

## Preface

The sober explanation for this book is a call by the Springer-Verlag, London, to edit a publication on 'The functional relevance of the collateral circulation' of the heart. Alternatively, it could be 'sold' as the result of my intention to reduce entropy of 18 years of scientific work on the topic of the coronary circulation, which was itself meant to diminish the amount of 'useless' energy. Such a process of reducing disarray in a system with the aim of grasping it better is related to simplification, which carries the risk of introducing error. This can be exemplified by the historic view of angina pectoris, which used to be simplified as being always fatal, thus obscuring for nearly two centuries the view of a 'self-healing' mechanism such as the collateral circulation of the heart. It would be naïve, to assume the present work to be free of erroneous oversimplification, because the very nature of scientific work is related to generating (simple) hypotheses with their subsequent falsification.

In that context and bluntly, my primary interest in the field of the collateral circulation was not initiated with a vision of eradicating the consequences of coronary artery disease (CAD) by promoting the growth of natural bypasses. The time for such sizeable ideas had passed in the 1970s with the start of the work by Wolfgang Schaper. My interest in the area related to maps, geometry charting landscape as a former cartographer and the linked process of minimizing error in doing so. At first sight, landscape is not organized and charting it realistically requires techniques of projecting it on a flat plane, while preserving distances, angles, object size relations. Apparently, biology in the sense of mathematical science is poorly organized. However, patterns of organization can be recognized, and this is even the case in ostensibly chaotic systems. In hindsight, my genuine interest in the field evolved from describing biological patterns with exact means, always including the calculation of the error made during mathematical modelling. Accordingly, one of my favourite occupation used to consist of modelling the coronary artery circulation, the model being a minimal cost function of energy expenditure for the transport of blood, whereby large 'tubes' dissipate little frictional energy but their construction and maintenance is costly because large, and vice versa. The 'maps' of coronary angiograms were crucial for delineating the local territory of 'irrigation', i.e. the so called ischaemic area at risk for infarction. The

oversimplification and, thus, error of the system consisted of demarcating different coronary regions, disregarding the possibility of links between them and the assumption that there are no intercoronary anastomoses.

The step between acknowledging inter-coronary anastomoses, links, natural bypasses, collaterals in the human coronary circulation and the structure of this book is small. The following questions, i.e. principle book chapters, arise instantaneously: are they relevant in the sense of life-saving for patients with CAD (Chapter 1); how can they be gauged (Chapter 2); how often are they present and how are they promoted *naturally* (Chapter 3); if present, how do they function physically (Chapter 4), and can they be promoted *artificially* (Chapter 5)? The epigrammatic answers to some of the above questions according to the actual state of (mis)calculation are: yes, they are relevant in every third patient with CAD and in every fourth without CAD; they can be measured invasively; they are able to dilate and constrict and do not function as rigid tubes; and yes, they can be promoted artificially. The demarcation between the main chapters is not absolute, i.e. there are ‘anastomoses’ among them for the purpose of allowing to read single chapters, and of reflecting the reality of multiple associations between the sub-topics. The potential ‘error’ of using the design of ‘permeable’ book chapters is the risk of redundancy, which on one hand, is an essential element of didactics. Conversely, it is anaesthetizing when applied in an overdose. Single- as compared to multi-authorship should reduce rather than amplify the risk of redundancy.

That human coronary collateral vessels are relevant *quo ad vitam* and that they are inducible artificially renders the subject of *collaterology*, which is aimed to be covered by this book, important from a medical standpoint of view. This is even more so considering the epidemiologic and economic burden of CAD and the fact that every sixth to fifth patient suffering from CAD cannot be treated sufficiently by conventional means. *Arteriogenesis*, the promotion of collateral artery growth employed in collaterology is on its way to be a treatment pillar of CAD, but the path is not as straightforward as thought before the first controlled clinical angiogenesis trials. With its winding pattern, it resembles the corkscrew shape of collateral vessels. This hallmark of vascular enlargement is caused by the fact that growth of the vessel is not restricted to one direction (cross-sectional calibre), but is ubiquitous, i.e. also lengthwise. In the absence of cardiac enlargement, an increase in vessel length translates into a meandering route. The latter evokes, again, the way of how scientific work advances with a generated hypothesis pointing into one direction, its (often occurring) falsification, which leads to a temporary retreat, meaning a change of the motion vector.

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