

## Case Report

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# Use of Isoflurane in Extracorporeal Circuit Leading Break in Polycarbonate Connector



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### Abstract

Invent of cardiopulmonary bypass has revolutionized the modern cardiac surgery. Mishaps during cardiopulmonary bypass, near misses and lethal incidents are known. We share one such rare case of break in polycarbonate connector due to the use of isoflurane in extracorporeal circuit and its successful management.

**Keywords:** Cardiopulmonary bypass; Polycarbonate; Isoflurane; Atrial septal defect

## Cadiopulmonary bypass (CPB)

Cadiopulmonary bypass has undergone many improvements since its first attempt to permit intracardiac surgery in humans at the University of Minnesota Hospital by Dennis et al. on April 5, 1951 [1]. These improvements have not come without complications. Equipment failure in cardiopulmonary bypass is lethal in most of the cases. In extra-corporeal circulation by CPB, volatile anesthetics are generally administered in the oxygen inlet line using a vaporizer to control the blood pressure. However, volatile anesthetics have a physicochemical effect on polycarbonates. There are reports of damaged plastic anesthetic equipment and other medical devices [2-6], particularly damaged CPB parts made from polycarbonate, such as membrane oxygenators [5,6]. We share here such an equipment failure which was successfully managed and tips to avoid such mishaps during the conduct of CPB.

### Case Presentation

A 30 year old male (body surface area 1.52, full pump flows 3.6litres/min) with no comorbidities was admitted for surgical closure of atrial septal defect (ASD). Following induction of anesthesia with thiopentone and maintenance was with isoflurane and morphine sulphate. Surgery was done through midline sternotomy and CPB was established with aortic and bicaval cannulation. After arresting the heart with antegrade cold blood cardioplegia, under moderate hypothermia (30 degree celsius), right atrium was opened to close the ASD. As

soon as the pericardial patch was started to suture close the ASD, there was change in color of the arterial line from bright red to dark color. After checking the circuit (preassembled by the

manufacturer), there was spontaneous disconnection of the gas inlet line (Capiiox SX 18R).

The problem was immediately picked up and communication was made to anesthetist and the surgeon by the perfusionist. Thought was given to further cooling the patient and replace the oxygenator. As the anticipated pump run for this routinely done surgery was just few minutes, decision was taken to handhold the disconnected gas input connector (1/4inch) to the oxygenator, increasing the FiO<sub>2</sub> to 100%, sweep gas at 4litres/min and to go ahead with surgery. Periodic arterial blood gas analysis done showed no hypoxia or acidosis. Patch closure of ASD was completed and cross clamp was released after adequate deairing. Once cross clamp was released, ventilation was resumed and there was no fall in saturations or increase in ETCO<sub>2</sub> noted. Came off CPB and patient was shifted to ICU with stable hemodynamics. Total cross clamp time was 15 minutes and total CPB time was 40 minutes. Patient became conscious 4 hours after shifting to ICU, was extubated after 6 hours of surgery. He was discharged on third post-operative day with no sequelae. After carefully reviewing the incident, it was found that the cause of the crack in the connector was traced to the initiation of CPB, when the vaporizer connected to the membrane oxygenator was filled with isoflurane and droplets of isoflurane fell onto the connector. After this incident, the isoflurane vaporizer was then moved to a safer location to prevent a similar incident from occurring again.

### Discussion

CPB is the part and parcel of majority of the cardiac surgeries from its invention in 1950s. According to a survey between 1996

and 1998 by Mejak et al., a CPB incident of the reported cases occurred once every 138 cases (0.7%). Break in polycarbonate connector of extracorporeal circuit is one of the uncommon problems encountered which may be potentially fatal.

In heart-lung bypass procedures, external circuits comprising different devices and tubing sets that are used to provide circulation, oxygenation and filtration of the blood as a temporary substitute for circulatory and pulmonary function. To maintain anesthesia and control blood pressure, a vaporizer may be included in the circuit to allow vaporized halogenated anesthetic agent to be mixed with the oxygen that supplies the oxygenator.

Leaching occurs when the plasticizer molecules in the PVC tubing are displaced by the anesthetic agent molecules [7]. This process is slow if the tubing is exposed only to vapors, but the reaction can be accelerated if liquid anesthetic is accidentally spilled from the vaporizer. As the plasticizer leaches from the tubing, the tubing becomes stiff and can crack. An oily material, primarily the di (2-ethylhexyl) phthalate (DEHP) plasticizer, collects inside the tubing. Although PVC is the most commonly used plastic tubing for heart-lung bypass circuits, plasticizers in other plastics may be soluble in halogenated anesthetic agents and may exhibit the same problem as PVC tubing.

Leaching of plasticizer is a known entity and care should be taken and connection sites should be inspected by the perfusionist while administering isoflurane. In our case, while administering isoflurane gas by the perfusionist, there was reaction of alcoholic agent (isoflurane) with medical grade polyvinyl chloride (PVC) which led to melting of PVC and disconnection from the oxygenator at the inlet site [8]. Liquid isoflurane accidentally spilled from the vaporizer due to vigorous shaking of the container. There was no blood leak from the oxygenator, so the situation was managed by manually holding back the inlet line with the connector.

## Conclusion

CPB circuit though is undergoing continuous modifications since its first use, are still not completely safe. During administering anesthetic gases like isoflurane, perfusionist should be cautious and look for the connection sites. Timely recognition and thoughtful management of the mishap during CPB are lifesaving. This case highlights the need for anesthesiologists to be alert to the physicochemical effects of volatile anesthetics on polycarbonates.

## Consent

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. Hospital ethical committee approval was taken for publishing the case report.

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