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D. Berdajs · M.I. Turina

**Operative Anatomy of the Heart**

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# Operative Anatomy of the Heart

With 948 Figures in 1070 Parts

*Illustrations by Gudrun and Adrian Cornford*

 Springer

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# Foreword

Prior to surgical procedures, the importance of the anatomy is often underestimated, and this despite the fact, that precise anatomical preparation during surgery is usually the safest route towards a successful outcome. There are a number of reasons that can explain the superiority of anatomical preparation in surgery. First of all, anatomical preparation per definition respects the grown structures in specific spaces with determined borders, thus permitting the definition of specific landmarks, more noble structures, and dependant territories. Respecting these known anatomical boundaries allows to avoid unnecessary tissue damage during and/or after the procedure and thus, impacts directly short and long term outcome.

Nowadays it is a routine to check prior to a surgical procedure, whether the anatomy of a specific location or a patient respectively is normal, or if there are anomalies, and/or pathological structures. However, in order to assess the anatomy in a specific case, one has to know what the most frequent anatomical landscape looks like, and whether, effectively in a given situation the anatomy is standard or different. For a better understanding of the issues raised here, we like the wording “functional anatomy”, a term reminding us, that for most anatomical structures there is a reason to be there, to construct there, to connect there, to resist there, to move there, to pass there, and so forth...

As a matter of fact numerous anatomists not only tried to identify specific bodily structures, but even more so worked on their interconnection in order to understand their function. Many of these efforts were made not that a long time ago by Andreas Vesalius (1514–1564) and his successors. Interestingly enough, it was very difficult in those days to have access to cadavers for dissection, which may explain why mainly the bodies of executed criminals were used in those days.

Already Vesalius had already described that the human heart had four chambers and that the blood vessels originated in the heart and not the liver. Of prime importance for cardio-vascular surgery was however the discovery of the circulation by William Harvey (1578–1657), and the proof of the capillary connection between the right heart and the left heart by Marcello Malpighi (1628–1694), a discovery only possible by a microscope as described by Antonie van Leeuwenhoek (1632–1723).

Not all anatomists received for their discoveries the recognition they deserved. As a matter of fact, Michael Servetus (1509–1553) who was probably the first to describe the pulmonary circulation was burned for heresy together with his works in Geneva in 1553, and the later confirmation of his anatomical findings by Realdo Colombo (1516–1559) and Andrea Cesalpina (1519–1603) was not exactly helpful for him.

Another interesting observation can be made on the quite recent attempts to protect the brain during circulatory arrest by retrograde superior vena caval perfusion, which gave and still gives matter for endless controversies about its usefulness. Many of these discussions might have been shortened by a thorough analysis of the literature, because it appears, that already in the 16<sup>th</sup> century Hieronymus Fabricio ab Aquapendente described in his book "De Venarum Ostioliis" published in 1603, a valve at the origin of the jugular vein (Tabula prima: A), a fact which indeed does not allow to perfuse the brain in retrograde fashion through the veins. It has been confirmed more than 400 years later, that the human species has not evolved in this respect, that the valves in the venous system draining the blood from the head towards the heart are still there, and that therefore retrograde cerebral perfusion remains an unreliable thing with, unfortunately, unpredictable outcome!

Of course, there are other examples for "new" therapeutic proposals, which are often not so new, not so useful, and often also not so true. Most such proposals are not really helpful as already suggested by Socrates (469 BC – 399 BC).

With the "Operative Anatomy of the Heart" Denis Berdajs and Marko I. Turina have realized a detailed documentation with splendid illustrations of the anatomy of the heart which can be recommended to anybody interested in the heart and its structures. Furthermore the surgeons should look-up "Operative Anatomy of the Heart" before they find themselves in the unfriendly waters of the unknown during surgery.

"Operative Anatomy of the Heart" is a reference for all procedures within and around the heart. "Operative anatomy of the Heart" not only provides minute details about what is where for the heart and its interiors, but also demonstrates how to get there...

Lausanne, May 8, 2010

*Ludwig K. von Segesser*

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# Preface

*Only those who dare to fail greatly can ever achieve greatly*  
Robert Kennedy 1925–1968

Books and articles on techniques in cardiac surgery date back to 1952, when the first successful closure of an atrial septal defect was performed. In all surgical disciplines, but particularly in cardiac surgery, success is greatly dependent upon the use of appropriate operative techniques. In one of the first textbooks on operative surgery, Kirschner remarked that a good operative technique requires a detailed knowledge of the underlying morphology. This rule has gained further importance since the introduction of minimally invasive techniques, which have highlighted the necessity of a perfect knowledge of the underlying cardiac and thoracic morphology.

A precise knowledge of the anatomy of not only the valvular structures, but also the coronary vessels and the conducting system has become essential for procedures involving the mitral or tricuspid valves. Similarly, new reconstructive procedures relating to the aortic and pulmonary root require not only detailed knowledge of the macroscopic anatomy, but also a thorough understanding of the spatial relationships between these complex physiological and morphological units.

The first chapter of this book describes the detailed topographical anatomy of the human thorax. The morphological regions are illustrated using preserved human specimens, which were dissected from skin level to the bony skeleton of the thorax. The most important regions are presented from the ventral and dorsal aspects. The second chapter discusses the approaches used in standard cardiac surgery, including a detailed step-by-step presentation of the standard sternotomy and right anterolateral thoracotomy. Special attention is devoted to minimally invasive approaches to the heart, such as limited sternotomies and thoracotomies, as well as the transdiaphragmatic approach to the inferior aspect of the heart. Furthermore, other approaches to the thoracic aorta, such as posterolateral thoracotomy and thoracoabdominal incision, are visualized.

The chapter on coronary surgery (Chap. 3) emphasizes the arterial coronary conduits. Normal coronary morphology and their anatomical variants, as well as surgical approaches are described. This chapter is divided into two major parts, the first dealing with the general anatomy of the coronary vasculature, from descriptions of their orifices to an analysis of arterial dominance. The second part is devoted to a description of the venous drainage of the heart and to the surgical exposure of target coronary vessels

Chapter 4 describes the heart valves. As in previous chapters, the general morphology and their variations are detailed together with the topography and histology, and a description of related structures. This is followed by the surgical section, wherein the valves are exposed and shown from the view-

point of the surgeon. The remaining chapters deal with the morphology of the interventricular septum, with special attention paid to the variations in its blood supply, the heart conduction system, and exposure of the thoracic and abdominal aorta.

We have chosen photographs that depict the structures as they appear to the surgeon in the operating theater. In order to clarify surgical procedures and anatomical structures, some photographs have been supplemented with drawings to provide better orientation.

We trust this new book will be of interest not only to the cardiac surgeon, but also to the cardiologist, surgical pathologist, and anesthesiologist, all of whom should profit from the detailed descriptions of the cardiac structures provided in this work.

*Denis Berdajs*

*Marko I. Turina*

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All dry dissected material presented herein was prepared in the Laboratory of Applied and Clinical Anatomy, Department of Anatomy, Histology and Embryology, Semmelweis University, Budapest during my student years under the supervision of Dr. Patonay Lajos. As the charismatic leader of the laboratory, Dr. Lajos supported me with his extraordinary knowledge and experience in the clinical aspects of human heart anatomy. Much gratitude is also extended to Prof. Réthelyi Miklós, alumnus chairman of Department of Anatomy, Histology and Embryology. We owe a particular debt to our co-workers in the Laboratory of Applied and Clinical Anatomy, Dr. Baksa Gábor, Kiss János, Dr. Benis Szabolcs, Dr. Bodon Gergely, Dr. Tóth Miklos and Dr. Nagy Krisztián for their assistance with the preparation and photography of the dissected specimens presented in this book. The histological specimens and their preparation were successful due to the extensive experience and accurate work of Horváth Péterfi Terzia. Adrian Cornford and Gudrun Cornford prepared the colored drawings and we thank them sincerely for their invaluable contribution.

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