

*Optical Neuroimaging Device to
Understand the Mechanisms of Brain
Damage*

Marta Camprubí Camprubí PhD, MD
Neonatal Intensive Care Unit

- ✓ Why neuromonitoring?
- ✓ Which are current the tools?
- ✓ Could they help with the prognosis?
- ✓ And the future...

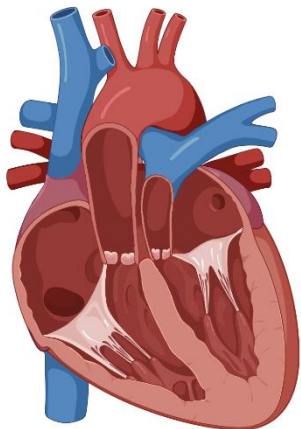


Congenital Heart Disease



**MOST COMMON BIRTH
DEFECT (1%)**

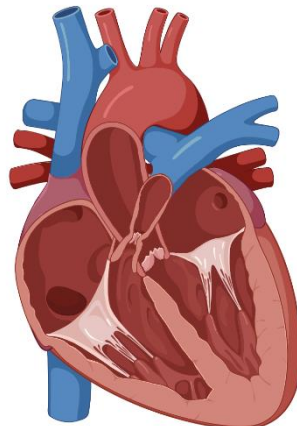
50,000 EU
newborns each year



**LEADING CAUSE OF
MORBIDITY &
MORTALITY**

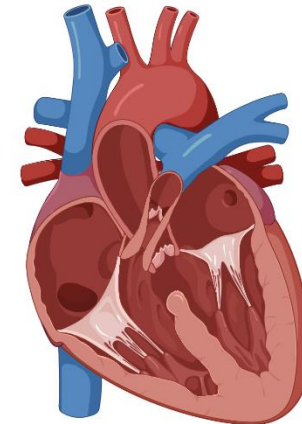


1st year of life



**9 OUT OF 10 REACH
ADULTHOOD**

Over
1 M adults in EU







Acute Neurological complications

Seizures

Delirium

Stroke

Hemorrhage



8-10% Decreasing incidence

Current Incidence of Acute Neurologic Complications After Open-Heart Operations in Children

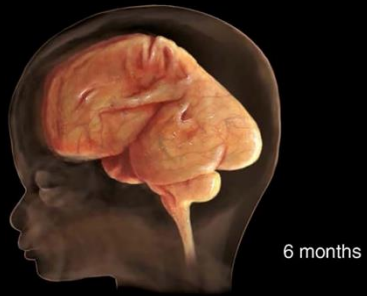
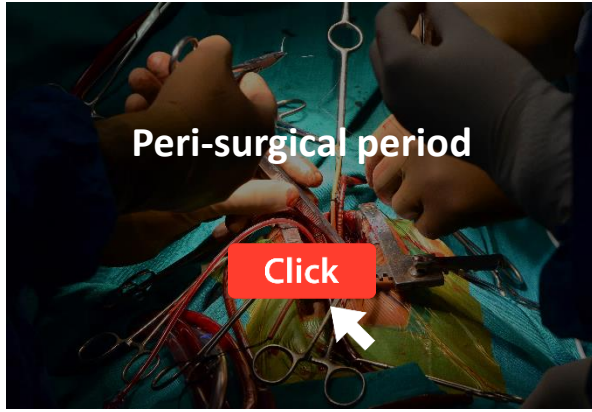
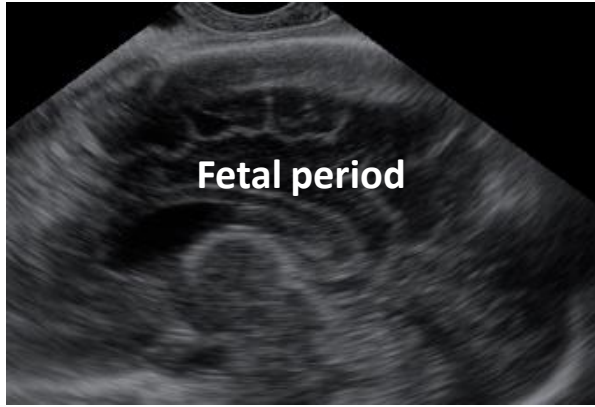
Caroline C. Menache, MD, Adré J. du Plessis, MBChB, David L. Wessel, MD,
Richard A. Jonas, MD, and Jane W. Newburger, MD

Departments of Neurology, Cardiology, and Cardiovascular Surgery, Children's Hospital, Harvard Medical School, Boston,
Massachusetts

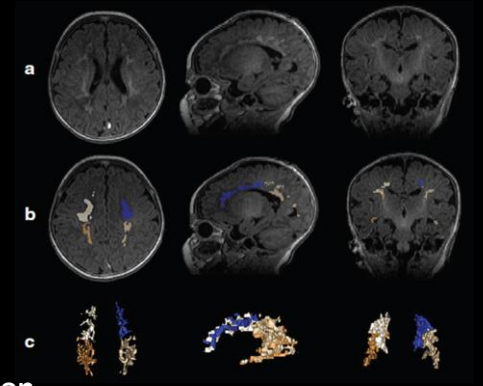
Acute Neurologic Injury in Children Admitted to the Cardiac Intensive Care Unit



Jamie L. Bell, MD, Lucas Saenz, MD, Yuliya Domnina, MD, Tracy Baust, BA,
Ashok Panigrahy, MD, Michael J. Bell, MD, Marta Camprubí-Camprubí, MD, PhD, and
Joan Sanchez-de-Toledo, MD, PhD



Birth



Brain Maturation



Cerebral ischemia

Low oxygen delivery

Decreased cardiac output

Severe Hypoxemia

Severe anemia

Increased metabolic demands

Post-operative agitation

Hyperthermia

Seizures

Hyperglycemia



Impaired cerebral autoregulation

Oxidative stress

Neuromonitoritzation





2015

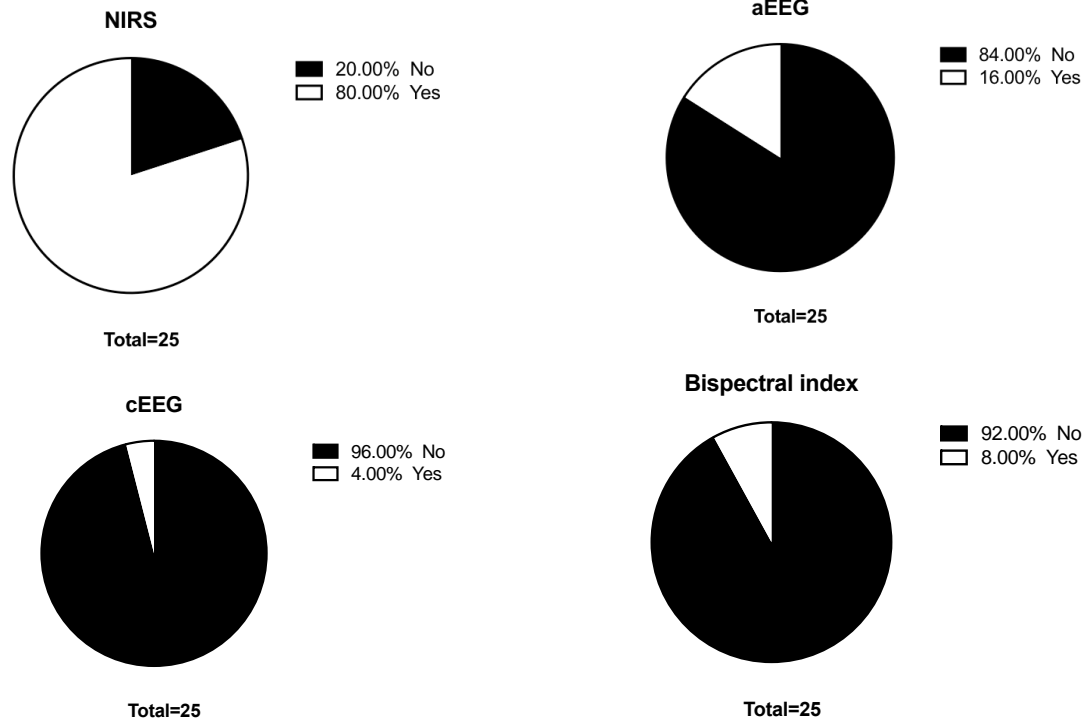


2017



2024

Neuromonitoring practice



- No intraoperative in 8%
- No response 12% (3/25)



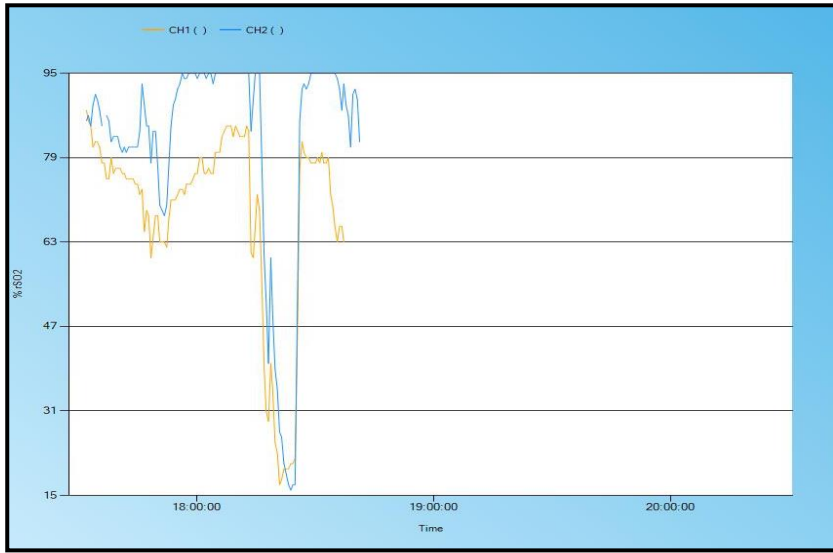
Feldman et al, Pediatric Research 2022 ABC_Consortium



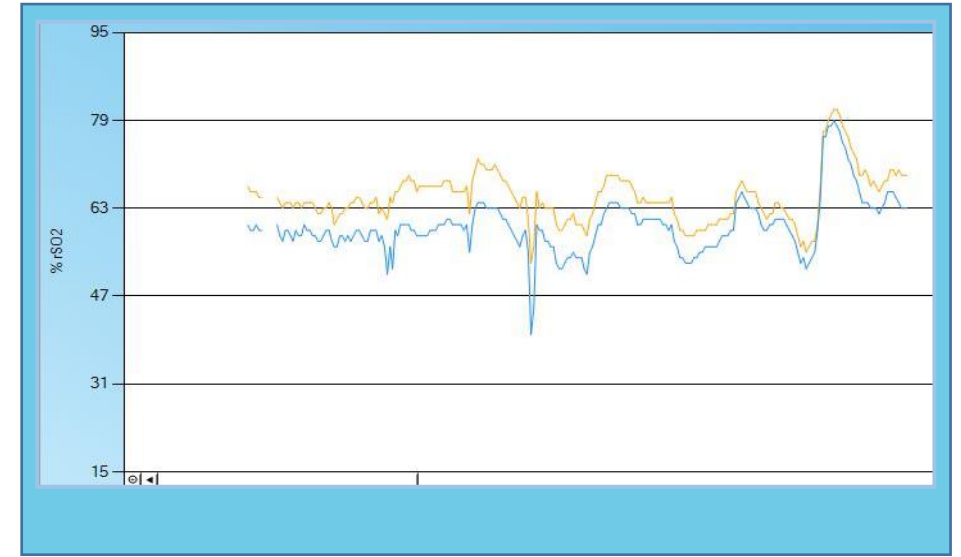


NIRS

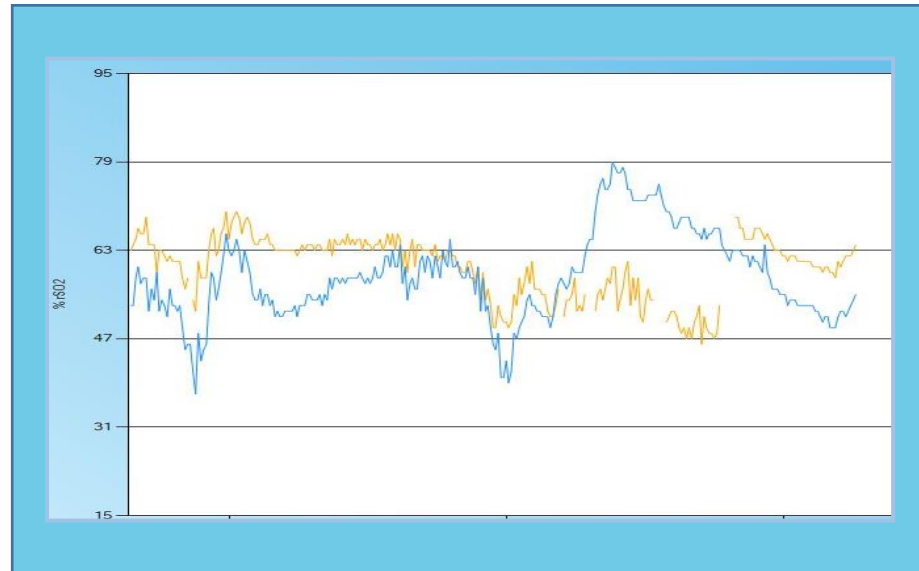
Cerebral Oxygen Saturation



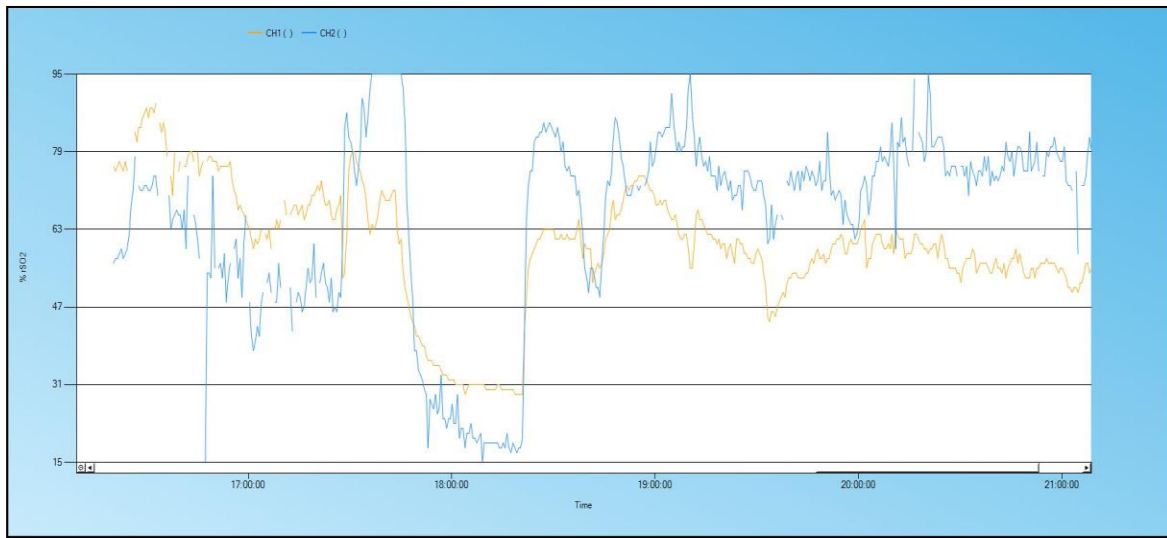
Coartectomy



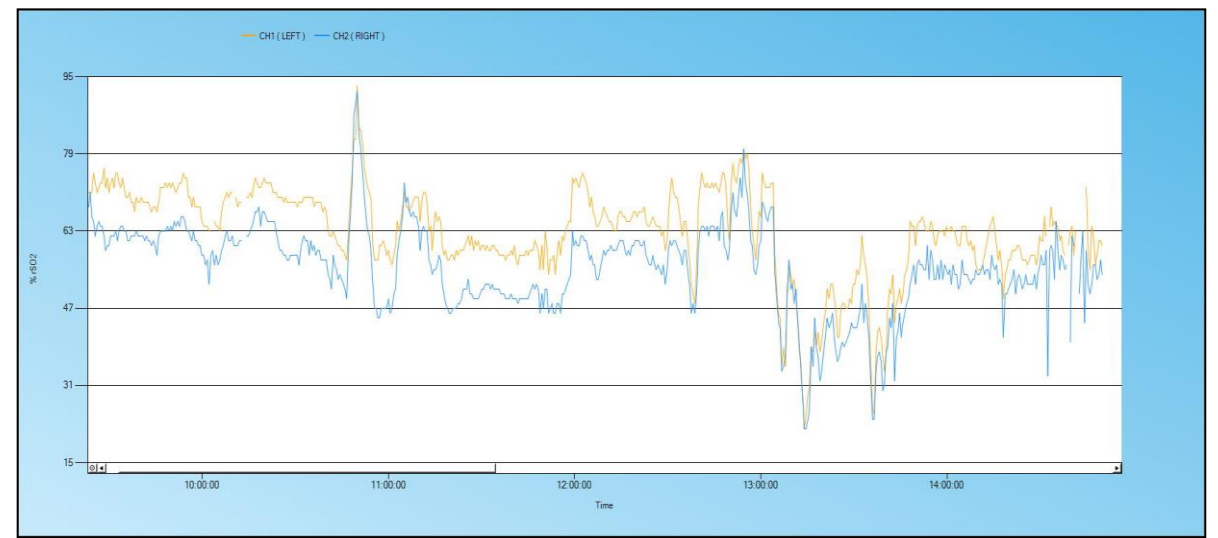
BT-Shunt



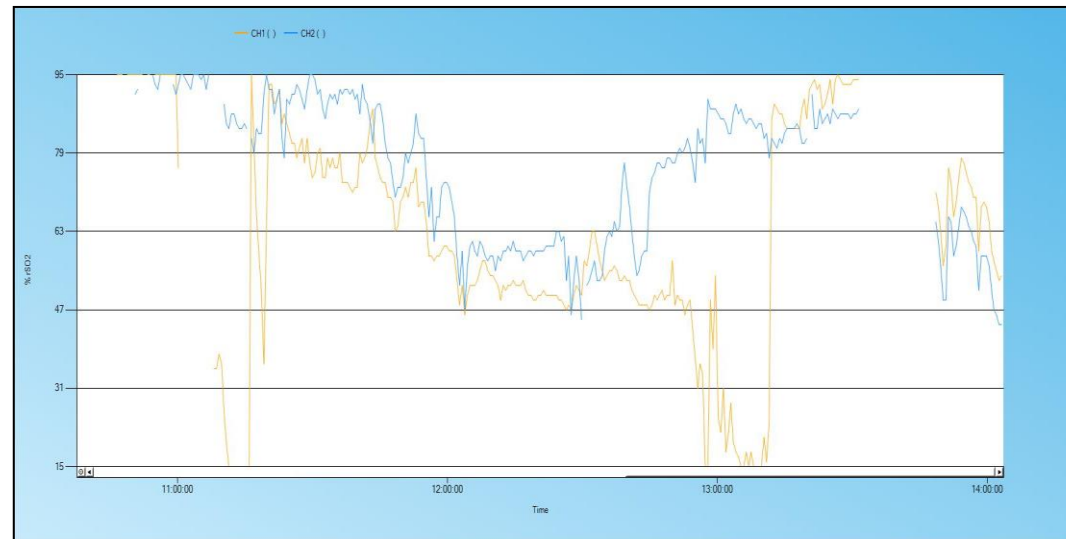
Pediatric CPB



DHCA



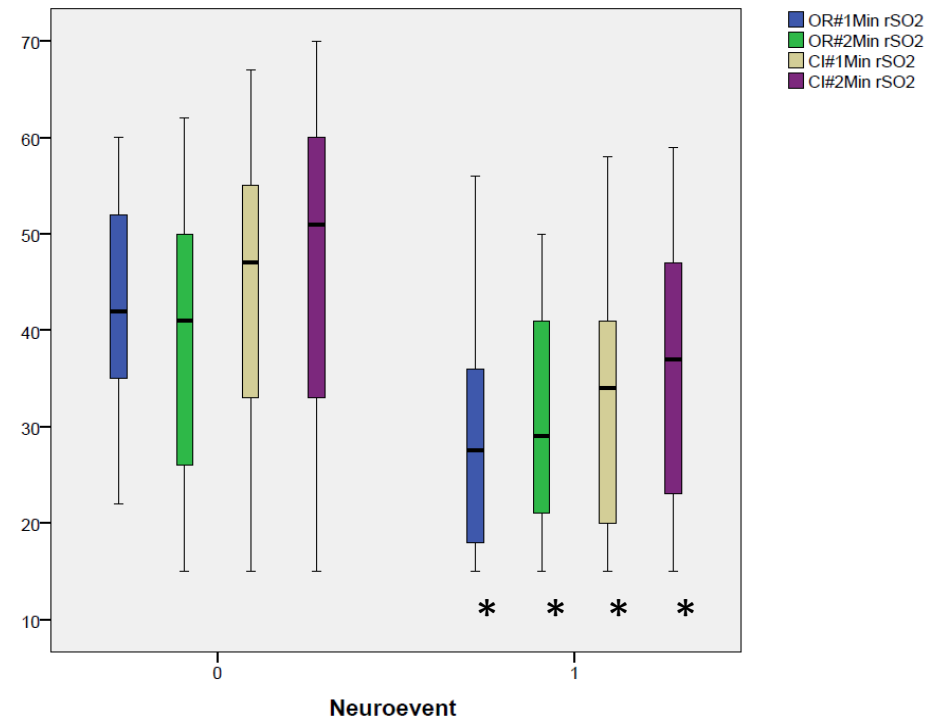
ACP



ACP - Cannula malposition

Cerebral Regional Oxygen Saturation and Serum Neuromarkers for the Prediction of Adverse Neurologic Outcome in Pediatric Cardiac Surgery

Joan Sanchez-de-Toledo · Constantinos Chrysostomou · Ricardo Munoz · Steve Lichtenstein · Cesar A. Sao-Avilés · Peter D. Wearden · Victor O. Morell · Robert S. B. Clark · Nicole Toney · Michael J. Bell



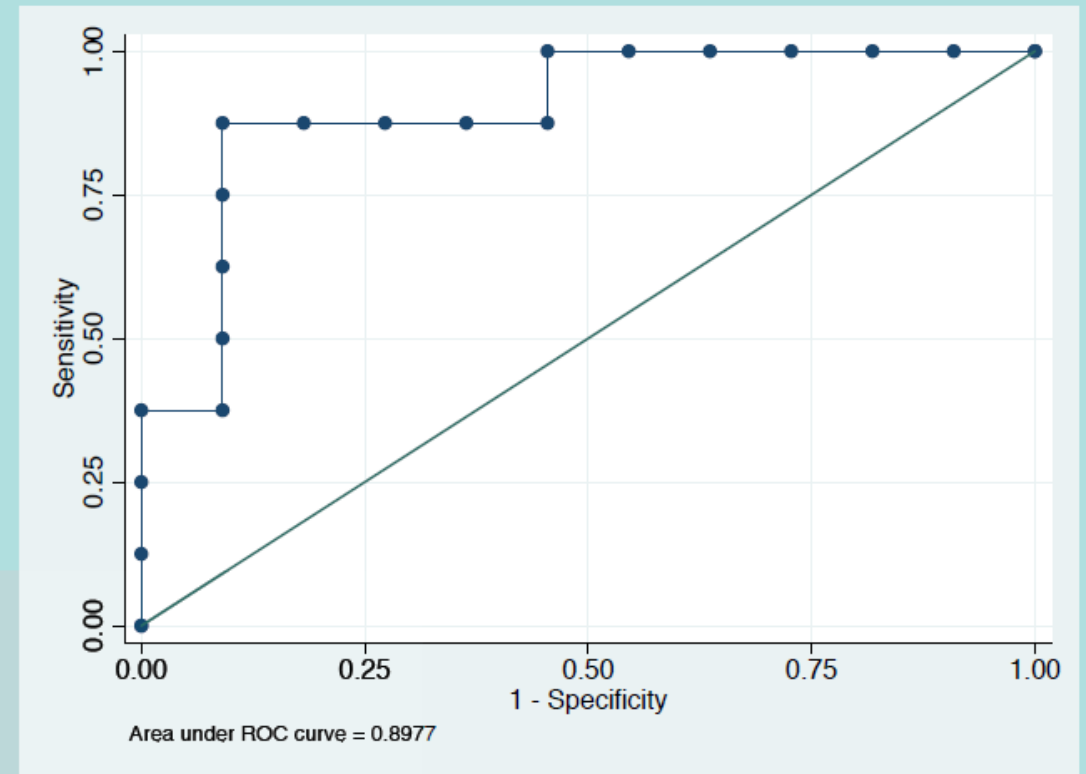
* p<0.005

46 patients were included

Time of rcSO₂ <40% 24 hours after CS was a good indicator of Neurological Outcome

(AUC of 0.677, p=0.017)
with a cut-off of 49 minutes

If we include levels of s100B at 72-hours and lactate after surgery the predictive AUC increased to 0.897 (p=0.033)



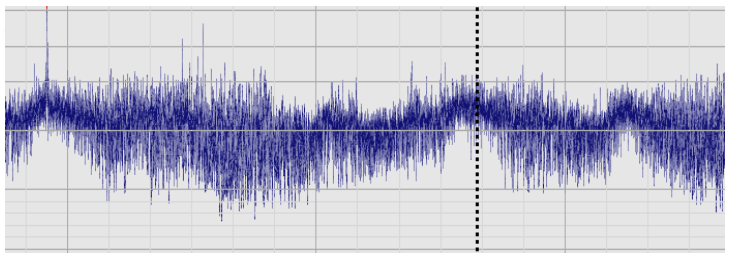
A close-up photograph of a newborn baby lying on their back. The baby's eyes are closed, and they appear to be asleep. Several EEG electrodes are attached to the baby's scalp, secured with white adhesive tape. A person wearing light-colored latex gloves is adjusting the electrodes. Multiple colored wires (blue, green, yellow, purple, grey) are connected to the electrodes and extend away from the baby's head. The background shows a patterned hospital gown.

Electroencephalography

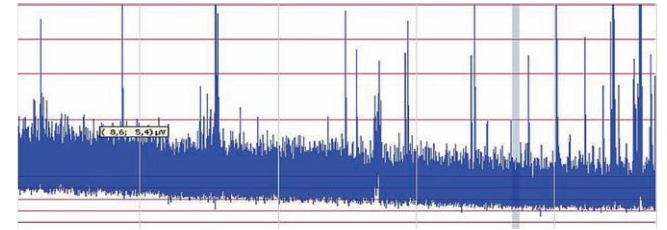


aEEG Pattern Classifications

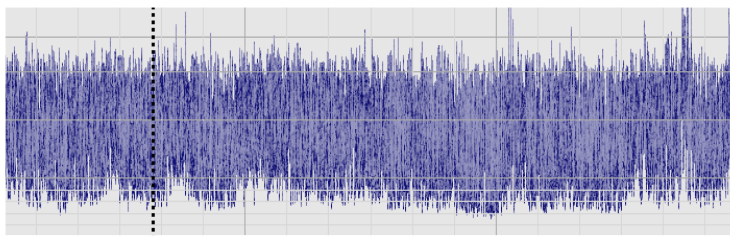
Continuous



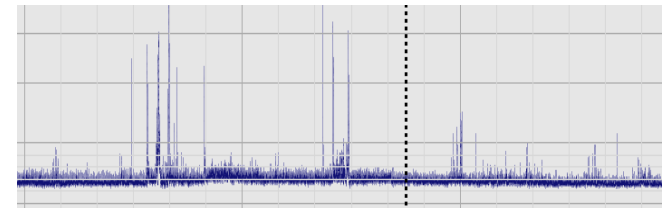
Low Voltage



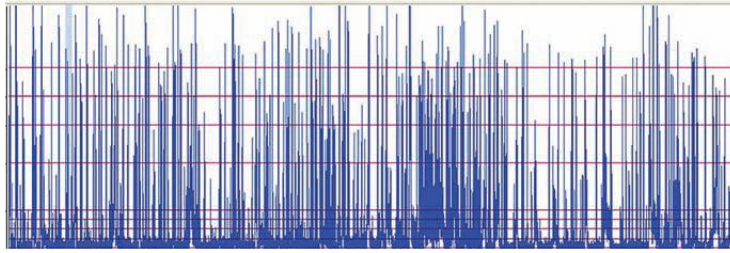
Discontinuous



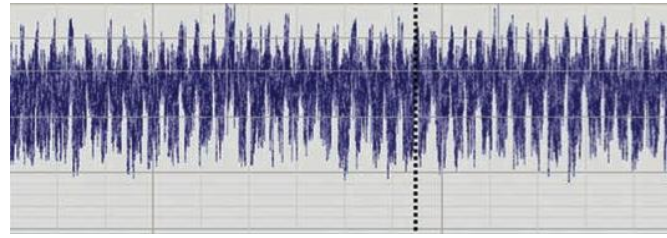
Isoelectric



Burst Suppression

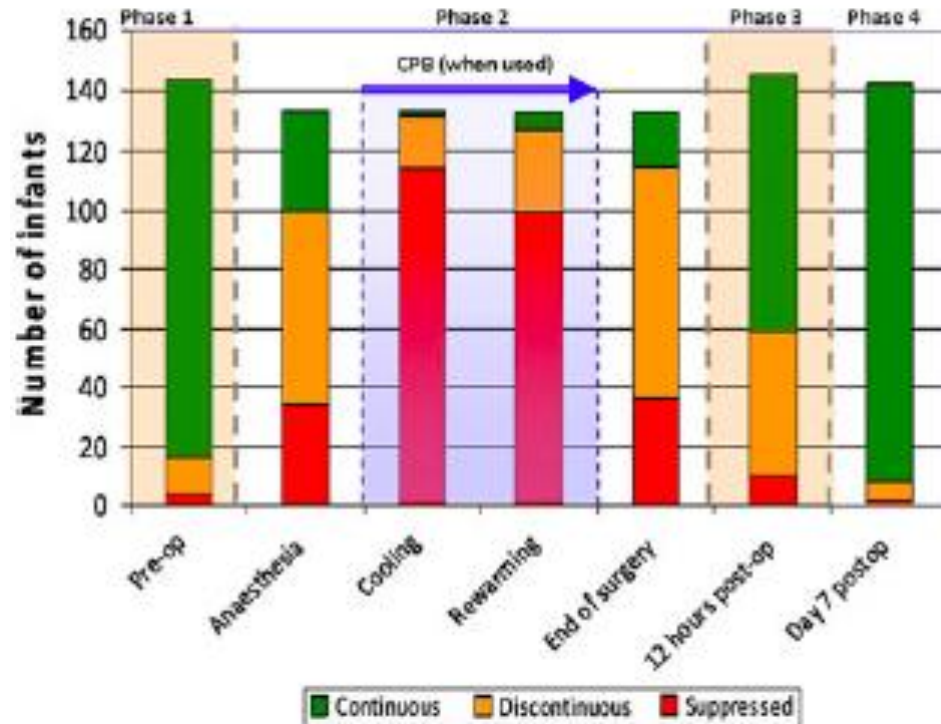


Status Epilepticus



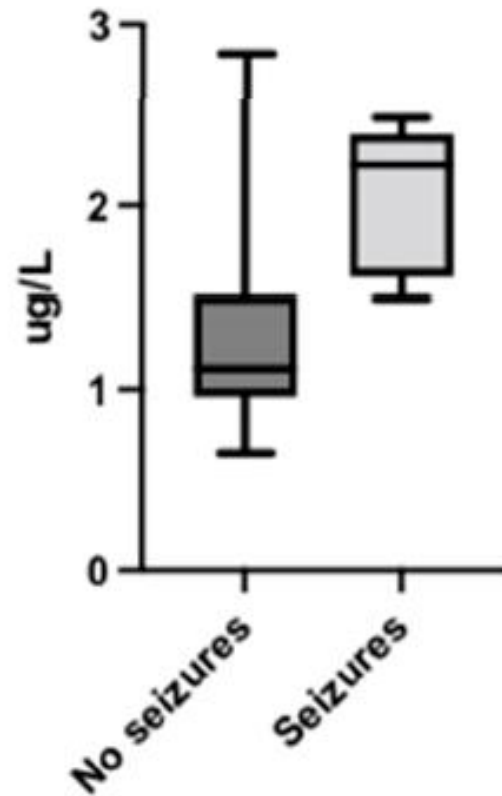
Julia K. Gunn
John Beca
Rodney W. Hunt
Monika Olischar
Lara S. Shekerdemian

Perioperative amplitude-integrated EEG and neurodevelopment in infants with congenital heart disease



- Decreased or isoelectric voltage during hypothermia
- The longer the recovery time, the worse the outcome (>48h)
- Non-recovery of the pattern after 7 days > DEATH

Post surgery s100b protein

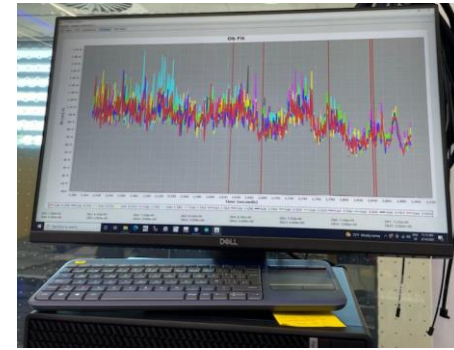
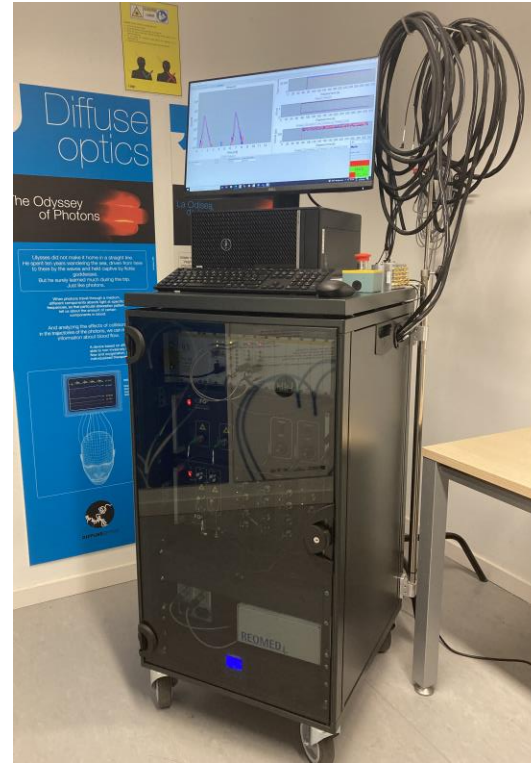
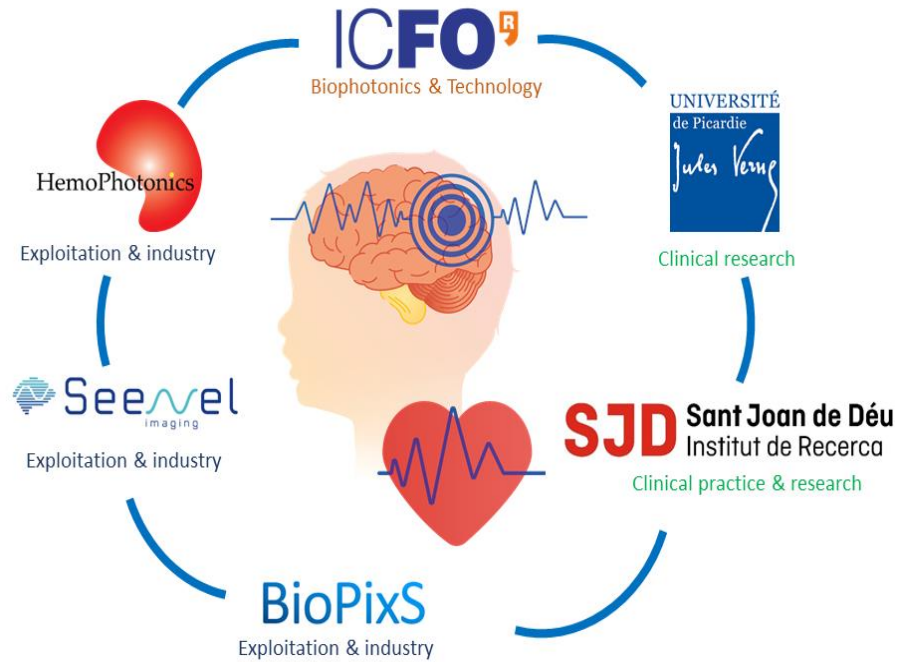


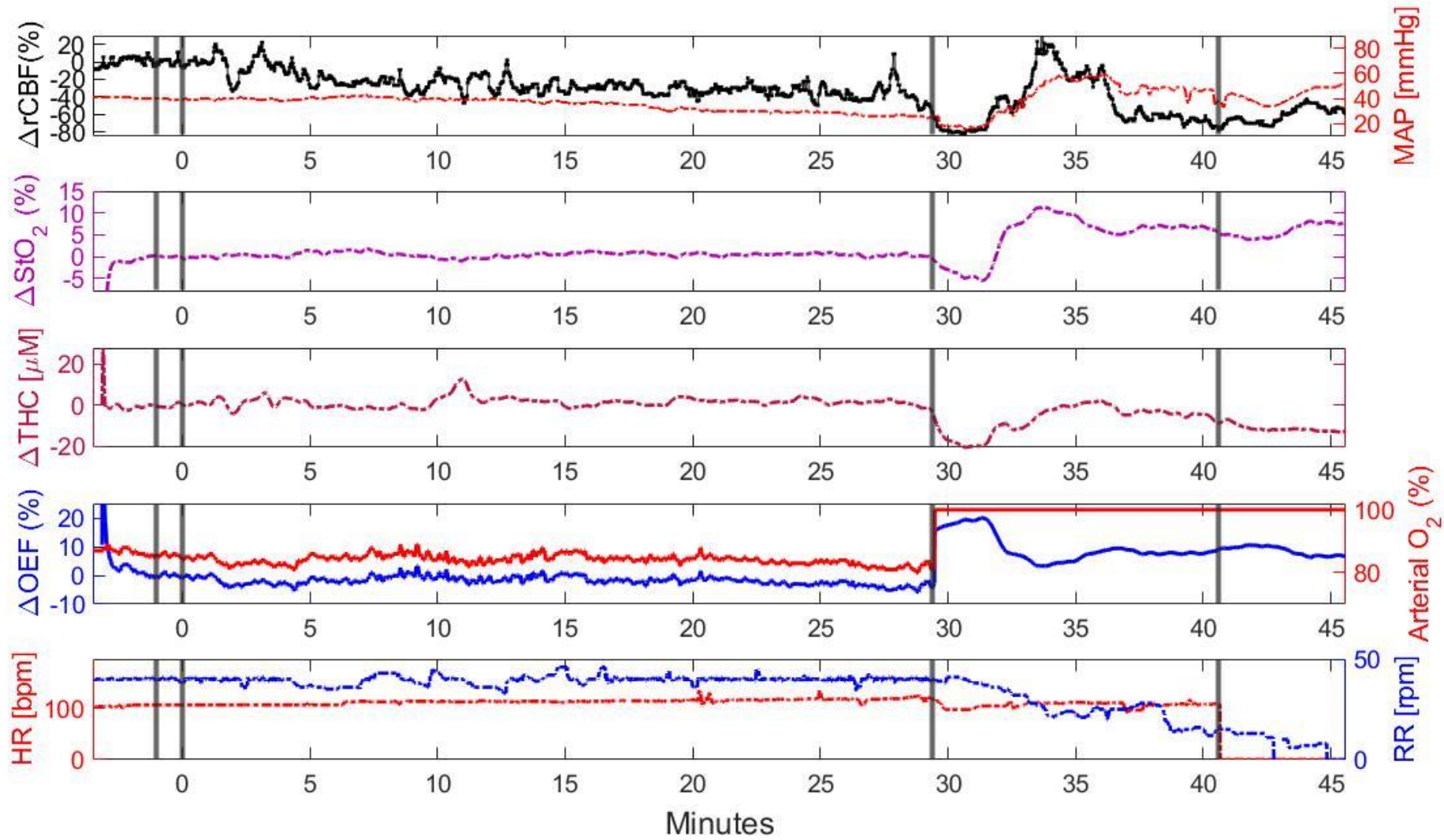
Intrasurgical seizures:

- Incidence around 20% in newborn patients; 2% Pediatric patients
- Increased levels of S100B protein
- Not related to neurological outcome

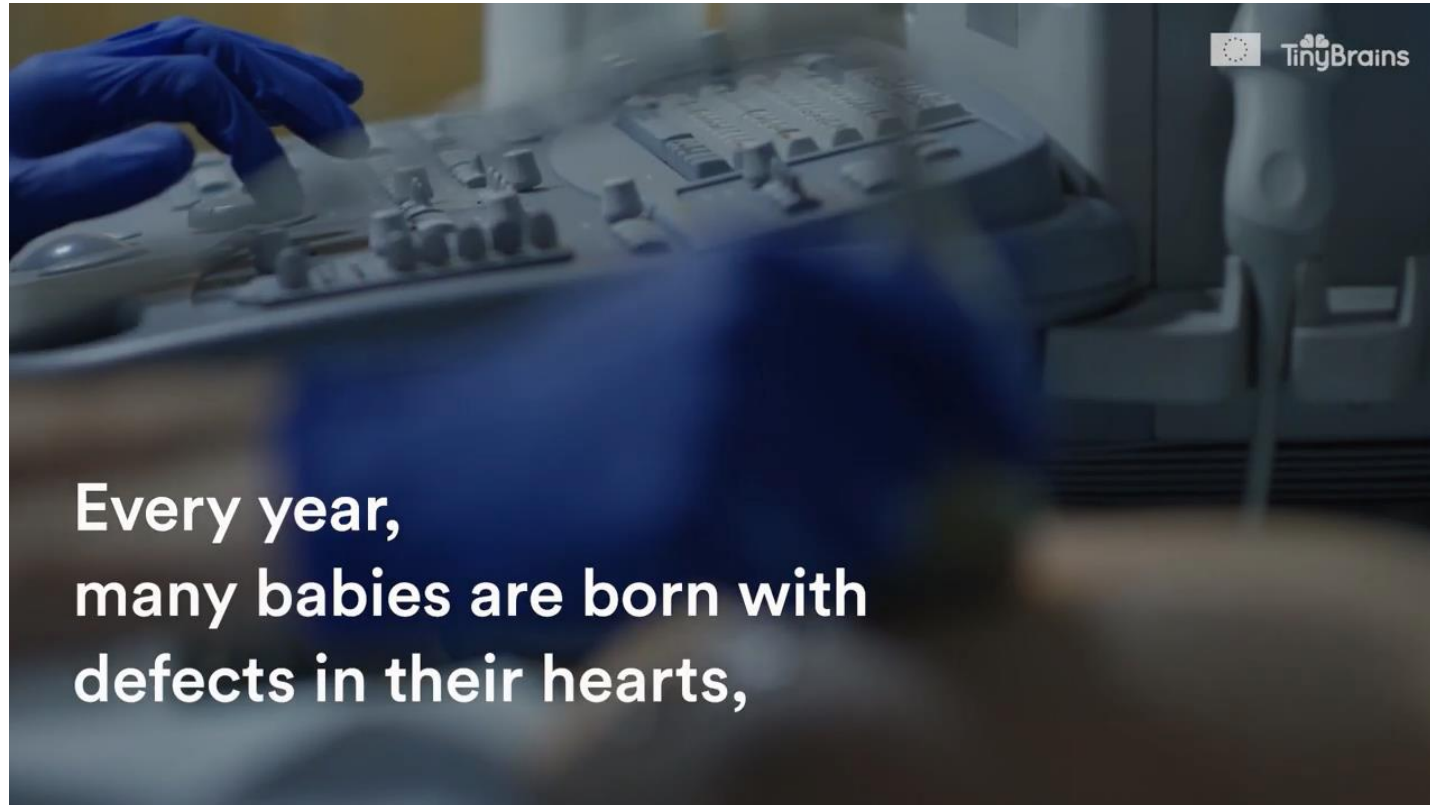


Future directions





TinyBrains: Understanding the brain damage in infants with CHD



Take home messages

- ✓ Importance of neuromonitoring
- ✓ Current tools
- ✓ Future options

“The quality of life resides in the brain”

TINYBRAINS TEAM



TinyBrains
PARTNERS - TinyBrains



TinyBrains
PARTNERS - TinyBrains



TinyBrains
PARTNERS - TinyBrains



TinyBrains
PARTNERS - TinyBrains



TinyBrains
PARTNERS - TinyBrains



TinyBrains
PARTNERS - TinyBrains



TinyBrains
PARTNERS - TinyBrains



TinyBrains
PARTNERS - TinyBrains



TinyBrains
PARTNERS - TinyBrains



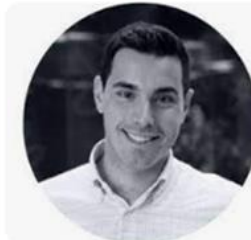
TinyBrains
PARTNERS - TinyBrains



TinyBrains
PARTNERS - TinyBrains



TinyBrains
PARTNERS - TinyBrains



TinyBrains
PARTNERS - TinyBrains



TinyBrains
PARTNERS - TinyBrains



TinyBrains
PARTNERS - TinyBrains



TinyBrains
PARTNERS - TinyBrains



TinyBrains
PARTNERS - TinyBrains



TinyBrains
PARTNERS - TinyBrains



TinyBrains
PARTNERS - TinyBrains



TinyBrains
PARTNERS - TinyBrains



TinyBrains
PARTNERS - TinyBrains



TinyBrains
PARTNERS - TinyBrains



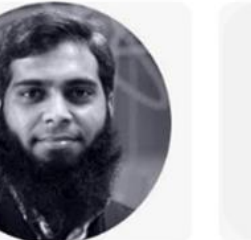
TinyBrains
PARTNERS - TinyBrains



TinyBrains
PARTNERS - TinyBrains



TinyBrains
PARTNERS - TinyBrains



TinyBrains
PARTNERS - TinyBrains



TinyBrains
PARTNERS - TinyBrains



Acknowledgments:

- Joan Sanchez-de-Toledo, MD, PhD
- Débora Cañizo Vázquez, MD
- Alba Rivas Piorno, MD
- Marta Perez
- Maria Clara Escobar, MD
- Pia Panisello, MD, PhD
- Emma Grau
- David Ferri, MD
- Marta Lopez, MD
- Dmytro Lushchencov, MD
- Cristina Ruiz-Herguido, PhD
- Ana María Garcia MD
- Alex Belfi

Neonatologists & NICU Nurses at SJD Hospital
Cardiac surgery and anesthesiology team
Our patients and their families

Thank you!

marta.camprubi@sjd.es