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Finite Element Modeling of Aortic Intramural Haematoma Shows Size Matters

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Abstract : Objectives: Intramural haematoma (IMH) is one of the pathologies, along with acute aortic dissection, that present as Acute Aortic Syndrome (AAS). Evidence suggests that unlike aortic dissection, some intramural haematomas may regress with medical management. However, intramural haematomas have been traditionally managed like acute aortic dissections. Given that some of these pathologies may regress with conservative management, it would be useful to be able to identify which of these may not need high risk emergency intervention. A computational aortic model was used in this study to try and identify intramural haematomas with risk of progression to aortic dissection. Methods: We created a computational model of the aorta with luminal blood flow. Reports in the literature have identified 11 mm as the radial clot thickness that is associated with heightened risk of progression of intramural haematoma. Accordingly, haematomas of varying sizes were implanted in the modeled aortic wall to test this hypothesis. The model was exposed to physiological blood flows and the stresses and strains in each layer of the aortic wall were recorded. Results: Size and shape of clot were seen to affect the magnitude of aortic stresses. The greatest stresses and strains were recorded in the intima of the model. When the haematoma exceeded 10 mm in all dimensions, the stress on the intima reached breaking point. Conclusion: Intramural clot size appears to be a contributory factor affecting aortic wall stress. Our computer simulation corroborates clinical evidence in the literature proposing that IMH diameter greater than 11 mm may be predictive of progression. This preliminary report suggests finite element modelling of the aortic wall may be a useful process by which to examine putative variables important in predicting progression or regression of intramural haematoma.

Keywords : intramural haematoma, acute aortic syndrome, finite element analysis,
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