

Arteriotomy for AV Fistula, Cut it Right!

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Background

Primary failure rate of an Arterio-venous Fistula (AVF) created for hemodialysis was noted to be 40% at 1 year and 49% at 2 years in a recent meta-analysis [1]. In the past, the high primary failure rate had been attributed to patient related factors based on demographics and co-morbid conditions like diabetes and atherosclerosis. However, recently the structural vascular remodeling due to the altered flow dynamics in the outflow vein of the AVF is considered to be an important factor in the early AVF failure. After creation of an AVF, the continued increase of blood flow traversing the outflow vein leads to varied levels of Wall Shear Stress (WSS) on the vessel wall. This hemodynamic stimulus and altered WSS directs biochemical signals to release vasodilating agents and growth factors affecting the balance between Vascular Smooth Muscle Cell (VSMC) proliferation and protease release which in response alters the configuration of the wall of blood vessels through neo-intimal hyperplasia [2]. WSS and neo-intimal hyperplasia share an inverse relationship in flow dynamics as demonstrated in various models [3,4]. We herein describe the impact of varying the arteriotomy angle during AVF creation on WSS and neo-intimal hyperplasia encountered on the vessel wall, thereby by affecting the primary patency of an AVF.

Technique

We digitally created an AVF model to represent the flow dynamics encountered within an AVF particularly centered on WSS. This model compares the varying magnitude of WSS when the angle of arteriotomy in relation to the long axis of artery was altered (Figure 1).

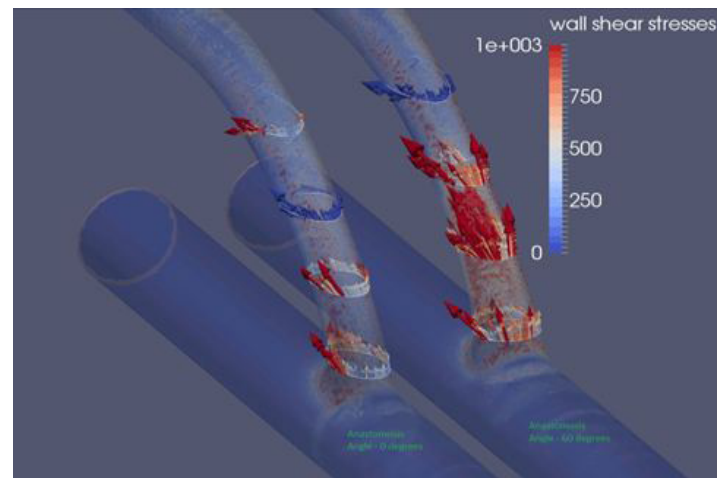


Figure 1: Comparison of WSS on AVF wall at 0° and 60°.

Results

Our computational model shows that juxta-anastomotic WSS is higher in AVF when arteriotomy is angled at 60° in the direction of lie of the AVF, than at 0° i.e. along the long axis of artery (Figure 2).

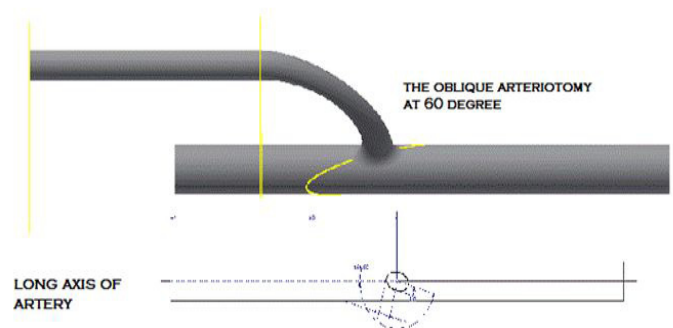


Figure 2: Arteriotomy angle in relation to the long axis of artery

Discussion

Juxta-anastomotic Stenosis (JAS) is the commonest cause of primary failure in an AVF created for dialysis access [5,6]. This is attributed to the low WSS and surgical manipulation of the mobilized vein segment in the juxta-anastomotic area [6]. Lower WSS on the vessel wall gives rise to neo-intimal hyperplasia leading to stenosis [7] in the juxta-anastomotic area of the AVF. Our model illustrates that by changing the angle of arteriotomy during AVF creation to 60 degrees as compared to being in line with the long axis of artery will lead to fewer incidences of JAS by minimizing neo-intimal hyperplasia.

Conflict of Interests: None to declare

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