COVID 19 AND PEDIATRIC CARDIAC ANESTHESIA PROGRAMS

Moderators:
Viviane G. Nasr, MD
Mona Momeni, MD
Session I: Changes in Institutional Practice during the COVID-19 Pandemic: Triage, COVID-19 testing, PPE and TEE use.


Session III: Panel discussion with representation from different regions in North America.
COVID-19 Disease Pandemic
Case Selection / Triage

Luis M. Zabala, MD
Professor of Anesthesiology
Director Pediatric Cardiac Anesthesia
Department of Anesthesia and Pain Management
UT Southwestern, Children’s Health
Dallas, TX
Outline

• Context
• Lessons Learned from other Countries
• Healthcare Response
• Children’s Health Dallas Experience
Context – PPE

Shortage of personal protective equipment endangering health workers worldwide

3 March 2020 | News release | Geneva

WHO calls on industry and governments to increase manufacturing by 40 per cent to meet rising global demand

https://www.who.int
Lessons Learned

Change in number of reported cases in Italy, by province

<table>
<thead>
<tr>
<th>Date</th>
<th>Cases</th>
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<tr>
<td>27 February</td>
<td>650 cases</td>
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<tr>
<td>5 March</td>
<td>3,858</td>
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<tr>
<td>12 March</td>
<td>15,113</td>
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Source: CPD, Italian government, March 12th

Infrastructure and Personnel

US Response – March 2020

<table>
<thead>
<tr>
<th>Guidance/ Recommendations</th>
<th>Goals</th>
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<tbody>
<tr>
<td>Social distancing</td>
<td>Decrease rate of infection</td>
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<tr>
<td>CDC</td>
<td>Preserve PPE</td>
</tr>
<tr>
<td>CMS and DHHS</td>
<td>Protect the safety of health care professionals</td>
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<tr>
<td>American College of Surgeons</td>
<td>Allocate scarce resources for the care of COVID patients</td>
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Community Needs
Dallas County Data / 8 Hospitals

Resources Available
- Total beds: 2,868
- Beds occupied: 1,542
- Total ICU beds: 361
- ICU beds occupied: 204
- Total ventilators: 342
- Ventilators in use: 139

Recent Numbers COVID-19
Total Cases 1877
Admitted to ICU 173

https://www.dallascounty.org/covid-19/
**COVID-19 Guidelines for Triage of Pediatric Patients**

**Congenital Heart Disease**

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
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<tr>
<td><strong>“Elective Cases”</strong></td>
<td>Delay results in minimal patient risk (&gt; 2 Months).</td>
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<td></td>
<td>- No anticipated short-term or long-term negative impact as a result of delaying a procedure or surgery.</td>
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<tr>
<td><strong>“Urgent or Medically Indicated Cases”</strong></td>
<td>Delays of days to weeks may be detrimental.</td>
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<td></td>
<td>- Deterioration or disease progression if the procedure is significantly delayed.</td>
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<tr>
<td><strong>“Emergency Cases”</strong></td>
<td>Delay is life threatening.</td>
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<tr>
<td></td>
<td>- Medically managed arrhythmias for EPS.</td>
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<td>- Slowly progressive AS scheduled for Ross operation</td>
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<td>- Valvular regurgitation managed medically</td>
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<td></td>
<td>- Obstructive lesions stabilized with PGE</td>
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<td></td>
<td>- AVC on maximal therapy / FTT/ repeat hospitalization</td>
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<td></td>
<td>- Most neonatal CHD</td>
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<td>- Obstructed veins, shunt thrombosis, HLHS intact atrial septum, ECMO or VAD,</td>
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<td>- Transplant</td>
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## COVID-19: Crisis Management in Congenital Heart Surgery

<table>
<thead>
<tr>
<th>Category</th>
<th>Classification</th>
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<tr>
<td><strong>Neonate</strong></td>
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<td><strong>Emergent</strong> (24-48 hours of diagnosis when adequate resources)</td>
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<td>note: timing for categories will depend on resources available, institutional protocols, and other pending cases</td>
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<tr>
<td>Shunts, Mixing Lesions</td>
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<tr>
<td>TAPVC/cor triatriatum</td>
<td>obstructed</td>
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<td>TGA</td>
<td>&lt;1 week if IVS</td>
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<td>Truncus Arteriosus</td>
<td>if stable</td>
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<td>Tetralogy of Fallot</td>
<td>severe hypoxemia/hypercyanotic spells</td>
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<td>Regurgitant Lesions</td>
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<td>Ebstein Anomaly</td>
<td>refractory medical management</td>
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<td>Obstructive Lesions</td>
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<td>Coarctation</td>
<td>shock unable to stabilize on PGE</td>
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<tr>
<td>Critical Aortic Stenosis</td>
<td>shock unable to stabilize on PGE</td>
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<td>PGE-dependent pulmonary blood flow</td>
<td>If PDA stent not available</td>
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<td>PA/IVS</td>
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<td>PGE-dependent systemic blood flow</td>
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<td>HLHS</td>
<td>intact, restrictive atrial septum if BAS not available</td>
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<td>Other</td>
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<td>Shunt</td>
<td>shunt thrombosis</td>
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<td>Arrhythmias</td>
<td>symptomatic congenital heart block unable to medically manage/externally pace</td>
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<td>ALCAPA</td>
<td>once medically stabilized</td>
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Children’s Health Dallas

• COVID–19 Surgical Review Committee
  – Surgical NP, OR Manager and Heart Center Administration

• Meetings
  – March 12th - Review the list through April 22nd
  – March 24th – Review the list through May 10th

• Cancelled > 70 elective surgery/ catheterization/ EP
  – Volume down 20% March / 50% April (projected)
Children’s Health Dallas

- Medically Indicated Procedures (Inpatients)
  - PICC Lines
  - Direct laryngoscopy bronchoscopy
  - Bronchoscopy / BAL
  - MRI brain (pre-surgery / diagnostic)
  - Bedside chest closures
  - CT Angio
Summary

- Time to prepare and anticipate is critical
- Understanding your community needs and resources is critical
- There is no single agreed upon surgical triage list for patients with CHD
- Triage will depend on clinical status, individual resources, capacity and personnel
- COVID-19 Surgical Triage Committee recommended
Testing for SARS-CoV-2
&
Personal Protective Equipment (PPE)

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Nomenclature

**SARS-CoV-2**  Severe Acute Respiratory Syndrome Coronavirus 2

**COVID-19**  Coronavirus Disease 2019 (declared a pandemic on March 11th 2020 by the WHO)
COVID-19 Dashboard by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU)

Total Confirmed: 2,273,382

Total Deaths: 156,064

Total Tested in the US: 3,574,392
ACE 2 protein expressed in lungs and is the binding site of the SARS-CoV-2 S protein which downregulates it. Low ACE2 can cause chronic heart failure & lung injury.

Frequent viral infections and vaccinations in children induce an active innate immune system which is protective against different pathogens.

Children infected with SARS-CoV-2 often have normal lymphocyte counts. Possibly due to the everlasting immune system activation in childhood. Less activation of cytokine storm.

Will children reveal their secret? The coronavirus dilemma  
*Eu Resp J 2020 In press*
Global strategy to control the COVID-19 pandemic is to **SLOW DOWN TRANSMISSION** and **REDUCE MORTALITY** associated with the disease.
Why test?

• Mitigation strategies
• Diagnosis to guide clinical care of the patient and appropriate PPE for healthcare workers
• Guide public policy to re-open operating rooms, businesses, schools etc.
• Verify future vaccines work

“Very aggressive contact tracing required for US to return to normal”
Robert Redfield, CDC Director. April 10th 2020
Yang, T.; Gentile, M.; Shen, C.-F.; Cheng, C.-M. Combining Point-of-Care Diagnostics and Internet of Medical Things (IoMT) to Combat the COVID-19 Pandemic. Diagnostics 2020, 10, 224.
Fast, portable tests come online to curb coronavirus pandemic

Testing kits delivered by courier and digital tools combine to battle the COVID-19 outbreak.

Cormac Sheridan

7 Viral RNA Tests in Commercial Development
13 Antibody Tests in Commercial Development
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Schematic of SARS-CoV-2
CRISPR–Cas12-based detection of SARS-CoV-2

10 min, manual extraction (1–8 samples)
60 min, automated extraction (up to 48 samples)

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<td>SARS-CoV-2 positive</td>
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<td>Presumptive positive</td>
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<tr>
<td><strong>Validation</strong></td>
<td>FDA EUA</td>
<td>FDA EUA</td>
</tr>
<tr>
<td></td>
<td>Clinical studies lacking</td>
<td>Clinical studies lacking</td>
</tr>
<tr>
<td><strong>Accuracy</strong></td>
<td>Highly sensitive and specific IF viral RNA present</td>
<td>Possible cross-reactivity with SARS-CoV and other coronaviruses</td>
</tr>
<tr>
<td><strong>Sample collection (&amp; sample quality)</strong></td>
<td>NP and OP swabs (availability issues) Nasal wash BAL if pneumonia, critically ill</td>
<td>Few drops of blood</td>
</tr>
<tr>
<td><strong>Time of Collection (&amp; variable virus load)</strong></td>
<td>Anytime – symptomatic or asymptomatic</td>
<td>7 – 14 days after exposure</td>
</tr>
<tr>
<td><strong>Time to result</strong></td>
<td>20 mins to 48 hrs</td>
<td>15 mins</td>
</tr>
<tr>
<td><strong>Equipment</strong></td>
<td>Certified labs, special equipment</td>
<td>Home kits</td>
</tr>
</tbody>
</table>
Who is CHC (viral RNA) testing?

- Every patient admitted to the hospital
- Every patient 24hr before anesthesia
  - Asymptomatic positives?
  - ‘False’ negatives?
- High risk outpatients (oncology, heart transplants)
- Health care workers with symptoms
- Parents?
US Aircraft Carrier Theodore Roosevelt

Tested 4,800 crew
- 600 SARS-CoV-2 Positive
  - 60% no symptoms

"With regard to COVID-19, we’re learning that stealth in the form of asymptomatic transmission is this adversary’s secret power”

Rear Admiral Bruce Gillingham, surgeon general of the US Navy
COVID 19 AND PEDIATRIC CARDIAC ANESTHESIA PROGRAMS

Preferably negative pressure room
Separate anesthesia workstation

<table>
<thead>
<tr>
<th>Intubation / Extubation and Room Clearance Wait Times</th>
<th>High-Risk Aerosol Generating Surgery &amp; Emergent Procedures*</th>
<th>All Other Procedures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intubation / Extubation</td>
<td>Full duration of case:</td>
<td>Intubation/extubation only:</td>
</tr>
<tr>
<td>Videolaryngoscopy</td>
<td>ALL team members in PAPR or fit-tested respirator</td>
<td>TWO providers in PAPR</td>
</tr>
<tr>
<td></td>
<td>Extubation: Minimize coughing</td>
<td>or fit-tested respirator</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Extubation: Minimize coughing</td>
</tr>
<tr>
<td>Room Clearance Waiting Time (After Intubation/Extubation)</td>
<td>None</td>
<td>15 min</td>
</tr>
<tr>
<td>Surgery</td>
<td>Continue PAPR or fit-tested respirator</td>
<td>Continue standard surgical attire following</td>
</tr>
<tr>
<td></td>
<td></td>
<td>intubation and room clearance time</td>
</tr>
</tbody>
</table>

High risk AGS: bronchoscopy, TEE, endoscopy, dental
COVID 19 AND PEDIATRIC CARDIAC ANESTHESIA PROGRAMS
Selected References


CORONAVIRUS DISEASE AND ECHOCARDIOGRAPHY

Wanda C. Miller-Hance, M.D., FAAP, FACC, FASE
President, Congenital Cardiac Anesthesia Society
Professor of Anesthesiology and Pediatrics
Department of Anesthesiology, Perioperative and Pain Medicine
Department of Pediatrics, Section of Cardiology
Baylor College of Medicine
Texas Children’s Hospital
Houston, TX
LEARNING OBJECTIVES

- Highlight impact of COVID-19 pandemic in echo services
- Review recent ASE recommendations
- Address consideration regarding TEE
- Outline suggested approach to patients requiring TEE

No Disclosures
COVID-19 – BACKGROUND

• caused by SARS-CoV-2
• transmission: droplet, fomites, aerosol
• infection in asymptomatic and pre-asymptomatic individuals
• virus detected in upper/lower resp tract, blood, stool
• lung injury, other organs, potential cardiovascular involvement

From, UT Southwestern Med Ctr
Heart Damage in COVID-19 Patients Puzzles Doctors

Up to one in five hospitalized patients have signs of heart injury. Cardiologists are trying to learn whether the virus attacks the organ.

Scientific American, April 6, 2020

Coronaviruses and the cardiovascular system: acute and long-term implications

Tian-Yuan Xiong, Simon Redwood, Bernard Prendergast, Mao Chen

*European Heart Journal*, ehaa231, [https://doi.org/10.1093/eurheartj/ehaa231](https://doi.org/10.1093/eurheartj/ehaa231)

Published: 18 March 2020

Potential Effects of Coronaviruses on the Cardiovascular System

A Review

Mohammad Madjid, MD, MS; Payam Safavi-Naeini, MD; Scott D. Solomon, MD; et al

*JAMA Cardiol*. Published online March 27, 2020. doi:10.1001/jamacardio.2020.1286
From John Hopkins Coronavirus Resource Center
ASE Statement on Protection of Patients and Echocardiography Service Providers During the 2019 Novel Coronavirus Outbreak

Endorsed by the American College of Cardiology
ASE Statement on Protection of Patients and Echocardiography Service Providers During the 2019 Novel Coronavirus Outbreak

Specific Considerations for the Protection of Patients and Echocardiography Service Providers When Performing Perioperative or Periprocedural Transesophageal Echocardiography During the 2019 Novel Coronavirus Outbreak: Council on Perioperative Echocardiography Supplement to the Statement of the American Society of Echocardiography

Endorsed by the Society of Cardiovascular Anesthesiologists
PEDIATRIC ECHOCARDIOGRAPHY

• primary imaging modality of CV system
• essential in dx, mgmt and surveillance
• various modalities
• outcome benefits
COVID-19 IN CHILDREN

- contribute to viral transmission
- minority of cases
- fewer symptoms, mild disease
- low fatality rate

COVID-19 in Children-USA, Feb 12–Apr 2, 2020
From MMWR Morb Mortal Wkly Rep 2020;69
COVID-19, CHILDREN AND ECHO

- SARS-CoV-2 infection more likely asymptomatic
- accompanied by parents/caregivers for exam
- uncooperative
- secretions
- limited ability to wear a mask
- unable to maintain social distancing
Specific Considerations for Pediatric, Fetal, and Congenital Heart Disease Patients and Echocardiography Service Providers During the 2019 Novel Coronavirus Outbreak: Council on Pediatric and Congenital Heart Disease Supplement to the Statement of the American Society of Echocardiography
TRANSESOPHAGEAL ECHOCARDIOGRAPHY

- **Provides significant benefits**
  - diagnostic, perioperative, and cardiac catheterizations

- **Heightened risk of SARS-CoV-2 spread**
  - droplet transmission and viral aerosolization
  - cross-contamination
COVID-19 AND TEE

• **Defer/Reschedule non essential studies/unlikely to impact care**
  - evaluate risk-benefit of all studies
  - case by case assessment
  - defer/reschedule/cancel elective cases
  - proceed with urgent/emergency cases
COVID-19 AND TEE

- Defer/Reschedule non essential studies/unlikely to impact care
- **Consider alternate options**
  - imaging modalities: TTE, contrast echo, CT, CMR, ICE, epicardial
  - others: invasive hemodyn data, direct surgical observation

From Broadcast Med  
Kim et al., JACC 53:2117-28, 2009
COVID 19 AND PEDIATRIC CARDIAC ANESTHESIA PROGRAMS

TEE VERSUS EPICARDIAL IMAGING

Epicardial Echo
- interrupts surgery
- risks:
  - infection
  - hemodynamic changes
  - arrhythmias
- limited windows
- need expertise

TEE
- standard intraop imaging
- continuous assessment
- esophageal and gastric windows
COVID-19 AND TEE

- Defer/Reschedule non essential studies/unlikely to impact care
- Consider options
  - *Pre-procedure SARS-CoV-2 testing if possible*
    - assume patient positive unless avail test
COVID-19 AND TEE

- Defer/Reschedule non essential studies/unlikely to impact care
- Consider options
- Pre-procedure SARS-CoV-2 testing if possible
- **Precautions**
  - limit personnel exposure
  - PPE recommendations (balance risk vs. resources)
  - prevent environment/equipment/reading room transmission
**SUGGESTED APPROACH FOR TEE IN COVID-19**

### BEFORE PROCEDURE
- Don PPE for airborne precaution measures (gown, face shield or goggles, airborne protection mask)
- Double glove
- Consider covering the ultrasound system (knobs, screen) with a plastic barrier, including transducer ports

### DURING PROCEDURE
- Consider using video laryngoscope or direct laryngoscopy to limit contact with patient’s secretions
- Limit examination time by performing a focused exam
- Remove outer gloves and wipe inner gloves with approved viricidal wipes or solution whenever other patient activities are undertaken
- Avoid unnecessary contamination of touchable surfaces of the ultrasound system (knobs, screen)

### AFTER PROCEDURE
- Remove TEE probe from patient, disinfect probe and place in closed container and/or biohazard bag
- Wipe outer gloves, gown, and sleeves with approved viricidal wipes or solution
- Wipe down equipment and probe container
- Remove outer glove
- Remove equipment and probe container to induction room/ante-room
- Wipe equipment and probe container with approved viricidal wipes
- Doff PPE
- Transport probe in closed container to the cleaning room for immediate cleaning

*From ASE TEE Coronavirus Statement 2020*
Handling and cleaning critical

- guided by institutional protocol, ID experts, manufacturers
- consider protective barriers
- two-people model
- reduce non essential equipment from system

From ASE TEE Coronavirus Statement 2020
COVID-19 AND TEE

- Defer/Reschedule non essential studies/unlikely to impact care
- Consider options
- Pre-procedure SARS-CoV-2 testing if possible
- Precautions
- Collaborative protocols with involved disciplines
COVID-19 AND TEE

From ASE Pedi, Fetal & CHD Coronavirus Statement 2020
SUMMARY

- Consider indications
- COVID-19 testing
- Regard TEE as aerosol generating procedure
- Precautions to minimize risk
- Develop standard approach
Blood Conservation for Pediatric Cardiac Surgery During COVID-19

Nina A. Guzzetta, MD
Emory University School of Medicine
Children’s Healthcare of Atlanta
No Financial Disclosures
Blood Conservation is Not New

“I’m at the age where not only can I not learn new tricks, I can’t even remember my old ones.”
Patient Blood Management for Neonates and Children Undergoing Cardiac Surgery: 2019 NATA Guidelines

David Faraoni, Jens Meier, Helen V. New, Philippe J. Van der Linden, Beverley J. Hunt

J Cardiothorac Vasc Anesth 2019;33:3249-3263

- Preoperative Anemia and Optimization of Hemoglobin
- Preoperative Coagulation Assessment and Risk Stratification
- Anti-fibrinolytic Therapies
- Cardiopulmonary Bypass and Priming
- Cell Salvage and Normovolemic Hemodilution
- Anticoagulation and Monitoring
- Intraoperative Monitoring of Hemostasis
- Postoperative RBC Transfusion and Thresholds
- Fibrinogen Supplementation
- Other Products: rFVIIa, PCCs, Desmopressin
Recommendations

- 31 bullet-pointed recommendations:
  - No Grade 1A
  - Grade 1B = 7: Strong with moderate quality evidence
  - Grade 1C = 13: Strong with low quality evidence
  - Grade 2C = 11: Weak with low quality evidence

Level C evidence: observational studies, unsystematic clinical experience, or randomized controlled trials with serious flaw; any estimate of effect is uncertain
Blood Conservation Strategy has to Work at Your Institution
Blood Conservation Strategies

- Preoperative Interventions:
  - Treatment of preoperative anemia
  - Diagnosis and treatment of acquired or congenital bleeding disorders
Blood Conservation Strategies

- Intraoperative Interventions:
  - Autologous blood collection and re-infusion
  - Intraoperative cell salvage
  - Miniaturized CPB circuits
  - Composition of CPB prime
  - Hemoconcentration techniques
  - Anti-fibrinolytic therapies
  - Topical hemostatic agents
  - Individualized transfusion algorithms
  - Procoagulant agents
Feasibility of autologous intraoperative blood collection and re-transfusion in small children with complex congenital heart defects undergoing cardiopulmonary bypass

A Kaiser, K Miller, G Tian, RH Moore, NA Guzzetta
Paediatr Anaesth 2018;28:795

- Children weighing <10kg who underwent CPB (n=18)
- 52 ml (+ 8 ml CPD) autologous blood off the study patients
- 1:1 matched design on preop Hct, surgical procedure and weight
## Results

<table>
<thead>
<tr>
<th></th>
<th>Study (n = 18)</th>
<th>Control (n = 18)</th>
<th>Odds Ratio or Mean Diff (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-CPB inotropic support* N (%)</td>
<td>7 (39)</td>
<td>6 (33)</td>
<td>1.2 (0.2, 7.5)</td>
<td>0.83</td>
</tr>
<tr>
<td>RBCs transfused on CPB (ml/kg)</td>
<td>21 (11, 32)</td>
<td>19 (8, 30)</td>
<td>2 (-11, 15)</td>
<td>0.76</td>
</tr>
<tr>
<td>Total volume transfused* (ml/kg)</td>
<td>47 (23, 71)</td>
<td>70 (49, 92)</td>
<td>-23 (-50, 4)</td>
<td>0.09</td>
</tr>
<tr>
<td>Total donor exposures* (n)</td>
<td>2.6 (1.2, 4.1)</td>
<td>6.5 (5.5, 7.5)</td>
<td>-4 (-5.7, -2.1)</td>
<td>0.0002</td>
</tr>
<tr>
<td>24 hour CTO (ml/kg)</td>
<td>25 (19, 31)</td>
<td>26 (18, 35)</td>
<td>-1 (-11, 9)</td>
<td>0.82</td>
</tr>
<tr>
<td>Duration mechanical ventilation (hours)*</td>
<td>26 (11, 62)</td>
<td>59 (28, 124)</td>
<td>N/A</td>
<td>0.009</td>
</tr>
<tr>
<td>ICU length of stay (days)*</td>
<td>3 (2, 5)</td>
<td>8 (5, 14)</td>
<td>N/A</td>
<td>0.005</td>
</tr>
<tr>
<td>ECMO, N (%)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>In-hospital mortality, N (%)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Kaiser et al. *Paediatr Anaesth* 2018;28:795
Transfusion Algorithms

- Standard coagulation tests
- Point-of-care viscoelastic tests
  - ROTEM
  - TEG
Blood Conservation Strategies

- Postoperative Interventions:
  - Limit blood sampling/minimize blood wastage
  - Postoperative cell saver
  - Restrictive transfusion practices
Surgical Hemostasis
Abnormal coagulation parameters are associated with poor prognosis in patients with novel coronavirus pneumonia

N Tang, D Li, X Wong, Z Sun
J Thromb Haemost 2020

- At admission, non-survivors had significantly higher D-dimer and FDP levels, and longer PT compared to survivors
- By late hospitalization, non-survivors had significantly lower fibrinogen and AT levels compared to survivors
- Conclusion: conventional coagulation parameters during the course of infection are associated with prognosis
- ? Low grade DIC ?
Plasma concentrations of pro-inflammatory markers are high in both ICU and non-ICU COVID-19+ patients.

Comparison between ICU and non-ICU patients showed that plasma concentrations of IL2, IL7, IL10 and TNFα were higher in ICU patients than non-ICU patients.

? Inflammatory state → pro-thrombotic state ?
Cyanotic Heart Disease

- Generates high shear stress
- Increases platelet activation
- Predisposes to the intravascular deposition of platelet and fibrin thrombi
- Low-grade consumptive coagulopathy confirmed by elevated levels of D-dimers
COVID-19

Cyanotic Heart Disease

The Canadian Experience

David Faraoni, MD, PhD, FAHA
Toronto, Canada

@dfaraoni  @PedsCardiacAnes
NO CONFLICT OF INTEREST
Considerations during the pandemic, post-pandemic and the future

Pandemic

COVID-19 Peak

Baseline

Emergencies only

But complex neonatal surgery or REDO

Post Pandemic

Future

Cardiac Procedures

COVID-19 Cases

Blood supply

Blood donors

Transfusion Expiration

Ramp up

Adapted from Viviane Nasr
National Plan for Management of Shortages of Labile Blood Components

**Green Phase Advisory**

**Definition:** CBS inventory levels are low with respect to a specific blood component.

**Action:**
1. Determine local inventory and report back to CBS as advised on the NEMBC notification.

**Amber Phase**

**Definition:** CBS inventory levels are insufficient to continue with routine transfusion practices.

**Action:**
1. Adjust inventory levels of affected components to pre-determined Amber Phase levels.
2. Request inventory from CBS based on Amber Phase levels.
3. Defer/cancel elective surgery/procedures that require the affected component.
4. Follow transfusion guidelines for Amber Phase (see page 2).
   a. All requests that do not fulfill pre-determined acceptance criteria require referral to Medical Director or designate prior to issuing. Record the requests/outcomes.

**Red Phase**

**Definition:** CBS inventory levels are insufficient to ensure non-elective transfusion practices.

**Action:**
1. Adjust inventory levels of affected components to pre-determined Red Phase levels.
2. Request inventory from CBS based on Red Phase levels.
3. Defer/cancel all surgery/procedures that require the affected component except for emergency procedures.
4. If possible, defer stem cell transplantation, chemotherapy treatments or other treatments requiring affected blood component.
5. Follow transfusion guidelines for Red Phase (see page 2).
   a. All requests that do not fulfill pre-determined acceptance criteria require referral to Medical Director or designate prior to issuing. Record the requests/outcomes.

**Recovery Phase**

**Definition:** CBS inventory levels have begun to increase and expected to be maintained.

**Action:**
1. Slowly adjust inventory levels and reinstitute procedures and transfusions on the basis of urgency. Review previous documentation of requests/outcomes to help determine order of resumption.
2. Slowly or partially replace emergency stocks to sites that had inventory redistributed.

---

**National Inventory Advisory**

<table>
<thead>
<tr>
<th>Date and time of issue</th>
<th>2020-04-16 0600 (EST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inventory Availability Phase</td>
<td>GREEN PHASE ADVISORY</td>
</tr>
<tr>
<td>Product(s)</td>
<td>Platelets and Plasma Protein Products</td>
</tr>
</tbody>
</table>

**Description**

This is a notice of continuation of the Green Phase Advisory, declared March 17, 2020, for platelets and plasma protein products.

The advisory does not apply to red blood cells, frozen plasma and cryoprecipitate. The advisory affecting these components was lifted last week as a result of improved inventory levels due to both a reduced hospital demand and the recent donor response augmenting the supply.

The impacts of COVID-19 and the uncertainties related to this pandemic continue to affect blood supply planning at Canadian Blood Services. Inventory of all blood components and products are currently at Green Phase levels. However, Canadian Blood Services forecasting predicts the potential for shortages with particular risk to the platelet and plasma protein product supply, given the ongoing pandemic situation.

Due to the dynamic and evolving nature of this situation, the advisory status for all products may be escalated quickly if demand outpaces supply.
Blood Components & Storage

- Red Blood Cells
  - 42 days
  - Treatment of Anemia/Cell Salvage
  - Irradiate >28 days/Wash

- Platelets
  - 7 days
  - No alternative (DDAVP?, PCC?)
  - Extend expiry date to 9-11 days?

- Frozen Plasma
  - 12 months
  - 4F-PCC

- Cryoprecipitate
  - 12 months
  - Fibrinogen Concentrate
The FIBRES Randomized Clinical Trial

Table 3. Primary and Secondary Outcomes: Allogeneic Blood Component Transfusions

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>Fibrinogen Concentrate</th>
<th>Cryoprecipitate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary Outcome: Cumulative Allogeneic Blood Components Transfused Within 24 h After Cardiopulmonary Bypass*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary analysis set</td>
<td>372</td>
<td>361</td>
</tr>
<tr>
<td>Median (IQR)</td>
<td>12.0 (5.5 to 22.0)</td>
<td>16.3 (14.9 to 17.8)</td>
</tr>
<tr>
<td>L5 Mean (95% CI)</td>
<td>14.0 (7.0 to 23.0)</td>
<td>17.0 (15.5 to 18.6)</td>
</tr>
<tr>
<td>Mean Difference of L5 Means (95% CI)</td>
<td>-0.73 (-3.10 to 1.64)</td>
<td></td>
</tr>
<tr>
<td>Noninferiority P Value</td>
<td>Unadjusted 0.96 (≈ to 1.05)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Unadjusted 0.91 (≈ to 1.03)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Per-protocol set</td>
<td>364</td>
<td>361</td>
</tr>
<tr>
<td>Median (IQR)</td>
<td>12.0 (6.0 to 22.0)</td>
<td>16.4 (15.0 to 18.0)</td>
</tr>
<tr>
<td>L5 Mean (95% CI)</td>
<td>14.0 (7.0 to 22.0)</td>
<td>16.9 (15.5 to 18.5)</td>
</tr>
<tr>
<td>Mean Difference of L5 Means (95% CI)</td>
<td>-0.50 (-2.90 to 1.89)</td>
<td></td>
</tr>
<tr>
<td>Noninferiority P Value</td>
<td>Unadjusted 0.97 (≈ to 1.10)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Unadjusted 0.92 (≈ to 1.03)*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Fibrinogen Concentrate and Cryoprecipitate

Outcome

<table>
<thead>
<tr>
<th>Outcome</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any adverse event</td>
<td>248 (66.7)</td>
</tr>
<tr>
<td>No. of events</td>
<td>623</td>
</tr>
<tr>
<td>Any serious adverse event</td>
<td>117 (31.5)</td>
</tr>
<tr>
<td>No. of events</td>
<td>224</td>
</tr>
<tr>
<td>Thromboembolic adverse events*</td>
<td>26 (7.0)</td>
</tr>
</tbody>
</table>

Callum J et al. JAMA 2019 Published online October 21, 2019.
(Adult) Cryoprecipitate vs. Fibrinogen Concentrate

Tranexamic Acid

< 12 mo

Loading: 30 mg/kg
Maintenance: 10 mg/h/kg

≥ 12 mo

Loading: 10 mg/kg
Maintenance: 10 mg/kg/h

Goobie SM & Faraoni D. Curr Opin Anaesthesiol 2019; 32(3):343-352
**Pre-Bypass**
- Preop. Coag, CBC, and AT
- Baseline ACT: ...
- TXA:
  - 30 mg/kg (≤ 1 yr.)
  - 10 mg/kg (> 1 yr.)
- Bleeding Risk Stratification:
  - High
  - Moderate
  - Low
- Heparin after sternotomy
- Heparin dose of 400 IU/kg

**Bivy**
- Prime:
  - Initial dose of RBC: ...
  - Initial dose of FFP: ...
- TXA: 10 mg/100 mL of prime
- CPB:
  - Total dose of RBC: ...
  - Total dose of FFP: ...
- Coag & CBC rewarming.
- MUF time: ...
- Bleeding coming off:
  - > 50 mL/min
  - < 30 mL/min

**Bleeding & Transfusion**
- PLT
  - < 150 $10^9$/L or
  - Bleeding > 50 mL/min
    - Order: PLT 10-15 mL/kg
- Fibrinogen
  - < 1.0 g/L or
  - Bleeding > 50 mL/min
    - Order: FC 50-100 mg/kg
- Plasma
  - Left from CPB: ...
  - Bleeding > 50 mL/min
    - Prepare: Plasma 10-20 mL/kg
- Surgical field inspection
- Tisseel
- Cell-Saver Ready
- Bleeding coming off: ...

**Post-Bypass**
- Protamine dose: ...
- Bleeding > 50 mL/min
  - Platelets transfused: ...
  - Pump blood max 2 syringes (CS)
  - Plasma: ...
  - ACT Post-protamine: Hep?
- 30-min bleeding assessment:
  - High
  - Moderate
  - Low
- If high/moderate
  - Residual heparin?
    - EXTEM A10 < 40 mm & FIBTEM A10 < 7 mm
      - FC 50-100 mg/kg
    - EXTEM A10 < 40 mm & FIBTEM A10 ≥ 7 mm
      - PLT: 10 mL/kg
    - EXTEM CT > 110 sec
      - PCC 50 IU/kg
- +30-min bleeding assessment:
  - High
  - Moderate
  - Low
Guidelines

Anesthesia & Analgesia Journal Publish Ahead of Print

DOI: 10.1213/ANE.00000000000004844

The Essential Role of Patient Blood Management in a Pandemic: A Call for Action

Aryeh Shander, MD,1 Susan Marie Goobie, MD,2 Matthew A Warner, MD,3 Matti Aapro, MD,4 Elvira Bisbe, MD, PhD,5 Angel A Perez-Calatayud, MD,6 Jeannie Callum, MD,7 Melissa M Cushing, MD,8 Wayne B Dyer, PhD,9 Jochen Erhard, MD,10 David Faraoni, MD, PhD,11 Shannon Farmer,12 Tatyana Fedorova, PhD,13 Steven M Frank, MD,14 Bernd
Take Home Message

• There is a risk of blood shortage
  – Daily communication with blood services
  – Monitor blood supplies

• Blood conservation protocol

• Pediatric vs. Adult

• Ramp up

Question?
david.faraoni@sickkids.ca
@dfaraoni