Early Warning of EUSIG Defined Hypotensive Events
Using a Bayesian Artificial Neural Network

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On behalf of the BrainIT Consortium
Conflict of Interest Disclosure

- Rob Donald — shareholder in C3 Global Ltd
- All other authors — no conflict of interest
Secondary Insults

- Miller et al, early 1980s

- Jones et al, 1994
  - Edinburgh University Secondary Insult Grading (EUSIG)
  - BPs <= 90, BPm <= 70, 5 min holddown
  - Hypotension related to outcome
  - Hypotension *not* just a TBI problem
Machine Learning

- Classification Technique
- Bayesian Artificial Neural Network
Data Preparation

- Input signals
- Sub Windows
- Summary
- Statistics
Data Preparation

- Input signals
- Sub Windows
- Summary Statistics
Data Preparation

- Input signals
- Sub Windows
- Summary Statistics
Data Preparation

- Input signals
- Sub Windows
- Summary Statistics
BANN Training

- Neural Network
- Input Connections
BANN Training

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- Neural Network
- Input Connections
Methods

Phase I Trial

- Local Hospital
- BrainIT Hospitals
- Central Datastore NeSC Glasgow

Diagram:
- Existing Data Collection
- Bedside Monitor
- Physiological Data
- Event/Treatment Data
- Demographic Data
- Local HypoPredict Engine
- Patient
- Existing Hospital IT Infrastructure
Phase I Trial

- Local Hospital
- BrainIT Hospitals
- Central Datastore NeSC Glasgow

Background
Methods
Early Results
Summary

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Phase I Trial

- Local Hospital
- BrainIT Hospitals
- Central Datastore NeSC Glasgow
Phase II Trial

- 2 Step Sequential Clinical Trial
- Simon 1989; Hanfelt et al. 1999
- Stage 1, 13; Stage 2; 46
- Targets, Sensitivity > 30%, Specificity > 90%
Model Selection
Block Technique

All Time (30 min Blocks)

- EUSIG Events
- Episodes
- Predictions

Legend:
- True Negative
- True Positive
- False Negative
- False Positive
- Removed Time Block

13 14 15 16 17 18
# Early Results

## Phase I - Results So Far

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Phase I — Model Assessment

- Initial assessment from 20 patients
  - Sensitivity
    41% S.E. 6%
  - False Positives (raw)
    17% S.E. 3%
  - False Positives (suppression techniques)
    14% S.E. 3%
  - Average Early Warning
    21 mins S.E. 0.74
Summary

- BANN Designed and Trained
- Part of a Prediction Engine
- Phase I — Sensitivity Good, Work On False Positives
- Phase II — Starting Soon
Acknowledgements

- Dr Tim Howells — Uppsala University Hospital
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Thanks for your time