

Emergency Portable Pump Oxygenation

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Abstract

(*J. Extra-Corpor. Technol.* 19[1] p. 228-230 Summer 1987). This report describes the successful use of emergency portable pump oxygenation (EPO) for a patient with critical aortic stenosis and severe hypotension. Portable pump oxygenation was used in the case of an 82-year-old female who manifested marked hypotension (40 mmHg. systolic), ventricular fibrillation, and acute pulmonary edema during a cardiac catheterization procedure. Cardiopulmonary bypass was initiated via femoral cannulation in the catheterization laboratory. The patient was then transported, along with the EPO apparatus, to the surgery suite where she underwent emergency aortic valve replacement. Total EPO time was 45 minutes. After an uneventful hospital stay, the patient was discharged home on postoperative day number 11.

Introduction

Cardiopulmonary bypass (CPB) in itself is a challenging and sometimes precarious aspect of health care technology. This is especially true when CPB is attempted on a portable or mobile basis. The margin for error in EPO is small. Away from the operating room environment, with limited available equipment, the perfusionist must become increasingly self-reliant. Proficiency with all equipment utilized in the EPO attempt proves to be an important success factor in the procedure.

It has been our experience in two attempts that time is the crucial factor in the success or failure of emergency portable pump oxygenation. The sooner EPO

can be initiated on patients warranting this treatment, the better their chance of survival appears to be. However, it is vital to mention here that the importance of teamwork and cooperation among these personnel involved in an EPO attempt cannot be overemphasized.

Case Report

An 82-year-old female with a long history of angina and heart murmur was admitted to The Milton S. Hershey Medical Center to undergo cardiac catheterization. In April 1980, the patient developed pulmonary edema and suffered a cardiac arrest from which she was resuscitated. She had done relatively well since that time until a recent onset of progressive heart failure, paroxysmal nocturnal dyspnea and rest angina.

On admission to the catheterization laboratory, the patient's blood pressure was 100/60 mmHg., pulse 86/minute and regular, and the echocardiogram showed calcification of the aortic valve and calcific mitral annulus. Precatheterization laboratory studies revealed sodium 141 mmol/L, potassium 4.4 mmol/L, hemoglobin 12.7 gm/dl, hematocrit 36.4%, platelet count 290,000/mm³, prothrombin time 11.4 seconds, and partial thromboplastin time 31 seconds.

After receiving 5 mg. of diazepam as a premedication, a #20 gauge catheter was inserted into the left brachial artery for blood pressure monitoring. The right femoral cannulation site was prepped and draped, and using 1% xylocaine, the right femoral vein was entered using percutaneous technique. A 7 Fr. Swan-Ganz balloon-tipped, flow-directed, thermodilution catheter was used to perform right heart catheterization and was left positioned in the pulmonary artery. The pulmonary artery pressure was elevated at 60/28 mmHg. with a mean pressure of 34 mmHg., the right ventricular pressures were elevated at 60/9 mmHg.

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with a mean pressure of 27 mmHg., and the pulmonary artery wedge pressure reading showed a mean of 26 mmHg. The left ventricular pressure was noted to be 165/28 mmHg. Left ventricular cineangiography was then undertaken using 40ml. of radio-opaque dye at 12 ml/sec.

After the ventriculogram, the patient became acutely hypotensive with a systolic blood pressure of 40 mmHg. Her left ventricular filling pressures were also greatly elevated at this time. She developed bradycardia progressing to ventricular fibrillation which responded to defibrillation. Unconscious, she was stabilized on a continuous infusion of dopamine hydrochloride with a systolic blood pressure of 50 mmHg. Because of severe acute pulmonary edema, she required endotracheal intubation.

The decision was made to place the patient on CPB in the catheterization laboratory using the EPO apparatus. The perfusion technology section was alerted and the EPO apparatus was taken immediately to the catheterization laboratory. (*Due to jarring and subsequent gross and microemboli showers, transport with a bubble oxygenator may be hazardous.*-Ed.) While the patient's left groin was being prepped and draped in a sterile fashion, the EPO circuit consisting of a Travenol^a high-flow roller pump head, Harvey H-1000 bubble oxygenator,^b battery power pack, oxygen

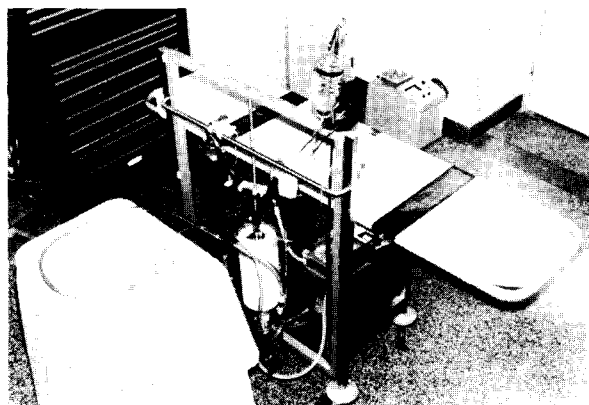


Figure 1

source, and integral patient stretcher^c was made ready (Figure 1).

The oxygenator was direct-primed with one liter of lactated Ringer's solution, one liter of 6% Hetastarch (Hespan),^c 50 meq. of sodium bicarbonate, and 10,000 units of porcine-mucosal heparin. The 3/8-inch - 1/2-

inch preconnected arteriovenous loop was primed and recirculated with de-airing carefully performed. A 40 micron Pall^d arterial line filter was used distal to the roller head.

As the circuit was made ready, dissections were carried down to the common femoral artery and the common femoral vein by the cardiac surgeon. The patient was heparinized with a total dose of 13,000 units. The patient's weight was 44 Kilograms. An 18 Fr. Bardic^b cannula was inserted into the left common femoral artery and a 32 Fr. USC1^b catheter was inserted into the left common femoral vein and advanced into the inferior vena cava. CPB was then established at normothermia at a blood flow rate of 3.5 to 4 liters/minute. When bypass was established, the patient and EPO apparatus were transported to the surgical suite as a single portable unit. The patient's temperature was allowed to drift slowly in route to the operating room, however no significant drop in temperature was noted. Great care was taken during transfer to avoid occlusion of the cannulae and pump lines, jarring of the oxygenator, and emptying of the arterial reservoir. The patient was then placed on the operating table, and while still on CPB, the groin, cannulae, and chest were prepped and draped in a sterile fashion.

A new 3/8-inch - 1/2-inch arterio-venous loop was then passed off to a 3.5 m² SciMed^e membrane oxygenator mounted on a Sarns^f 5000 heart lung machine. This circuit was prepared in advance as the patient was cannulated in the catheterization laboratory. The new circuit was primed with one liter lactated Ringer's solution, one liter of 6% Hetastarch, 50 meq. of sodium bicarbonate, and 5000 units of porcine-mucosal heparin. The new loop was recirculated and de-aired carefully. Simultaneously, a primary median sternotomy was made and the superior vena cava was cannulated through the right atrial appendage. At this point, bypass was discontinued and the arterial and venous lines to the EPO unit were clamped. The inferior vena cava cannula (from the femoral vein insertion site) was connected, along with the 34 Fr. superior vena cava cannula, to the new pump lines using a "Y" type plastic connector. The 18 Fr. femoral artery cannula was secured and left in place. Full CPB was again instituted using the membrane oxygenator. The total circulatory arrest time to accomplish this transition was 45 seconds. The patient was then cooled to 20° by the perfusate and underwent an uneventful aortic valve replacement with a total aortic cross clamp time of 42 minutes. Total time on the EPO circuit was 45 minutes. Total bypass time including EPO was 2 hours and 4 minutes.

a Travenol Corporation, Artificial Organs Division, Morton Grove, IL 60053

b C.R. Bard Corporation, Billerica, MA 01821

c American Critical Care (Division of American Hospital Supply Corporation) McGaw Park, IL 60085

d Pall Biomedical Products Corporation, Glen Cove, NY 11542

e SciMed Life Systems, 13000 County Road 6, Minneapolis, MN 55441

f Sarns/3M, Ann Arbor, MI 40106

Postoperative Course _____

Eight hours postoperatively, the patient was fully awake, moving all extremities, and answering simple yes/no questions. Her postoperative hematocrit was 36% after one unit of packed red blood cells. She was extubated after 24 hours total ventilator time, placed on a 40% aerosol face mask for 12 hours followed by a 3 liter/min. binasal cannula. She was transferred to an intermediate care unit on her second postoperative day, and was ambulatory without assistance on her third postoperative day, walked up and down four steps, and had no complaints or symptoms related to her cardiovascular disease. She was discharged to home on her eleventh postoperative day.

Discussion _____

EPO offers some patients in acute stages of cardiopulmonary failure a "second chance" for survival. It has been our experience, in two attempts, that the EPO apparatus in some instances can be brought to a patient in less time than it takes to transport a patient to the operating room under a "code" condition. This is by no means to imply that EPO should be attempted in all institutions. The purpose of this report is to present that under a given set of circumstances, the EPO concept

can be a considerable adjunct in the open heart surgery field.

The success of this particular effort was contingent on several factors:

1. The rapid decision to place the patient on CPB in the catheterization laboratory by the cardiac surgeons.
2. The rapid response time by the perfusionists in transporting the EPO apparatus to the patient.
3. The correct management of the patient's physiological needs in a "code" situation by the cardiologists and catheterization laboratory staff.
4. Adequate staffing allowing another CPB circuit to be prepared in the operating room as the patient was being placed on bypass in the catheterization laboratory.
5. The full cooperation of all personnel involved in the care of the patient during the critical times involving movement and transport of the patient.

Portable EPO provides another dimension to an already challenging field. Inherent in its use are potential dangers not normally associated with CPB in an operating room setting. These arise from the amount of movement of a cannulated patient and an operational bypass circuit needed to accomplish EPO transfer. Perhaps new equipment and techniques in the future will lessen these dangers as this aspect of perfusion expands.