Abdominal aortic aneurysm (AAA), the ongoing growth of the abdominal aorta at the abdominal level is a cardiovascular disease that affects a large part of the elderly population. Among factors affecting the AAA disease, hemodynamic forces and intraluminal thrombus (ILT) are suggested to play important roles. Despite the effort made to understand these roles, much remain to be learned. This suggests a need to better understand relationships among the three factors: hemodynamics, ILT accumulation, and AAA expansion. Specially using patient-specific information of AAA patients at different times throughout the progression of the disease. Hence, this study used 59 computer tomography (CT) scans from longitudinal studies of 14 different AAA patients to analyze the relationship between them. Various hemodynamic variables were obtained from performing computational fluid dynamics (CFD) and Lagrangian particle method on patient-specific lumen volumes of each AAA at each scan; ILT accumulation was estimated by mapping changes of ILT thickness (ΔILT) between two consecutive AAA scans, and ILT accumulation and AAA expansion rates were estimated from changes in ILT and AAA volume, respectively. Ultimately, the relationship between local values of hemodynamic parameters and ΔILT was tested on each scan of each patient using Pearson correlation coefficients. Results showed that, while low WSS was observed at regions where ILT accumulated, the rate at which ILT accumulated occurred at the same rate as the aneurysm expansion rate (Rsq=0.738; (AAA)_{exp}=p1*(ILT)_{acum}+p2; p1=0.87±0.203,p2=10440±4335). Comparison between AAAs with and without thrombus showed that aneurysm with ILT recorded lower values of WSS and higher values of AAA expansion than those without thrombus. In fact, correlation analysis showed that among all local hemodynamic parameter tested, WSS showed to be inversely correlated to ΔILT in approximately half of the scans from all AAA tested (52.5% of n number of scans; n=40). Vortical structures were also studied in all AAAs (with and without ILT). Results from this analysis showed that in aneurysms that developed thick ILTs, vortices consistently dissipated near zones of positive ΔILT during the diastolic phase. In these AAAs, level of activation of platelets exposed to these vortices were estimated and results showed that none of the highest activation level recorded in any AAAs tested reached or exceeded the proposed activation threshold.
These finding suggest that while vortical structures might be important in convecting and concentrating platelets and other main coagulation species (e.g. Thrombin) on regions where positive $\Delta$ILT is observed, these vortices might not be responsible of activating platelets. Findings also suggest, that regardless of the platelet activation pathway, low values of WSS might be promoting the formation of thrombus and submits the idea that by increasing WSS levels ILT accumulation may be prevented.

*Persons with disabilities please contact the Mechanical Engineering office at [517-355-5131](tel:517-355-5131) to request accommodations.*