

# Development of extracorporeal membrane oxygenation in Hong Kong: current challenges and future development

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Reviews of the clinical application of venovenous (VV) and venoarterial (VA) extracorporeal membrane oxygenation (ECMO) were published in the April and June issues, respectively, of the *Hong Kong Medical Journal*.<sup>1,2</sup> These issues have presented practical aspects of ECMO, including recent technological advances, practical physiology, patient selection, bedside management, complications, and current evidence. Here, we will discuss about the development of ECMO in Hong Kong.

## The present

Fifty years have passed since the first successful clinical application of ECMO. Over these decades, despite a lack of robust supportive data, ECMO has been used for severe respiratory and cardiac failure refractory to conventional treatment. With the global H1N1 influenza outbreaks of 2007–2008 and 2008–2009, ECMO experienced a resurgence in use to support patients with acute respiratory distress syndrome (ARDS) who failed conventional mechanical ventilation. In 2010, five ECMO centres focusing on VV-ECMO were established under the governance of the Coordinating Committee in Intensive Care Units (COC ICU) of the Hong Kong Hospital Authority. The goal was to provide accessible ECMO facilities during an influenza outbreak. Since that time, these ECMO services have faced a steady increase in service demand, especially for VA-ECMO (unpublished data from ECMO workgroup, COC ICU). This trend is similar to that for international registry data published by the Extracorporeal Life Support Organization (ELSO).<sup>3</sup>

Current ECMO support provided by ICUs is not confined to VV-ECMO for patients with severe ARDS. Most ECMO ICUs also provide VA-ECMO support for patients with severe circulatory failure and some to rescue patients with refractory cardiac arrest. The early local survival outcomes appear comparable with international data.<sup>4</sup>

As a sophisticated technology, there is a grave risk of patient harm from human error and equipment failure, necessitating a higher level of vigilance, staff training, and equipment maintenance. Moreover, ECMO remains a low-volume clinical activity. This 'high-risk low-volume' nature of ECMO means globally, nursing and medical clinical educators need

to develop ECMO simulation education programmes to improve clinical practice. Simulation training has been used to train novice ECMO providers, to refresh experienced ECMO users, and to enhance team communication during ECMO crisis management. It may also be part of an ECMO credentialing programme.<sup>5</sup>

Although there is as yet no demonstrable mortality benefit for simulation training in ECMO, most studies have shown an improvement in self-perceived confidence and knowledge of ECMO.<sup>6</sup> Some have demonstrated shorter ECMO cannulation times after simulation.<sup>7</sup> In Hong Kong, some ECMO educators, with the support of the Hospital Authority and Asia-Pacific Chapter of the ELSO, have organised ECMO simulation training for local ECMO providers and those in South-East Asia. Feedback indicates a high level of satisfaction from local and international attendees.

How ECMO developed in Hong Kong deserves mention. Such technique evolved from perfusionist-run cardiopulmonary bypass in the operating theatre. When ECMO then emerged as an ICU service, it was heavily reliant on perfusionists,<sup>8</sup> or at least required perfusionist support in most centres.<sup>9</sup> This created manpower stress and financial concern for the hospital administrator, especially during the H1N1 pandemic when there was a lack of ECMO-trained staff to meet the demands for service. In 2010, ELSO guidelines advised that nurses could be trained as 'ECMO specialists',<sup>10</sup> especially when a perfusionist may not be readily available. Globally, there are variations in practice; 'ECMO specialists' can be doctors, nurses, perfusionists, or respiratory therapists.<sup>9</sup>

With the latest-generation miniaturised and simplified ECMO circuits, less technical expertise is required. As a result, in Hong Kong, many units have not used perfusionists in the establishment and running of an ECMO service. In Hong Kong, the nursing-led bedside care model, the 'single caregiver model', that complements ECMO physicians has dominated, and contributed to a successful roll-out of Hong Kong ECMO services over a relatively short period of time.

## Challenge

The planning of future ECMO services will be a

challenge for the Hospital Authority. First, it is an expensive, labour-intensive technology associated with life-threatening complications that lacks unequivocal evidence to support its generalised use over conventional therapy. High-level-evidence recommendations to initiate ECMO are lacking, leading to highly variable practices: across countries, across institutions, and even within one ICU.<sup>11</sup> Ironically, the use of ECMO is increasing despite the lack of supportive evidence. Quintel et al<sup>12</sup> pointed out that the burgeoning use of VV-ECMO in Germany and the United States may be driven by national regulations, reimbursement policies, financial interests, fascination with new gadgets, and ambition rather than solid clinical evidence. Chen et al<sup>13</sup> also reported that the internet and newspapers tend to be over-optimistic about ECMO survival and this may result in unrealistic requests from or expectations of the general public. The development of a local registry is urgently needed to monitor the appropriateness of case selection and outcome while awaiting the results of more clinical trials.

Second, there is no standard model for an ECMO programme. For example, there are only five ECMO centres in the United Kingdom whereas in France and Germany, the number of centres is unrestricted. In 2012, the ELSO published a consensus paper by an international group of ECMO physicians and health care workers. The focus of the paper provided an insight into various aspects of organising an optimal and safe ECMO programme for adults with acute respiratory failure.<sup>14</sup> It concluded that a restrained approach was advisable until further evidence is available. This paper can provide a framework when hospital administrators consider a new ECMO programme.

## Future

The use of VA-ECMO for cardiac arrest refractory to conventional cardiopulmonary resuscitation (CPR) is a rapidly expanding indication for ECMO. The technique, VA-ECMO, maintains cerebral circulation during circulatory arrest and facilitates rescue cardiac interventions, eg percutaneous cardiac intervention, during the arrest period. It usually involves multidisciplinary collaboration, eg emergency physicians, cardiologists and intensivists, and a well-trained resuscitation team who can maintain good-quality CPR while ECMO cannulation is performed in the emergency situation.<sup>15</sup> Nonetheless despite a seemingly good outcome in a large case series, the lack of randomised controlled trial data and potential ethical issues<sup>16</sup> prohibit its widespread use during resuscitation.

To conclude, ECMO is a developing technology with substantial potential in patients with critical cardiorespiratory failure. It may also be a double-edged sword, however, given its significant complications. More data are required before widespread use of ECMO can be advocated. Finally, in order to

maximise the benefit of ECMO technology, an ECMO programme director and hospital administrator should focus on quality and safety.

## Declaration

Dr SWC Sin is the Education Co-chair of Extracorporeal Life Support Organization Asia-Pacific Chapter.

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