Case Report

Oxygenator Failure Due to Contact With Bathing Alcohol: A Case Report

Scott D. Niles, BS, Jay Ploessl, CCP, Robin G. Sutton, MS, CCP and John B. Steinberg, MD
Department of Cardiothoracic Surgery, University of Iowa Hospitals and Clinics

Keywords: oxygenator damage, acetone, bathing alcohol

Abstract

Polycarbonate plastics are used in the construction of cardiopulmonary bypass oxygenator shells. Oxygenator failure due to contact with organic and anesthetic solvents can occur. An incident in which bathing alcohol was spilled onto a hollow fiber oxygenator, necessitating its replacement during cardiopulmonary bypass, prompted this case report. We recommend additional safety precautions and urge manufacturers to label components constructed of such material to prevent this potentially catastrophic event.

Introduction

The development of polycarbonate plastic has revolutionized cardiopulmonary support by providing a transparent and disposable shell for oxygenator components. (1) Unfortunately, this material is not without limitations. An incident at The University of Iowa Hospitals and Clinics in which an oxygenator was damaged when bathing alcohol was spilled on it, prompted this case report. The potential catastrophic effects of oxygenator failure due to solvent damage merits renewed consideration.

Case Description

A 62-year-old, 73 kilogram male, eleven years status post coronary artery bypass x 3 vessels, presented with unstable angina and was admitted to the hospital. Coronary catheterization and angioplasty were performed. This procedure was complicated by the development of *Staphlylococcus aureus* bacteremia, which was treated with a two week course of intravenous nafcillin. After antibiotic therapy, echocardiogram revealed no valvular vegetations and blood cultures were negative. The patient was discharged, but returned two weeks later with shortness of breath and a new aortic murmur. Coronary catheterization revealed 4+ aortic insufficiency. The patient was taken to the operating room for aortic valve replacement.

A median sternotomy and institution of cardiopulmonary bypass were performed without incident. The patient was cooled to 24°C and the aorta cross clamped. During placement of the prosthetic valve the assisting surgeon's glove and forefinger were pierced. The surgeon requested that the wound be rinsed with bathing alcohol[a], containing 70% ethyl alcohol, 1.6% acetone, 0.3% methyl isobutyl ketone, and bitrex 1.4 mg/100 ml, before regloving. While rinsing the wound approximately 10 ml of alcohol spilled onto the oxygenator[b].

One minute after the spill occurred, a small leak was noticed at the juncture between the heat exchanger and the membrane portion of the oxygenator. As preparation was underway to replace the damaged oxygenator the arterial inlet to the heat exchanger began to leak. The patient's temperature was maintained at 24°C while one unit of packed red cells (PRC) and one liter of crystalloid were administered to assure adequate venous reservoir levels. The arterial and venous lines were clamped. Inflow, outflow, and recirculation lines of the damaged oxygenator were then cut and joined to a new unprimed oxygenator[b].

The oxygen line was reattached and prime was recirculated for 60 seconds, during which time one unit of PRC and 500 ml of crystalloid were added to the bypass circuit. Bypass was resumed after approximately 90 seconds of circulatory arrest. A hemoconcentrator[c] and the addition of two units of PRCs increased the hematocrit from 13% to 24%. Ten thousand additional

Address correspondence to:
Scott D. Niles
The University of Iowa Hospitals and Clinics
Department of Cardiothoracic Surgery
1601 JCP
Iowa City, IA 52242-1062

a University of Iowa, College of Pharmacy Pharmaceutical Services, Iowa City, Iowa 52242
b Model 16310 Sarns Inc./3M, Ann Arbor, MI 48106
c Hemocor Hemoconcentrator Model HC 500-3, Minntech Corp. Minneapolis, MN 55441.

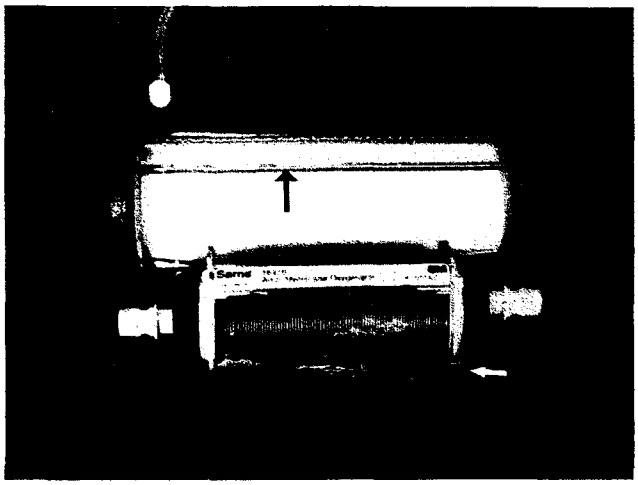

Figure 1
Acetone damage to a Sarns Model 16310 oxygenator showing broken inlet to heat exchanger (White arrow) and reaction with adhesive material (Black arrow).

units of heparin were administered to maintain activated coagulation times (ACT) above 480 seconds. Valve replacement was completed, the patient warmed to 37°C, and cardiopulmonary bypass terminated. Heparin was neutralized by continuous intravenous administration of protamine sulfate over a five minute period. Total bypass time was 2 hours 18 minutes with an aortic cross clamp time of 1 hour 32 minutes. Post bypass blood gases and ACTs were normal after the administration of three units of PRCs, two units fresh frozen plasma, and six units of platelets. The patient had a normal postoperative recovery and was discharged with no apparent sequelae on postoperative day seven.

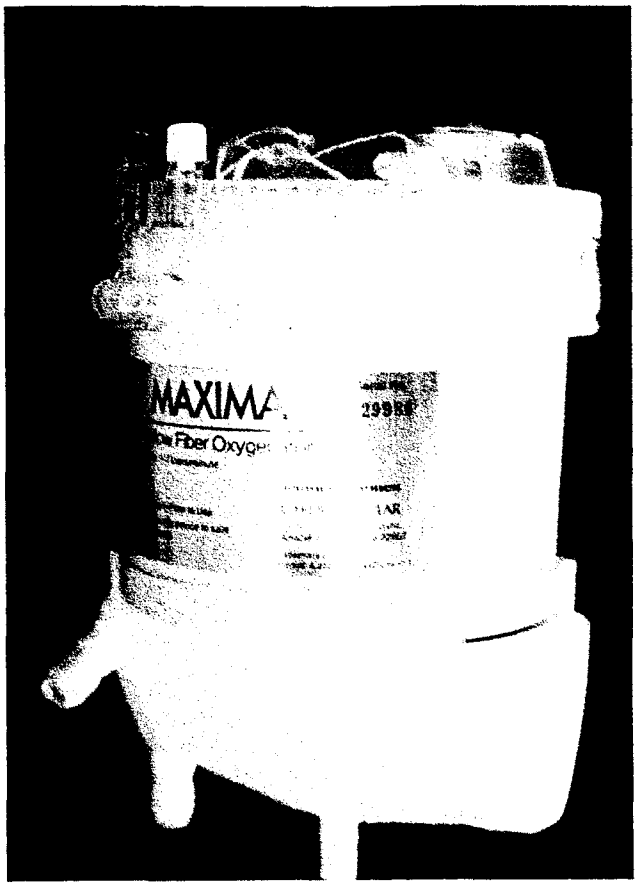

Figure 2
Isoflurane induced cracking of a Medtronic Maxima oxygenator.

Discussion

A review of the literature suggests that our experience was not an isolated case. Problems associated with organic and anesthetic solvent damage to oxygenators and ventricular assist devices have been previously reported. (2-5) This is particularly disturbing in light of the fact that many institutions use an anesthetic vaporizer during cardiopulmonary bypass, necessitating pouring of liquid anesthetics into the vaporizer located on the heart-lung machine. (6,7)

Subsequent to this incident, testing of various oxygenators and solvents in our laboratory suggest that the destructive agent in the bathing alcohol was the acetone (Figure 1). Isoflurane was also found to be very damaging (Figure 2). These findings confirm observations by others. (2-5) Ethyl alcohol alone (70%) appeared to have no effect.

The potentially life-threatening ramifications of oxygenator failure due to anesthetic solvent damage has mandated that anesthetic vaporizers be filled only prior to extracorporeal circuit set up. Measures have also been taken to ensure that operating room personnel use solvents with utmost caution when they must be used near oxygenators, oxygenator components, and cell savers. We urge others to implement similar precautionary steps to existing policy and procedure to avoid such an emergency situation.

Manufacturers of polycarbonate cardiopulmonary bypass products should be encouraged to apply cautionary labels on these items to minimize this inherent hazard.

References

1. Galletti PM, Brecher GA. Materials used in extracorporeal circuits. In: Heart-Lung Bypass: Principles and Techniques of Extracorporeal Circulation. New York: Grune & Stratton; 1962: 34-40.
2. Walls JT, Curtis JJ, McClatchey BJ, Wood D. Adverse effects of anesthetic agents on polycarbonate plastic oxygenators. J Thorac Cardiovasc Surg. 1988; 96: 667-672.
3. Lohmann DP, Pennington DG, McBride LR. Acetone: A hazard to plastic medical products-a case report. J Thorac Cardiovasc Surg. 1991; 102: 937-938.

4. Maltry DE, Eggers GWN Jr. Isoflurane-induced failure of the Bentley-10 oxygenator. Anesthesiology. 1987; 66: 100-101.
5. Cooper S, Levin R. Near catastrophic oxygenator failure. Anesthesiology. 1987; 66: 101-102.
6. Nussmeier NA, Lambert ML, Moskowitz GJ, et al. Washin and washout of isoflurane administered via bubble oxygenators during hypothermic cardiopulmonary bypass. Anesthesiology. 1989; 71: 519-525.
7. Stern RC, Weiss CI, Steinbach JH, Evers AS. Isoflurane uptake and elimination are delayed by absorption of anesthetic by the Scimed membrane oxygenator. Anesth Analg. 1989; 69: 657-662.