NEUROLOGICAL OUTCOMES: THE PERIOPERATIVE PERPECTIVE

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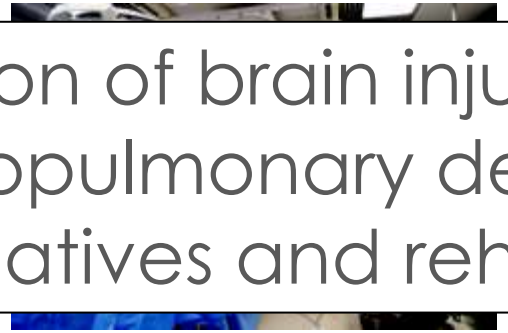
NO DISCLOSURES

Perelman School of Medicine
University of Pennsylvania

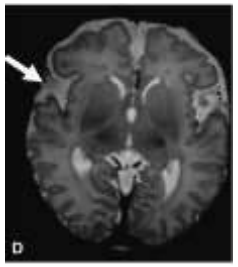
Children's Hospital of Philadelphia
Cardiac Center

PERI-OPERATIVE STRESSORS AND BRAIN INJURY

Fetal | Preoperative | Operative | Postoperative



Identification of brain injury
Prevention of cardiopulmonary deterioration
Minimization of sedatives and rehabilitation

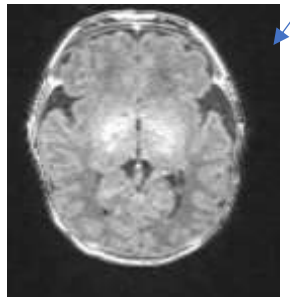


Postnatal diagnosis
Hypoxemia
Timing of Surgery

DHCA ?RCP
Hematocrit
Hypotension

Low Cardiac Output
Hypotension
Hypoxemia
Cardiac Arrest
ECMO

Brain Injury



Petit Circ 2009 Licht JTCVS 2009 Peyvandi 2019 Life 1965

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Adolescents With d-Transposition of the Great Arteries Corrected With the Arterial Switch Procedure

Neuropsychological Assessment and Structural Brain Imaging

Academic achievement, memory, executive function, visual-spatial skills, attention less than normative population

Postoperative seizures was the variable most consistently associated with worse outcomes

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Bellinger Circulation 2011

EEG MONITORING AT CHOP 2012-2022

1080 neonates were monitored with EEG

9.4% had postoperative seizures

Seizures were EEG-only in 86%

Status epilepticus in 23 % (2012-2013 60%)

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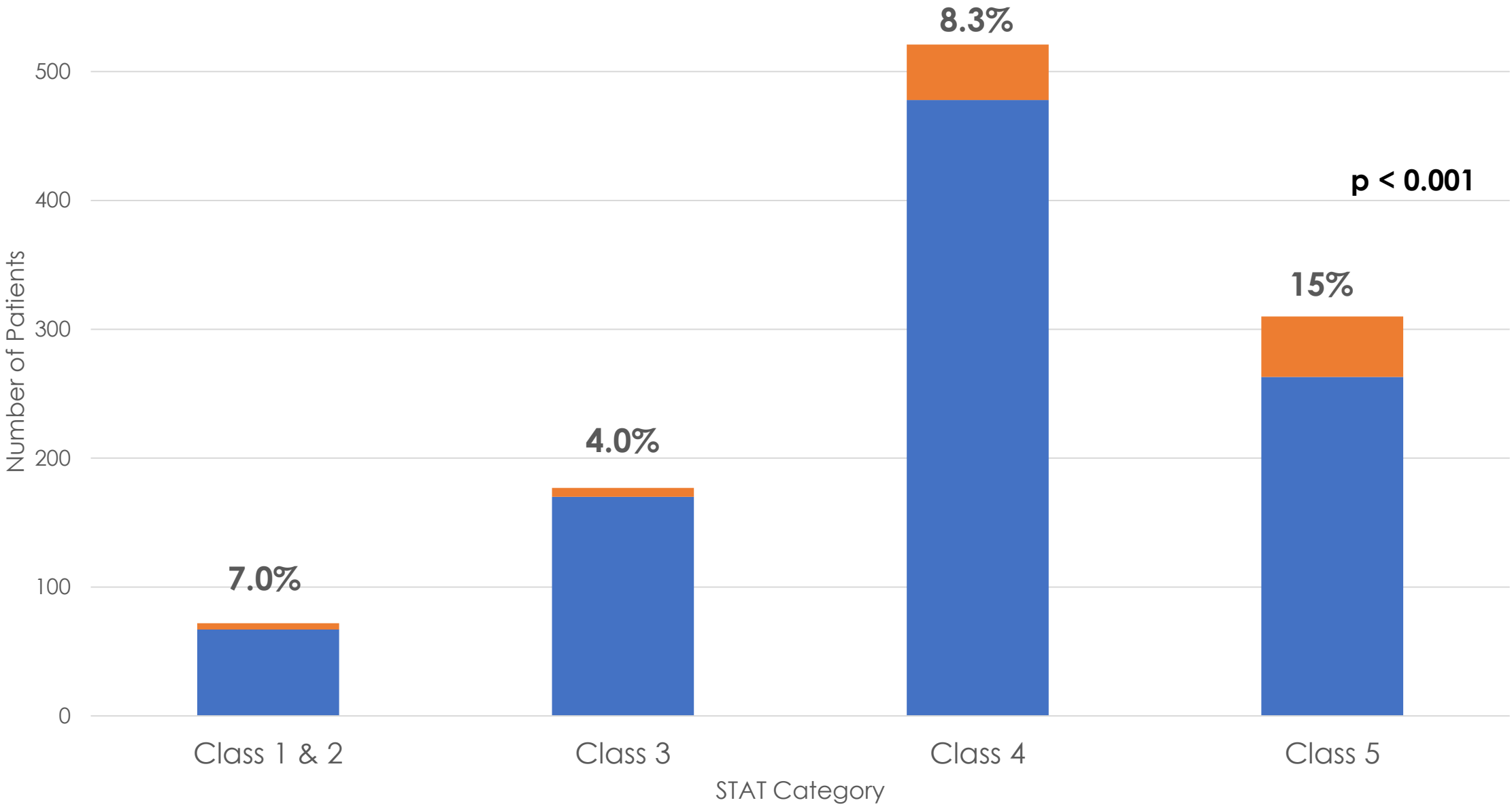
Hsia PCICS 2022, Cardiology 2023

SEIZURE INCIDENCE BY STAT CATEGORY



Hsia PCICS 2022, Cardiology 2023

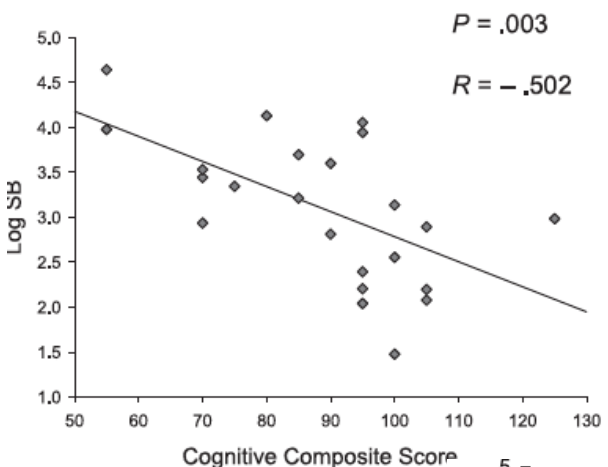
Incidence of postoperative seizures in neonates following cardiac surgery with regional cerebral perfusion and deep hypothermic circulatory arrest

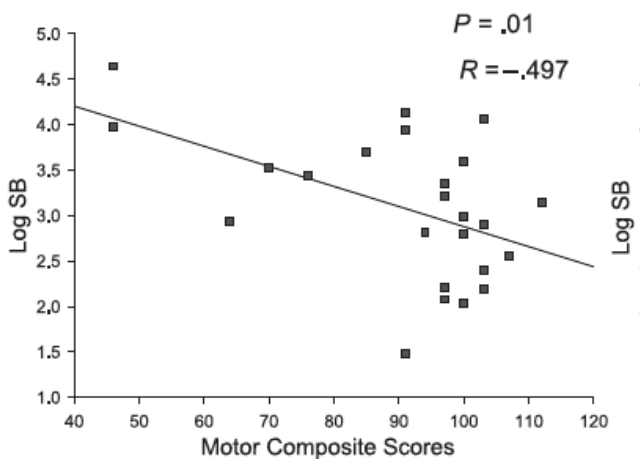
Jill Hsia, MD,[a] Nicholas S. Abend, MD, MSCE,[b] J. William Gaynor, MD,[c] Jonathan M. Chen, MD,[c] Stephanie Fuller, MD,[c] Katsuhide Maeda, MD, PhD,[c] Constantine D. Mavroudis, MD, MSc, MTR,[c] Muhammad Nuri, MD,[c] Jan Leonard, MSPH,[d] Steve B. Ampah, PhD,[d] Daniel J. Licht, MD,[e] Shavonne L. Massey, MD, MSCE,[b] and Maryam Y. Naim, MD, MSCE[f]

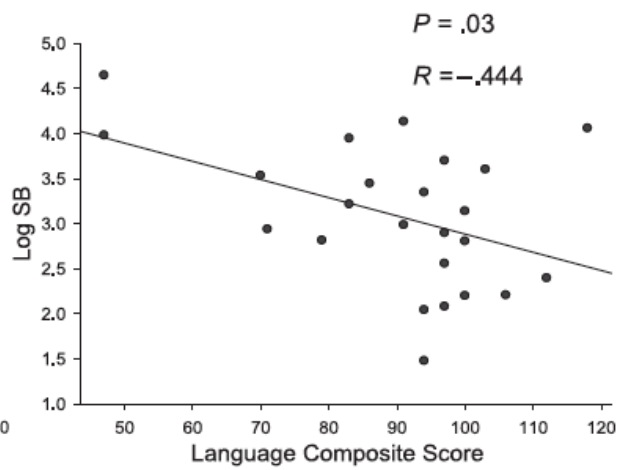
Propensity matched analysis seizure incidence was no different in the RCP group (12%) compared to the DHCA group (12%)

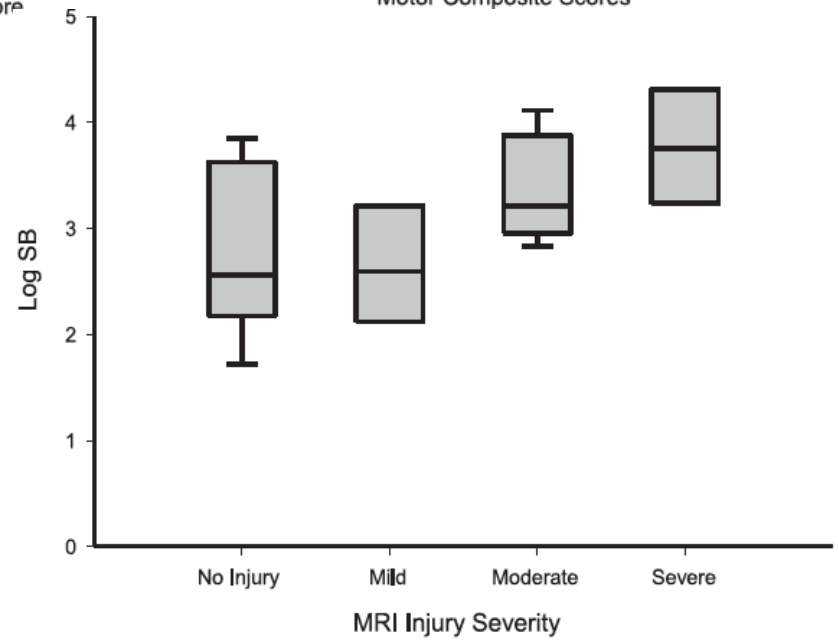
JTCVS Open 2023

Treating EEG Seizures in Hypoxic Ischemic Encephalopathy: A Randomized Controlled Trial









Increasing seizure burden associated with higher MRI brain injury scores and lower performance on all 3 Bailey domains

Srinivasakumar Pediatrics 2015

How can we prevent other stressors like cardiopulmonary decompensation?

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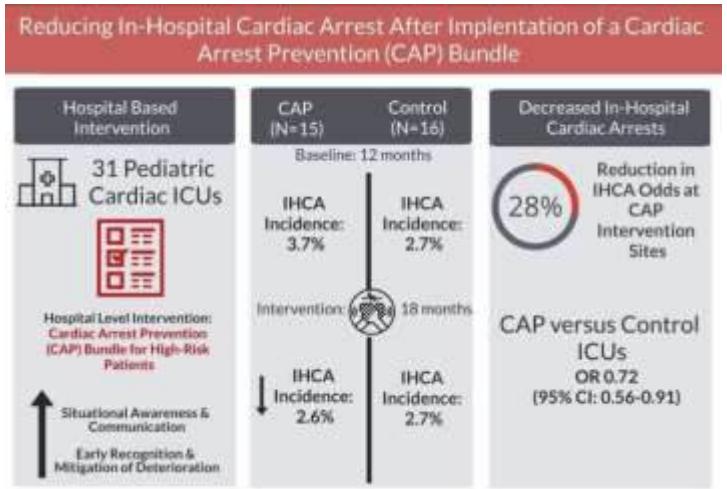

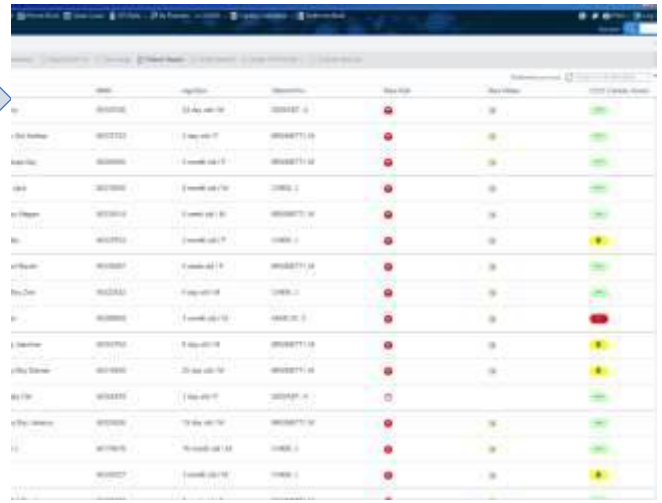

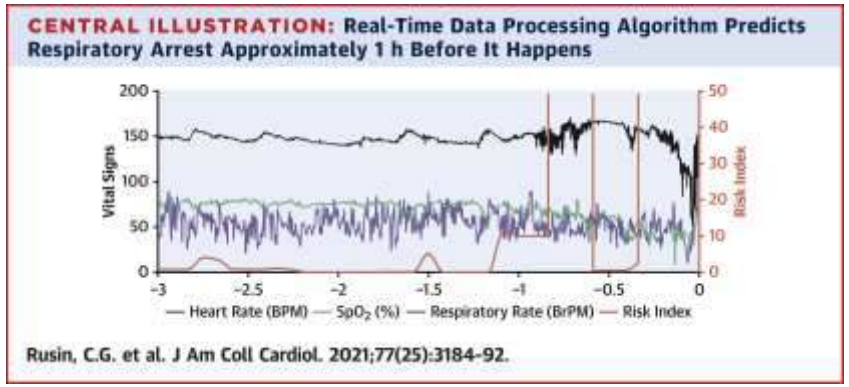

Bedside Huddle
Situational awareness
Emergency Medications

Alten JAMA Peds 2023

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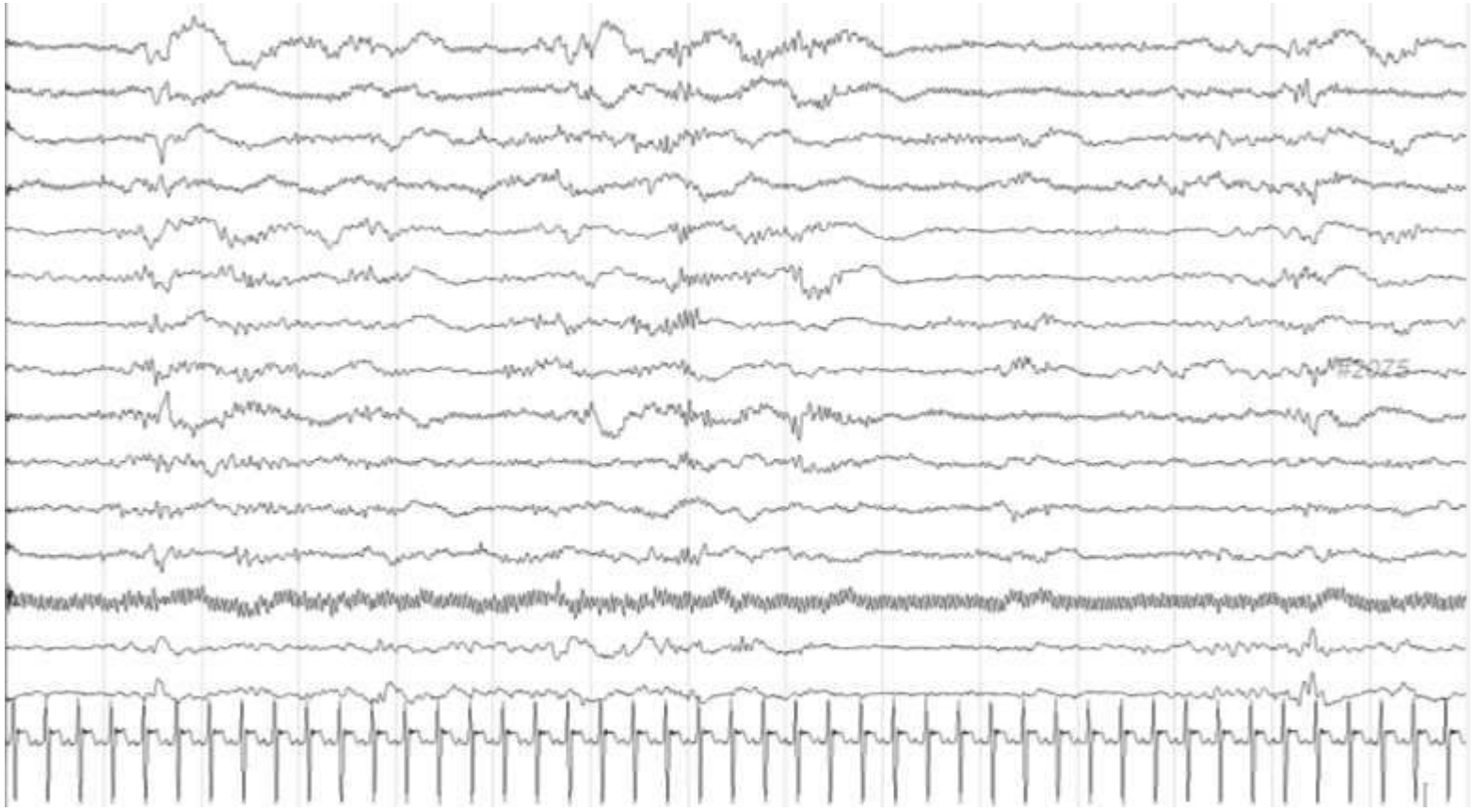
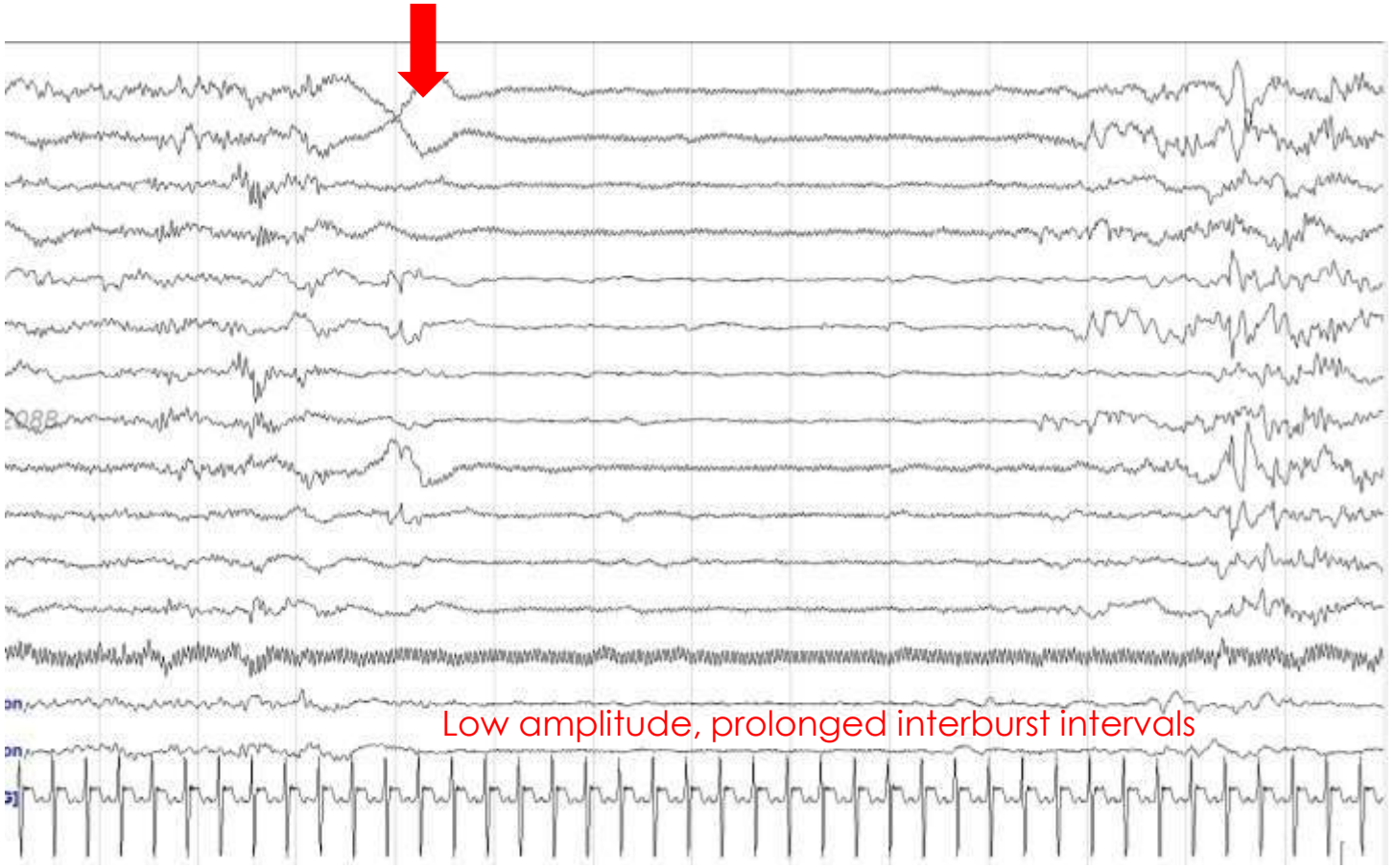
Electroencephalographic patterns preceding cardiac arrest in neonates following cardiac surgery

Shavonne L. Massey[a,], Nicholas S. Abend[a,b], J. William Gaynor[c], Daniel J. Licht[a], Vinay M. Nadkarni[b], Alexis A. Topjian[b], Rui Xiao[d], Maryam Y. Naim[e]*

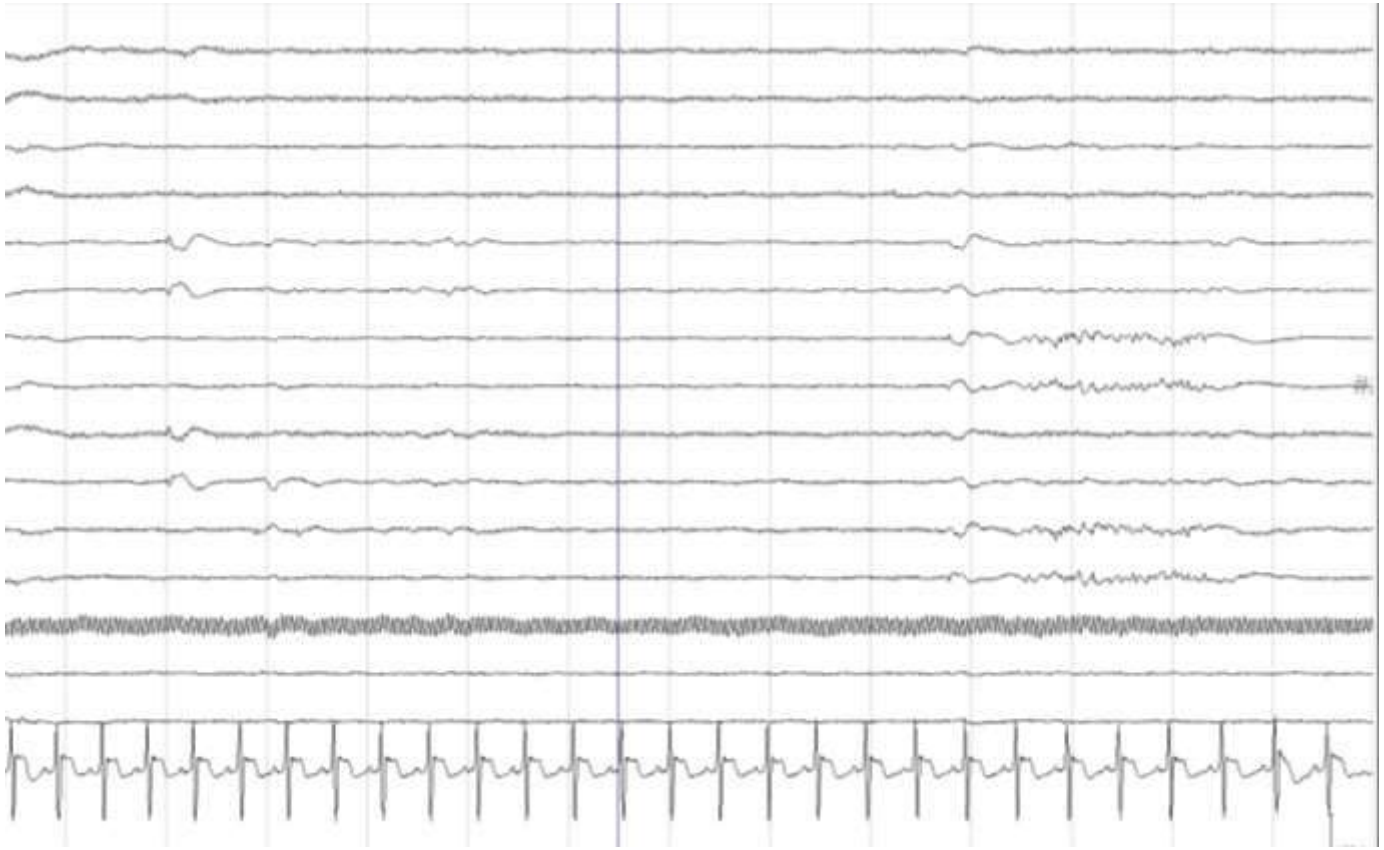


Massey Resuscitation 2019

First pre-arrest cEEG Background Change: Progressive Excessive Discontinuity



Immediate pre-arrest cEEG Background:
Low Voltage Suppression



Immediate pre-arrest cEEG Background:
Low Voltage Suppression

Cardiac Arrest Onset cEEG Background:

CPR Artifact

FINDINGS AND IMPLICATIONS

EEG background was abnormal in 68% of neonates immediately following cardiac surgery and worsened in 100% several minutes prior to the cardiac arrest (median 3 minutes)

EEG changes may be an early sign of impending cardiac arrest and may predict developing cerebral dysfunction

Identification of EEG changes could allow for interventions to prevent cardiac arrest

Lastly sedation and rehabilitation…..

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Caring for Critically Ill Children With the ICU Liberation Bundle (ABCDEF): Results of the Pediatric Collaborative*

OBJECTIVES: Assess clinical outcomes following PICU Liberation ABCDEF Bundle utilization.

DESIGN: Prospective, multicenter, cohort study.

John C. Lin, MD[1]
Avantika Srivastava, MS[2]
Sara Malone, LCSW[1]
Susan Jennison, BNS, RN[3]

Assess, Prevent, and Manage Pain, **B**oth Spontaneous Awakening Trials (SAT) and Spontaneous Breathing Trials (SBT), **C**hoice of analgesia and sedation**, D**elirium: Assess, Prevent, and Manage, **E**arly mobility and Exercise, and **F**amily engagement and empowerment

Associated with decreased mortality in PICU patients

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Pediatric Critical Care Medicine 2023

Physical Rehabilitation in Critically Ill Children: A Multicenter Point Prevalence Study in the United States

Sapna R. Kudchadkar, MD, PhD, FCCM[1,2,3]; Archana Nelliot, MD[1]; Ronke Awojoodu, RN, MPH[1]; Dhananjay Vaidya, PhD[4]; Chani Traube, MD[5]; Tracie Walker, MD[1]; Dale M. Needham, MD, PhD[3,6,7]; for the Prevalence of Acute Rehabilitation for Kids in the PICU (PARK-PICU) Investigators and the Pediatric Acute Lung Injury and Sepsis Investigators (PALISI) Network

82 PICUs and CICUs, 35% patient mobile with occupational or physical therapy

19% completely immobile

Less mobility with endotracheal tube and urinary catheter

Critical Care Medicine 2020

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CONCLUSIONS

EEG monitoring can detect subclinical seizures in neonates following surgery with cardiopulmonary bypass

Treatment of seizures may improve outcomes

Prevent Cardiac Arrest with real time physiologic data platforms with algorithms are promising for postoperative deterioration

Minimize sedation and mobilize

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