



## Book Review

**Handbook of vascular motion**, 1<sup>st</sup> ed. C. P. Cheng, editor. (Academic Press, London, UK) 2019. 410 pages. Price: Not mentioned.

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Endovascular therapy to treat vascular diseases has evolved as the preferred and primary modality with the advent of stents and stent grafts over the last two decades. Although much less stressful, implantable devices mandate close, often burdensome surveillance in view of device fatigue, endoleaks and several sequelae thereof. Recent studies have shown vascular motion as the pivotal underlying mechanism and in this context this book has brought in newer thoughts and refinements regarding the failure mode of vascular devices well and is the first of its kind in literature on vascular sciences.

This handbook opens with an interesting question pertaining to whether blood vessels move at all. In meeting in the USA in the year 2000 wherein the answer to this question was in negative, that changed to an emphatic yes two years down the line. Mechanical failure was found in femoral artery stents in large numbers by 2002. Several factors were identified as mentioned in the chapters on topics such as cardiac pulsatility, respiratory deformations and musculoskeletal causes contributing to vascular motion thereby material fatigue for alloy rinsed in blood. Another critical impact on material fatigue is the shape memory and superelasticity, both of which contribute to stent fracture of superficial femoral and coronary arteries in particular.

Medical imaging techniques are described in detail from basic ultrasonogram and duplex scan. These evaluations help delineate functional assessment and are possible for peripheral vasculature and abdomen. However, for confirming the findings, the most valuable imaging technique is contrast-enhanced computed

tomography angiography which is widely used for diagnosis, therapy as well as surveillance.

The chapter dealing with Supra-aortic trunk describes cardiac pulsatility, high volume of blood passing through and more importantly musculoskeletal impact of the movement of the neck causing axial deformation while turning contralateral to stented carotid.

Chapter 8 concerns the important domain of the thoracic aorta and aortic arch zone, in particular, wherein cardiac pulsatility, respiratory mechanics and factors influencing structural and functional vascular system add to exponential challenge in management. Those factors apart, supra-aortic branch vessel geometry, curved aortic arch that forms a proximal landing zone and sudden turn of the arch into upper descending aorta like a golf ball into pit provide a recipe for complications of migration of stent graft with attendant retrograde dissection or type I endoleak following arch repair/thoracic endovascular aortic repair.

Abdominal aortic aneurysm management often involves viscerorenal preservation in the short neck, juxta/pararenal type and type IV thoraco-abdominal aortic aneurysms. Although haemodynamic impact is less as compared to thoracic aneurysm, two factors of cross-sectional pulsatile deformation and aortic cross-sectional lumen area indicated graft migration in studies. However, volumetric assessment is considered an accurate and sensitive yardstick for surveillance.

Complex EVAR requires one or more viscerorenal arteries, and altered compliance of a stented artery comes into play in vascular motion along with the main body device. In such a case, respiratory changes have more pronounced effect on vascular motion. Follow up studies will be able to provide data on the failure mechanism of the device.

Chapter 14 depicts the device design and computation on the product development process starting from a clinical question, thoughtful discussion on appropriate product, its design and development, laboratory tests and prototype making. The author has given a vivid description of polymers and alloys needed stressing on the qualities of shape memory and superelasticity. This initial activity is a collective interaction of doctors, engineers and scientists. Thereafter, proof of the pudding is the all-important human implantation which along with follow up studies decides the fate of stent/stent graft. Needless to add that this chapter provides insight from the idea to realization of the implantable device in a nutshell.

Chapter 15 deals with material fatigue and durability of cardiac and vascular implants. While cardiac implants are tested in accelerated wear tester at rates of 700/m to obtain the equivalent of strain in one or two years instead of 70/m of normal heartbeat, such fast-forwarding laboratory testing is, however, not available for the vascular device. The quality of nitinol which scores over steel and alloys is that it has the highest strain recovery, hence adjudged most suitable for vascular devices.

In Chapter 16, the author, an astute surgeon-scientist brings in corrosive effect for the metallic failure of vascular device bathed in blood all the way. He has further detailed about the clinical impact of stent fracture in coronary and lower limb arteries and aortic stent grafts. Despite attempts, newer endografts are also fraught with device fatigue, so the quest for its abolition is a challenge ahead.

The chapter on 'The Product Development Process' underlines the need to make a thorough study of vascular anatomy and identify mistakes early since facing and mending faults and mistakes could be costly, painful and a waste of precious time. The author further cites examples of such late identifications leading to abandoning projects.

The last chapter, 'Conclusion and Future Directions', comes full circle about dynamic blood vessels, vascular deformation and causes thereof. The author has brought in new, hitherto unheralded, information on vascular motion, deformation and its implication on implanted vascular device durability. Furthermore, stent failure mode is well elucidated, particularly in the neck and lower limb artery wherein movement, walking and repeated muscular actions contributed immensely. Further, he has made suggestions in medical imaging, design and manufacturing strategies as well.

In conclusion, this Handbook is the first of its kind in vascular literature addressing the all-important failure mode of stent/stent graft that is pivotal in vascular surgeon's armamentarium. This is an important contribution in the state-of-the-art endovascular therapeutic modality.

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