2007

Measuring the Accuracy of Predictions from Patient-Specific Models of Intracranial Pressure Dynamics

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Citation Details
Wakeland, W. Measuring the Accuracy of Predictions from Patient-Specific Models of Intracranial Pressure Dynamics. Poster presentation at the 6th International Conference on Complexity in Acute Illness (ICCAI), 2007 in Long Beach, CA.
Measuring the Accuracy of Predictions from Patient-Specific Models of Intracranial Pressure Dynamics
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Objective
Determine the prediction capability of a computer model of ICP dynamics

Methods
- Clinically annotated prospective data collected: mild physiologic challenge protocol
  - Head of bed: 0 to 30 degrees
  - Respiration Rate: mild hyper- to hypo-ventilation
- 9 TBI patients, 24 sessions
- Data from early in single long session or from prior sessions used to estimate patient-specific parameter values for computer model of ICP dynamics
  - Curve-fitting optimization minimized squared error, modeled ICP vs. data
- Resulting patient-specific models used to predict patient’s ICP response to interventions
  - Later in the same session
  - In subsequent sessions

Results
- Avg. mean absolute error (MAE) for fitness of model to the data: 1.9 mmHg
  - for segments with avg. mean absolute deviation of 3.1 mmHg
- Avg. MAE for predictions:
  - 4.0 mmHg w/in same session;
  - 6.7 mmHg across sessions

Discussion/Conclusion
- Despite small error in model fit to data, model prediction error is too large to be clinically useful
- Caution warranted: prediction is hard!!
  - A good fit between model and historical data may not yield good predictions!

Figure 1: Model ICP (blue) vs. Actual ICP (green), w/HOB (red) and Respiration Rate (dotted black)