DHCA IN A PATIENT WITH KNOWN COLD AGGLUTININ ANTIBODIES

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What is it?

- A type of autoimmune hemolytic anemia
- Cold-reactive antibodies are directed against erythrocytes
- Usually IgM immunoglobulins
- Binding of the antigen-antibody complexes causes the red cells to “clump” (agglutinate)
- Diagnosed with a positive Direct Coombs Test (DAT)
- 0.02%-0.3% incidence rate

Complications

- Once red cells agglutinate:
  - *Hemolysis**
  - *Anemia**
  - *Vessel obstruction**
  - *Hemoglobinuremia*
  - *Renal dysfunction*
  - *Cardiac dysfunction*
  - *Etc…*

Patient History

Parameters

- 65-year-old male
- 102.1 kg and 175.9 cm (BSA= 2.23 m^2)
- PMH of Type A dissection repair done in London, England (2004)
  - *NO history of cold agglutinin antibodies at previous cardiac surgery*
- Oropharyngeal cancer treated with chemoradiation (2017**)
  - *Evidence of anemia and agglutination*

Presentation upon coming to CCF

- Aortic root dilation
- Proximal descending aneurysm beginning right after the previous graft
  - *Arch and descending*
- 2+ Tricuspid regurgitation

Suspected agglutination

- Patient was anemic when undergoing chemoradiation
  - *Due to radiation > hemolysis*
  - *Agglutination suspected*
- Blood tests and titers were done upon arrival to Cleveland Clinic
- Direct antiglobulin (Coombs) test positive for 2+ complement (C3) and negative for IgG
- Slightly elevated levels of IgM
- 22C (Critical temperature) and 4C at titers of 64 and 256 respectively
  - *Weak reactivity at 37C*

Proposed Surgery….

- REI
- ARC
- FET
- ASCENDING GRAFT REPLACEMENT W/ ROOT REPAIR
- TRICUSPID VALVE REPAIR

HOW DO WE CIRC ARREST ON A PATIENT WITH COLD AGGLUTININ ANTIBODIES ACTIVE AT 22C???

Preparation is key!

- Patient: Plasmapheresis
- Surgeon: Experienced, quick
- Perfusion: Knowledge of procedure, team work with surgeon

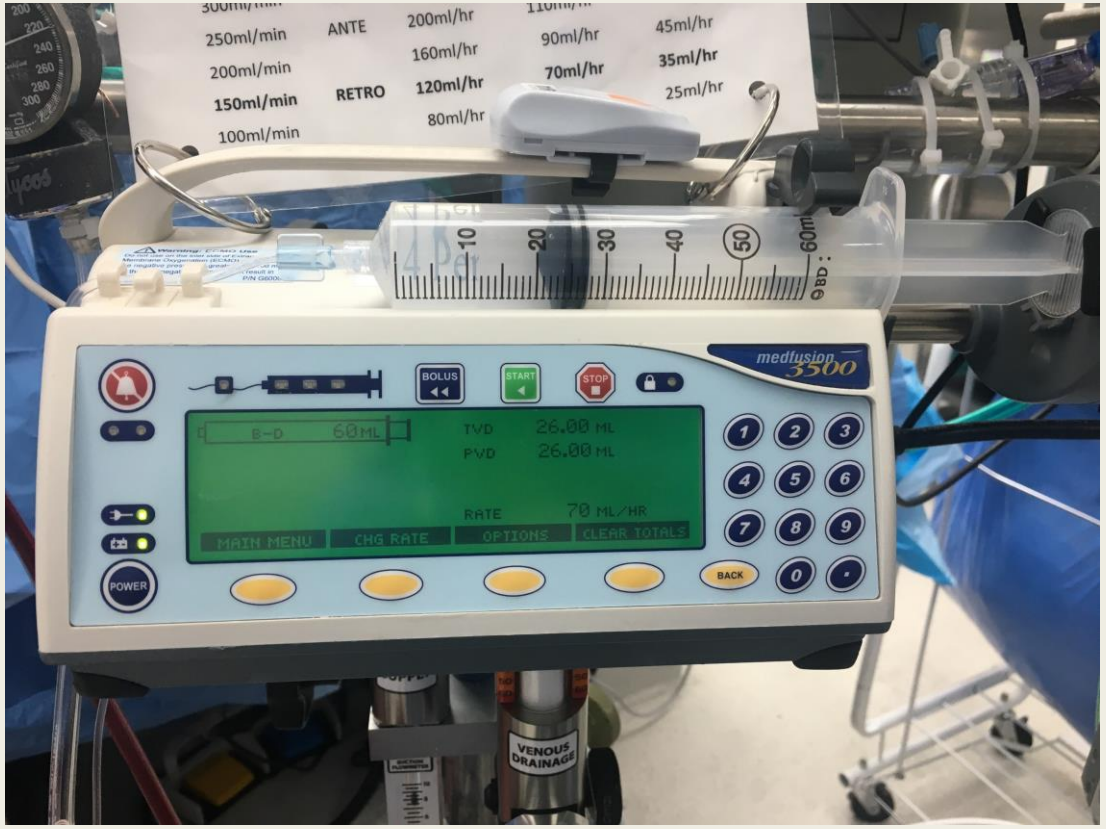
CONDUCT OF PERFUSION

Temperature Management

- Normal DHCA temperature: 16-20C
- Critical temperature: 22C
- Stayed at 24-25C for the duration of the case
  - *Arterial and venous blood temperature**
  - *Nasopharyngeal*
  - *Bladder*
  - *Swan*
- Monitor temperature, did not pack head with ice, blood products if given needed to be put through a warmer

Cardioplegia Management

- Microplegia with syringe pump (Medfusion 3500)
- Continuous-moderately hypothermic antegrade infusion (25C)
- 280 mL/hr: induction
- 15-40 mL/hr: maint.
    - *Cardioplegia pump flow: ~350 mL/min induction ~100 mL/min maint.*



DHCA Management

- Axillary arterial and bicaval venous cannulation
- Antegrade cerebral perfusion through an axillary graft at ~1LPM
  - Adjusted accordingly to cerebral oximetry
  - Targeted flow 10mL/kg is guideline
- Normal DHCA temperature: 16-20C
- “Deep” hypothermic circulatory arrest
  - *24-25C*

Procedure

- Cannulated, initiated bypass, and began cooling
- X-clamped; asystole was achieved through antegrade microplegia
- Secured FET graft
- Stent LSCA
- Replace arch
- Recannulate arterial cannula into side graft to restore flow to body and rewarming began
- Replaced the ascending graft
- Continuous microplegia was stopped
- Remodel root
- Retrograde microplegia given to help deair the aorta
- X-clamp taken off to help rewarm and restore cardiac activity while tricuspid ring was put in place

Procedure Times

- Cooling: 40 min
- Circ arrest w/ antegrade cerebral perfusion: 55 min
- Rewarming: >60 min
- Total x-clamp time: 145 min
- Total pump time: 208 min

Important Lab Values

- K+ stayed below 6 mEq/L
- Lactate reached 6.1 mmol/L immediately following DHCA, but was reduced to 3.5 mmol/L before weaning from bypass
- Cerebral oximetry was above baseline for the duration of DHCA
  - *(40% SO2 for the left side and 35% SO2 for the right side)*
- pO2 dropped <200 mmHg immediately following DHCA but increased with reperfusion and washout of body
  - *pCO2 also increased but was quickly managed with sweep*

Post-operative Outcome

- The patient was kept intubated and taken to the ICU
- Slight AKI with a mildly elevated serum creatine levels which was treated with Lasix
- Extubated POD 1
- Started on warfarin POD 8
- Discharged POD 11 with no other complications

Conclusion

- Cold agglutinins might not be as difficult to manage with proper preparation
- Is 18C necessary?
- Protocols, experience, pre-operative diagnosis, and knowledge of disease significantly increase good outcomes of patients with cold agglutinins undergoing cardiac surgery

Resources

- Suraj Yalamuri, MD et al. “Cardiopulmonary Bypass Management Complicated by a Stenotic Coronary Sinus and Cold Agglutinins”. Journal of Cardiothoracic and Vascular Anesthesia 31 (2017) 233–235.
- Barbara, David W. et al. “Cold agglutinins in patients undergoing cardiac surgery requiring cardiopulmonary bypass”. The Journal of Thoracic and Cardiovascular Surgery. 146:3. 2003. 668-680.
- Sigbjørn Berentsen, Klaus Beiske & Geir E. Tjønnfjord (2007) Primary chronic cold agglutinin disease: An update on pathogenesis, clinical features and therapy, Hematology, 12:5, 361-370, DOI: 10.1080/10245330701445392
- S. Allard & Q. A. Hill. “Autoimmune haemolytic anaemia”. ISBT Science Series 11. 85–92. 2016.