Minimal invasive Extra-Corporeal Circulation (MiECC): a revolutionary evolution in perfusion†

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Since the beginning of extracorporeal circulation (ECC) in cardiac surgery, a multitude of changes and improvements were aimed to reduce the adverse systemic effects caused by the artificial surfaces of the perfusion circuit. The clinical picture is similar to a systemic inflammatory response syndrome [1]. The magnitude of the inflammatory response adversely influences clinical outcomes [2]. Hence, the overall morbidity associated with cardiac surgery is substantial [3]. The off-pump coronary artery bypass (OPCAB) technique was introduced as a strategy to decrease the side effects of cardiopulmonary bypass (CPB). But the real advantages of OPCAB have been questioned in recent years [4].

In the early 2000s, a simplified perfusion system comprising all technological advancements was designed [5]. The modifications of the new system were much more revolutionary than the individual improvements to the existing conventional CPB circuits. The idea was to create a system including all established benefits in one CPB set-up. The Minimal Extra-Corporeal Circulation (MiECC) technology was born.

Since then, MiECC systems have been developed to increase the technical ease of on-pump surgery while tempering its disadvantages. For many years, cardiac surgeons, anaesthesiologists and perfusionists considered MiECC systems as a miniaturization or simplification of traditional CPB only. MiECC significantly attenuated morbidity attributed to conventional ECC, as for beating-heart procedures, while permitting optimal technical surgical conditions [6]. The authors believe that MiECC technology represents more than a miniaturization process: it is a major step forward and a totally new philosophy to be integrated in contemporary cardiac surgery [7]. The idea of MiECC systems has initiated new efforts to improve the biocompatibility of CPB systems and minimize their side effects, offering finally better postoperative end-organ function. Characteristics of MiECC include the following: (1) a blood pump with optimal biocompatibility, low thrombogenicity, minimal haemolysis and activation of leucocytes as well as proinflammatory mediators; (2) a minimal tubing length to reduce the priming volume required and thus minimize haemodilution, decreasing the need for foreign blood transfusions; (3) coated surfaces to reduce protein adsorption and platelet activation; (4) separation of shed blood and exclusion of activated blood components via cell salvage; (5) closed system to avoid blood-air contact; (6) temperature management depending on the need and magnitude of surgery should be possible; (7) use of modern concepts of myocardial protection, like blood cardioplegia, must be easy to integrate; (8) safe de-airing must be possible following open heart procedures; (9) finally, it should help modern concepts of fast-track anaesthesia [7, 8]. These characteristics will help to make MiECC an element of a minimal invasive procedure rather than simply a miniaturized CPB system.

Numerous randomized clinical studies have proved that MiECC exerts significant beneficial effects on postoperative morbidity, by reducing haemodilution, mediastinal bleeding, need for blood transfusion and inflammatory response. Clinical benefits are: improved end-organ (myocardial, renal and cerebral) protection and reduction of the length of intensive care unit stay [5–8]. Moreover, it is associated with a significant survival benefit in coronary procedures compared with conventional ECC as shown in a recent meta-analysis. This analysis reported randomized trials including 24 studies with a total of 2770 patients [9] and provided a Scientific Class I, Level of evidence A for implementation of MiECC, at least for coronary revascularization.

Despite these clear clinical advantages, penetration of the MiECC technology into clinical practice remains significantly low. Thus, the authors took the initiative to organize the 1st International Symposium on Minimal invasive Extracorporeal Circulation Technologies (1st MiECT) in Thessaloniki, Greece during June 13–14 to create a dedicated international forum to stimulate the exchange of ideas in clinical application and research in the field of Minimal invasive Extracorporeal Circulation Technology without geographical bias (www.miect.org).

More than 400 participants from all continents registered. Beside scientific sessions, wet-labs with two simulators for ‘hands-on training’ allowed participants to practice on all commercially available MiECC systems. Twenty abstracts were selected for publication and are part of this Interactive Cardiovascular and Thoracic Surgery issue. During the congress, the ‘Minimal invasive

Extracorporeal Circulation Technologies international Society (MiECTiS) was founded. This is an initial step to bring together cardiothoracic surgeons, anaesthesiologists, perfusionists, basic researchers and industry to promote application of MiECC worldwide. A consensus paper will be prepared later this year with the corporate effort of the Steering Committee, Founding Members and experts on the MiECC.

Discussions showed that refinements in perfusion technology have contributed to answering open questions regarding MiECC safety. Introduction of modular systems finds many advocates within the cardiac surgical and perfusion community. The term ‘modular’ refers to the possibility of integrating different components, such as, for example an additionally mounted, clamped-off venous reservoir, which allows the perfusionist to run the system as an open circuit, if required. This strategy offers an additional ‘safety net’ in case of an unexpected intraoperative event.

We conclude that a wider application of an integrated minimal invasive strategy regarding CPB, called ‘MiECC strategy’, is a fundamental step towards improved patient perfusion during surgical cardiac procedures. There is an immense need for large multicentre prospective randomized studies to confirm potential clinical benefits resulting from MiECC in different surgical procedures. We strongly believe that MiECC could finally replace conventional CPB.

REFERENCES