FINAL PROGRAM – ABSTRACT BOOK

21st European Conference on Perfusion Education and Training

Venue : Centre Convencions International de Barcelona
Room 211

Organized by the

1991

THE EUROPEAN BOARD OF CARDIOVASCULAR PERFUSION

The European Board of Cardiovascular Perfusion

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1991 The European Board of Cardiovascular Perfusion

OUTLINE ABSTRACT BOOK

WELCOME

The European Board of Cardiovascular Perfusion (EBCP) is very pleased to welcome you to their annual & hybrid European Conference on Perfusion Education and Training (ECoPEaT) !

Adaptability : ***the*** word of 2020-2021… Adapting on a day-to-day base towards changing rules & restrictions; this is what all of us were required to do past 18 months. No more certainties, no longer long-term planning… Still, the EBCP always aimed at and hoped for a LIVE ECoPEaT meeting, as interconnection between colleagues and meeting with peers remains important to give us the drive in our profession.

The best we currently and proudly could manage - to reach the maximum number of colleagues all over Europe - is to provide a hybrid meeting format; giving those who can or like to travel a LIVE meeting, yet also facilitating a virtual meeting for those unable to be with us in Barcelona.

As the EBCP was founded in 1991, this is an anniversary edition; yet a humble one until all of us can freely travel and celebrate again.

Our 2021 ECoPEaT meeting content is designed considering the numerous constructive suggestions from the survey which was sent after the last live ECoPEaT meeting in Milan as well the current needs which arose since then.

The Barcelona ECoPEaT LIVE meeting consists of ***3 Scientific sessions*** and ***1 'Meet the Industry'-session***. We will be wrapping up around 17.00, hoping you will find some time to socialize with your international colleagues.

Each scientific session will host a few highly academic invited speakers as well as interesting research abstracts which we received from within the perfusion society.

The theme of this year's conference is:

„ Celebrating milestones and remembering benchmarks - LIVE "

During **the 'Meet the Industry' session**, our **platinum & gold sponsors** will receive the opportunity to speed-date with all of you; each will deliver a Pecha Kucha talk to share their most important mission or message. Of course, you are all encouraged to chat to them – and to our other sponsors - afterwards or visit their boot at the EACTS exhibition hall!

Before and during the meeting there will be ***free coffee*** during the breaks and we also offer ***free lunch*** for all attendees. Please take this opportunity to mingle, socialize and engage in discussions but ***please do return to the meeting room in due time out of respect for our presenters.***

After the meeting, a new survey will be sent around to all attendees, so – with your help – we can continue to reshape this meeting towards the needs of the current and future European perfusion community.

Last but not least; we gratefully recognize and truly appreciate our generous sponsors; without them it would be impossible to keep this educational perfusion meeting FREE OF CHARGE !

Platinum sponsors : Medtronic – LivaNova – Getinge

Gold sponsors : Terumo – Cytosorb - Eurosets

We also would like to thank ***EACTS*** for their logistic support.

We hope we will meet your expectations, hope you will enjoy the meeting and look forward to meet many of you!

The EBCP Congres Organising Committee

FACULTY

Invited Presenters :

M. Mata – Spain
S. Gunaydin - Turkey
F. Pappalardo - Italy
M. Schmidt - France
C. Vandenbriele - Belgium.
M. Lubnow - Germany
J. Belohlavek – Czech Republic
I. Condello- Italy
A. Parasido - France
H. Peperstraete - Belgium
A. Wahba – Norway
C. Hamilton - Austria

Research Papers Oral Presenters :

N. Bansal – UK
I. Condello - Italy
S. Maruniak – Ukraine

Session Moderators

Members of the EBCP Board in conjunction with our invited speakers.

PROGRAM AT A GLANCE

08.00 – 09.00 "Welcome to Barcelona!"

08.00 – 08.50 **Welcome Coffee + Registration**

08.50 – 09.00 **Welcome Address :** F. De Somer

09.00 – 17.00 "Celebrating Milestones & Remembering Benchmarks LIVE"

09.00 – 10.30 **Scientific Session I : Emerging Equipment & Technologies**
Moderators : J. Belohlavek – C. Vandenbriele - K. Vandewiele

10.30 – 11.00 ***Coffee break***

11.00 – 12.30 **Scientific Session II : Extra-Corporeal Life Support**
Moderators : H. Peperstraete - F. Pappalardo – L. Vercaemst

12.30 – 13.30 ***Lunch break***

13.30 – 14.30 **"Meet The Industry" Speed Date Session**
Moderators : G. Debeuckelaere

14.30 – 15.00 ***Coffee break***

15.00 - 16.50 **Scientific Session III : Education & Training**
Moderators : G. Kunst – A. Wahba - A. Degani

16.50 – 17.00 "Time for Farewell"

16.50 – 17.00 **Closing remarks :** K. Vandewiele

DETAILED SCIENTIFIC PROGRAM

08.00 – 08.50 Coffee & Registration
08.50 – 09.00 Welcome Address : F. De Somer

„Celebrating Milestones & Remembering Benchmarks - LIVE“

09.00 – 10.30 : Scientific Session I

Session I will learn us more about emerging equipment & technologies

09.00 - 09.15	***Normothermic regional perfusion***	*M. Mata, Spain*
09.15 – 09.30	***Myocardial protection in 2021***	*S. Gunaydin, Turkey*
09.30 – 09.45	***Hemoadsorption per and post cardiac surgery : The 2021 update***	*F. Pappalardo, Italy*
09.45 – 10.15	***Discussion***	
10.05 – 10.15	***ABSTRACT Submission: Magnetic levitation pump versus constrained vortex pump: A pilot study on the Hemolysis effect during minimal invasive extracorporeal circulation***	*I. Condello*
10.15- 10.25	***ABSTRACT Submission: The Selection of Prime Constituents for Cardiopulmonary Bypass in the UK and Ireland***	*N. Bansal*
10.25- 10.30	***Discussion***	

10.30 – 11.00 

11.00 – 12.30 : Scientific Session II

Session 2 will focus on ECLS

11.00 – 11.15	***Coordination of ECMO Supplies and logistics in pandemics***		*M. Schmidt, France*
11.15 – 11.30	***Walking the Line: Anticoagulation vs Thrombosis in MCS***		*C. Vandenbriele, Belgium*
11.30 – 11.45	***Consumption Coagulopathy during ECMO***		*M. Lubnow, Germany*
11.45 – 12.00	***"ECPR – a Routine for Cardiac Arrest?***		*J. Belohlavek, Czech Republic*
12.00 – 12.20	*Discussion*		
12.20-12.30	***ABSTRACT Submission: "The Use of ECMO during Myocardial Revascularization in Cardiac Catheterization Laboratory: Own Experience***		*S. Maruniak*
12.30-12.35	*Discussion*		

12.30 – 13.30

13.30 – 14.30 : "Speed date with the industry" Session

Industry Pecha Kucha talks

from our PLATINUM/GOLD SPONSORS

13.30-13.38 : M. Van Driel

13.38 - 13.46 : E. Bonetti

13.46 - 13.54 : A. Becker

13.54 – 14.02 : Dr. Marijana Matejic-Spasic

14.02 – 14.10 : C.A. Tassi

14.30 – 15.00 ***and meet our other sponsors!***

15.00 – 17.00 : Scientific Session III

Scientific session 3 will focus on Education & Training

15.00 – 15.15	***"Management Algorithms and Artificial Intelligence Systems for CPB***	*I.Condello, Italy*
15.15 – 15.30	***E-Learning for ECMO Training***	*H. Peperstraete, Belgium*
15.30 – 15.45	***European Perfusion Guidelines: Where are we now?***	*A.Wahba, Norway*
15.45-16.00	*Discussion*	
16.00 – 16.10	***ABSTRACT Submission : State of the Art of Perfusionists in Europe***	*A.Parasido, France*
16.10 – 16.15	*Discussion*	
16.15-16.45	***EBCP : Celebrating 30 years***	*C. Hamilton, Austria*

16.45 – 17.00 Closing remarks – K. Vandewiele

17.00 Adjourn

09.00 - 09.15 Normothermic Regional Perfusion

Maite Mata
Mata MT. Ruiz A**.Chief of Perfusion Unit*. Transplant Procurement Unit**. Hospital Clínic.*
University Hospital. Barcelona, Spain.

Donors after circulatory death (DCD) have shown to be a potential source of transplantable organs that has yet to be fully utilized. Controlled DCD (cDCD) involves planned withdrawal of ventilatory and organ perfusion support in the face of catastrophic illness (Maastricht III), whereas uncontrolled DCD (uDCD) involves unexpected cardiopulmonary arrest and unsuccessful resuscitation (Maastricht II)
Spain has a long history and experience in the management of organ donation, being a world reference. At the Hospital Clínic de Barcelona, uncontrolled donation after circulatory death began in the 1980s; initially most donors were patients in brain death. With the development of new preservation methodologies and the acquired knowledge of both DBD and uDCD, the cDCD program began to be carried out in 2014.
Initially, uDCD with ECMO support was performed by the medical team of the Transplant Procurement Unit, because the Perfusion Unit was not staffed enough to be able to collaborate with the program.
Despite this, perfusionists always had a cordial relationship and acted as advisers, in the face of technical problems derived from ECMO support. But when cDCD with ECMO support began to be carried out, the Transplant Procurement Unit itself proposed the Perfusion Unit to be part of the recovery team and manage and control ECMO therapy.
In June 2018 we began our journey together with the Transplant Procurement Unit. From June 2018 to October 2021 we have made a total of: 27 uDCD and 54 cDCD. 57 of these donors were valid for liver, kidney and pancreas.
Perfusion unit and organisation:
The Perfusion Unit consists of 9 perfusionists (including the head of the unit), and undertakes 4
on-call activities monthly: Cardiac Emergencies, Cardiac Recoveries, DCD activities and Heart Transplantation.

Once the on-call perfusionist is activated, if it is an in-hospital DCD (controlled or uncontrolled), only a perfusionist attends. If it is a cDCD outside our center, 2 perfusionists are involved (oncall donation + on-call cardiac recovery)

Equipment:
- Rotaflow PLS centrifugal pump for in-hospital DCD
- Cardiohelp HLS for external cDCD.
- Cannulation of femoral artery and vein 21, 23, 25Fr and 15-17-18-20Fr
- Priming with plasmalyte-A-148 and according to previous hematocrite if known, a blood concentrate is added.
- Theoretical blood: flow 60-70% of the total CO of the donor.
- Once the infusion has started, all electrolyte alterations are corrected.
- Analytical controls at 5 minutes after the start of ECMO, and every 30 minutes.
- After 60 minutes of perfusion, cannulation of main vessels and the different cold preservation solutions are administered for each organ to be recovered and the perfusion with ECMO is stopped.

Results:
Organs from cDCD and uDCD with ECMO support by perfusionists have been implanted with at
least similar results of recovery and discharge of recipients.
Since the perfusionists started to provide ECMO support for DCD, renal transplantation rate in
uDCD improved from 67,4% to 75,8% (p=0,088). In cDCD liver transplant rate tended to improve from 61.1% to 65% (p=0,701), with no difference regarding renal transplant rate.

Conclusions:
The incorporation of perfusionists to organ recovery units has marked a turning point in DCD preservation in our center. The way in which the perfusionist perfuses and treats the donor is different, since we start from the basis that he is a deceased patient but with organs that must be kept alive in order to be successfully transplanted and increase life expectancy to our recipients .In uDCD, where warm ischemia is severe, the experience and skills of a perfusionist is essential to maximize organ preservation and procurement.
The figure of the perfusionist is essential in both cases, the management of donors and the management of patients who require ECMO therapy. We

consider the procedure as teamwork, a multidisciplinary team in which each one plays a role; if we want the orchestra to sound good, we must act together, as we are all necessary. The incorporation of the Perfusion Unit to the Transplant Procurement T

Similar to motorised vehicles enabling people to travel long distances and providing comfort in life, driving a car can be potentially lethal when not sticking to traffic rules and without common sense. Concordantly, the introduction of centrifugal pumps resulted in giant leap in extracorporeal circulation technology, offering long-term applications and treatment of new patient populations. But similar to reckless driving a car, operating a high-end, seemingly simple-to-operate centrifugal pump can result in unforgiving and lethal accidents.

Even though most pump operators are well trained and know about basic centrifugal pump technology, many still lack in-depth knowledge of this major circuit component providing blood transport. Centrifugal pumps can be applied in a spectrum of bypass applications, each in which the pumps serves a different purpose and requires a complete different approach and awareness of operation. The spectrum varies from acting as a main arterial pump, a venous drainage pump, or as a pumping combining both in minimised bypass circuits, to an assisting pump in veno-venous and/or veno-arterial extracorporeal life support, or as a ventricular assist in para- or intracorporeal applications. As a result of the wide range of applications under -without exemption- unforgiving conditions, small, simple, but unfavourable decisions can easily result in potential dangerous and irreversible patient harm. Under unfavourable pump operating conditions, the pump and blood can be damaged, support can be impaired, and even gaseous microemboli can be generated and transferred, with time, resulting in impaired patient outcome.

A centrifugal pump can therefore be regarded as an advanced circuit component, potentially lethal when not obeying ‘traffic rules’, but, when properly applied, life saving in critical support-demanding patients.

INVITED TALK

09.15 - 09.20 Myocardial Protection in 2021: In Search Of Optimal Cardioplegia *Covering Every Type Of Cardiac Surgery*

Prof. Serdar Gunaydin, MD, PhD
Department of Cardiovascular Surgery, University of Health Sciences,
Ankara City Hospital Campus, Turkey

Adequate myocardial protection during cardiac surgery is essential for successful clinical outcomes. Despite a multitude of commercially available cardioplegic solutions, no clear consensus has been reached on the optimal composition or technique for using them.
Heterogeneity in delivery temperature, dosing frequency, and substrate composition makes it difficult to evaluate these solutions in a clinical setting. Experimental work on cardioplegia aiming to assess myocardial protection use time-consuming, invasive, and often expensive approaches such as continuous monitoring of intra myocardial pH, myocardial lactate production or myocardial biopsy for adenosine-triphosphate dosage, which are unrealistic in routine clinical practice.
There is momentum to incorporate myoprotective methods that extend the safe ischemic time, reducing the need for cardioplegia redosing. These techniques increase the time between dosing, which may lower cross-clamp times and, ultimately, the time on cardiopulmonary bypass, both of which are linked to improved outcomes.

Despite the increasing popularity of single-dose cardioplegia techniques in coronary artery bypass
grafting, the time window for successful reperfusion remains unclear.

Donation after circulatory death (DCD) donors are becoming a common source of organs for transplantation globally. However, the graft survival rate of DCD organs is inferior to that of organs from brain-dead donors. The rapid retrieval technique is used by most donor organ procurement teams. The normothermic regional perfusion (NRP) technique has been implemented to minimize warm ischemic damage to the organs. However, there is limited information on the

effect of NRP on the quality of the donor lungs.

Diminishing cardioplegic delivery volume via nanotechnology is another hot topic. Experimental studies using nanoparticles to overcome hemodilution and transfusion are encouraging.

The goal of this talk is to share our own experiences on different single-dose techniques compared with conventional formula with a wide documentation of long-term clinical outcomes in minimally invasive surgery as well as experimental design, combined with a review of the emerging literature, by highlighting principles for the adult cardiac surgery community. Novel comparative studies for implementation of single dose techniques in routine surgery covering every type will also be cited. Our experimental studies on organ protection solution on DCD/NRP strategy will be summarized. Recent trials in our laboratory on condensed cardioplegic solution by nanoparticles will also be shared.

INVITED TALK

09.30 - 10.45 "Hemoadsorption Per and Post Cardiac Surgery : The 2021 Update

Frederico Pappalardo
Dept. of Cardiothoracic and Vascular Anesthesia and Intensive Care, AO SS Antonio e Baggio e Cesare Arrigo, Alessandria (Italy)

10.05 - 10.15 Magnetic levitation pump versus constrained vortex pump: A pilot study on the Hemolysis effect during minimal invasive extracorporeal circulation

Ignazio Condello[1], Giuseppe Santarpino[1,2,3], Giuseppe Filiberto Serraino[3], Pasquale Mastroroberto[3]; Giuseppe Speziale[1]; Giuseppe Nasso[1].

[1]Department of Cardiac Surgery, Anthea Hospital - GVM Care & Research, Bari, Italy
[2]Department of Cardiac Surgery, Paracelsus Medical University, Nuremberg, Germany
[3]Cardiac Surgery Unit, Department of Experimental and Clinical Medicine-University "Magna Graecia" of Catanzaro, Italy

Background : Elevated plasma free hemoglobin is associated with multi-organ injury. In this context, minimally invasive extracorporeal technologies represent a way to reduce this complication following cardiac surgery.
Methods : We present a pilot study focused on plasma free hemoglobin levels in 40 patients undergoing isolated coronary artery bypass grafting (CABG) . The same circuits for minimally invasive extracorporeal circulation (MiECC) were used in all patients. The ECMOLIFE magnetic levitation pump was used in the study group (n=20), and the AP40 Affinity CP centrifugal blood pump was used in the control group (n=20).
Results : In the immediate postoperative period, plasma free hemoglobin (PFH) and lactate dehydrogenase (LDH) were significantly lower in the study group than in the control group (10.6±0.7 vs 19.9±0.3 mg/dL, p=0.034; and 99.16±1.7 vs 139.17±1.5 IU/L, p=0.027, respectively). Moreover, patients treated with the magnetic levitation pump showed lower creatinine and indirect bilirubin (0.92 vs 1.29 mg/dL, p=0.030 and 0.6±0.4 vs 1.5±0.9 mg/dL, p=0.022, respectively) at 24 hours after the procedure, and received fewer transfusions during the whole postoperative period (3 vs 9 red blood cell units (RBC), p=0.017).
Conclusion : Our pilot study suggests that the use of magnetically levitated centrifugal pumps for extracorporeal circulation support is associated with a lower risk of hemolysis, though larger studies are warranted to confirm our results.

10.15 - 10.25 The Selection of Prime Constituents for Cardiopulmonary Bypass in the UK and Ireland"

N. Bansal
UK

Introduction

Cardiopulmonary bypass (CPB) is an essential component of modern cardiac surgery. The bypass circuit/CPB exposes the patient to a plethora of unphysiological conditions which undoubtedly evoke inflammatory, immunological, haemodynamic instability and haemolytic responses (1). Whilst most of the aforementioned responses are attributed to the circuit, CPB priming constituents (used to prepare and de-air the CPB circuit) (2) may also contribute to this systemic response (1). During the early years of bypass development, extracorporeal circuits were primed using homologous blood. However, the strain placed upon blood banks to provide multiple units of blood to prime CPB circuits for each patient, prompted the use of asanguineous primes as an alternative strategy in the 1960s (2). A wide variation in CPB priming practices across the UK has been demonstrated by previous studies carried out in 1994 and 2002 (1, 3). Evidence regarding the ideal choice for pump priming practices, particularly with respect to colloid and crystalloid fluids, is conflicting, potentially contributing to the wide variation in practice as previously established. The primary objective of this survey was to determine pump priming preferences in the UK and Ireland in order to determine if pump priming practices have evolved since previous similar studies have been carried out, and the factors which may have influenced any changes made to CPB priming protocols.

Methods

An online 10-question survey was distributed amongst 52 chief clinical perfusion scientists across the UK and Ireland. The questionnaire stated that respondents were to answer the questions based upon their routine prime used for CPB, as stated in their department protocols. Questions were broadly categorised to assess 3 different areas, the types and volumes of solutions used,

priming protocol modifications and the rationale behind current routine priming protocols. The survey remained open for 1.5 months.

Main results

A total of 27 responses were analysed (response rate of 52%). No 2 units across the UK and Ireland use the same prime, with a majority of centres' priming protocols being influenced by 'historical beliefs' or have been altered over the past decade on an anecdotal basis. 100% of respondents reported the use of a crystalloid component in their prime; however, the use of colloids in combination with crystalloids has increased in popularity. Heparin was the most commonly used additive (100%), followed by mannitol (62.9%). Modifications were made to CPB prime according to the type of surgery being carried out, with prime volume reduction using retrograde autologous priming and the addition of blood to prime for some patients being amongst some of the most popular prime modifications.

Conclusions

The results of this survey showed that although pump priming preferences have evolved over the last decade, thus suggesting a greater understanding of the impact of prime constituents upon the physiological state of patients. However, there still appears to be a lack of consensus regarding the 'optimal' prime for CPB in the UK and Ireland.

References

1. Lilley A. The selection of priming fluids for cardiopulmonary bypass in the UK and Ireland. Perfusion. 2002 Sep;17(5):315–9.

2. Gu YJ, Boonstra PW. Selection of priming solutions for cardiopulmonary bypass in adults. Multimed Man Cardiothorac Surg MMCTS. 2006 Jan 1;2006(109):mmcts.2005.001198.

3. Hett DA, Smith DC. A survey of priming solutions used for cardiopulmonary bypass. Perfusion. 1994 Jan;9(1):19–22.

INVITED TALK

11.00 - 11.20 Walking the Line: Anticoagulation vs Thrombosis in MCS

Christophe Vandenbriele
Cardiology and Intensive Care, University Hospital Leuven, Belgium

Patients supported with extracorporeal membrane oxygenation (ECMO) or any other form of mechanical circulatory support (MCS) experience a very high frequency of bleeding and ischaemic complications, including stroke and systemic embolism. These patients require systemic anticoagulation, mainly with unfractionated heparin (UFH) to prevent clotting of the circuit and reduce the risk of arterial or venous thrombosis but increasing their bleeding risk. This challenges physicians to find the optimal balance of anticoagulation and therefore, optimal monitoring of anticoagulants is key. Bleeding is not only due to UFH-administration, but also due to shear-stress induced acquired von Willebrand and platelet consumption/consumptive coagulopathy, even further increasing the challenge for treating these precarious critically ill.
Monitoring of UFH can be very challenging. While most centres routinely monitor the activated clotting time and activated partial thromboplastin time (aPTT) to assess UFH, measurement of anti-factor Xa (anti-Xa) level best correlates with heparin dose, and appears to be predictive of circuit thrombosis, although aPTT may be a better predictor of bleeding. Although monitoring of prothrombin time, platelet count and fibrinogen is routinely undertaken to assess haemostasis, there is no clear guidance available regarding the optimal test. Each test has their specific role, strengths and limitations.
Monitoring UFH-levels by a parallel assessment of aPTT/anti-Xa is the preferred way of monitoring UFH in critically ill MCS-patients, supported by rising evidence that mortality augments when aPTT and anti-Xa start to diverge. When the aPTT starts to diverge as compared to anti-Xa, other underlying problems should be explored (hypofibrinogenemia, liver failure, FXI/FXII-consumption, …). This standardized approach might help improving the outcome of this precarious MCS patient population.

INVITED TALK

11.20 - 11.40 Consumption Coagulopathy during ECMO

Matthias Lubnow
University Hospital Regensburg, Germany

INVITED TALK

11.30 – 11.45 ECPR – a Routine for Cardiac Arrest?

Jan Belohlavek
Prague, Czech Republic

11.45 - 12.00 Coordination of ECMO supplies

Mathieu Schmidt, MD, PhD
Pitié-Salpêtrière Hospital, Paris, France

Early on, guidelines for the management of suspected COVID-19 recommend administering venovenous ECMO to eligible patients with COVID-19- related acute respiratory distress syndrome. Recent reports have also confirmed the potential benefits of this technic in selected patients during this pandemic.
The planning of ECMO services during an outbreak of an emerging infectious disease such as COVID-19 can be broadly categorized into ensuring appropriate organisation of personnel, equipment, facilities, and systems. As with any scarce resource in times of high demand, a mismatch in these factors can develop. During the 2009 influenza A(H1N1) pandemic, inadequate surge capacity highlighted the need for intensive-care reserves and improved health-care resource planning at all levels.
To improve ECMO preparedness for an outbreak of an emerging infectious disease, I will highlight the key components of an ECMO action plan to ensure quality care for patients and their families and staff safety and wellbeing. To illustrate, I will describe the ECMO network organization developed during the COVID-19 pandemic in Greater Paris.

12.15 - 12.30 The Use of ECMO during Myocardial Revascularization in Cardiac Catheterization Laboratory: Own Experience

*Loskutov O.A.[1,2], Druzhyna O.M.[1,2], **Maruniak S.R[1,2]**, Kovtun G.I.[1], Todurov B.M.[1]*
[1] - State Institution "Heart Institute Ministry of Health of Ukraine", Kyiv, Ukraine;
[2] - Department of Anesthesiology and Intensive Care, P.L Shupyk National Healthcare University of Ukraine, Kyiv, Ukraine

Introduction. In recent years, the usage of extracorporeal membrane oxygenation (ECMO) has significantly increased in clinical practice. It became an effective method for the treatment of patients with severe cardiac and pulmonary dysfunction that has become resistant to conventional therapy. The aim of this article was to summarize an experience of extracorporeal membrane oxygenation usage for cardiac dysfunction, which develops in patients with coronary heart disease during percutaneous transluminal coronary angioplasty (PTCA).

Materials and methods. The study comprised a retrospective, single-center analysis of 23 patients with coronary heart disease (19 men and 4 women, average age - 65.7±12.3 years), who undertook the extracorporeal membrane oxygenation technique during PTCA. The sampling period was from March 2014 to July 2018. The outcomes assessed included mortality and complication on ECMO: lower extremities ischemia, bleeding, hemolysis; 30-day mortality

Results. Total of 13 (56.52%) patients died directly in the hospital, or 30 days after a discharge. Independent predictors of fatal outcomes were: diabetes mellitus (OR = 17.58; 95% CI = 6.47-47.48; p = 0.00125), chronic renal failure (OR=20.81; 95%CI =5,95-72.21; p=0.00014), and damage to the right coronary artery (OR=25.51; 95%CI=8.27-79.12; p=0.00013). For deceased patients, the "no reflow" phenomenon was indicated in a larger percentage of cases (23.1% in the group of deceased, versus 10% in the group of survivors). A routine connection to extracorporeal membrane oxygenation before the occurrence of cardiac events was significantly more often used in the group of survived patients (90% of cases) compared with the deceased (p=0.0000001).

Conclusions. Diabetes mellitus, chronic renal failure, and damage to the right coronary artery were independent predictors of mortality during percutaneous transluminal coronary angioplasty in patients with coronary heart disease. The number of affected coronary arteries was not a risk factor for death for the examined category of patients. The routine use of extracorporeal membrane oxygenation in high-risk patients with PTCA was a positive prognostic factor of patient survival.

15.00 - 15.15 Management Algorithms and Artificial Intelligence Systems for CPB

Ignazio Condella
Ignazio Condello[1], PhD; Giuseppe Santarpino[1,2,3], MD; Giuseppe Nasso[1], MD; Marco Moscarelli[1], MD; Flavio Fiore[1], MD; Giuseppe Speziale[1], MD.

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Abstract
This article introduces management algorithms to support operators in choosing the best strategy for metabolic management during cardiopulmonary bypass using artificial intelligence systems. We developed algorithms for the identification of the optimal way for assessing metabolic parameters. Different management algorithms for extracorporeal procedures interfaced with metabolic monitoring systems already exist on the market and are applied in clinical practice. These algorithms could provide guidance for selecting the best metabolic strategy with the aim at reducing human error and optimizing management.

Introduction
Extracorporeal circulation devices have become technologically advanced, intuitive and simple. There has been a reduction in size and a qualitative selection of materials and electronic systems, leading to the development of systems for the safe management and monitoring of vital parameters [1,2]. The

tremendous and rapid technological advances that humans have achieved in the last decade have definitely impacted how surgical tasks are performed in the operating room (OR). As a high-tech work environment, the contemporary OR has incorporated novel computational systems into the clinical workflow, aiming to optimize processes and support the surgical team. Artificial intelligence (AI) is increasingly important for surgical decision making to help address diverse sources of information, such as patient risk factors, anatomy, disease natural history, patient values and cost, and assist surgeons and patients to make better predictions regarding the consequences of surgical decisions [3]. Future research on use of AI in the OR should therefore focus on clinical validation of AI applications, the legal and ethical considerations, and on evaluation of implementation trajectory [4]. A console for traditional extracorporeal circulation is equipped with software and hardware that allow (Figure 1): (i) to obtain a bloodless operating field and relaxed heart; (ii) to keep the patient and vital organs alive, ensuring adequate circulation to the tissues through cardiopulmonary bypass (CPB).

There are "new" consoles equipped with:

- electrically powered roller pumps;
- a potentiometer and a touch screen for aspirator management with flow and revolution monitoring; - the administration of the cardioplegia solution
- a master pump (roller or centrifugal type) for flow generation.

The goal of these new technologies is to keep oxygen delivery (DO_2) >285 mL/min/m^2 so as to preserve organ function, particularly renal function [4]. This paper describes management algorithms to support operators in choosing the best strategy for metabolic management during CPB using artificial intelligence (AI) systems.

Classification of artificial intelligence

According to John Searle, a distinguished scholar of language and mind, "the appropriately programmed computer is really a mind, that is to say literally that computers with the right programs understand and have cognitive states". There are different dimensions of intelligence that belong to the strong AI: cognitive intelligence, sensor monitoring intelligence, emotional intelligence, and finally, social intelligence. The most frequent and current uses of AI are in the field of cognitive intelligence for logic, planning, problem solving and autonomy. Despite what is believed, the theory on strong AI has not reached the point that shows that robots can feel emotions, but one day it is possible

that AI may develop a will of its own and have an autonomous conscience [5]. The "weak" definition of AI refers to the evolution and use of AI in very specific fields of application. The weak AI essentially proposes to create artificial systems capable of performing complex tasks, systems that can mimic (simulate) aspects of human cognitive processes but cannot reproduce those same processes (as they are not able to think, nor possess a mind). At this point, modern AI research comes into play in the sense that almost all the current areas of use of robots belong to the so-called weak AI (Figure 2).

Safety

Safety and accident prevention is a fundamental prerequisite for the certification of a biomedical device, which documents the absence of adverse events and accidents during a procedure. In fact, all the devices are equipped with a main control panel with integrated software (with or without touch screen) which provides interactive security control between operators and devices for pressure monitoring, air presence detection, volume monitoring, interlocking of the rotating pumps, blocking or slowing down of pumps, in case of high pressures or for level control, alerts for electrical failures and the use of battery in case of electricity disruption [5].

Training

These are devices most commonly known as simulators, which help operators in the understanding and application of the aspect of safety and are made up of software and hardware with the aim of training operators in the practice and management of CPB, particularly in knowing how to recognize and cope with procedural complications. They consist mainly of a traditional heart-lung machine, interfaced with a simulator controlled by programs that simulate the characteristics of a patient during the procedure [5].

Translation-comprehension and interpretation of parameters

These biomedical devices are developed with the aim of translating and quantifying blood parameters through sensors that use spectrophotometry and ultrasound. These devices integrate the metabolic parameters together for the perfect functioning of the device. There are various devices on the market, very similar to each other, but using different reading methods (mainly the spectrophotometry): some devices use an indirect reading on the cuvettes connected to the polymer tubes while other types connect directly to the tubes

of extracorporeal circulation. The device measures variables which are divided into two macro areas, i.e. measured and derived variables [5].

Measured and derived parameters for metabolic management

Measured parameters: arterio-venous temperature (°C), arterial and venous oxygen saturation (SaO_2-SvO_2; mmHg), partial pressure of arterial and venous oxygen (PaO_2- PvO_2; mmHg), partial pressure of arterial and venous carbon dioxide ($PaCO_2$-$PvCO_2$; mmHg), arterial and venous hemoglobin content (g/dL), main and suction pump flow (L/min-RPM), cardiac index (L/min/m^2), mean arterial pressure (mmHg), central venous pressure (CVP; mmHg), CO_2; (P (E) CO_2) oxygenator exhaust PCO_2 (mmHg), venous return vessel, vacuum-assisted venous drainage with negative pressure (mmHg), electronic clamp for volume management, gaseous micro emboli (µg/L).

Derived parameters: DO_2 (mL/min), flow rate (L/min/m^2), body surface area (m^2), oxygen extraction (%), oxygen consumption (VO_2; mL), systemic vascular resistance index (dyn*s/cm^5). The integration of the variables during extracorporeal circulation with anesthesia parameters (NIRS tissue saturation spectrophotometry, BIS spectrophotometric index on the anesthesia level) allows to have an important metabolic monitoring map.

Algorithm for fluid dynamics management at the beginning of cardiopulmonary bypass

This is an algorithm integrated into the monitoring system that guides the operator in entering the extracorporeal procedure, to allow fluid dynamics and metabolic stability during this delicate phase of the procedure. It is necessary to achieve a good parametric balance in order to guarantee a bloodless surgery. The algorithm includes the principal variables that can be used to achieve the best metabolic management using weak AI [6]. There are basically six main variables: anticoagulation, CVP, cardiac index, oxygenation (PaO_2, $PaCO_2$), and pressure parameters of the machine (safety systems) and of the patient [6].

Model for the quantification of fluid dynamics parameters with the support of artificial intelligence

The flow chart lists the main parameters that allow optimal management of the procedure over time (Algorithm 2). Using the EACTS/EACTA/EBCP guidelines on CPB in adult cardiac surgery [6], anticoagulation before the beginning of CPB is monitored with an activated clotting time (ACT) measured in seconds, the ideal time after heparin administration is >480 s; CVP during the procedure must be

between 0-1 mmHg to guarantee adequate drainage of the right sections; the volume of the ideal venous reserve is included at a full cardiac index between 500 and 800 mL; the ideal value of cardiac index during the initial phase to be effective in the regulation of fluid dynamics is 2.4 L/min/m^2 according to current guidelines. The correct oxygenation parameter is correlated to the oxygenator model and the blood characteristics, ratio of air flow/% of oxygen in relation to blood flow ideal value (PaO_2 >150 mmHg - $PaCO_2$ 40-45 mmHg) [6].
Using the parameters defined by current guidelines in weak AI, it is possible to achieve adequate stability of flow dynamics for metabolic management.

Anticoagulation

The management of anticoagulation is a complex process. There are different types of anticoagulants, therefore it would be appropriate to develop a management algorithm that guarantees the best strategy in the management of anticoagulation. This strategy depends on the type of the monitoring device, the pharmacological approach, and the clinical situation. The algorithm simplifies the management of anticoagulation at the beginning of CPB using simple and conventional measuring instruments such as the ACT (in s) and the reference value of antithrombin III (%). The reference value of ACT in clinical practice, as reported in the scientific literature, is 480 s with administration of heparin sodium of 300-400 IU/kg of body weight [6].

Central venous pressure

CVP is an indirect parameter that allows to monitor the state of volume and hemodynamics of a patient and to diagnose a possible fluid dynamic overload in the presence of CVP values >18 mmHg. At the beginning of the extracorporeal circulation, CVP is a indirect parameter that can be used for evaluating the correct emptying and drainage of the right sections of the heart so as to allow a venous reserve volume capacity to maintain adequate cardiac output and reduce the formation of gaseous micro emboli. The ideal value of CVP at the establishment of CPB is between 0-1 mmHg, if it is >3 mmHg, repositioning of the cannula is necessary to improve CVP. If this maneuver is not sufficient due to, for example, a size mismatch of the cannulas, it can be applied at full flow a live negative pressure of -20 mmHg to improve CVP and indirectly favor drainage of the right sections and increase venous reserve, resulting in better cardiac index and higher availability of oxygen to support aerobic metabolism (Figure 3).

End-tidal CO_2

The end-tidal CO_2 management together with the management of CVP represents the indirect parameter of cardiac output, thus an increase in end-tidal CO_2 correlates with increased cardiac output and, as a result, increased blood in- and outflow from the pulmonary circulation correlates with CVP in non-pathological hemodynamic situations between 7-11 mmHg. Further, a reduction in end-tidal CO_2 concentration correlates with reduced cardiac output entering and leaving the pulmonary circulation with a reduction also in CVP [11].

Venous return

Venous return during extracorporeal circulation using conventional techniques with venous reservoir is a parameter directly dependent on variables describing patient characteristics: the state of hydration, volemia and peripheral vascular resistance. At the beginning of CPB, the correction of venous return during the first minutes does not allow an immediate assessment of the pathophysiological mechanisms that can influence it, therefore for parameters <500 mL/min cardiac index is not supported as it is not adequate to satisfy the metabolic demand of the patient, requiring additional volumes of solutions: colloids for hemoglobin values >11 g/dL and crystalloids for hemoglobin values <11 g/dL, in order to maintain the osmotic colloid pressure without reducing hemoglobin content to transport oxygen and support the flow of circulation [8-13]. Once the volume is stabilized, the operator will increase the cardiac index through the main pump. In the subsequent paragraphs, the algorithms for managing vascular resistance and microcirculation during metabolic management during the pipeline will be presented [7-12].

The cardiac index

The cardiac index is the volume of blood pumped by the heart per minute indexed to square meter of body surface area that is necessary to meet the metabolic demand (with a standard flow rate reported to be 2.4 l/min/m^2 for adults). The cardiac index is one of the key parameters related to oxygen consumption which, in turn, is influenced by body temperature and sedation. The cardiac index is interdependent on many other parameters, such as venous return, vascular resistance, and must be managed and regulated in relation to the parameters of transport and oxygen consumption in order to ensure the correct metabolic balance. The increase in mean systemic arterial pressure, for

a value >80 mmHg could limit the achievement of the cardiac index during extracorporeal procedures. This intuitively leads the operator to decrease the cardiac index to reduce mean arterial pressure, but in this circumstance anesthetic support is required for the selection of the vasodilator and a possible control of the anesthesia plan [6].

Oxygenation index

Oxygenation and carbon dioxide removal are managed in line with the blood flow of the CPB pump. It is a fundamental parameter for calculating DO_2 that supports metabolism, additionally it is an essential parameter for the vital biochemical and cellular processes. This algorithm shows (Figure 4) a recommended good practice to deal with a decrease in arterial saturation (SaO_2) below 100% during CPB [7].

A weak AI could support the perfusionist with possible options that are shown on the monitor for resolving the decrease of oxygenation. A good guidance for correcting SaO_2 values <100% is the following:

-Step 1: Reduce the temperature of the heat exchanger from 36°C to 32°C for the preservation of metabolism,

- Step 2: Check the oxygen air connections,
- Step 3: Check the air-oxygen gas mixer,
- Step 4: Check the connection line between the mixer gas and oxygenator and check for any leaks,
- Step 5: Check the pressure difference between the inlet and outlet of the oxygenator should it be high [8]
- Step 6: If SaO_2 is not 100% use a mechanical ventilation,
- Step 7: Wean the patient from CPB,
- Step 8: If weaning is not possible, the oxygenating module must be replaced.

The perfusionist should click on the monitor every time a suggested step has been performed.

Figure 4 shows an example of support in the management of oxygenation at the beginning of CPB.

Mean arterial pressure

The ideal value of mean arterial pressure during extracorporeal circulation is reported to be between 50 and 70 mmHg. For values <50 mmHg, the first maneuver is to increase the cardiac index and reduce aortic endo-cavitary aspiration. If these maneuvers are not sufficient to increase blood pressure

above 50 mmHg, anesthetic support with the addition of vasoconstrictors or a variation of the anesthetic management plan is required [6].
Figure 5 provides an example of support in the management of mean arterial pressure at the beginning of CPB.

Algorithms for CPB management with AI

In this part of the paper, we present examples of metabolic management that could be implemented using weak AI. These algorithms cover typical metabolic problems (orange color of parameters) and possible corrective solutions (green color indicates the solution) for experienced and non-experienced perfusionists. Goal directed perfusion aims at maintaining the optimal balance between DO_2 and VO_2 during extracorporeal circulation (Figure 6), previously described in a formula. The metabolic activity during CPB in this project is managed with algorithms that exploit the correction of five main variables: 1) volemia; 2) scope; 3) gas exchange; 4) heat exchanges, and 5) control of vascular resistance [10-12]. Figures 6 to 8 show examples of metabolic management through goal directed perfusion during CPB, e.g. in case of thermal exchanges or linked to hemoglobin values [9-10].
As in any new system, this management algorithm has a limitation, in that the system should be validated in further and larger-scale studies that will be undertaken shortly.

Conclusions

The advantage of AI applied to metabolic management during extracorporeal circulation resides in the possibility of integrating the calculated and highly variable metabolic parameters into the monitoring systems. This management system remains flexible to the changes in internal data management parameters that can be expanded and modified by the staff, thus customizing the type of conduct based on the experience of the center. Goal directed perfusion has improved metabolic management resulting in a lower incidence of acute renal failure. However, there have not been systems with algorithms for the identification of the optimal way to resolve metabolic problems. Different management algorithms for extracorporeal procedures interfaced with metabolic monitoring systems already exist on the market and are applied in clinical practice. These algorithms could provide guidance for selecting the best metabolic strategy with the aim at reducing human error and orienting young operators towards optimized management.

15.15 - 15.30 "E-Learning for ECMO Training

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E-learning for education in ECMO

In the last decade, online learning has been developed with growing interest for medical education.

E-learning is defined as any platform available via the Internet that we can use to acquire knowledge.[1] The content is fixed; however, the speed and sequence in which it is completed is entirely determined by the user. In time and space, there is no direct contact with the instructors. Several advantages have already been demonstrated in the literature such as accessibility, ease of use, cost-effectiveness and user satisfaction. [2–4] Online textbooks, podcasts, etc. are not only hip, but they are also easily accessible in a world where the Internet is available everywhere and multimedia is an integral part of everyday life. Compulsory lectures are losing popularity and printed reference books are often already outdated when published. Many students prefer to study at their own pace and at a location of their choice. [2]

Moreover, e-learning allows you to reach large groups, across city and country borders. It is possible to bring together international expertise. Platforms allow for discussion and exchange of knowledge. Linked to this, it is clear that once an e-learning module is developed, the cost is lower.[1,2,4] There is a possibility to provide a standardized method, with attention for continuous training, possibility of feedback and updates over time. Ideally, an e-learning module should have a test attached to it so that participants are motivated to meet the objectives and thus increase participation.

Ruiz et al and de Leeuw et al have highlighted the power of e-learning in medical education in the past. [2,3] Major barriers to the development and implementation of online learning are: 1) the technical skills deficit of educators, 2) Inadequate time to devote to the development and amelioration of the electronic tool, 3) Lack of infrastructure and technology, 4) Poor communication about key skills and methodologies for e-learning, 5) A negative attitude when receiving harsh criticism, when the process seems difficult to use and time-consuming. The institution should ensure that the faculty has a deep

understanding of why the e-learning is beneficial. [5]

Extra Corporeal Membrane Oxygenation (ECMO) can be a life-saving option for the critically ill patients suffering from severe respiratory or circulatory failure. With an international survey , we aimed to generate consensus on essential ECMO skills. These skills will be used for educational purposes: the development of an e-learning program and fine-tuning of the existing ECMO-simulation program at Ghent University Hospital, Belgium. A "two-round Delphi questionnaire" approach was used, this technique is a method for systematic solicitation and collection of judgments on a particular topic. A set of carefully designed sequential questionnaires interspersed with summarized information and feedback of opinions derived from earlier responses was used. [6,7]
Experts from different parts in the world were invited to participate. This Delphi questionnaire was created with the software platform RedCap® (Research Electronic Data Capture, Nashville, Tennessee), topics were chosen from the existing theoretical program and the ELSO guidelines for didactic sessions, completed with new and possible interesting content. Experts working in critical care as physician or nurse and perfusionists participated.
In the first round, experts were asked to score 56 statements about knowledge skills, technical skills, and attitude. The importance of each skill was rated on a 5-point Likert-scale and qualitative comments were made if needed. Based on the information obtained from round one, the Round two Delphi questionnaire was developed.
Statistical analysis was performed using SPSS 26.0 (Statistical Package for the Social Sciences, IBM Company, US), by using non-parametric testing. A statement is considered to be a key competency when the internal consistency shows a Cronbach Alfa score >80% and at least 80% of the experts agreed (rating 4/5) or strongly agreed (rating 5/5) with the statement.
Fifty-four panelists, of the 106 invited, agreed to participate across 13 countries. Response rate in the first round was 88.9% (48/54) and 60.4% (29/48) completed the second round. The mean age was 43 years (min 29 - max 65). The mean level of experience was 12 years. The study consisted of two rounds of questionnaires. The consensus achieved in the first round was 90.9% for the statements about knowledge, 54.5% about technical skills and 75.0% about attitudes, for the second round 94.6% about knowledge skills, 90.9% about technical skills and 75.0% about attitudes.

An expert consensus was accomplished about the content of "ECMO essential skills" amongst physicians, nurses and perfusionists, from geographical Europe and Australia. These results serve now as directive principles for developing E-learning modules and simulated ECMO cases.

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RESEARCH PAPER

15.30– 15.45 State of the Art of Perfusionists in Europe

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INTRODUCTION

The interprofessional collaboration between clinical perfusionists and heart surgeons, anesthesiologists, cardiologists and internists is an integral part of the treatment of patients of all ages with congenital and/or acquired heart problems, chest and vascular diseases. A constant in all European countries, or at least that should be the case. To date, within the various European countries, there is no uniformity regarding the laws to recognize clinical perfusion as a qualified profession with a specific certification. At the national and international level there is no educational standard as an entry requirement to professionally perform clinical perfusion, nor are there any tasks described. Therefore, the gap within each nation and between nations , exists and in some cases is very obvious, but should be filled by common recommendations regarding the required knowledge, special tasks and responsibilities of the clinical perfusionist.

BACKGROUND The use of extracorporeal circulation (ECC) in cardiosurgical patients has been instituted for over 60 years. In the context of the complex treatment processes of these patients, pre-operative, intraoperative and postoperative sub-processes require interdisciplinary cooperation between perfusionists and the medical team of cardiosurgery, anesthesia, cardiology and internal medicine. The cardiosurgeon, anesthesiologist, cardiologist and perfusionist, with their respective areas of expertise, act in a single team with the common goal of successfully treating cardiac patients. The interaction and competence of all personnel involved in cardiac surgery and adequate infrastructure are essential to maintain the quality of treatment and results. The definition of the responsibilities and quality standards, as well as the definition of the knowledge and tasks required for the professional groups concerned are important steps in this context in order to implement a sharing of legal responsibilities, are the basis of a clear division of tasks and the

principle of trust. THE CLINICAL PERFUSIONIST'S SCOPE OF ACTIVITY The clinical perfusionist represents a medical profession that is not limited to the practice of medicine. In addition to medical activities, there are also areas of engineering responsibility that are not part of medical practice. The profession of clinical perfusionist is characterized by the close interweaving of knowledge and basic technical and engineering skills with particular medical knowledge. The activity of the clinical perfusionist is indispensable for the practice of medicine and surgical care by the involved physicians, because it requires skills and knowledge beyond the medical field of competence. In this activity, the clinical perfusionist is guided by internal hospital guidelines or (if available) binding standard operating procedures. The activity of the clinical perfusionist is indispensable for the practice of medicine and surgical treatment by the doctors involved, because it requires skills and knowledge beyond the field of medical competence. Moreover, the clinical perfusionist is responsible for the technical support, maintenance and operational safety of the employed medical devices, taking into account and adhering to the specifications of the Medical Devices Act and potential other statutory regulations. EUROPE Legal recognition Due to the lack of legal regulations at the European level, the European Board of Cardiovascular Perfusion (EBCP) has set itself the goals of defining the competence level of clinical perfusionists with regard to structured training and of establishing the corresponding requirements uniformly throughout Europe. Unfortunately, however, there are completely different situations between European states. In fact, each state and each national association of perfusionists must adhere to different legal norms and training paths for different perfusionists. This often involves a lack of legal and economic recognition of the profession with a consequent "demotion". Qualification of the clinical perfusionist Here too, there are many differences between the various European nations. There are countries in which there is a theoretical-practical training of the university type as in Italy, The Netherlands and the UK, while in countries where training is based on a system of accompanying students with perfusionists already trained and other countries where in recent years the situation is trying to evolve by creating specific courses.

CONCLUSION The obvious differences in terms of training, legislature and recognition mean that there are different statutes in Europe with different responsibilities. First of all, we should see the differences within each country,

so that there are clearer regulations in every respect; and secondly, we could think of making European recognition valid in all countries equally. Of course, it would bring about a unification of recognition, of tasks and consequently of responsibilities, a little like in the US system

15.45 - 16.00 "European Perfusion Guidelines: Where are we now?

Alexander Wahba
Norway

Introduction/Aims: Veno-venous extracorporeal membrane oxygenation (VV ECMO) represents a rescue strategy in acute respiratory distress syndrome (ARDS) not responding to conventional therapies, permitting ultra-protective ventilation. The ECMO membrane lung (ML) replace failing native lung (NL), completely or partially according to the patient's needs. Evaluation of gas exchange partitioning between ML and NL could represent a useful clinical tool to monitor ECMO support level and to guide patient's extracorporeal weaning.

***Methods*:** We included 35 VV ECMO patients (52.3±14.0 years, 31.4% males) in this multicentric pilot study. We measured total patient carbon dioxide elimination ($V'CO_2tot$) both from ML and NL (*ml/min*). $V'CO_2ML$ was calculated from ML sweep gas flow and CO_2 concentration at ML gas in mechanical ventilator integrating volumetric capnometry.

Results: For every patient we considered the ratio $V'CO_2NL$ ($rV'CO_2NL$): the relationship (*percentage*, *%*) between $V'CO_2NL$ e $V'CO_2tot$. We studied two different groups: ECMO-weaned patients (28) and patients who died on ECMO (7). In the last day of ECMO support $rV'CO_2NL$ was 59±7% for ECMO weaned patients, while 41±14% for patients who died on ECMO ($p<0.02$). Moreover ROC curve of $rV'CO_2NL$ (see figure 1) shows a predictability on ECMO weaning (AUC until 0.79).

Conclusions: Monitoring of $rV'CO_2NL$ could represent an interesting instrument to guide lung rest on ECMO and it could guide physician during ECMO weaning. Further investigations are needed to confirm its role in this context.

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