

Risk prediction based on cardiac autonomic modulation and repolarisation indices from intradialytic computerized electrocardiography

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Introduction

Mortality in haemodialysis (HD) patients remains extremely high and significant proportion is attributed to fatal arrhythmias. Computerised non-invasive electrocardiography (ECG) has been used for risk profiling in cardiac patients by assessing both repolarisation irregularities using 3D reconstruction of the cardiac electrical signal and cardiac autonomic regulation using heart rate variability (HRV). This pilot study assessed if intradialytic ECG monitoring can yield subject specific electrocardiographic profiles that can be used to identify high risk individuals.

Methods

We have recently described the methodology of intradialytic monitoring and reported on the intrasubject stability of measurements of repolarisation¹ and cardiac autonomic regulation². In brief, in stable HD patients on sinus rhythm, continuous electrocardiograms were obtained during HD and repeated 5 times at 2-weeks intervals. The repolarisation descriptors QRS-to-T angle (TCRT) and T wave morphology dispersion (TMD) were calculated in overlapping 10 second ECG segments. The high- (HF) and low-frequency (LF) components and the LF/HF ratio of HRV were calculated every 5 minutes. Repolarisation and HRV indices were averaged during the first (f) and last (l) hour of dialysis for intrasubject stability assessment (repeated measures ANOVA) and subsequently over all recordings in each subject. Patients were followed up for major arrhythmic events (MAE) defined as sudden cardiac death or ventricular arrhythmias and total mortality. Comparison between dead and alive patients was performed with t-test and Mann-Whitney U test were appropriate.

Results

We investigated 76 patients aged 60±14 years, 32% females and 37% diabetics. Baseline characteristics are shown in table 1. All repolarisation and HRV indices showed intra-subject stability^{1,2}. During a follow up period of 35.9 ±3 months 12 patients died (7 sepsis, 2 withdrawal, 1 intracranial haemorrhage, 1 hyperkalaemia, 1 sudden cardiac death) and 3 experienced MAE (1 SCD and 2 ventricular arrhythmias which were successfully treated). Comparison between dead and alive patients showed that TCRT, TMD and LF/HF ratio predicted mortality (Table 2). MAE patients exhibited extreme values of TCRT and TMD.

Conclusion

Combination HRV and repolarization descriptors derived from intradialytic monitoring may serve risk assessment in future prospective studies in haemodialysed patients.

Table 1. Baseline Characteristics

		Males (n=52)	Females (n=24)
Age (years)		61±16	61±13
Ethnicity	Asian	13 (25%)	6 (25%)
	Black	16 (31%)	11(46%)
	Caucasian	23(44%)	7(29%)
Diabetes Mellitus		19(36.5%)	9 (37.5%)
Coronary Artery Disease		13(25%)	3(12.5%)
Months on dialysis		35(5-180)	43 (5-190)
Access for dialysis	AVF	36(69.2%)	16(66.7%)
	AVG	9 (17.3%)	5 (20.8%)
	Lines	7 (13.5%)	3(12.5%)
Ultrafiltration (ml)		2263±902	2195±1033
On beta blockers		19(36%)	5(20%)
Hb (g/dL)		11.1±1.2	10.9±1.2
CRP (mg/L),		10.0±13.7	12.2±15.2
Albumin (g/L)		33±4	33±3
Phosphate(mmol/L)		1.6±0.4	1.5±0.3
Corrected calcium (mmol/L)		2.3±0.1	2.3±0.2
PTH (pmol/l)		46±34	37±28
Pre-HD SBP (mmHg)		139±18	142±20
Pre-HD DBP (mmHg)		71±14	70±14

Table 2. Baseline repolarisation and autonomic regulation indices in survivors and non-survivors after 35.9 ±3 months

Indices	Dead (12)	Alive (63)	P val.
TCRT(f)	-0.12±0.53	0.20±0.53	0.009
TCRT(l)	-0.24±0.61	0.19±0.58	0.017
TMD(f)	46±22	27±20	0.002
TMD(l)	58±22	33±21	0.001
LF/HF(f)	0.19±0.21	0.43±0.30	0.010
LF/HF(l)	0.16±0.25	0.48±0.35	0.003

References

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