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Introductory Chapter: Tour De Force of Transplantation Science

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1. Overview

As one of the relatively young, yet already well-established medical disciplines, transplantation medicine encompasses a wide variety of clinical subspecialties. The concept of failing organ replacement with the donor's or an artificial one has found its way into literally every clinical field, where one or multiple organ insufficiency and eventual failure are concerned. Ever-increasing number of the patients on the waiting lists, rapidly growing demand for donor organs, already well-proved efficiency of organ transplantation as an ultimate treatment for end-stage organs' failure, and ever-expanding infrastructure of transplantation industry are factors promoting the explosive growth of the transplantation industry. The foundation of this industry rests on two pillars: transplantation medicine and transplantation science, with substantial overlapping and blurred boundaries. The sheer immensity of transplantation industry may be best illustrated by very impressive statistics and facts, accomplishments, and ongoing research trends [1–5].

At present, organ and tissue transplantation procedures of any kind are being performed in more than 111 countries, which cover about 81% of world population, and new countries are joining this club every year. Close to 140,000 organs are being transplanted every year worldwide. According to most recently published OPTN data (May 22, 2019), in the USA alone during the period of 31 years (from January 11, 1988 to April 30, 2019), close to half million (451,847, to be precise) kidney, 166,383 liver, 73,216 heart, 38,989 lung, 23,959 kidney-pancreas, and numerous other organ transplantations have been performed in more than 80 transplant programs, and the exponential increase of these numbers constitutes the current trend.

Fifteen international and more than 140 local/countrywide organizations in more than 111 countries are incessantly doing a great job in coordinating efforts in the areas of research promotion, development, and improvement of practical aspects of organ donation and transplantation process. Dozens of scientific meetings in many countries worldwide provide stage for scientists and physicians to present results of research, share experience, and exchange opinions.

Ever since the very first successful solid organ transplants (1954, first successful kidney transplant; 1967, first successful liver and heart transplants), transplantation science remains in the state of rapid exponential growth. Physicians and researchers from literally every imaginable specialty are getting more and more involved in transplantation medicine, which long ago overgrew the boundaries of one particular medical specialty and became a whole new field of medical science. Results of clinical and experimental research provide a plenty of material for myriad publications worldwide every year. There are easily more than 75 periodic issues, among which are more than 40 high-impact journals, publishing results

of countless research works from all over the world. PubMed search alone returns about 800,000 titles of the indexed publications, pertinent to the field of transplantation, which covers approximately 70% of the total published works on the transplantation-related topics worldwide. There are also numerous books, book chapters, and other publications on these topics, that find their readers every year. Ongoing research is funded by tens of millions dollars and euros; these funds are coming from various government organizations and private investors, surpassed probably only by cancer and heart research funding.

And yet, among countless publications, covering most areas in this particular field, such a specific segment of key importance as perioperative care for the organ recipient remains underrepresented, and many topics of it still uncovered. The resulting lack of big, prospective studies, along with relative scarcity of conceptual level review articles, has prompted us to choose the main topic of this book, with the true intention to fill in the gap by collecting and presenting the articles dedicated to at least some of the under-covered problems.

2. Components of perioperative care

Perioperative care for organ transplant candidate/recipient is an exceedingly complex and multifaceted enterprise. It comprises three main components.

A. Preoperative care begins from selection of the proper candidate. In today's realm of organ transplantation, the current trend of performing combined, more complicated organ transplants on ever-increasing number of sick patients with severe cardiopulmonary, renal, endocrine co-morbidities, once considered as posing insurmountably high risk, prohibitive for surgery, is quickly becoming an everyday reality. At this stage, a person's medical and surgical history and current disease status, treatment progress, success or lack thereof, and compliance with numerous medication regimes are being reviewed. The critical portion of the selection includes a great deal of current functional status assessment, ability to tolerate multiple challenges of organ transplant surgery and postoperative period, and, most importantly, prediction of outcome, immediate and long-term. There are numerous prediction algorithms and systems, such as MELD score for liver transplant candidates, for example. The degree of functional impairment (after all, majority of patients suffer from end-stage organ failure, sometimes severe multi-organ insufficiency) is a matter of continuous re-assessment and optimization, whenever appropriate and feasible, in preparation to actual organ transplantation surgery. Numerous diagnostic studies, some of which invasive, are employed at this stage to pinpoint the problem and track the treatment progress.

This stage also includes an assessment of patient's mental status, habits, lifestyle, social and financial aspects, geographical factors, housing and transportation particulars, availability of family support in the posttransplant period, coping skills and intellectual capacity, illicit drug use and alcohol consumption, and many other pieces of the information, necessary to make an initial selection, and keep the candidacy active.

The organ transplant surgery is a culmination of the transplantation process, the central and most important part of the whole enterprise. The very possibility of the surgery is contingent on availability, oftentimes immediate, and proper quality of the donor organ. Current policies and practices of organ donation and sharing,

procurement and conservation techniques comprise a huge field of scientific and practical knowledge, and their discussion is beyond the scope of this book.

- B.** Intraoperative care for organ transplant recipient, even in the relatively straightforward cases, is by far one of the most challenging tasks the anesthesiologist ever encounters in his/her practice. The spectrum of problems and challenges include choice of particular anesthesia technique (that depends on organ failure involved and other patient-related factors), significant, sometimes life-threatening hemodynamic disturbances and acid-base/electrolytes disbalance, major ongoing blood loss, massive blood products administration, coagulation deficit correction, necessity of temporary organ replacement techniques (such as intraoperative dialysis), use of case- and organ-specific technologies and modalities, such as use of vasoactive agents for hemodynamic optimization, TEE, ECMO, total circulatory arrest, and plenty more. Some of the most challenging aspects of anesthesia care for transplant recipient include unpredictability of the timing (it is literally 24/7, no exclusions) and length of procedures, and, with ever-growing body of practical experience, incidence of unanticipated, rare complications, such as stress cardiomyopathy or intraoperative myocardial infarction. For all these reasons, and more, transplant anesthesiology has been established as one of the major independent subspecialties in the field of anesthesiology.

Immediate postoperative care is an inseparable part of this stage. The challenges here, albeit quite similar to those encountered in the operating room, are different in many ways (time resolution, for one). The reasons of major morbidity and mortality of freshly transplanted patient include variety of cardiovascular complications; primary transplanted organ dis- and non-function; super-acute rejection; and numerous surgery-specific complications, such as hemorrhage, vascular thrombosis, dehiscence, bronchial anastomosis leaks, biliary leaks, wound infections/septic state, and also plenty of seemingly trivial, matter-of-everyday-practice problems, such as hemodynamic instability, blood glucose fluctuations, acid-base disturbances, ventilator-associated problems, pulmonary complications (pulmonary edema, ARDS, pneumonias, atelectasis), and early cognitive dysfunctions—all of which require immediate and apt attention and incessant efforts directed on correction, as soon and as complete as possible.

- C.** Later, posttransplant care encompasses the time period from recipient's discharge from critical care unit until discharge from the hospital. The time frame for this stage varies (the range is from days to months), due to transplanted organ-, surgery-, related specifics, early complications and other medical conditions. At this stage, clinicians face quite different and very specific set of challenges, which includes choice and maintenance of immunosuppressive therapy; early, late, sub-acute, and chronic rejections; late organ dysfunctions; transition from pretransplant organ-specific hemodynamic profile to normalized one; wide variety of infectious complications (opportunistic bacterial, viral, and fungal infections); exacerbations of chronic diseases; early malignancies; PTSD and other mental, mood, and memory problems, and more. Albeit already not as acute and severe as major immediate perioperative problems, these conditions nevertheless remain as important and, oftentimes, as deadly, and certainly bear an enormous weight on the short- and long-term patient and organ survival and well-being.

Deep understanding and detailed knowledge of these components, their mutual influences, connections, and interactions are necessary conditions for any further progress in this particular field, both in scientific and practical aspects.

3. The book's concept and purpose

The presented book is addressed to physicians and researchers, working in the ever-expanding research and practice fields of transplantation medicine.

This book's purpose is to present the transplantation community with the collection of works performed and articles written by prominent experts in the variety of transplant-related fields, encompassing most recent scientific and practical developments and accomplishments in the highly specialized segment of transplantation medicine, such as perioperative care for organ transplant candidate and recipient.

While considering the inclusion of broad, well-researched, albeit constantly discussed, topics, such as candidacy/selection criteria, indications for transplant, hemodynamic management, coagulopathy, renal failure, diabetes in transplant recipient and more, as undoubtedly beneficial, it should be stressed though, that the very intent of this book is rather to focus on problems and issues, encountered while providing intra-(anesthesia) and postoperative critical care for patients, undergoing single and combined organ transplant surgery.

Considering and actually making a perioperative care specifically for organ transplant recipient a conceptual base for the selection of scientific, research- and practical-oriented articles is not an easy task. The amount of mutually influencing factors; interactions; and seemingly far-fetched, but, after close examination, very relevant pieces make such a selection work quite arduous, taking into account the sheer volume of already published excellent works in the field of transplantation science. It is our hope, however, that the collection of outstanding articles, containing most updated, pertinent, and highly relevant information, presented in this book, will help explore new horizons of knowledge, inspire new ideas for research projects, and promote practical improvements and developments.

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