



Perioperative management of patients with undergoing mechanical circulatory support

Despite the romantic notions attached to it, the heart is a muscular pump. —S.A.M. Nashef (1).

Heart failure is a major burden of the modern 2020 society. It is estimated at 26 million sufferers in the world (2). This compared with the 5 million COVID-19 registered cases by 22 May 2020 (3) puts into perspective the magnitude of the problem. It appears to be a problem of the modern wealthy society. Our population is ageing, and multiple comorbidities are no longer fatal. Thus, inadequate heart function is no longer a fast killer, it is rather a disease one lives with. Fortunately, this great burden dictates the need for novel treatments thus advancing medical knowledge and options. Since the advent of successful heart transplantation (4) it has become the most effective way of treating heart failure. However, the constant demand/supply problem has driven the pragmatic medics into a direction of mechanical circulatory support. Patients who need an assessment if their body is fit enough to sustain the major trauma of heart transplantation and the ensuing immunosuppression or are unable to find immediately available organs can be bridged to decision making or treatment via mechanical pump support. The rise of the machines was the motto of the first decade of the 21 century (5). Some would even suggest that the body does not need a heart at all and the concept of the artificial heart (6) took off. There were more than 3,000 total artificial heart implantations by 2019. Nevertheless the left ventricular assist devices remained the main stream of support.

With the excellent survival of patients who are supported by short term mechanical circulatory support and survival of long-term device implanted patients to transplant over the years the medical profession turned their eyes towards another parameter: morbidity. We know the survival is good (7), now can we reduce the complications? Indeed, how can the medical profession sell our art to the patients, their families and the society that these traumatic and expensive treatments are valuable? Maybe offering a high survival rate with lower complication rate is a convincing argument. The second decade of the 21 century seemed to be the era of the evolutionary rather than revolutionary development of mechanical circulatory support: excellence in perioperative care for these patients. Now medics can offer very advanced support for heart failure patients at lower complication risk. Based on wealth of evidence and guidance from bodies like ISHLT we can prepare a generation of physicians who are geared with expertise to manage these highly complex patients pre-operatively, intra-operatively, and post-operatively for best outcomes.

In this series of *Annals of Translational Medicine* we offer balanced review approach for the reader on what is the state-of-the-art perioperative management of patients needing and receiving circulatory support.

The review by Bowden *et al.* on statistics of heart failure and mechanical circulatory support in 2020 highlights the global picture of heart failure in the world. It highlights the problem that despite the gradual increase in transplantation there is still a deficit of donor organs. In addition, the article presents estimates of the colossal global cost of heart failure treatment. The current data clearly indicates that mechanical support has “overshadowed” the medical management of heart failure.

Many of the crucial decisions about management of patients with acute heart failure or chronic decompensated heart failure are done when they are admitted in the intensive care unit (ICU). The review of the management of the patients with advanced heart failure in the ICU explains the stabilisation, pre-optimisation and general principles of management of mechanically supported patients. It offers the current statistics of mortality and evidence to support the decision making. This eludes to the complexity and advanced knowledge and expertise required by members of multidisciplinary team to offer optimal management. While heart failure is a disease with pivotal malfunction of one organ and its pump function, it is a multisystem disorder, and all systems need to be managed effectively at the same time.

In many patients the use of mechanical circulatory support starts with short-term devices (intra-aortic balloon pump, Impella, extracorporeal membrane oxygenation, TandemHeart) during a period of acute cardiogenic shock or acute decompensation of a chronic heart failure. The article by Wong and Sin discusses these options with the pros and cons for different devices as well as provides a suggested guide for decision making and device choice. The article offers a valuable discussion in the options for mechanical support of the failed right ventricle. While over the decades the mechanical options for right ventricular support have been more problematic the article discusses the new technology available with its potential

benefits.

This article is logically followed by the review of perioperative management of patients with undergoing durable mechanical circulatory support. This technology has indeed revolutionised the treatment options for end-stage heart failure patients. The engineering involved has evolved beyond recognition and the machines are safe with very low complication rates. This review provides an overview of the perioperative management for these devices. As the support devices are predominantly for the left heart the information about predicting right ventricular failure and the management of right ventricular performance post-operatively is very valuable too.

Predictably post-operative infections are a major problem for patients needing mechanical circulatory support. The infection surveillance and prophylaxis, as well as antibiotic treatment are discussed in breadth in the paper by Tan and Zeng in this series. The specific to this technology infections, drive line and pocket site, and their management are presented. Guidance from the ISHLT according to the data available from the database has also been presented. Additionally, the blood stream infections which are problematic for ECMO patients are discussed in detail. Importantly the review presents some data on antibiotic pharmacokinetics of antibiotics during use of extracorporeal circuits.

Post-operative bleeding is a particular problem with mechanical circulatory support surgery. The article by Martin Besser discusses the risk factors and how to optimise coagulation in patients. The specific to these devices problem with haemolysis and how technology has tackled it over the years is also eloquently presented. Prevention of thrombosis and embolism associated with circulatory support devices and some evidence-based conclusions are presented too.

Renal failure plays a major role in the management of heart failure patients. It is a contraindication for transplantation, and avoidance and management of this condition require team approach and clinical expertise. The review by Austin *et al.* offers an insight of the pathophysiology and dissects through the wealth of knowledge to offer guidance on evidence-based approach to the condition.

In the process of convalescence of mechanically supported patients rehabilitation plays a key role. The article of Salna *et al.* explains the importance of this intervention in the awake patients receiving ECMO support. It provides an overview of the mobilisation considerations for different mechanical circulatory support devices and presents the vast experience described in the literature.

Despite improving safety of mechanical circulatory support complications still occur. The balanced approach used by Ali and Abu-Omar's article describes the type of complications associated with mechanical circulatory support and how to tackle them.

In conclusion this special edition focuses the attention of the reader on the next step up for mechanical circulatory support. The excellent survival records move towards reducing complications for even better outcomes. We thank the authors who have vast experience in their field and believe these review articles to be not only discussion of published literature but also be seen through the eyes of the practicing doctor. We hope they will be interesting for many specialities medics and allied professionals who are working with patients in advanced heart failure supported by machines.

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