Circuit Emergency During CPB: Are you prepared?

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Goals of Presentation

- Description/discussion of case report
- Discuss tools for emergency preparedness and/or prevention
- Discuss the aftermath of perfusion incidents
- Future direction – what do we need?
Perfusion-related incidents

CPB-related incidents occur at a rate of as high as 1 per 15.6 cases\(^1\). Others have reported rates of 1 in 84\(^2\) and 1 in 220\(^3\).

Perfusion incidents resulting in serious injury or death has been reported as high as 1 in 1,236\(^1\). Others have reported rates of 1 in 1,453 cases\(^2\) to 1 in 2,500 cases\(^4\).
Not all Perfusion incidents look like this

Case Report

- Patient with history of ischemic cardiomyopathy
- Implanted with LVAD as BTT
- Several months later, heart transplant
Surgical Procedure

- Procurement team says “heart is good”
- 300 units/kg of heparin given prior to cannulating ascending aorta and bicaval venous cannulation
- ACT >480s, Heparin Conc = 300 IU/kg
- Full CPB initiated and LVAD turned off

Case Report - Circuit

- Terumo FX25 oxygenator
- 3/8” x 1/2” AV loop
- Roller pump
- No VAVD
- In compliance with IFU
Case Report - Circuit

Terumo FX25 oxygenator

3/8” x 1/2” AV loop

Roller pump

No VAVD

In compliance with IFU

Case Report - Prime

1,100 mL Plasmalyte A

50 mEq Sodium Bicarb

10,000 IU Heparin

50 g Albumin
Case Report – Early CPB

- XC was placed several minutes after start of CPB
- Patient kept warm
- Heart excised in preparation of donor heart
- Then, ~60 minutes into unremarkable bypass....

Case Report – Unexpected event

Phenylephrine drip slowed unexpectedly....
Phenylephrine drip slowed unexpectedly....

Perfusionist checked the IV roller-type clamp – no change

Suspecting an obstruction at the luer, it was disconnected from the cardiotomy chamber.
Case Report – Unexpected event

Suspecting an obstruction at the luer, it was disconnected from the cardiotomy chamber.

A clear, audible release of pressure was heard.

Case Report – What next?

- Cap removed from vertical port
- Sucker rates reduced
- Thorough visual inspection
Case Report – What next?

- For the next few minutes, the circuit functioned normally (at decreased sucker rates).

- But then…

Case Report – What next?

- The integrated cardiotomy filter began to fill with blood from the suckers/vents
- Required complete termination of suckers/vents
- Visual inspection revealed nothing notable
- …but the surgeon needs “lots of suction!”
What would you do?

Emergency Response

- A second perfusionist was called to assemble and prime a separate CPB circuit (just in case)

- Circuit was reconfigured using a Medtronic hard-shell blood collection reservoir as the cardiotomy filter
Emergency Response

- Full circuit functionality was restored

- There was never any disruption in patient support in terms of blood flow or gas exchange throughout the event
A bit more information…

- No drugs (aside from phenylephrine) were administered after initiation of CPB and prior to the event
- ACT remained >500 seconds at all times
- Visual inspection during and post-CPB revealed no source of obstruction such as thrombus

Outcome

- Patient was transferred to ICU and extubated within 24 hours
- Routine hospital stay and discharged after 2 weeks
- No apparent complications related to the event
After seeing what was done, would you have done anything differently?

Can you think of a potential cause?
Interesting…

- There are NO published case reports or survey mentions of this type of event
- Had more than 5 emails from perfusionists that read the article, sharing similar experiences

We still aren’t quite sure why this happened
Perfusion-related incidents

What tools can be used prior to doing a case that can minimize risks of a perfusion related incident?

Preparation for Cases: Tools

- Checklists
- Standards and Guidelines
- Protocols
- Training / simulation
- A mental approach – all it takes is once!
Checklists, David Lee Roth, and Brown M&Ms

- Atul Gawande⁶:
  - Just by ensuring that everyone in the operating room knows each other by name, complications and deaths dropped 35%!
  - Pilot checklists were developed after a test flight B-17 crash in 1935. Same plane then flew 1.8 million miles without incident.

- With the help of checklists, the construction industry has an annual failure rate of less than 0.00002%.
- David Lee Roth and article 126 (and brown M&Ms)
Could a checklist line item have helped in this case?

How do you determine what items are in your checklist?
How many checklists do you use for a typical cardiopulmonary bypass case?

Standards and Guidelines

- Published by AmSECT’s International Consortium of Evidence Based Perfusion
- Can help you design your practice, and protect you in the aftermath
Standards and Guidelines

Definitions:

Standard: Practices, technology and/or conduct of care that institutions shall meet in order to fulfill the minimum requirements for cardiopulmonary bypass.

Guideline: A recommendation that should be considered and may assist in the development and implementation of protocols.
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Standards and Guidelines

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Standards and Guidelines

**Standard 6: Safety Devices**

**Standard 6.1:** Pressure monitoring of the arterial line, cardioplegia delivery systems and venous reservoir (when augmented venous drainage is utilized), shall be employed during cardiopulmonary bypass (CPB) procedures.
Standards and Guidelines

- Our circuit was within the standard – this could have helped us in the aftermath

- Does the standard need to be changed?

Protocols

- AmSECT definition:
  
  - an institution-specific written document, derived from standards and guidelines, which contains decision and treatment algorithms.
Protocols

- Does your institution have cardiopulmonary bypass-related protocols?

- How do you decide which protocols to have?
Training / Simulation

- Do you practice your protocols using hands-on training or simulation?

The aftermath...

- Describe your institution’s process following a perfusion incident, device failure, etc.
The aftermath...

- Describe your institution’s process following a perfusion incident, device failure, etc.

- How can you protect yourself following a perfusion-related incident?

What do we need?

- Remember that I had over 5 perfusionists contact me stating similar incidents, yet there is nothing published.
What do we need?

- Remember that I had over 5 perfusionists contact me stating similar incidents, yet there is nothing published.

- As a field, are there resources that we need to better learn from these types of experiences?

Mental Approach
All it takes is once
References