Jurnal Medical Aradean (Arad Medical Journal)
Vol. XX, issue 3, 2017, pp. 5-8

CO2 EXTRACORPOREAL TREATMENT. AN EFFECTIVE METHOD OF RESPIRATORY SUPPORT FOR PATIENTS PRESENTING EXACERBATION OF CHRONIC OBSTRUCTIVE PULMONARY DISEASE: CLINICAL CASE PRESENTATION

Nicolescu Cristian[1,2] Moldovan Silviu[1] Firu Liviu[1,2] Crisan Adrian[1,2] Moca Maria[1] Pop Alexandru[2]

[1]-Arad County Clinical Hospital
[2]-"Vasile Goldis" Western University of Arad

ABSTRACT. This article presents the case of a patient with exacerbation of chronic respiratory failure due to exacerbations of chronic obstructive pulmonary disease (COPD), possibly secondary to a viral infection. The purpose of this paper is to highlight the effective method of decarboxylation, Co2 (EECO2) extracorporeal treatment compared with non-invasive ventilation method that has been used for years in ICUs.
KEYWORDS: Exacerbation of chronic respiratory failure, chronic obstructive pulmonary disease, non-invasive ventilation, decarboxylation.

INTRODUCTION

CO2 extracorporeal treatment -decarboxylation is based on the high diffusion coefficient of CO2 [1], 20 times higher compared to O2, this coefficient is directly proportional to the solubility of the gas in the liquid, and inversely proportional to the square of the molecular weight. This feature of the CO2 makes possible the rapid traverse to a lower pressure gradient (approximately 5 cm H2O) of the molecule through the alveolo-capillary membrane [2], resulting in CO2 a diffusible pulmonary capacity of 400ml / min / m2. [3]

EECO2 is an invasive method which involves installing a double lumen venous central catheter, at least 13 Fr, usually into the femoral vein [4.5], the blood is brought by a cartridge blood pump containing a filter that is made of propylmethylpentan, with an area of 1.8 m2 and coated with a surfactant phosphorylcholine [6]. This filter is thought to have the role of alveolocapillary membrane [7], which diffuses CO2 and subsequently removes it from the organism. The image below shows the EECO2 device ProLung which performs, after having fitted the kit and the filter and circuit have been activated [8].

The process employed may record the removal of C02 by measuring the expiratory flow of CO2 by Prolung -meter, the elimination of CO2 depends on blood flow provided by the blood pump [9], the maximum value being 400 ml/min,[10] and by the air flow intake - the maximum value of 15L/min [11]. The purpose of this

Jurnal Medical Aradean (Arad Medical Journal)
Vol. XX, issue 3, 2017, pp. 5-8

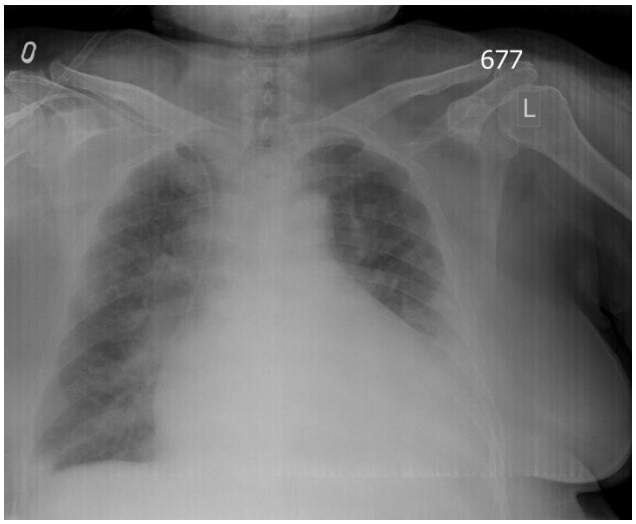
procedure is to remove CO2 at a higher constant flow of over 100 ml/min [12].

Decarboxylation requires, as any purification procedure, systemic anticoagulation with heparin administration (bolus or continuous) monitoring APTT - maintaining it within the range of 60-80 sec, this process can be used up to 5 days. [13]

MATERIAL

Is represented by P.R., 61 year old patient, who was admitted to the ICU emergency. On admission the patient is sleepy with a Glasgow score of about 13 (R.V3, R.M6, R.O4) is hemodynamically stable, and perioral cyanosis of the extremities shows, as well as a degree of shortness of breath. Listeners can detect a murmur vesicular overly attached, tightened without the crackles. Anamnesis shows that the patient presented last week, at home, episodes of cough with fever for which she took anti-inflamatory medication, antipyretic and antibiotic, and that she is known to have COPD for many years, for which they administer O2 at home.

Laboratory samples are as follows: leukocytes 5,600, urea 45 mg/dl, created 1.11mg/dl, Glucose 137 mg /dl, Hg23 g/dl, Ht 63% Astrupp parameters indicating respiratory acidosis pH of 7.22, pCO2 120 mmHg pO2, 88mmhg , HCo3-50.3meq,.lactic ac 0.57 mg/dl. Chest radiography (see picture below).



Interpretation Rx./ right subclavian catheter. Intercleidohilar buckling right infrahilarar right. Peribronhovascular emphasized bilateral interstitial perihilar. Cord diameter increased rack and wiped aortic button.

Eco cord- right ventricle dilated 3.6 cm diameter. in diast., moderate tricuspid regurgitation, pulmonary artery voltage of 56 mmHg, the left ventricle increased in volume, with a diameter of 5.6 cm in diastole, but with an ejection fraction 50%

The following diagnoses is established:
- chronic obstructive stage 4 bronchopneumonia
- chronic exacerbation of respiratory failure
- global heart failure NYHA 4
- chronic pulmonary heart
- tricuspid insufficiency
- average Pulmonary Hypertension
- hypercapnia encephalopathy
- pneumonia, possible viral aetiology
- stage III Obesity

The non-invasive ventilation therapy is established - using BiPAP non-invasive manner simultaneously with antibioterapia- cefoperazone-sulbactam 2 moxifloxacin 500 mg GLA and 12 hour day, oseltamivir at 12 hour 1TB, 125 mg methylprednisolone cortico-therapy- initially intravenous infusion, then 50 mg i.v slow at 6 hours, with declining doses after 3 days bronchodilatory treatment consisting of salbutamol six puffs each (90ug / puff) 6h combined with Miofilin 125 mg each intravenous infusion at 12 hours, corticosteroid inhalation consisting of Simbicort 1 puff each at 12h , ranitidine 50 mg i.v gastric protection at 12 hours and I sc Fraxiparine 0.6ml ampoule per day, for the prophylaxis of venous thromboembolism. The patient is monitored clinically and in terms of parameters Astrupp, tracheobronchial secretions are collected.

At 24 hours from the beginning of intensive respiratory and non-invasive ventilator therapy it is a slight improvement observed, clinical and laboratory pCO2 of 85 mmHg and pO2 120 mm Hg, 7.36 pH, but after 3 days the patient's condition worsens despite non-invasive ventilation and respiratory intensive treatment, showing profound drowsiness, 115 mmHg and pH of 7.23, thus the decarboxylation process is set which consists of CO2 extracorporeal treatment using the Pro-Long device.

METHOD

To detect the efficiency of the process of decarboxylation, in this clinical case, it was determined at equal time intervals the pCO2 and pH values, in the case of the two methods of non-invasive ventilatory support versus the decarboxylation process. The tables and charts below present the comparison of these values.

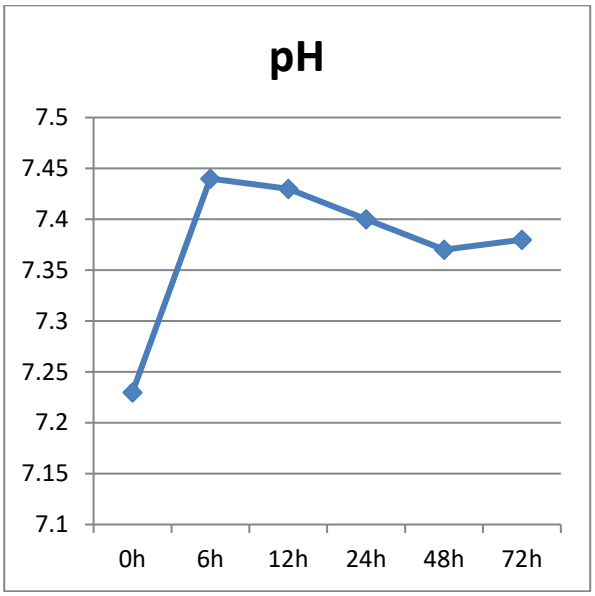
RESULTS

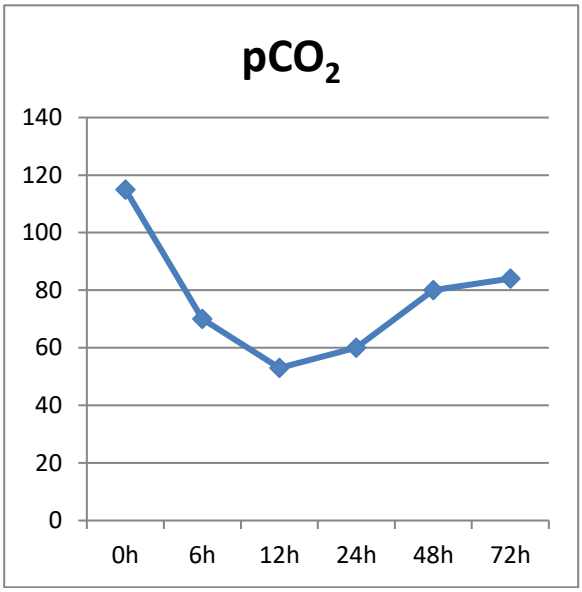
The table below shows the values of pH and pCO2 in the case of using decarboxylation process.

HOUR	00	06h	12h	24h	48h	72h
pH	7.23	7.44	7.43	7.40	7.37	7.38

pCO_2	115	70	53	60	80	84

The charts below are variations in pH and pCO2 in the case of the decarboxylation procedure, there is a rapid drop of CO2 in blood in the first hour with increasing pH, followed by a stabilization of pCO2 at around 80 mm Hg with a pH in the normal value range. Well mentioned, this pCO2 value was well tolerated by the patient, allowing a favorable evolution. The inspiratory air flow was initially at 10L/min, subsequently dropped to 6L/min, then after 24 hours it was increased to 14L/min to ensure a constant CO2 removal of 100ml / min, the blood pump flow being maintained at 200ml/min.

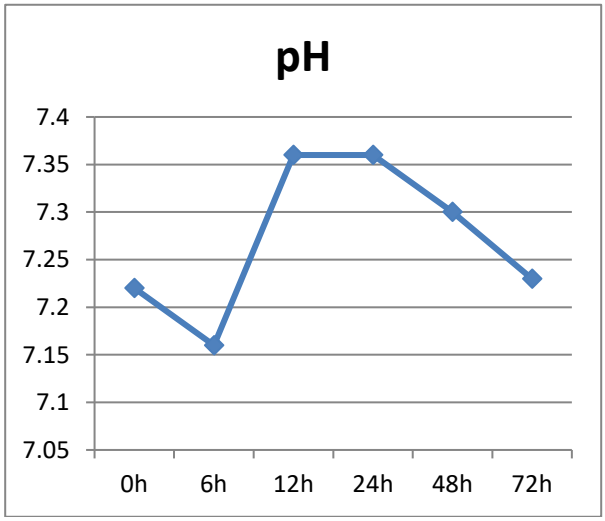


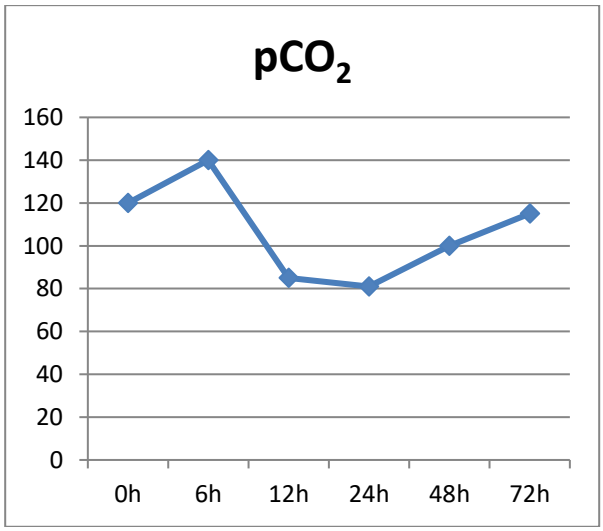


The table below represents the variation pCO2 and pH in non-invasive ventilation.

HOUR	**00**	**06h**	**12h**	**24h**	**48h**	**72h**
pH	7.22	7.16	7.36	7.36	7.3	7.23
pCO_2	120	140	85	81	100	115

The graphs below represent the variation in pH and pCO2 in the case of non-invasive ventilation, it is observed that after a slight improvement, pCO2 starts to increase reaching a value 115 mmHg, which was poorly tolerated by patients and that determined a pH of 7.24, therefore a decarboxylation procedure needed to be established.





CONCLUSIONS

In the case of this patient, the invasive extracorporeal CO2 removal procedure -decarboxylation, which was established when non-invasive ventilation failed, allowed a favorable evolution, in that it allowed an efficient and controlled removal of CO2 and thus avoided orotracheal intubation and mechanical ventilation.

Clearly decarboxylation, as well as mechanical ventilation (invasive or non-invasive), need to be regarded as therapy for respiratory support, such as anti-infectives, anti-inflammatory, bronchodilator, nutritional support and the rest of the respiratory therapy adjuvant remain important as well in the evolution of these cases.

BIBLIOGRAPHY

1.Dantzger DR.Pulmonary gas exchange In.dantzger Dr, Cardiopulmary critical care .22nd ed.Philadelphia Wb saunders 1991,25-43

2.Lanken PN,Ventilation-perfusion relationships In.Grippi MA,ed.pulmonary pathophysiology Philladelphia JB Lippincott 1995,195-210

3.D'Alonzo GE,dantzger DR.Mechanisms of abnormal gas exchange.Med. Clin.north.Am. 1983, 67.557-571

4. Matthay MA, Zimmerman GA, Esmon C, Bhattacharya J, Coller B, Doerschuk CM, et al. Future Research Directions in Acute Lung Injury: Summary of a National Heart, Lung, and Blood Institute Working Group. Am J Respir Crit Care Med 2003; 167(7):1027-35.

5.The Acute Respiratory Distress Syndrome Network. Ventilation with lower tidal volumes as compared with traditional tidal volumes for acute lung injury and the acute respiratory distress syndrome. N Engl J Med 2000; 342(18):1301-8.

6. Thompson BT, Hayden D, Matthay MA, Brower R, Parsons PE. Clinicians' approaches to mechanical ventilation in acute lung injury and ARDS. Chest 2001; 120(5):1622-7.

7. Hoeper MM, Welte T. Extracorporeal lung assist: more than kicking a dead horse? Eur Respir J 2008; 32(6):1431-2.

8. Gattinioni L, Kolbow T, Tomlison T, IAPICHINO G, SAMAJA M, WHITE D et al. Low-frequency positive pressure ventilation with extracorporeal carbon dioxide removal (LFPPV-ECCO2R): An experimental study. Anesth Analg 1978; 57(4):470-7.

9. Bein T, Weber F, Philipp A, Prasser C, Pfeifer M, Schmid FX et al. A new pumpless extracorporeal interventional lung assist in critical hypoxemia / hypercapnia. Critical Care Medicine 2006; 34(5):1372-1347

10. Calfee CS, Matthay MA. Nonventilatory treatments for acute lung injury and ARDS. Chest 2007; 131(3):913-20

11. Matthay MA. Treatment of acute lung injury: clinical and experimental studies. Proc Am Thorac Soc 2008; 5(3):297-9.

12.Barlett RH,Rollof DW,Custer jr Extracorporeal life supportZ:The experience of Michingan University
JAMA 2000,283,904-908

13.Bein th,Weber F,Phillip A,PrasserC,PfeifferM,Schimd FX,Butz B,Birnabaum D,Tager K,Schillt HJ A new pumpless extracorporeal interventional lung assist in critical hypoxemia/hypercapnia crit.Care Med.2006,1372-1377