Current situation, efficacy, and safety of extracorporeal cardiopulmonary resuscitation in China

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To the Editor: The survival rate from conventional cardiopulmonary resuscitation (CCPR) of out-of-hospital and in-hospital cardiac arrest ranges from 9% to 20%.[1] Without returning of spontaneous circulation (ROSC) after CCPR, the chance of recovery is very poor. Initiating venoarterial extracorporeal membrane oxygenation in those patients may provide adequate organ perfusion that allows for longer organ viability and permit time for therapies seeking to correct the inciting pathologic event, which is termed extracorporeal cardiopulmonary resuscitation (ECPR).[2] Time to treatment, ECPR-related complications, as well as etiology, have been recognized as the main predictors of survival for ECPR patients.[3] ECPR has been carried out more and more in China, but the information on ECPR application remains unknown. Therefore, we conducted a retrospective survey about the usage of ECPR in China, including patient selection, initiation and management of extracorporeal mechanical ventilation (ECMO), patient outcome, and compared the status during 2017 and 2020.

All patients treated with ECPR in China were identified from the Chinese Society of Extracorporeal Life Support (CSECLS) Registry Database from January 2017 to December 2020. The CSECLS registry collects information of ECMO patients from ECMO centers using a standardized electronic reporting sheet via the organizations' website in China.[4] The study was registered at clinicaltrials.gov (registration number NCT04158479). We surveyed the database of all adult (>18 years of age) cases defined as documented refractory cardiac arrest who suffered cardiac arrest and did not respond to standard CCPR, which were reported from 42 ECMO centers covering 19 provinces in China. A total of 11 ECPR centers in 2017 and 42 in 2020 uploaded patients' information [Supplementary Table 1, http://links.lww.com/CM9/B333]. A total of 577 patients experienced ECPR, 439 (76.1%) were male, 365 (63.3%) patients removed from ECMO successfully, 175 (30.3%) discharged alive. The average ECMO duration (Q_1–Q_3) was 49.53 (14.42–117.30) hours. Treated cases increased gradually year by year (33 cases in 2017, and 274 cases in 2020). The survival rate also increased (24.2% in 2017 *vs.* 33.6% in 2020).

The etiology of ECPR mainly includes acute myocardial infarction (AMI), valvular heart disease and cardiomyopathy, severe pneumonia and sepsis, pulmonary embolism, acute myocarditis, malignant arrhythmia, and others (including traumatic cerebrovascular diseases, unknown etiology or unreported). The proportion of disease has not changed much from 2017 to 2020, AMI accounted for approximately half of cases from 2017 till 2020, acute myocarditis approximately 4.9% (28/577), and acute pulmonary embolism 5.7% (33/577, Figure 1A). The type of disease varied with age. For patients under 40 years old, AMI accounted for 20.8% (22/108), AMI rose to 55.7% (144/258) in patients aged 40 to 60 years and 61.1% (129/195) in patients >60 years. Increasing clinical experience suggests that resuscitated cardiac arrest victims without an obvious non-cardiac etiology should undergo emergency coronary angiography and, where indicated, percutaneous coronary intervention.[5] However, in our survey, only 51 patients (8.8%) underwent further noncardiac intervention. Patients with myocarditis and pulmonary embolism had higher survival rates of 46.4% (13/28) and 48.5% (16/33), respectively. In contrast, patients with severe infection and sepsis had the lowest survival rate of 18.0%.

The time from cardiac arrest to CPR, from CPR to installation of ECMO and duration (Q_1, Q_3) of installation all decreased (Q_1, Q_3) gradually from 2017 to 2020 (6.00 [1.00, 20.00] min *vs.* 1.00 [0.00, 3.00] min; 60.00

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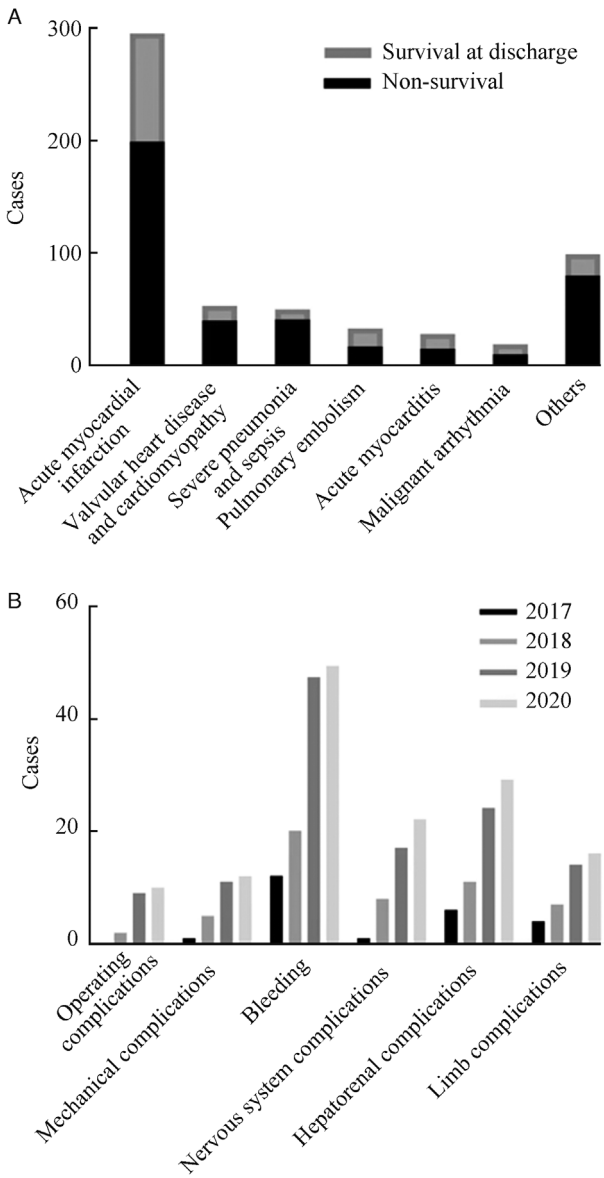

Figure 1: (A) Among 577 patients, 295 (51.1%) suffered acute myocardial infarction, of which 96 patients (32.5%) survived. The survival rates in acute myocarditis and pulmonary embolism were higher, with 13 in 28 acute myocarditis patients survived and 16 in 33 pulmonary embolism patients survived. Patients with severe infection suffered the lowest survival rate with nine in 50 patients who survived. (B) Among ECMO-related complications, bleeding was the most common complication, followed by liver and kidney complications and nervous system complications.

[25.00, 100.00] min *vs.* 35.00 [20.00, 60.00] min; 40.00 [30.00, 50.00] min *vs.* 25.00 [16.00, 35.00] min, respectively). The average time to achieve ROSC after CPR was 35 (18, 70) min, similar among years [Supplementary Figure 1, http://links.lww.com/CM9/B333]. Bleeding was the most common ECMO-related complications (128 patients, 22.2%), followed by liver and kidney complications (70 cases, 12.1%), then nervous system complications (48 cases, 8.3%) from January 2017 to December 2020 (Figure 1B). Bleeding complications declined gradually over time (36.4%[12/33] in 2017 to 17.9%[49/274] in 2020). Bleeding (15.4%[27/175] vs. 25.1%[101/402], $P = 0.012$), limb complications (2.9% [5/175] *vs.* 9.30%[36/402], $P = 0.008$), and neurological complications (2.3% [4/175] *vs.* 10.9%[44/402], $P = 0.001$) were significantly lower in surviving patients than in those who died.

According to studies,[6] we divided ECMO centers into two groups: ≥20 cases and <20 cases. The successful removal rate of ECMO was higher in centers with ≥20 cases than those with <20 cases (68.5% *vs.* 54.2%, $P = 0.003$). The survival probability within 60 days showed saw an upward trend in centers with ≥20 cases ($P = 0.052$).

Our retrospective survey of the current situation of ECPR in China showed that ECPR was used widely over years in patients who failed to ROSC under CCPR in China registered centers, with an average survival rate of 30.3%. The main pathogenisis of ECPR was AMI, and bleeding was the most common complication. Centers with ≥20 cases had a higher removal rate from ECMO. The decreased time from the installation to running of ECMO, as well as the reduction in the incidence of complications, might be important reasons for the improved survival rate. These promising results are supportive of the initiation of ECPR programs in other regions.

Conflicts of interest

None.

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