Adaptive Telemetry Systems for Monitoring Neonatal Neurodevelopment

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Introduction

Significance of Monitoring
- Neonatal brain injuries require continuous monitoring

Technological Integration
- Advanced technologies improved neonatal neurodevelopment

aEEG
- Effective for infants with suspected seizures

NIRS
- Continuous monitoring of cerebral oxygenation

Innovations
- Portable, low-cost EEG systems for sonification and visualization

Figure 1. Neonatal Brain Stethoscope: EEG Sonification and Monitoring using Android Device.

Technological Overview

Amplitude-Integrated EEG (aEEG): Monitoring for seizure detection and prognostic evaluation

Near Infrared Spectroscopy (NIRS): Non-invasive technology measuring cerebral oxygenation

Portable EEG Monitoring and Sonification: Low-cost, portable EEG systems

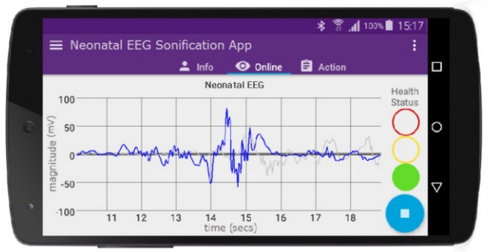


Figure 4. The Android app demo.

Methodology

Integration of aEEG in Neonatal Care
- Electrodes placed on scalp
- Signal processing is amplified and displayed

Implementation of Portable EEG Monitoring
- Portable EEG devices transmit signals
- Visualized on smartphone

Data Collection and Analysis
- Detection of abnormalities
- Algorithms identify neurological patterns

Studies	Time hours	*N*	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)
Hellström-Westas et al. [3]	6	47	95	89	86	96
Eken et al. [4]	6	34	94	79	84	92
Al Naqeeb et al. [5]	6	56	93	70	77	90
Toet et al. [6]	6	68	91	86	86	96
Shalak et al. [7]	12	15	79	89	73	91
Van Rooij et al. [8]	6	161	83	85	88	91
Shany et al. [9]	6	39	100	87	69	100

Clinical Implications and Outcomes

Improved Early Diagnosis
- aEEG and NIRS in NICUs enhances early diagnosis

Enhanced Safety
- Improve patient safety

Reduced Infant Mortality Rates
- Monitoring technologies in NICUs reduce death

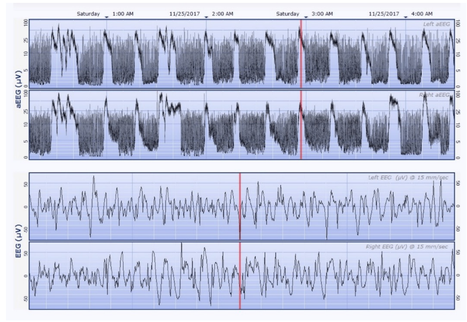
Broader Accessibility and Cost-Effectiveness
- Portable EEG systems using smartphone technology

Clinical Training and Awareness
- Proper training essential for effective use of aEEG and NIRS

Case Studies

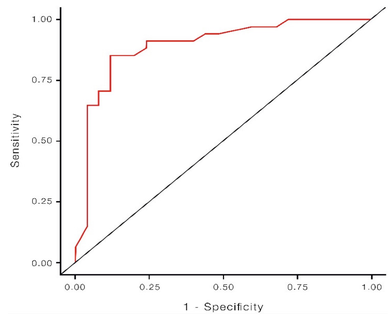
Case Study 1: Use of aEEG in Full-Term Infants with Hypoxia-Ischemia
- Study with 68 infants monitored using aEEG
- Resulted in detecting seizures and abnormal aEEG patterns

Case Study 2: Portable EEG Monitoring in Resource-Limited Settings
- Portable EEG monitoring in rural area
- Resulted in increased access to and affordable monitoring



Predicting Neurodevelopment Patterns

Predictive Values of aEEG Patterns
- Studies assessed first 3-12 hours of life to predict brain outcomes
- Sensitivity: 79% - 100%
- Specificity: 70% - 89%
- Positive Predictive Value
  - Likelihood from 69% to 88% that infant will have health issue
- Negative Predictive Value
  - 90% to 100% successful prediction for infant's health



Future Developments

Improving Sensor Technology
- Develop algorithms to reduce noise
- Use infection-resistant materials

Advanced Data Analysis
- Use AI to predict adverse events

Cost Reduction and Accessibility
- Develop portable monitoring systems
- Improve affordability

Standardization of Protocols
- Implement standardized guidelines

Conclusion

Technological Integration
- aEEG, NIRS, and portable EEG systems

Benefits
- Continuous, non-invasive assessments
- Early diagnosis and timely intervention

Accessibility
- Portable, low-cost EEG systems

Challenges
- Address signal interference, data integration, cost

References

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