INTRODUCTION
Critically ill patients often exhibit abnormal glycemia due to the severity of their illness. High blood glucose levels and high glycemic variability have both been independently associated with increased mortality in these patients. More recently, it was hypothesized that glucose complexity may also be associated with increased mortality.

Two studies have used Detrended Fluctuation Analysis (DFA) to investigate glucose complexity in continuous glucose monitoring (CGM) data from critically ill patients. Both studies reported an association between glucose complexity and mortality in critically ill patients. The aim of this study was to extend the knowledge of glucose complexity in critically ill adults by investigating the effects of CGM device type/calibration and CGM sensor location on DFA results.

METHODS

Monofractal Detrended Fluctuation Analysis (DFA)

“The monofractal structure of biomedical signals are defined by a single power law exponent, and assumes that scale invariance is independent on time and space.” (Ihlen 2012)

Monofractal DFA results in an exponent, H - the Hurst coefficient, which describes the scaling properties of a time series

\[ X(\text{ct}) = c^H X(t) \]

The larger the H, the less 'complex' the signal is

- Failing regulatory system
- Lower Glucose complexity = higher Hurst coefficient
- Mortality?

Multifractal Detrended Fluctuation Analysis (MF DFA)

If scaling properties of the signal are not independent on time and space, multifractal DFA should be used to analyze the signal. For multifractal signals, H is dependent on q-order statistical moments and the complexity of the signal is better described by the ‘Multifractal Spectrum’

RESULTS

Table 2: Monofractal DFA cohort results

<table>
<thead>
<tr>
<th>CGM device type</th>
<th>Abdomen</th>
<th>Thigh</th>
</tr>
</thead>
<tbody>
<tr>
<td>iPro - Thigh</td>
<td>1.43</td>
<td>1.56</td>
</tr>
<tr>
<td>Guardian - Abdomen</td>
<td>0.72</td>
<td>0.52</td>
</tr>
</tbody>
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There was no clear associations between any of the CGM parameters tested and the shape, width or location of the multifractal spectrums (Figure 3). Furthermore, on several occasions Monofractal and Multifractal DFA gave contradictory results and indicate that future DFA results should be interpreted with care (Figure 4).

CONCLUSION

This study clearly highlights where care should be taken in future DFA studies. Monofractal DFA results were sensitive to the type of CGM device used to collect the glucose data. Multifractal DFA results were not always consistent with monofractal DFA results. The width of the multifractal spectrums suggests that multifractal DFA is more appropriate for this type of data. Finally, an association between DFA results and mortality could not be detected in this limited data set.

Can this new glycemimetric tell me if my critical care patients are going to live or die?

F. Thomas, M. Signal, J.G. Chase, G.M. Shaw