

Indications and Perioperative Outcomes of Extracorporeal Life Support in Clermont-Ferrand

Abstract

Objectives: To report the epidemiological profile of the patients who underwent extracorporeal life support (ECLS) and then analyze the indications and outcomes of this procedure. **Methods:** It consisted of a retrospective and descriptive study based on the database from the department of cardiovascular surgery. **Setting:** University hospital clinic. **Patients:** One hundred and sixty-one patients have participated in the study. Included were all patients who presented with left-sided heart or biventricular failure. Those who were suffering from either isolate respiratory failure or isolate right ventricle failure were excluded. **Interventions:** Participants underwent ECLS: central ECLS or peripheral ECLS. **Results:** The mean age of the patients was 54 years; there were 73% of male patients and the mean duration of ECLS was 5.3 days. There were two types of ECLS: central (71%) and peripheral (29%). Indications for support were dominated by cardiogenic shock in 69%. Bleeding was the most frequent complication (23.5%). The overall in-hospital mortality of patients who underwent ECLS was 60%. **Conclusion:** The number of ECLS performed increases in proportion to mastery of surgical technique. There is a high rate of mortality and morbidity with ECLS. However, it remains a lifesaving therapy for many clinically urgent situations.

Keywords: *Cardiogenic shock, cardiorespiratory support, extracorporeal life support, ventricular failure*

Introduction

Extracorporeal life support (ECLS) has been used in cardiac surgery since the 1950s and has subsequently been applied to patients outside the operating room (OR) with cardiopulmonary failure.^[1] Currently, ECLS means the venoarterial extracorporeal membrane oxygenation (VA ECMO).^[2] The indications have been extended so that it has become an invaluable tool in the care of adults and children with severe cardiac and pulmonary dysfunction that are refractory to conventional management.^[3] According to the Extracorporeal Life Support Organization registry, ECLS was used in over 86,287 cases in 2016.^[4] ECLS is a widely accepted temporary mechanical support and is used as “rescue therapy” for emergency and unexpected cardiogenic shock (CS) owing to the ease and rapidity with which it can be applied and its ability to rapidly restore the circulation that supports biventricular and respiratory function.^[5] Nonetheless, ECLS is strongly associated with complications such as bleeding, limb ischemia, infection,

and thromboembolic events,^[6] and the occurrence of these events increases throughout the course of ECLS. In this work, we aim to report the epidemiological profile of patients who underwent ECLS. Then, we will analyze the indications and outcomes of this procedure.

Methods

This study shows the indications and in-hospital outcomes of ECLS that have been performed at the University Hospital of Clermont-Ferrand between January 2005 and December 2014.

We used retrospective and descriptive methods based on the database from the Department of Cardiovascular Surgery. Included were all patients who underwent ECLS for left-sided heart or biventricular failure. Those who were suffering from either isolate respiratory failure or isolate right ventricle failure were excluded. CS included hemodynamic parameters such as mean arterial pressure (MAP) 30 mmHg lower than baseline, severe decrease in cardiac index (1.8 L/min), and high filling pressure. Postcardiotomy CS where the shocks that

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Access this article online

Website: www.annals.in

DOI: 10.4103/aca.ACA_170_17

Quick Response Code:



How to cite this article: Bata AKB, Sawadogo A, D'ostrevy N, Geoffroy E, Dauphin N, Eljezi V, *et al.* Indications and perioperative outcomes of extracorporeal life support in clermont-ferrand. *Ann Card Anaesth* 2018;21:181-4.

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occurred after open heart surgery. The patients who were weaned from ECLS were alive and had no longer ECLS. The procedure was performed at the Intensive Care Unit, in the bed, or OR depending on the emergency. Criteria of weaning were as follows: stable hemodynamic (MAP >60 mmHg without vasoactive drug), pulsating arterial line during 24 h at least, and good oxygen curve. The weaning process started by decreasing the flow (66%) during 10–15 min to get a minimal cardiac output (1–1.5 L/min) and tube clamping during 15–20 min in the OR. Then, we removed if MAP >60 mmHg and left ventricle ejection fraction >25%. We took the number of patients from each year on whom the ECLS procedure was performed and broke down the statistics to show parameters that included age, sex, indication and type of ECLS, duration of hospitalization, and outcomes of the procedures. IBM® SPSS® Statistics Version 22 was used to analyze statistics. Means and 95% confidence intervals were calculated.

Results

Overall, in a period of 10 years [Figure 1], 292 patients underwent ECMO. Of these, 161 (76%) were treated with ECLS. The mean age was 54 (± 17), ranging from 2 months to 87 years. Male patients represented 73% and females 27%, corresponding to male-to-female ratio of 2.7:1.

Taking into account the sites of arterial and venous cannulation, there were two types of ECLS: central ECLS and peripheral ECLS. The results were as follows: 114 patients (71%) had peripheral ECLS and 47 (29%) had central ECLS.

The average duration of ECLS in the ICU was 5.3 (± 4.8) days. The extremes were 0.2 and 23 days.

The main indication for ECLS was CS (69%), followed by cardiorespiratory arrest (21%), and third, the early of deterioration of grafts (10%). Other pathologies indicating ECLS were rare; they included myocarditis, intoxication, hypothermia, Takotsubo syndrome, and others [Table 1].

Early outcomes were as follows: 73 (45.3%) died under ECLS, 56 (34%) had successful weaning, 12 (7.5%) underwent heart transplantations, 9 (5.6%) patients had peripheral ECLS converted to central ECLS, 7 (4.3%) patients had converted to venovenous ECMO, and 4 (2.4%) had assistance devices. The complications [Table 2] were dominated by cannulation site bleeding in four cases (23.5%); lower limb ischemia in four cases (23.5%); thrombocytopenia in three cases (18%); thrombosis of cannula in two cases, (11.8%); and intra-atrial thrombosis in two cases (11.8%). From hospital admission to discharge, 96 patients (60%) died and 65 (40%) survived [Figure 2].

Discussion

There has been an increase in the use of ECLS for the management of cardiorespiratory failure at the University

Hospital of Clermont-Ferrand, France. ~76% of ECLS were performed during the last 5 years. The increasing interest in this procedure has been observed in many centers. Indeed, the study of Combes *et al.*^[7] on the use of ECLS from 2001 to 2007 at Pitié-Salpêtrière Hospital of Paris showed that two patients underwent ECLS in 2001; 10 in

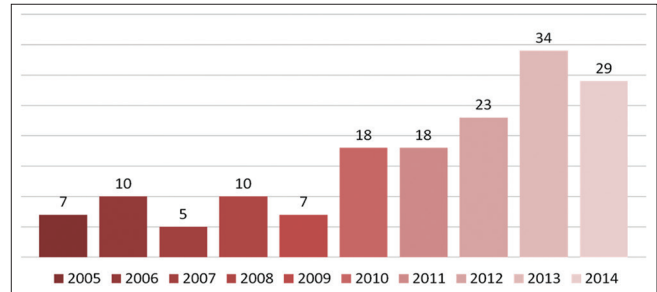


Figure 1: Number of performed extracorporeal life support per year from 2005 to 2014

Table 1: Indications for extracorporeal life support

Indication	Percentage (%)	Total (%)
Cardiogenic shock		
Postcardiotomy	46 (28.6)	111 (69)
Postmyocardial infarction	36 (22.4)	
Others (arrhythmia, sepsis, etc.)	29 (18)	
Refractory cardiorespiratory arrest		21 (13)
Primary CABG failure		10 (6.2)
Myocarditis		7 (4.3)
Others		
Intoxication	4 (2.5)	12 (7.3)
Hypothermia	2 (1.2)	
Takotsubo syndrome	2 (1.2)	
Wound of pulmonary artery	1 (0.6)	
Acute transplant rejection	1 (0.6)	
SIRS	1 (0.6)	
Mechanical aortic prosthesis thrombosis		

CABG: Coronary artery bypass grafting, SIRS: Systemic inflammatory response syndrome

Table 2: Complications of extracorporeal life support

Type of complication	Percentage (%)
Cannulation site bleeding (aorta, RA, femoral vessels)	4 (23.5)
Lower limb ischemia	4 (23.5)
Thrombocytopenia	3 (18)
Thrombosis of cannula	2 (11.8)
Intra-atrial thrombosis (LA, RA)	2 (11.8)
Venous cannula kinking	1
Retroperitoneal bleeding	1
Malposition of venous cannula	1
Infection of venous cannula	1
Arrhythmia (VT, VF)	1
Total	20

LA: Left atrium, RA: Right atrium, VF: Ventricular fibrillation, VT: Ventricular tachycardia

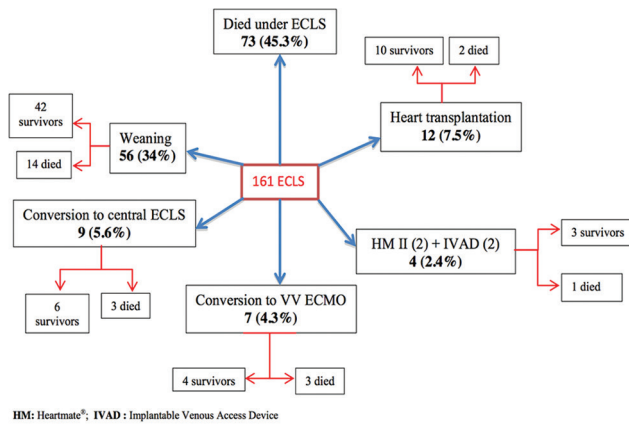


Figure 2: Perioperative outcomes of extracorporeal life support

2002; 22 in 2003; 67 in 2004; 100 in 2005; 145 in 2006; and 180 in 2007. Another French study in Vanzetto *et al.* [8] during the same period showed a yearly performance of ECLS as follows: 4 cases in 2002; 4 in 2003; 5 in 2004; 36 in 2005; 30 in 2006; and 21 during the first 6 months of 2007. In this series, 87% of ECLS were performed in the last 3 years; the main reason for this is probably that the number of ECLS performed increases in proportion to mastery of surgical technique.

In the literature, some authors report findings similar to our mean age, sex, and main duration of ECLS, for example, Doll *et al.* [9] studied 95 ECLS that were indicated for postcardiotomy CS in Leipzig (Germany) between 1997 and 2000. They found that the mean age was 59.8 ± 13.3 years; regarding sex, they found 69% were males and 31% were females. The mean duration of ECLS was $2.8 (\pm 2.1)$ days. A second German study in Frankfurt [10] relating to 360 postcardiotomy ECLS performed between 2001 and 2013 found a mean age of $62 (\pm 17)$ years, 76% of male patients, and the mean duration of ECLS was $7 (\pm 1)$ days. Like our series, CS was the main indication for cardiac or respiratory support in all the other studies. [5,11]

Complications with ECLS are very common, and as expected, it is associated with significant increases in morbidity and mortality. These complications are mainly related to the underlying pathology or to the ECLS procedure itself (surgical insertion, circuit tubing, anticoagulation, etc.). Of the 161 patients of our study, 17 (10.55%) developed complications relating to the procedure. Bleeding was the preponderant complication and occurred in about one-fourth of the patients. Some authors report a rate of hemorrhage ranging 10%–30%. [12,13] Aubron *et al.* reported up to 34% in VA ECMO (ECLS) that required surgery for bleeding issues. [14] Bleeding may occur at the surgical site, at the cannula site, or into the site of a previous invasive procedure; also, intrathoracic, abdominal, or retroperitoneal hemorrhages may occur. Bleeding is increased because of systemic heparinization, platelet dysfunction, and clotting factor hemodilution. Bleeding is

managed by decreasing or stopping heparin and infusion of platelets and clotting factors. [15] The use of ECLS represents a therapeutic option for life-threatening cardiorespiratory patients and is a component of resuscitation, which is why all the studies report a particularly high rate of mortality.

In our study, 34% of the patients were primarily weaned from ECLS, and 45.3% have died under ECLS.

The overall perioperative outcomes were poor. From admission to discharge, 96 out of 161 ECLS patients died.

In the other series, this same high rate of mortality was reported. For example, Vanzetto [8] reported 60% of death under ECLS and only 30% of successful weaning in Grenoble; Combes *et al.* [7] reported 58% of death under ECLS and 42% of weaning. Although the mortality is high, this procedure is to be continued as it is, most of the time, the only bridging measure between heart transplantation and cardiac assist devices.

Conclusion

ECLS is an established method that is being increasingly used for the management of cardiorespiratory failure in which conventional therapies have failed. Peripheral ECLS is the most commonly performed technique, and indications for its use are dominated by CS. Although there is a high rate of mortality and morbidity with ECLS, it remains a lifesaving therapy for many clinically urgent situations.

Acknowledgment

The authors would like to thank Mrs. Lynn Payne (Birmingham, UK) for reading and corrections of the English language issues

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Johnson NJ, Acker M, Hsu CH, Desai N, Vallabhajosyula P, Lazar S, *et al.* Extracorporeal life support as rescue strategy for out-of-hospital and emergency department cardiac arrest. *Resuscitation* 2014;85:1527-32.
2. Lunz D, Philipp A, Dolch M, Born F, Zausig YA. Venous-arterial extracorporeal membrane oxygenation. Indications, limitations and practical implementation. *Anaesthesist* 2014;63:625-35.
3. Makdisi G, Wang IW. Extra corporeal membrane oxygenation (ECMO) review of a lifesaving technology. *J Thorac Dis* 2015;7:E166-76.
4. Extracorporeal Life Support Registry Report. Available from: <https://www.else.org/Registry/Statistics/InternationalSummary.aspx>. [Last accessed on 2017 May 24].
5. Park SJ, Kim JB, Jung SH, Choo SJ, Chung CH, Lee JW, *et al.* Outcomes of extracorporeal life support for low cardiac output syndrome after major cardiac surgery. *J Thorac Cardiovasc Surg* 2014;147:283-9.
6. Sidebotham D, McGeorge A, McGuinness S, Edwards M, Willcox T, Beca J, *et al.* Extracorporeal membrane oxygenation for treating severe cardiac and respiratory failure in adults: Part 2-technical considerations.

- J Cardiothorac Vasc Anesth 2010;24:164-72.
7. Combes A, Leprince P, Luyt CE, Trouillet JL, Chastre J. Assistance cardiorespiratoire par extracorporeale membrane oxygenation (ECMO) Reanimation 2009;18:420-7.
 8. Vanzetto G, Akret C, Bach V, Barone G, Durand M, Chavanon O, *et al.* Assistance circulatoire extracorporelle percutanée dans les défaillances hémodynamiques aiguës graves: Expérience monocentrique chez 100 patients consécutifs. Can J Cardiol 2009;25:179-86.
 9. Doll N, Fabricius A, Borger MA, Bucerius J, Doll S, Krämer K, *et al.* Temporary extracorporeal membrane oxygenation in patients with refractory postoperative cardiogenic shock – A single center experience. J Card Surg 2003;18:512-8.
 10. Papadopoulos N, Marinos S, El-Sayed Ahmad A, Keller H, Meybohm P, Zacharowski K, *et al.* Risk factors associated with adverse outcome following extracorporeal life support: Analysis from 360 consecutive patients. Perfusion 2015;30:284-90.
 11. Swol J, Buchwald D, Strauch J, Schildhauer TA. Extracorporeal life support (ECLS) for cardiopulmonary resuscitation (CPR) with pulmonary embolism in surgical patients – A case series. Perfusion 2015;1:1-6.
 12. Bartlett RH, Gattinoni L. Current status of extracorporeal life support (ECMO) for cardiopulmonary failure. Minerva Anesthesiol 2010;76:534-40.
 13. Hemmila MR, Rowe SA, Boules TN, Miskulin J, McGillicuddy JW, Schuerer DJ, *et al.* Extracorporeal life support for severe acute respiratory distress syndrome in adults. Ann Surg 2004;240:595-605.
 14. Aubron C, Cheng AC, Pilcher D, Leong T, Magrin G, Cooper DJ, *et al.* Factors associated with outcomes of patients on extracorporeal membrane oxygenation support: A 5-year cohort study. Crit Care 2013;17:R73.
 15. Peek G, Wittenstein B, Harvey C. Management of bleeding during ECLS. In: Van Meurs K, Lally KP, Peek G, *et al.* ECMO in Critical Care. Ann Arbor: Extracorporeal Life Support Organization; 2005.