated with high blood pressure, atherosclerosis, and other diseases.

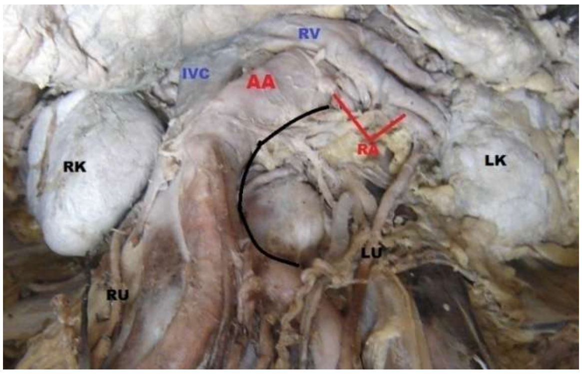

Figure 1: AA- abdominal aorta,IVC- inferior vena cava,RV- left renal vein,RK-right kidney,LK- left kidney,RU-rt ureter,LU- lt ureter,RA- lt lower renal artery,Black curved line- tortuosity of abdominal aorta

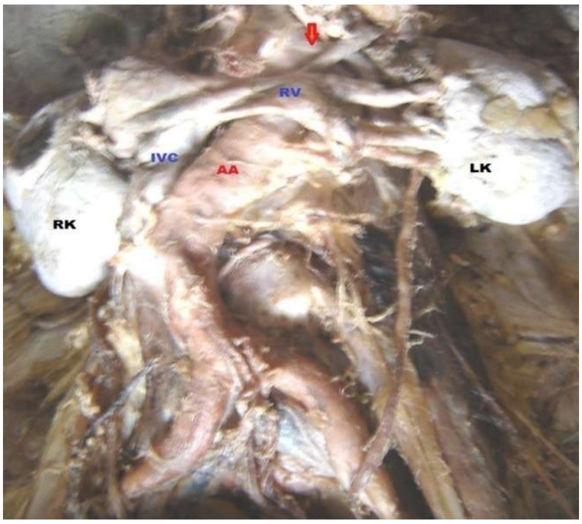

Figure 2: AA-abdominal aorta,IVC- inferior vena cava,RV- left renal vein,RK-right kidney,LK- left kidney, Red arrow – shows upper lt renal artery

Liu Q et al [3] have suggested that arterial buckling could be a possible mechanism for the initiation of tortuous shape. Experimental results showed that under pulsatile pressure arteries buckled when the peak pressures were approximately equal to the critical buckling pressures under static pressure.[3] The stability of blood vessels under the lumen blood pressure is essential to the maintenance of normal arterial function. Han HC[4] demonstrated that arteries may buckle due to high blood pressure or low axial tension and that residual stress in the arteries increases the buckling pressure. At junctions like aortic bifurcation, transmitted pressure waves may weaken the intimal lining. Difference in luminal diameters of common iliac arteries may set up turbulence in blood flow, injuring the the intima of the distal abdominal aorta.[1]

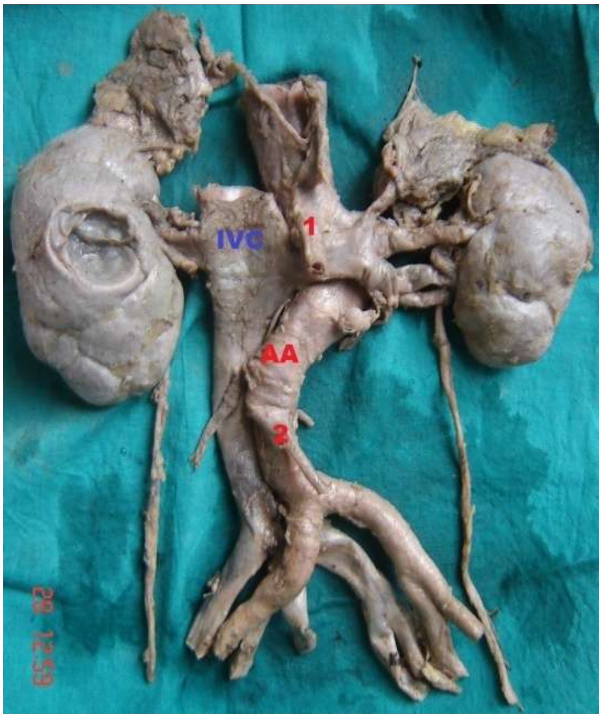

Figure 3: AA-abdominal aorta,IVC- inferior vena cava,1- superior mesenteric artery,2-inferior mesenteric artery

The haemodynamic implications of tortuosity are likely to create flow profile asymmetries as a consequence of which abnormal wall shear stress develops and prones the vessel to atherosclerosis.[5] Aortoiliac tortuosity particularly in the infrarenal region is associated with increased complexity of endovascular aneurysm repair and with predischarge endoleak and more frequent use of arterial reconstruction.[6] In a study by Fillinger MF et al[7] anatomic characteristics of ruptured abdominal aortic aneurysms were studied radiologically. Abdominal aortic diameter of 6.5 ± 2 cm with value of 5.6 cm±1 cm in the control group ($p<.0001$) was significantly associated with rupture abdominal aortic aneurysm. In the present case the tortuosity and diameter of the abdominal aorta had similar predisposing factors for rupture. Mild tortuosity may be asymptomatic,but severe tortuosity can lead to ischemic attack in distal organs.

Clinically,tortuous arteries and veins with aging are linked with atherosclerosis, hypertension, genetic defects and diabetes mellitus.[8] Vessel tortuosity causing high fluid shear stress, is a precursor of thrombosis. Thrombus was initiated at inner walls in curved regions due to platelet activation. Initiation of thrombus is hastened due to increased venule tortuosity modifying fluid flow. Compared to the same sized venule, flow in the arteriole generated a higher amount of mural thrombi and platelet activation rate. So, the extent of tortuosity is an important factor in thrombus initiation in microvessels.[9]

Arterial tortuosity syndrome (ATS) is an autosomal recessive connective tissue disorder, mainly characterized by tortuosity and elongation of the large- and medium-sized arteries with predisposition to stenoses and aneurysms. Vascular imaging revealed kinking and anomalous origin of the aortic arch branches, marked tortuosity of the aorta, pulmonary and most middle arteries, and a small aneurysm of the splenic artery.[10]

So tortuosity ,alteration in caliber of major blood vessels like abdominal aorta are essential risk factors for development of atherosclerosis,thrombus formation, rupture and other fatal complications.The knowledge of anatomic characteristics of abdominal aorta ,lumen diameter and early radiological diagnosis can prevent catastrophe.

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