

## Case Report

# Possible Fire Hazard Caused by Mismatching Electrical Chargers With the Incorrect Device Within the Operating Room

Martin Hargrove, FCCP; Thomas Aherne, FRCSI

*Cardiothoracic Surgery Unit, Cork University Hospital, Wilton, Cork, Ireland*

### OVERVIEW

It has come to our attention that numerous devices that need charging adaptors during cardiopulmonary bypass (CPB) have similar charging sockets but different voltage requirements. This has caused one of our devices in the operating theater to overheat and completely shut down when connected to an incorrect higher-voltage charger. The possibility of fire, device destruction, or patient harm in such circumstances is of serious concern.

### DESCRIPTION

An 80-kg male undergoing CPB for routine coronary artery bypass (CABG). During activated clotting time (ACT) monitoring while using a Hemochron Response (International Techynidyne, Edison, NJ), a temperature alarm alert was seen on the screen after ~10 minutes. Temperature, as measured by the Hemochron device, was 41°C. This caused the machine to shut down on both measuring chambers. The device was taken out of service and bench checked. The Hemochron was replaced with a similar device and testing continued.

The device was withdrawn from service and subsequently examined. The same temperature alert and shut down was observed. However, on testing the device using battery power only, no temperature alarm was seen, and temperature was steady at 37°C. At this point, the charger was examined and found to be delivering 18 V instead of the required 12 V. This caused excessive heat build-up in the circuitry, with consequential device shut down. The device was checked using the correct 12-V charger, which resulted in no further problems, and was subsequently put back in service.

On examining other devices that we use during CPB, we found that three devices had the same charging direct cur-

rent (DC) sockets (internal diameter, 2.5 mm; external diameter, 5.5 mm) but had different outputs varying from 7.5 to 18 V (Figure 1). These devices are the Hemochron Response, Dideco Datamaster in line PO<sub>2</sub> monitor (Sorin Italia, Mirandola, Italy), and the Gish Statsat (Gish Biomedical, Irvine, CA) venous saturation device. Because the charging plug will fit all these devices, the potential exists for the 18 V to be connected to a device that only requires 7.5 V. There is a potential risk of fire should these devices be allowed to charge unsupervised overnight. It should be noted that the Gish Statsat does not have any indication as to the power rating on the back plate. This device has the highest voltage requirement (18 V).

### COMMENT

All devices for use in the operating theater should be checked by the Biomedical Department, and chargers and plugs should be labeled before release into a clinical setting. It is the end user responsibility that they are used and maintained correctly.

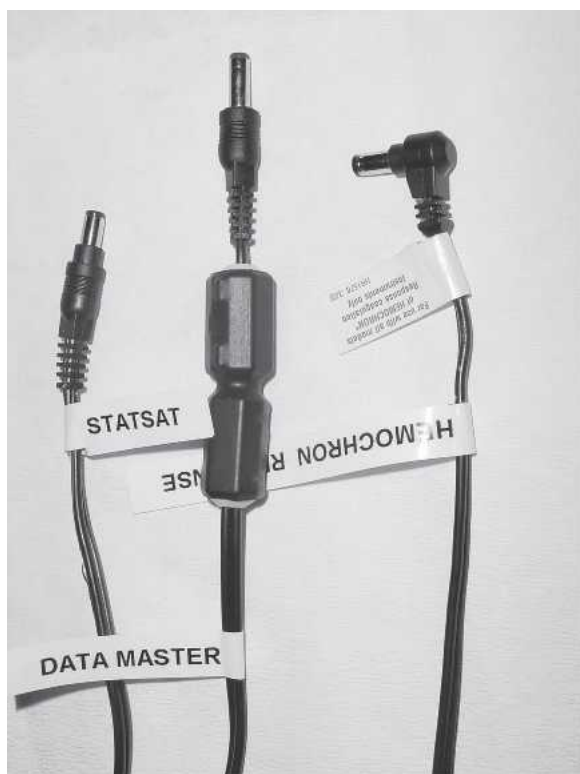
Fire in the operating theater is well documented and has been reported to occur mainly during head and neck surgery (1), caused by bowel and anesthetic gases (2,3). Skin preparation and antiseptic solutions have also caused explosions and fire (4). During the authors' 32 years of perfusion, only one incidence of fire occurred during CPB. This occurred when a fibrillator shorted out, causing the lead insulation to ignite, resulting in drapes catching fire. No patient injury resulted.

The Society of Perfusionist of Great Britain and Ireland has recommended that all patients undergoing CPB should have in-line monitoring to include arterial PO<sub>2</sub> and venous saturation (5). These recommendations have resulted in a number of monitors being used during CPB. Because of the increased use of stand-alone in-line monitoring, all of these devices have a charging system with transformer. Because the charging systems are usually outsourced by the device manufacturer, some of these chargers are not labeled by the device manufacturer, and the possibility exists for these instruments to be connected to an incorrect charger. If the charger becomes faulty, it is

---

Address correspondence to: M. Hargrove, Cardiothoracic Surgery Unit, Cork University Hospital, Wilton, Cork, Ireland. E-mail: Martin.Hargrove@mailp.hse.ie

The senior author has stated that authors have reported no material, financial or other relationship with any healthcare-related business or other entity whose products or services are discussed in this paper.



**Figure 1.** These devices have similar device plug tops but all have different voltage outputs.

usually replaced by the Biomedical Department with a generic device that will not have a device label. A further possibility is the charging transformer melting and connecting to the output windings. This could result in main voltage reaching the patient if the device is a blood in-line monitor such as the Dideco Datamaster. We reported a power surge in the cardiac theater a number of years ago in which the generator voltage reached in excess of 600 V. This caused all equipment in the operating theater to shut down. Devices with no input fuse had their isolating transformer destroyed (6).



**Figure 2.** Labeling of transformer and plug tops.

Although battery-operated devices offer protection in transformer isolation for the patient, no system is in place to prevent overcharging with higher voltages. On examination of equipment used in the cardiac theater, a number of devices do not have any labeling on the input socket nor do any of the computer laptops. Although some of the devices such as Dell laptops (Dell Ireland, Dublin, Ireland) have a label on the transformer, the input plug is not labeled. Some vital sign monitors such as the Philips monitor (Philips Medical, Andover, MA) have the transformer in a bracket on the monitoring stand and the socket is a five-pin device that is specific to the monitor. Other devices such as the Dinamap compact vital signs monitor (J+J Medical, Gwent, UK) have a high-voltage input of between 12 and 30 V but similar input socket as the above devices.

Having informed the hospital risk management department, the above occurrence was also reported to the Biomedical engineering section for hospital wide attention. An asset number is to be attached to all transformers and charging plugs, which should match when using the device. We also labeled (Figure 2) all transformers and plug ends with DYMO Letra Tag white washable plastic labels (Dymo bvba, Sint-Niklaas, Belgium). The Biomedical Department also ascertained that the above report is a hospital-wide problem and can be dangerous when devices are loaned from one department to another.

Manufacturer's response was favorable, and Gish agreed to label their devices. International Techynidyne has already labeled the input plug, but the older devices we use will have to be upgraded. Sorin Datamaster has a label on the transformer but will need the plug labeled. Not all devices will have the same temperature safety cut-out as the Hemochron.

In conclusion, it is imperative that a labeling system be put in place for each of the charging systems, both on the transformer and the plug, used in operating theaters to minimize the risk of fire, device destruction, or patient harm.

## REFERENCES

1. Paugh DH, White KW. Fire in the operating room during tracheotomy: a case report. *AANA J.* 2005;73:97-100.
2. MacDonald AG. A brief historical review of non-anaesthetic causes of fire and explosions in the operating room. *Br J Anaesth.* 1994;73:847-56.
3. Harden HJ. Danger of fire and explosion in anaesthetic and surgical departments. *Prakt Anaesth.* 1976;10:192-203.
4. Meltzer HS, Granviller R, Aryan HE, Billman G, Bennett R, Levy ML. Gel based surgical preparation resulting in an operating room fire during a neurosurgical procedure: A case report. *J Neurosurg.* 2005;102(3 Suppl):347-9.
5. Recommendations for Standards of Monitoring and Alarms During Cardiopulmonary Bypass. London, UK: Society of Perfusionist of Great Britain and Ireland, Association of Cardiothoracic Anaesthetists, Society of Cardiothoracic Surgeons of Great Britain and Ireland; 2001.
6. Hargrove M, Ramish BC, O'Donnell A, Aherne T. Electrical failure during cardiopulmonary bypass: an evaluation of incidences, causes, management and guidelines for preventative measures. *Perfusion.* 2002;17:369-72.