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Original Article

Some Remarks on Preliminary Effectiveness of Vein to Vein Extracorporeal Membrane Oxygenation in Management of Serious Acute Respiratory Distress Syndrome at Bach Mai Hospital

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Abstract

Purpose: **Until now ARDS (Acute Respiratory Distress Syndrome) mortality rate remained as high at 40 to 60%. If applicable ECMO for cases that do not meet ventilation achieving, survival rates was improved from 50 to 70%. We evaluate the technical efficiency ECMO venous-venous (ECMO V-V) in the treatment of patients with severe ARDS.**

Materials and Methods: **Fifteen patients with ARDS without chronic disease, serious bleeding supported with ECMO venous - venous with ECA PaO_2 / FiO_2 <80, at the Intensive Care Unit Bach Mai Hospital enrolled.**

Results: **The mean age 45.7 ± 15.7 years (youngest 18, oldest 70), male / female = 8/7. APACHE II and SOFA Score: 16.2 ± 5.0 and 7.7 ± 3.4. ARDS may cause 4/15 (26.6%), bacterial, 2 cases of TB, viral 2/15, 11/15 (73.3%) do not see the root microorganisms. Ratio PaO_2 / FiO_2 before ECMO 58.4 ± 12.8 (37-78), while 10.2 ± 6.1 ECMO support (4-28 days). ECMO successful withdrawal rate 11/15 (73.3%), the survival rate 10/15 (66.7%), deaths 5/10 (33.3%). Some complications: bleeding catheter site 5/15 (33.3%) and wound infections 3/15 (20%) are the most common. 10.2 ± 6.1 time day ECMO.**

Conclusions: **ECMO V - V initially showed to be effective in treating severe ARDS. More research needs to be grounded on application as well.**

Keywords: **ECMO, ARDS, managememt of patients with severe ARDS**

Introduction

ARDS - Acute Respiratory Distress Syndrome is a common pathological which needs to care the Intensive care unit. Despite many advances in treatment, but mortality in patients with ARDS are reported through studies still up to 40-60%. Technique of ECMO - Extracorporeal Membrane Oxygenation is the last measure in managing the severe ARDS disease, does not respond to ventilation. The world has more than 100 centers perform ECMO in adults: proportion

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survival have been indicated to treat by ECMO below 35%, today's higher than 50 to 60%[1-3,5-8].

Now aday in Vietnam, ARDS were treated in major centers such as Bach Mai, one of the biggest medical centers in Vietnam. However, the mortality remains high, especially with the case of ARDS due to severity and progress, bleeding, do not respond to the artifficial ventilation. Since being introduced ECMO treatment of complex cases of ARDS patients have been survived. Therefore, we conduct the study aiming to assess the effectiveness of ECMO technique for the treatment of syndrome of ARDS and make recommendation for applying in the medical facilities.

Materials and Methods

Subjects

15 patients were diagnosed with ARDS as defined Berlin 2012, the severity of ARDS. The severity was defined as $PaO_2/FiO_2 \leq 100$ in ≥ 5 cmH_2O PEEP, severe ARDS does not respond to the methods of artificial ventilation optimal index: $PaO_2/FIO_2 < 80$ with $FIO_2 > 80\%$ prolonged > 3h or pH <7.25 (increased frequency ventilator to 35 times / minute) with Pplat <32 cm H_2O PEEP $\geq$ 10 cmH_2O in.

Exclusion criteria are the patients with chronic inability to recover and / or have contraindications to anticoagulation, thrombus in the jugular.

Methods

A prospective study, described clinically documented patient information form.

ARDS patients are resuscitation and treatment as recommended updates ARDS network, all the patients were mobilized by the method CPAP alveolar 40/40. Patients supported ECMO intravenous methods by two canul single vein. Way out taking blood from the femoral vein, the way into the right jugular vein.

Adjusting the ventilator at a minimum frequency 8l/f, VT placed 5 ml/kg, PEEP 8-15, keeping Pplateau <25.

Results

From January/2014 to August/2016 there are 15 ARDS qualified, supported by ECMO machine manner veins - veins, including 8 men and 7 women with mean age 45.7 ± 15, 7 (youngist 18 years old and oldest 70 years old). Cause of ARDS are 4/15 (26.6%) by bacteria, including 02 cases of tuberculosis, viral absence 2/15, 11/15 (73.3%) do not see the root microorganisms. 13/15 (86.7%) used a membrane ECMO, 2/15 (13.3%) to replace the 2nd ECMO membrane.

Survival patients are 10/15, accounting 66.7%, and died 5/10 accounting 33.3%, however there were 4/15 accounting 26.7% not ruled by ECMO due to irreversible serious lung pathology. Of the 10 patients were survived, 1 death after the 10th day after stopping ECMO by the nosocomial infection. 11/15 (73.3%) ECMO was stopped, however there were 4/15 (26.7%) not ruled due to irrrversible lung lesions.

General features ARDS patient groups before ECMO support.

5/15 (33.3%), pneumonia, ARDS severe circulatory failure was indicated for vasoactive drugs, the average dose is not high.

Features ARDS severe hypoxemia

Patients have P/F under 80, although much reduced compliance ventilated with alveolar mobilization measures, according to protocol ARDSnetwork high PEEP.

The change in the patient's blood oxygen ARDS

Chart 1 Changes in FiO2 ventilator during ECMO

Immediately after ECMO reduced oxygen breathing apparatus, ensuring PaO_2 58-80 as recommended by ARDSnetwork. After 2 days, FiO2 machine has recuded in the 5th day,100% reduction of around 50%.

Chart 2 Changes in PaO_2 after ECMO

10 ECMO patients were used ECMO in 5 days, 5 have been applied for 6 to 9 days, PaO_2 improved immediately after ECMO, with FiO_2 decreased 63.5 ± 27.9% at The change in the expansion of the lungs during ECMO.

Chart 3 Changes compliance

Expansion of lungl improved from day 4 to day 7, with the ventilator parameter settings for the lungs at rest with VT 4-5 ml/kg, frequenc 8.

Duration of ECMO application and common complications.

Chart 4 Distribution of cases by time supporting with ECMO

Table 1 Characteristics of the study group

Characteristics	Average ± Bias	Lowest - Highest
Pulse (rates/minute)	127,8 ± 21,0	98 - 160
Systolic blood pressure (mmHg)	118,0 ± 8,7	110 - 140
Diastolic blood pressure (mmHg)	65,0 ± 10,8	50 - 80
Urine (ml/h)	166,0 ± 110,0	60 - 400
proBNP (pcmol/L)	129,9 ± 89,9	21 - 248
Urea (mmol/l)	5,1 ± 2,7	2,5 - 10,9
Creatinin (µmol/l)	96,0 ± 38,6	51 - 152
Total bilirubin (µmol/l)	13,5 ± 3,7	9,7 - 19,9
White blood cell (G/L)	11,3 ± 5,9	4,8 - 23,0
Procalcitonin (ng/mL)	26,9 ± 41,9	0,33 - 100,0
SOFA	7,7 ± 3,4	3 - 12
APACHE II	16,2 ± 5,0	6 - 23
Lactat (mmol/l)	2,5 ± 1,9	0,9 - 6,7
Vasopressor dose (µg/kg/p)(n =5)	0,44 ± 0,23	0,2 - 0,8

Table 2 Characteristics of severe ARDS

Characteristics	Average ± Bias	Lowest - Highest
PaO_2/FiO_2	58,4 ± 12,8	37 - 78
$PaCO_2$ (mmHg)	41,6 ± 13,5	22 - 68
pH	7,37 ± 0,89	7,20 - 7,46
PEEP (cmH_2O)	15.6 ± 2,0	10 - 18
Compliance	17,6 ± 4,0	11 - 25
The time from when sick until at science HSTC (days) 7.0 ± 6.5 2-27	7,0 ± 6,5	2 - 27
Duration of ventilation before ECMO (day)	2,1 ± 2,5	0,5 - 7
Lenght stay in ICU (day)	21,9 ± 9,1	12 - 45

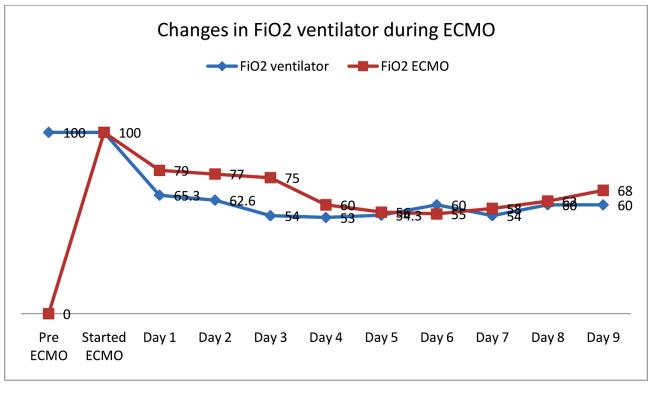

Figure 1

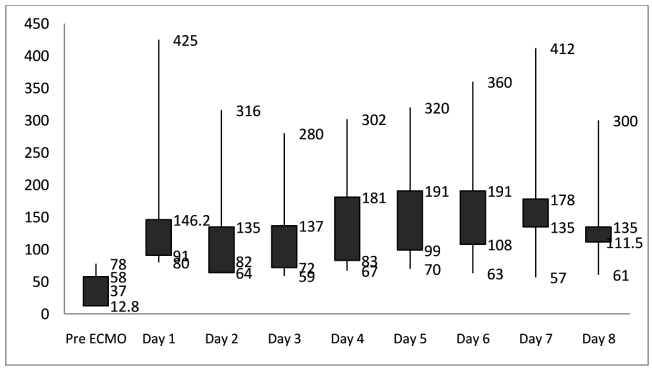

Figure 2

The average time of 10.2 ± 6.1 ECMO day (4-28). 6/14 (40%) stop ECMO 7 days, 12/15 (80%) stop ECMO before 11 days.

Common complications.

5/15 (33.3%), bleeding (bleeding catheter 3 cases, lung in 1 case) multi-organ failure 2/15 (13.3%), shock 3/15 (20%), arrhythmias 1 / 15 (6.7%), rupture of 1/15 (6.7%), extubation ofECMO 1/15 (6.7%), nosocomial infections 3/15 (20%).

Discussion

The average age in the study group, 45.7 ± 15.7 years old (minimum 18 oldest is 70). The results of the other study c as Le Duc Nhan 49.4 ± 20.4 years old[9], Ng

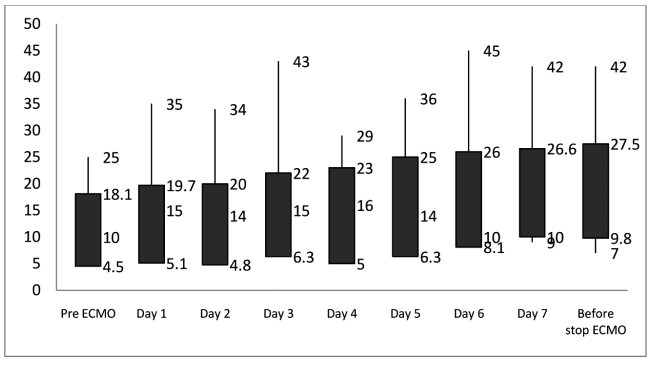

Figure 3

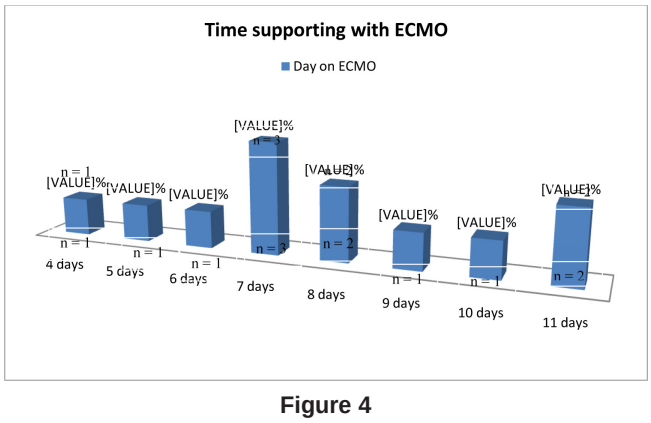

Figure 4

and Leung G.WY..KH 42.3 ± 14.1 years old[5].

APACHE II Score average 16.2 ± 5.0 (6-23 points) and point 7.7 ± 3.4 average SOFA (lowest 3 and Highest 12), in the study of Le Duc Nhan: were 21.1 ± 3.2 and 9.2 ± 2.5[9].

The average duration of ventilation before ECMO application were 2.1 ± 2.5 (0.5 to 7 days), average time supported by ECMO were 10.2 ± 6.1 day (from 4-28 days). Average length stay in ICU is 21.9 ± 9.1 (12-45 days). In the study of Zangrillo. A, SOFA average scores was 9, and the average duration of ventilation before ECMO support was 2 days, while the average day for ECMO was 10 days[10].

According to Davis A, period average ECMO support was 10 days (7-15) while Moore SA time ECMO support was 12,2 days (from 1 to 56 days)[11].

Features of severe ARDS group supported ECMO

Blood oxygen characteristics:

Before and at the start of ECMO support, 100% of patients were ventilated with FiO_2 100%, but the ratio P/F before ECMO 58.4 ± 12.8 (37-78) with a 15.6 average PEEP ± 2, 0 cmH_2O (10-18). In the study of Davis A et al before ECMO although optimal ventilator support but the ratio P/F average 56 (48-63) with PEEP average of 18 (15-20)[4].

Immediately after using ECMO reduced oxygen breathing apparatus, after 2 days, FiO_2 ECMO machine has reduced the 5th day, 100% reduction of around 50%.

The ratio P / F improved immediately after ECMO at PEEP 8, VT ventilator 5 ml / kg, 10/15 (66.7%) to the 5th ruler is ECMO.

Dilatometric (Compliance) lung:

Is a very important parameter to assess the expansion of lung damage. In our study, the expansion rate of lung was very low as 17.6 ± 4.0 ml / cmH_2O (11-25).

Outcomes of treatment:

Stoped ECMO successful in 11/15 cases (73.3%), however there were 4/15 (26.7%) which did not rule due to lung damage irreversible.

Survival were 10/15 (66.7%), deaths 5/10 (33.3%). Of the 10 patients are survived, one death after 10 days due to nosocomial infections. In the series of Davis, 68 patients accounting in 78% stopped ECMO successful, 13% of patients died during ECMO, the survival rate after detoxification ECMO was 71%, mortality 24%, discharge is 47%[4]. This result in our study is lower than the Davis A, possibly because our data is low. According to Moor SA, the pregnant patients survived whom required ECMO support was 77.8%[11].

Complications:

Bleeding is the most common complication, 5/15 (33.3%), including catheter sites bleeding 3 cases, the lungs 1 ca. Multi-organ failure 2/15 (13.3%), shock 3/15 (20%), arrhythmias 1/15 (6.7%), rupture of 1/15 (6.7%), extubation ECMO 1/15 (6.7%), nosocomial infections 3/15 (20%).

In series of Cheng. R, when applying the ECMO to support the cardiology shock, the complications are bleeding in 9.6%, infections in 15.9%, kidney failure in 30.8%[12].

According to Zangrillo A: The most common complication of kidney failure need hemodialysis continuously accounted for 52%, 33% infection, bleeding 33%, 29% ECMO membrane replacement[10]. In our study no kidney failure, other than the Zangrillo study because the author combinated analysis cardiogenic shock patients included. Bleeding complications in our series are the same of Zangrillo A,

but other complications may be lower due to our data less.

Conclusions

Despite the advances in medical management and resuscitation, the treatement of patients with ARDS particularly severe cases, bleeding complications is difficult and high mortality. The application of ECMO veins - veins initially showed to be effective in treating severe ARDS receiving artifficial ventilation does not respond. Reference studies worldwide show that this is technically feasible and effective in the treatment of ARDS and pathological use is recommended.

REFERENCES

1. Rubenfeld G, Caldwell E, Peabody E, et al. Incidence and outcomes of acute lung injury. N Engl J Med 2005;353:1685-93.
2. Eachempati SR, Hydo LJ, Shou J, Barie PS. Outcomes of acute respiratory distress syndrome (ARDS) in elderly patients. J Trauma 2007;63:344-50.
3. Estenssoro E, Dubin A, Laffaire E, et al. Incidence, clinical course, and outcome in 217 patients with acute respiratory distress syndrome. Crit Care Med 2002;30:2450.
4. Davies A, Jones D, Bailey M, et al. Extracorporeal membrane oxygenation for 2009 Influenza A(H1N1) acute respiratory distress syndrome. JAMA 2009;302:1888-95.
5. George WY Ng, Leung AKH, Sin SY, et al. Three-year experience of using venovenous extracorporeal membrane oxygenation for patients with severe respiratory failure. Hong Kong Med J 2014;20:407-12.
6. Hemmila MR, Rowe SA, Boules TN, et al. Extracorporeal life support for severe acute respiratory distress syndrome in adults. Ann Surg 2004;240:595.
7. Ullrich R, Lorber C, Röder G, et al. Controlled airway pressure therapy, nitric oxide inhalation, prone position, and extracorporeal membrane oxygenation (ECMO) as components of an integrated approach to ARDS. Anesthesiology 1999;91:1577.
8. Brogan TV, Thiagarajan RR, Rycus PT, et al. Extracorporeal membrane oxygenation in adults with severe respiratory failure: a multi-center database. Intensive Care Med 1999;35:2105.
9. Lec Nhun, Vu Van Dinh, Nguyen Dat Anh. Evaluating the effectiveness of artifficial ventilation by lung expansioné technique in treatment of respiratory distress progression. Practical Medicine Journal 2011;9:98-102.
10. Zangrillo A, Biondi-Zoccai G, Landoni G, et al. Extracorporeal membrane oxygenation (ECMO) in patients with H1N1 influenza infection: a systematic review and meta-analysis including 8 studies and 266 patients receiving ECMO. Crit Care 2013; 13;17.
11. Moore SA, Diet CA, Coleman DM .Extracorporeal life support during pregnancy. J Thorac Cardiovasc Surg 2016;151.
12. Cheng R, Hachamovitch R, Kittleson M, et al. Complications of extracorporeal membrane oxygenation for treatment of cardiogenic shock and cardiac arrest: a meta-analysis of 1,866 adult patients. Ann Thorac Surg 2014;97:610-6.