



Effect of cooling dialysate on heart rate variability in children on regular hemodialysis



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- Analysis of heart rate variability provides a non-invasive method for investigating autonomic input to the heart.
- Altered autonomic control of cardiovascular function has been described in patients with chronic renal failure and may be associated with hemodynamic instability and dialysis-induced hypotension.
- Repeated episodes of intradialytic hypotension are associated with an increased risk of mortality and morbidity, providing the impetus for more hemodynamically friendly dialysis prescriptions.
- Increase in body temperature during hemodialysis has been well-documented and may contribute to impaired control of vascular tone and hypotension.
- In a randomized study including ten adult patients prone to intradialytic hypotension, cool HD resulted in a reduction in heart rate and maintenance of arterial pressure through a significantly greater increase in total peripheral resistance.

OBJECTIVE

to determine the effect of using lowered-temperature (cool) dialysate on cardiac autonomic function and intradialytic hypotension among children with end-stage renal disease treated with maintenance hemodialysis.

METHODS

Population:
28 children; 4-16 yrs old; ESRD on HD

Intervention:
3 months dialysis using normal temperature dialysate at 37°C (warm dialysis), then 3 months using lowered temperature dialysate at 35°C (cool dialysis)

- UF according to set patient's dry weight
- No other change in prescription
- Monitoring for vital signs, chills, dialytic hypotensive episodes

Data obtained:
Clinical & routine laboratory data
Vital signs, chills, hypotensive episodes during dialysis
Echocardiographic assessment of LV function

Heart rate variability assessment:

- During the midweek dialysis session
- Computerized analysis of short term heart rate samples using Hanning Window type; 1024 beat analysis of heart rate variability parameters

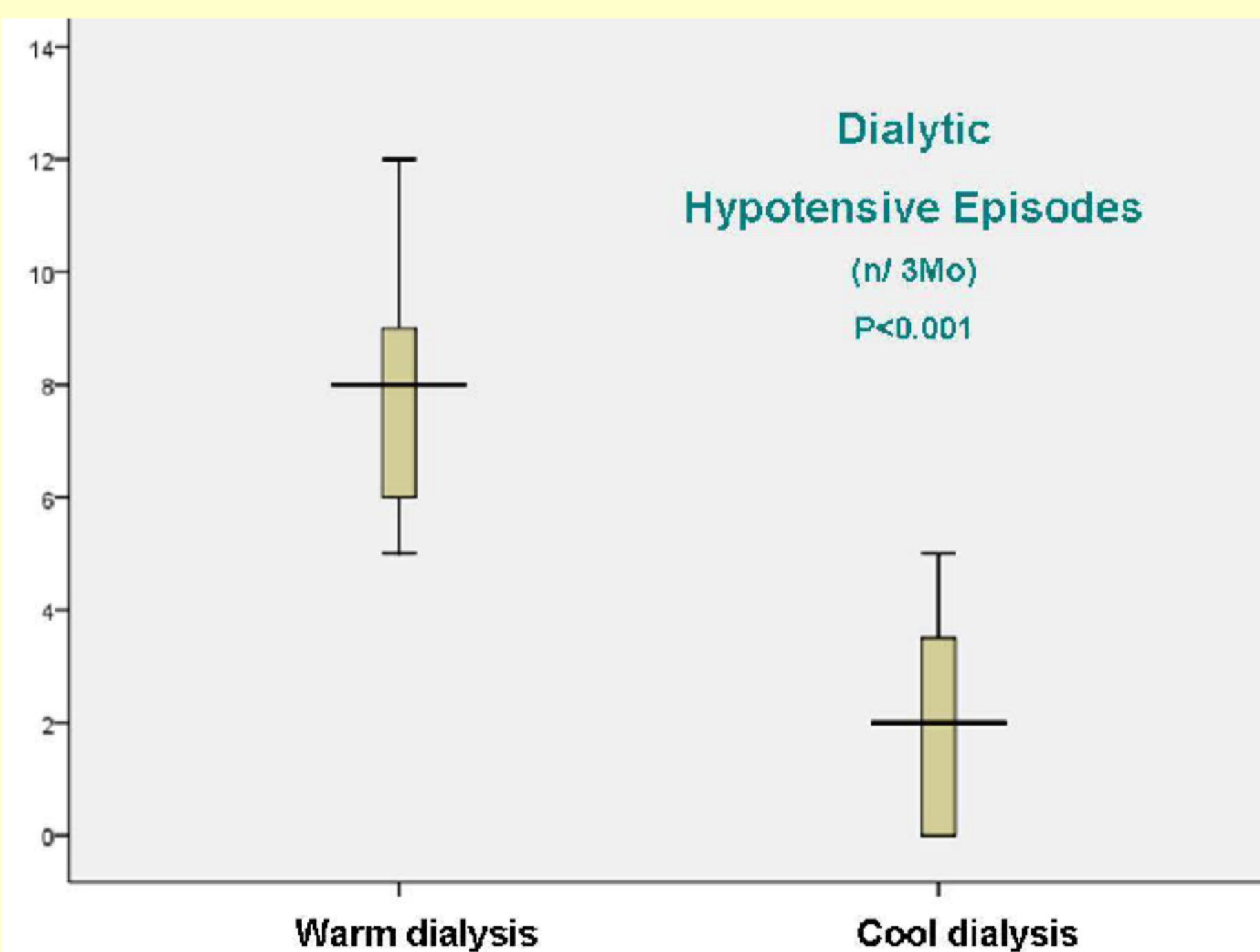
RESULTS

- 13 boys (46%) & 15 girls, Mean age ± SD = 9.9 ± 3.1 yrs
- Dialysis for 6Mo – 6 yrs (mean 2.9 yrs) at enrollment
- 7 (25%) received antihypertensive medications
- No significant difference between cool/ warm dialysis regarding basic laboratory data. No significant adverse effects

HEART RATE VARIABILITY PARAMETERS DURING WARM AND COOL DIALYSIS

	Warm dialysis (Mean ± SD)	Cool dialysis (Mean ± SD)	P value
TIME DOMAIN			
HR (bpm)	110.07 ± 17.49	98.57 ± 18.31	0.002
Mean RR (ms)	558.7 ± 87.18	629 ± 114.4	0.003
Median RR (ms)	558.77 ± 87.18	630.23 ± 115.89	0.035
	Median (IQR)	Median (IQR)	
SD RR	26 (19.5-40)	33 (19-54.25)	0.053
Mean Deviation	20.5 (15-32)	26 (15-43.25)	0.042
dRR (ms)	14 (6.5-23.25)	16.5 (9-35.5)	0.118
SD dRR	11.5 (5.5-18.25)	12.5 (6.5-26)	0.171
PNN50 %	1 (0-6.25)	1.5 (0-23.75)	0.118
RMS	19.5 (8.5-28.25)	22 (11-45.25)	0.153
FREQUENCY DOMAIN			
Total power	3112 (1768-4716)	2876 (1739-5769)	0.248
%VLF	18.3 (13.1-27.6)	20.4 (16.2-30.8)	0.53
%LF	22.3 (15.4-29.5)	21 (15-25.6)	0.347
%HF	11.6 (5.1-16.9)	10.3 (4.3-17.8)	0.51
LF/HF	2.32 (1.25-3.72)	2.3 (1.2-3.9)	0.402

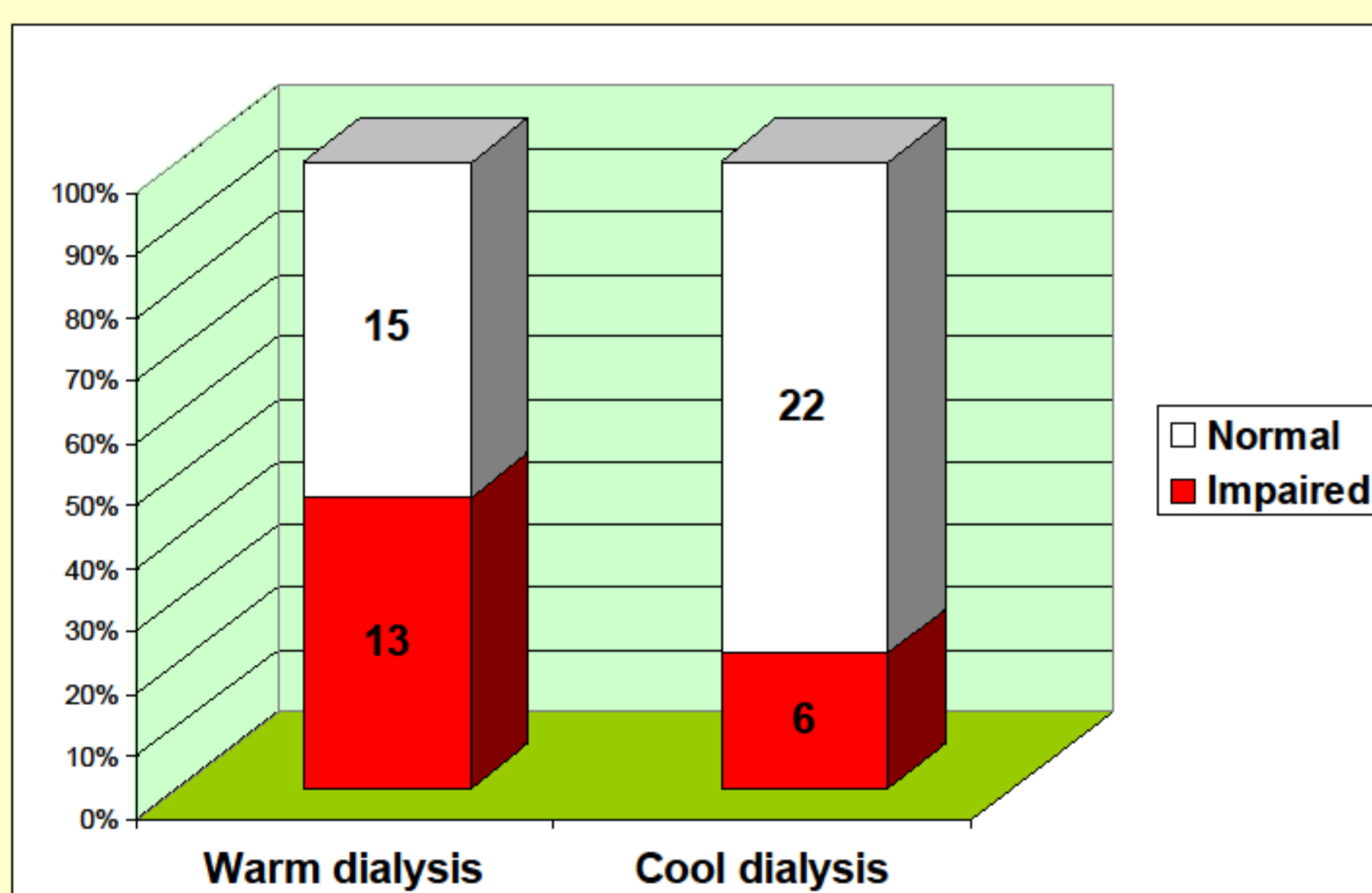
HR= heart rate, bpm= beats per minute, VLF= very low frequency, LF=low frequency, HF=high frequency



MBP
Warm: 96.31 ± 13.19 mmHg
Cool: 87.02 ± 10.24 mmHg
(p < 0.001)

Hypotensive episode: symptomatic reduction of >20% of baseline BP

Cool dialysis was associated with significantly less dialytic hypotensive episodes despite a lower predialysis blood pressure



Impaired systolic function was significantly more (p=0.02) on warm dialysis

Mean FS 32.5 ± 8.4% on warm and 40.67 ± 8.5% on cool dialysis (p=0.01)

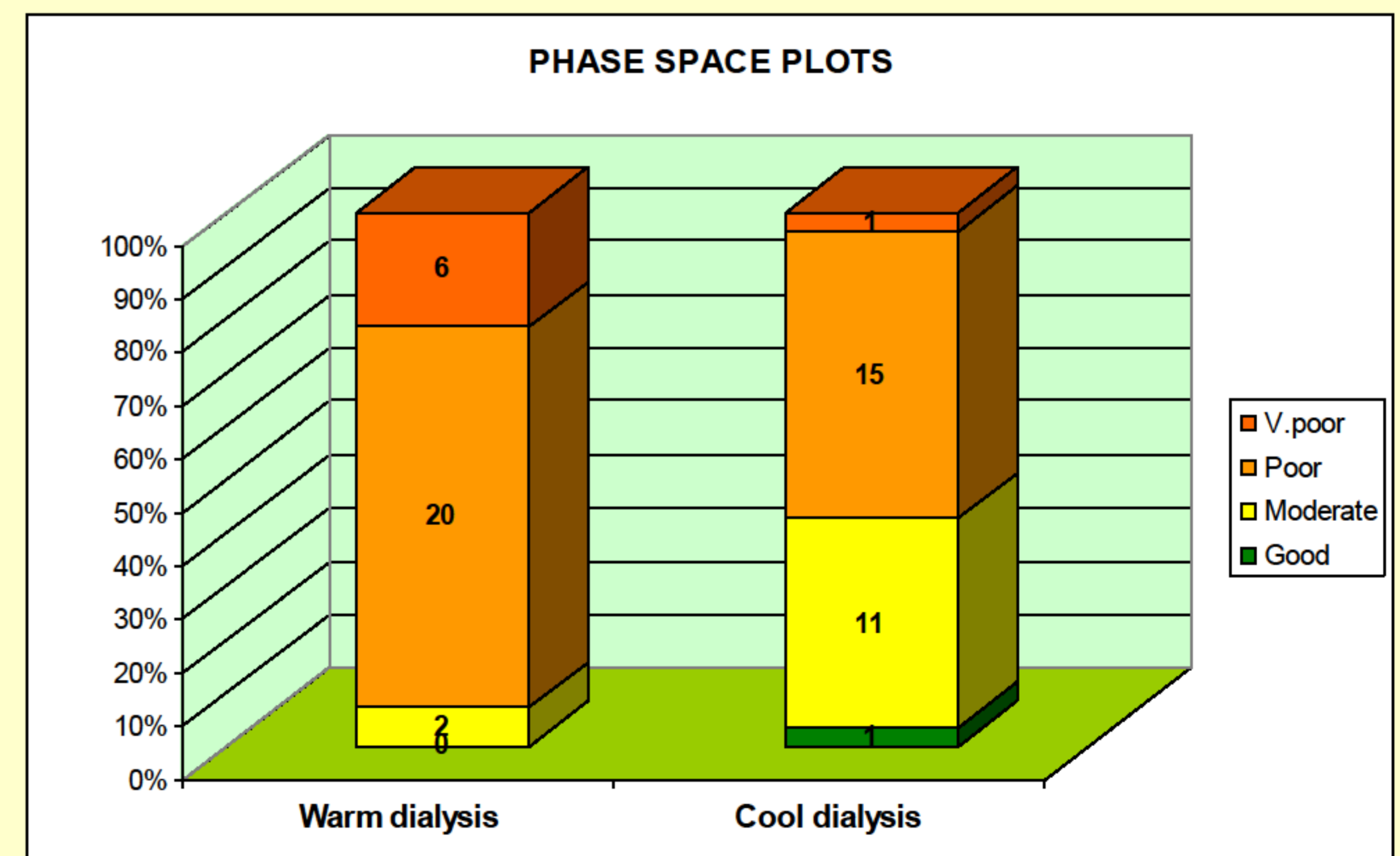
While on cool dialysis, patients tended to show better time domain parameters of HRV. Frequency domain parameters were not significantly different.

CONCLUSION

In pediatric patients with ESRD, using cool (35°C) dialysate is well tolerated and associated with:

- Improved hemodynamic stability
- Improved left ventricular systolic function and some HRV parameters within 3 months

The long-term impact of these effects on cardiovascular risk and patient outcome needs further study



Phase space plots showed a significantly (p=0.001) better dispersion on cool dialysis

