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ECLS: Past, present, and future

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Extracorporeal life support (ECLS) is the prototype example of translational research. It began in laboratory studies to design, test, and characterize devices for prolonged extracorporeal circulation in the 1960s. The first clinical cases of ECLS for heart and lung failure were in the 1970s. These cases were met with skepticism, but the results in neonatal respiratory failure were encouraging. In the early 1980s, two centers conducted randomized trials in neonates, which demonstrated much higher survival with ECLS, and the term extracorporeal membrane oxygenation (ECMO) was coined. By 1986, there were 18 neonatal ECMO centers and data on 700 cases. These centers formed a consortium (The Extracorporeal Life Support Organization: ELSO) to maintain the registry, define guidelines and techniques, provide education, and hold an annual meeting.

In the 1990s, these centers expanded indications to older children with lung and heart failure. ECMO management for post-operative cardiac failure became standard in major pediatric heart centers. A multi-center randomized trial in the UK demonstrated a major survival advantage to ECMO in neonates. A few centers continued to evaluate and improve ECMO and extracorporeal CO_2 removal (ECCOR) in adults with 50–60% survival in uncontrolled case series. At the ELSO meeting in 1999, a group met to plan a randomized trial in adult respiratory failure (ARDS). That study was carried out in the UK from 2002 to 2006 (the CESAR trial) using the same study design as the neonatal trial. The results were similar to the neonatal trial but adult intensivists were still skeptical, arguing that the single ECMO center in Leicester was just better at respiratory care than the other non-ECMO centers. During all this time, we used modified pumps, oxygenators, and other equipment designed for cardiac surgery. A new medical profession of "ECMO specialist" developed to manage the ECMO system and patient. The number of specialists determined the

number of ECMO cases that could be treated. Around 2008, a few companies made major improvements in these devices and manufactured specific ECMO machines. These machines were much safer, simpler, and reliable than the early ECMO equipment, and patients could be managed for weeks, primarily by the bedside ICU nurse with support from the specialist. This new equipment came along at the same time as the H1N1 flu pandemic of 2008 – 2009. ECMO was remarkably successful in saving the sickest patients, and adult intensivists scrambled to learn the technology. This was born out by two matched-pairs trials. ECMO for ARDS (acute respiratory disease syndrome) grew rapidly in adult intensive care units (ICU). The use of awake ambulatory ECMO as a bridge to lung transplantation has been expanded to all ECMO patients, in fact, to all ICU patients.[1]

Currently, ECMO is used for severe heart and lung failure in all ages. Research is focused on improving anticoagulation and devices, defining indications, and new applications like septic shock, ECPR for cardiac arrest, and EDCD to salvage organs for transplantation. Laboratory research has continued as clinical practice proceeded, and it currently includes an artificial placenta for very premature infants and four versions of implantable, wearable lungs for chronic support.[2]

Keywords: ECLS history, ECMO, extracorporeal life support, VA, VV, ECPR

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