Methods

We are undertaking a pilot study to analyse the vital signs of 40 haemodialysis patients during two groups of four dialysis sessions over a 6 month period. The vital signs are incorporated into a real-time data fusion algorithm to derive a probability density function of normality.

The data fusion algorithm is used to identify potentially unstable patients by tracking their vital signs in relation to a pre-defined zone of normality. This 4 dimensional zone is computed from a training data set of the vital signs of stable dialysis patients. This approach has proven effective in the early identification of critically ill patients. We report provisional results from 2 cases as an illustration of the potential utility of this technique.

Results

Of the 15 patients studied to date, 2 have experienced adverse clinical events (cardiac death on dialysis; and cardiac death following transplantation). In both of these cases, and none of the others, the pulse rate varied markedly when analysed in 5 minute windows, especially within the final hour of the 4 hour dialysis session.

Analysis of the continuous ECG data showed that these patients remained in sinus rhythm and often with an overall pulse rate within the normal range. These findings were not due to supraventricular/ventricular ectopies or paroxysmal arrhythmias. This phenomenon was often associated with hypotension, and as illustrated for one of the patients below, a relative oxygen desaturation when compared to oxygen saturations at the beginning of dialysis (see Figure 1).

During the final hour of dialysis, both of these patients experienced physiological aberrations that fell unequivocally outside of the parameters of the usual physiological limits demonstrated by stable patients (see Figure 2).

Conclusion

We appreciate that this is preliminary data and that the numbers of patients analysed to date is small; however, we plan to further investigate this apparent correlation between pulse rate variability and dialysis related cardiac morbidity, as well as continuing to refine the model and study the longitudinal progress of more patients. As pulse rates remained in the normal range, it appears to be the pulse variability which is more significant. It is not clear whether this presumed autonomic instability is a cause or the effect of a tendency to intradialytic decompensation. Of significance is that disturbances in pulse variability over this periodicidty would not be detected using traditional monitoring methods. Data fusion of vital signs may be of utility in future research to further our understanding of intradialytic physiology and assess the benefits of changes to dialysis parameters.