To Cool or Not to Cool: Does Dialysate Temperature Matter?

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Session: Controversies and Advances in Hemodialysis Techniques

Issue of Cooling in Hemodialysis?

Proc EDTA (1981) Vol 18

EFFECT OF EXTRACORPOREAL BLOOD COOLING ON DIALYTIC ARTERIAL HYPOTENSION

Q Maggiore, F Pizzarelli, C Zoccali, S Sisca, F Nicolò, S Parlongo

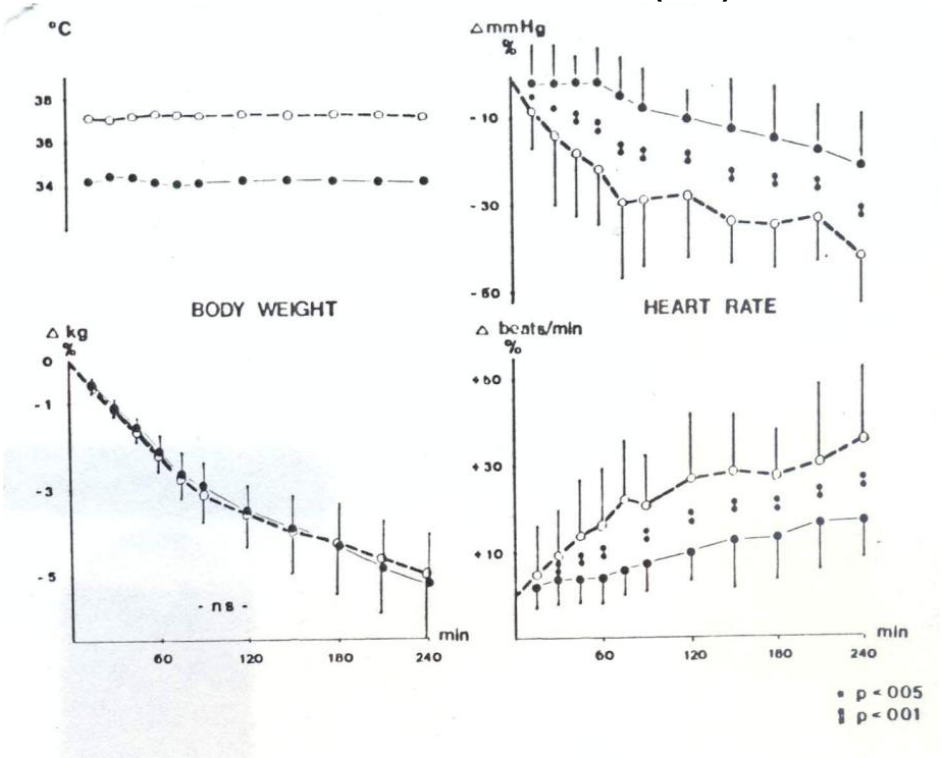
Centro di Fisiologia Clinica del Consiglio Nazionale delle Ricerche, Reggio Calabria, Italy

6 patients who had frequent episodes of symptomatic hypotension during UF-HD treatment

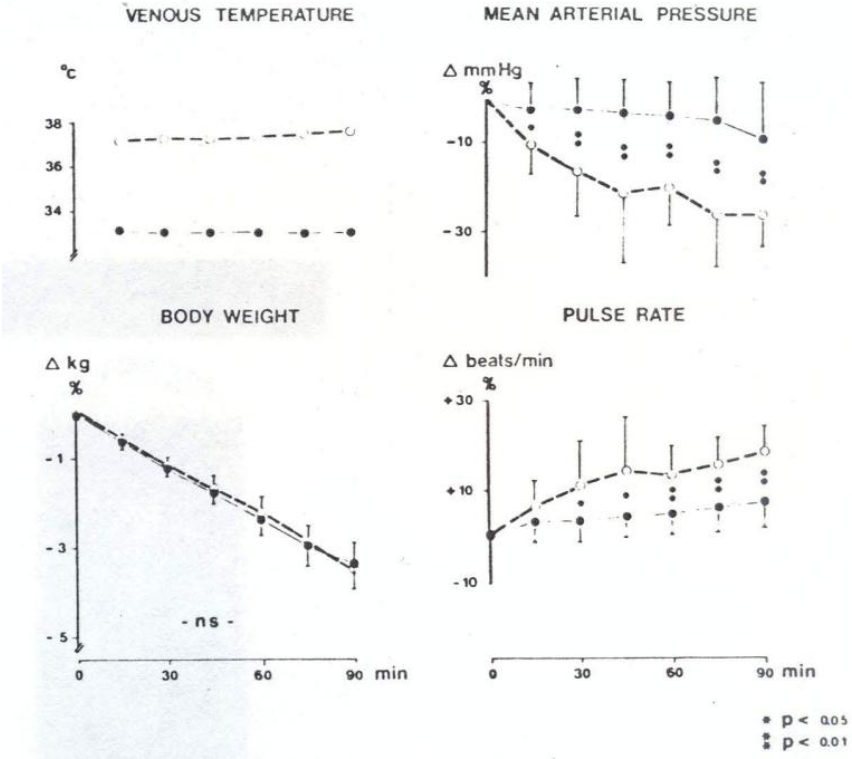
1) Conventional 4 hours UF-HD vs. Cooled 4 hour UF-HD using control of dialysate temperature.

2) **Isolated 90 minutes UF vs. rewarmed 90 minutes UF**
for isolated 90 UF, there was a drop in temperature through the extracorporeal circuit from 35°C to 33.1°C; this gradient remained almost unchanged during the 90 minute treatment.
for Rewarmed UF, rewarming via thermostatic bath in venous return line

Conventional vs. Cool (4hr)



Isolated UF vs. Rewarming UF (90min)



The ”Intradialytic Hypotension" of Hemodialysis

Frequent Complication

Despite advancements in technology, it still affects 20 to 30% of dialysis sessions

Systemic Impact

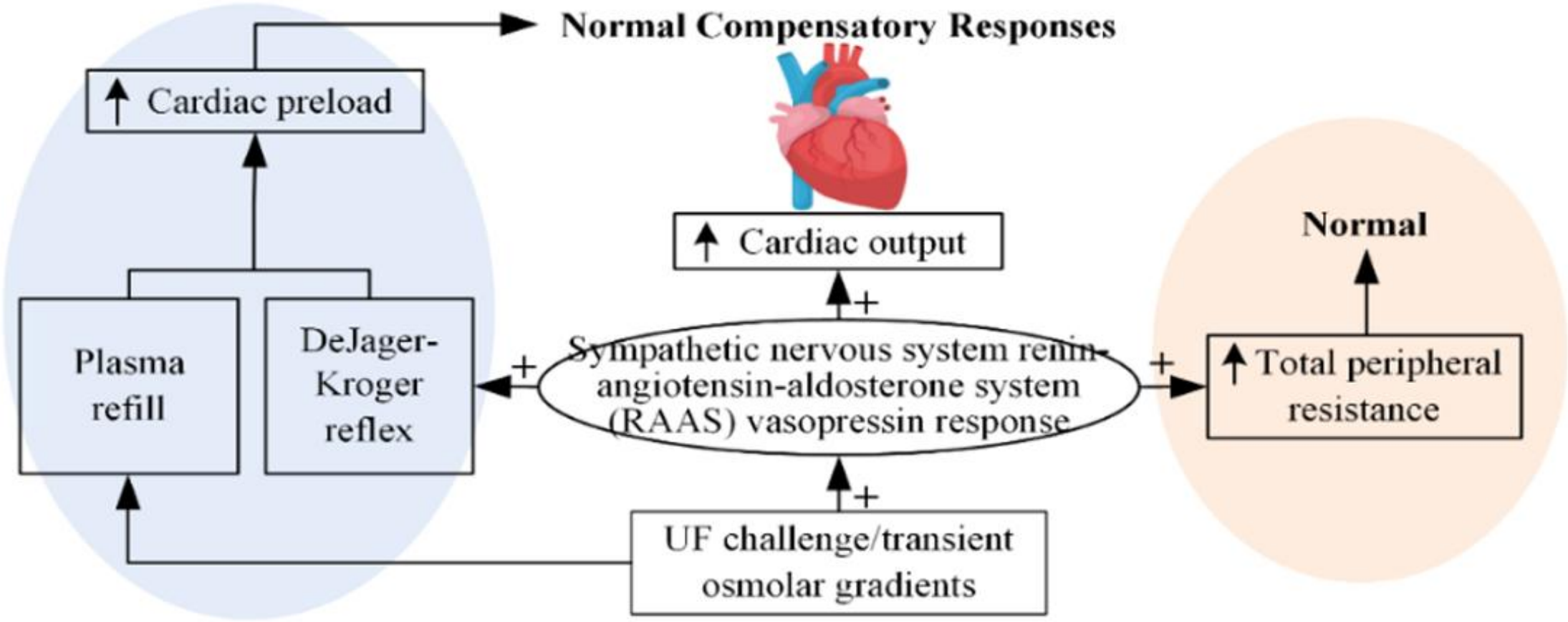
It causes end-organ damage: myocardial stunning, cerebral hypoperfusion, and gut ischemia and loss of residual kidney function.

Mortality Risk

It is a strong Independent predictor of cardiovascular and all-cause mortality in ESKD patients.

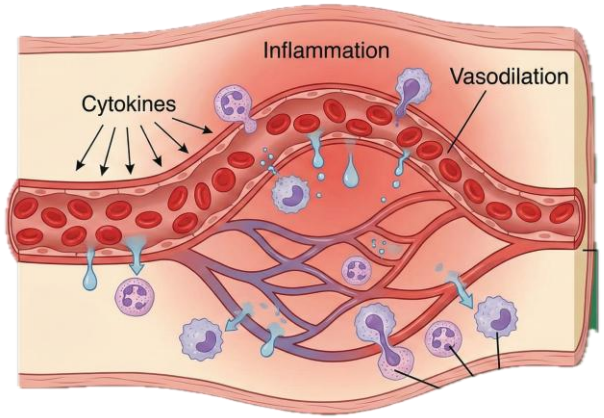
Habas et al. Blood Pressure 2025

Pathophysiology of IDH



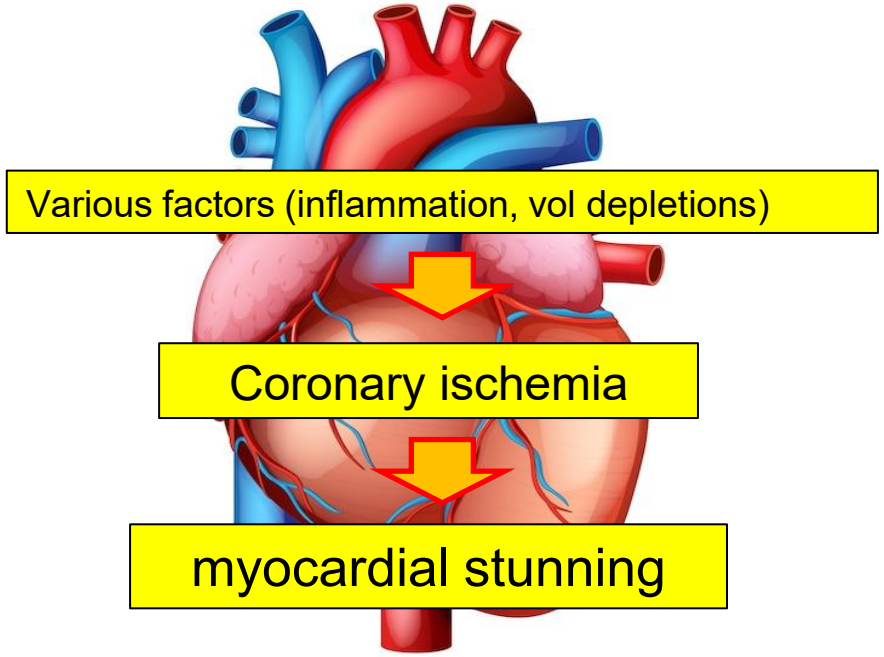
Bae et al. Int J Env. Res. And Public Health 2022, Habas et al. Blood Pressure 2025

Pathophysiology of IDH : The Aspect of Heat



Heat Accumulation: During hemodialysis, metabolic activity and inflammatory responses generate heat, which becomes accumulated within the body.

Heat Dissipation–Induced Vasodilation: To dissipate this accumulated heat, the body compensatorily induces systemic vasodilation, promoting heat release to the external environment.



Mild hypothermia

→ **attenuate Ischemic heart injury and inflammation**

in vovo and human studies.

These theory and finding suggest that **Cool dialysis** may **beneficial for vascular tone and heart function.**

Selby et al. Clin J Am Soc Nephrol. 2006, D'Elia et al. Int Urol Nephrol. 2025

Evidences… Favorable Effect of Cool dialysis on IDH

Bazzato *et al.*, 1985
In patients with dialysis-induced hypotension, continuous monitoring and **adjustment of dialysate temperature were shown to reduce hypotensive episodes and promote more stable hemodynamics.**

Lindholm *et al.*, 1985
Dialysate temperatures around 35°C enhanced peripheral vasoconstriction and helped maintain blood pressure, resulting in fewer BP drops and symptomatic IDH compared with standard-temperature dialysis.

Marcen *et al.*, 1988
A long-term cohort using **low-temperature dialysate (35–35.5°C) demonstrated reduced frequency and severity of IDH without compromising dialysis adequacy**, supporting its safety and feasibility for chronic use.

Jost *et al.*, 1993
In a crossover study of **12 "problem dialysis patients"** (IDH-prone or large interdialytic weight gain), **35°C dialysate resulted in significantly less BP decline** over 3 hours. **Notably, 16 of 18 symptomatic hypotensive episodes occurred at 37°C, while none occurred at 35°C.**

Evidences of Cool dialysis on IHD

Dheenan *et al.*, 2001
In **10 IDH-prone patients, five strategies** (standard, high-sodium, sodium profiling, UF profiling, and cool dialysate) **were compared**. **Cool dialysate and sodium profiling produced the fewest IDH episodes** and the highest post-dialysis BP, showing at least comparable or superior protection relative to other established maneuvers.

Rezki *et al.*, 2007
In a crossover study of **16 patients**, **cool dialysate—alone or combined with sodium profiling—significantly reduced IDH** signs, symptoms, and nursing interventions compared with standard dialysis.

The Guidelines?

In 1997, **reduction of dialysate temperature** was recommended by the **DOQI Guidelines** to prevent **intradialytic hypotension** . A systematic review recently published found that **‘intradialytic hypotension occurred 7.1** (95% CI, 5.3–8.9) **times less frequently with cool-temperature dialysis**. A total of 22 studies comprising 408 patients were included, all studies were of crossover design and relatively short duration’

In 2006, the **European Best Practice Guideliness** on cardiovascular instability, **announced** at the 2006 ERA-EDTA Congress, **only cold dialysis scored with evidence level I, among the different dialysis techniques usually adopted to prevent intradialytic hypotension.**

Bad points of Cool dialysis

Cold Intolerance, Chills, and Hypothermia-Related Concerns

Dheenan *et al.* (Kidney Int, 2001) demonstrated that cooled dialysate effectively decreased IDH frequency; however, **most of** the 10 **patients** reported a "**cold sensation**," and several experienced **shivering, indicating potential tolerability issues.**

Ayoub *et al.* (Nephrol Dial Transplant, 2004) reported that although a dialysate temperature of 35°C reduced the incidence of intradialytic hypotension (IDH), **a substantial proportion of patients experienced cold sensations, chills, and overall discomfort.**

Bad points of Cool dialysis

Removal of Uremic toxins.

Although cool dialysate has no negative effect on Kt/V and may even improve it via decreasing of IDH

Phisutrattanaporn *et al.* (2024, *Journal of the Medical Association of Thailand*) highlighted important **negative aspects of low-temperature dialysis**, particularly its impact on **β_2-microglobulin (β_2M) clearance.**
They reported Warmer dialysate more effective for removal of β_2M
Warmer dialysate (approximately 37°C) induces peripheral vasodilation and **enhances tissue perfusion**, allowing sequestered toxins to mobilize into the systemic circulation, **thereby improving β_2M removal** and alleviating patient discomfort.
In contrast, **cooler dialysate (35°C or lower) causes peripheral vasoconstriction**, which may hinder the mobilization of tissue-stored toxins into the bloodstream and consequently **reduce β_2M clearance.**

Limited Benefits of Cool dialysis on IDH

Long-term survival and small size of study

Mustafa *et al.* (Clin J Am Soc Nephrol, 2016) conducted a systematic review and meta-analysis showing that lowering dialysate temperature **reduces IDH** and **improves short-term hemodynamics**. However, **limitations in study size and duration prevented definitive conclusions regarding long-term outcomes** such as **mortality or cardiovascular events**; several studies also noted increased patient discomfort.

Kanbay *et al.* (Clin Kidney J, 2020) highlighted that while cool dialysate may reduce IDH and offer potential organ-protective effects. However, **concerns regarding tolerability** and **the absence of long-term safety data** indicate the need for further research before broad routine implementation.

These controversy

lead us to raised following question.

Can it be applied safely and effectively

in routine and long-term HD practice?

The MyTEMP Trial (2022)

Personalised cooler dialysate for patients receiving maintenance haemodialysis (MyTEMP): a pragmatic, cluster-randomised trial

*The MyTEMP writing committee**

***Lancet* 2022; 400: 1693–703**

Study Overview

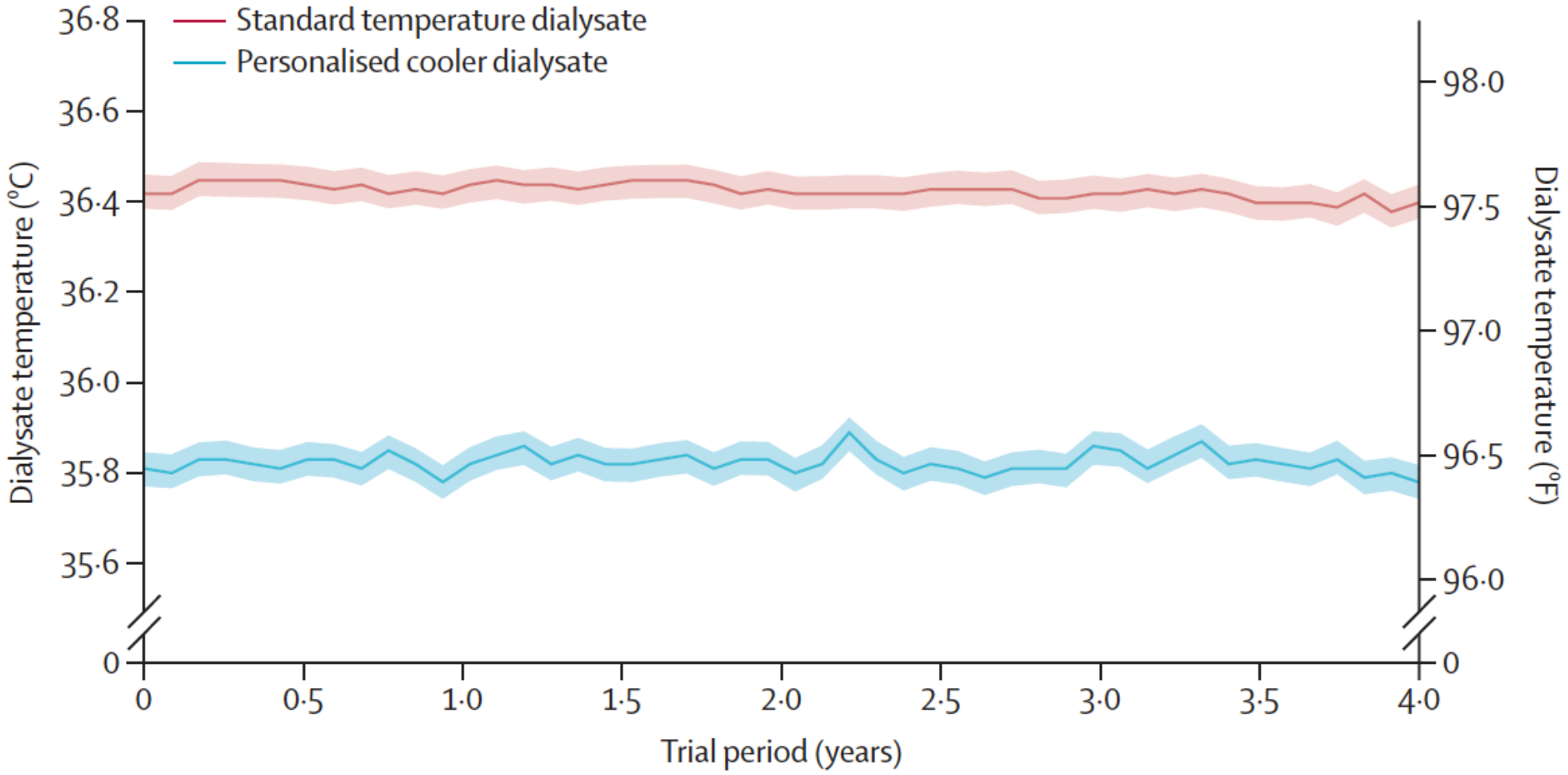
Design: Pragmatic, Cluster-Randomized Trial.

Scale: 84 centers in Ontario, Canada (N > 15,000).

Intervention: Center-wide adoption of personalized cool dialysis (0.5°C in core temp, lowest 35.5 °C) vs. Standard (36.5°C) dialysis.

Primary Outcome: Cardiovascular-related death or hospitalization.

The MyTEMP Trial (2020)

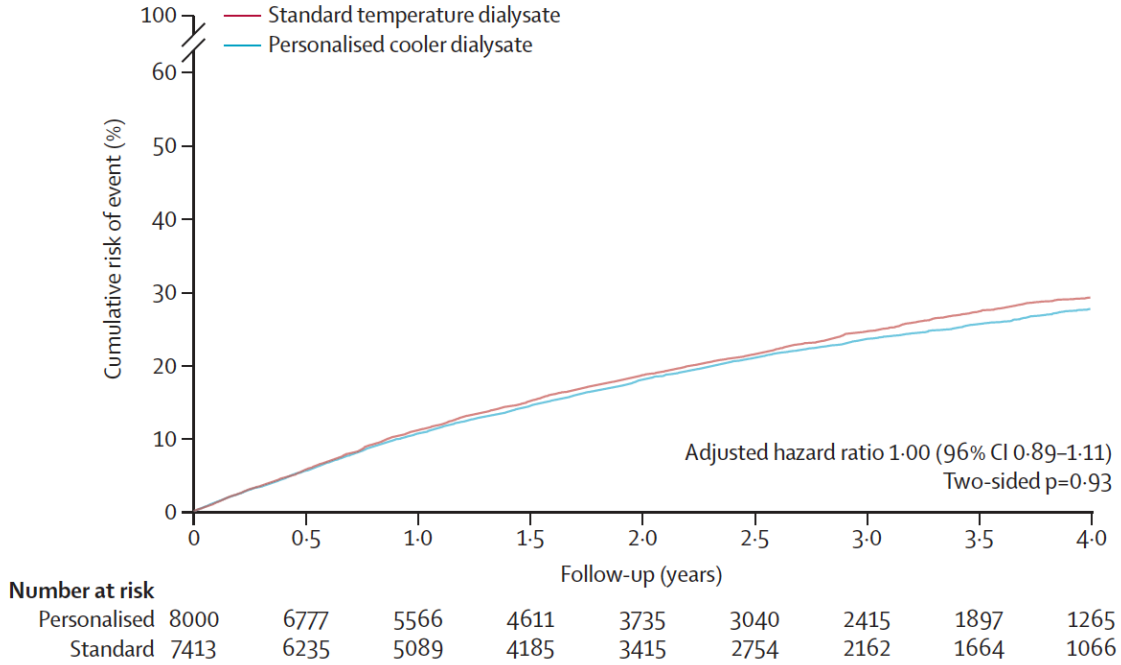


MyTEMP Trial Results

The "NEGATIVE" Result

Despite the physiological rationale, the trial found **no significant difference** in the primary composite outcome.

- **HR:** 1.00 (95% CI 0.89–1.11)
- **IDH Episodes:** there is no meaningful difference in intradialytic systolic BP drop (26.6 mmHg in the cool group vs 27.1 mmHg in the standard group), whereas unpleasant cold sensations during dialysis were more frequent in the cool dialysate group.



	Personalised cooler dialysate (N=8000)	Standard temperature dialysate (N=7413)	Adjusted hazard ratio*†	p value
Primary composite cardiovascular outcome‡	1711 (21·4%)	1658 (22·4%)	1·00 (0·89–1·11)	0·93

MyTEMP Trial Results

Canadian Society of Nephrology/ Société canadienne de néphrologie
CANADIAN JOURNAL OF KIDNEY HEALTH AND DISEASE

Original Clinical Research Quantitative

Bayesian Analysis of Time-To-Event Data in a Cluster-Randomized Trial: Major Outcomes With Personalized Dialysate TEMPerature (MyTEMP) Trial

Canadian Journal of Kidney Health and Disease
Volume 12: 1–10

DOI: 10.1177/20543581251341710
journals.sagepub.com/home/cjk
Sage

Yongdong Ouyang[1,2,3], Bin Luo[4,5], Stephanie N. Dixon[4,5,6], Ahmed A. Al-Jaishi[6], P.J. Devereaux[7,8], Michael Walsh[7,8,9], Ron Wald[10], Merrick Zwarenstein[4,11], Sierra Anderson[4,5] and Amit X. Garg[4,5,6]; for the MyTEMP Investigators

to address the limitations of traditional frequentist (P value–based) methods and to provide clinicians with more intuitive answers."

Consistent Findings Across Scenarios: It is analyzed 6 different prior scenarios, ranging from "**Strongly Enthusiastic**" to "**Strongly Skeptical**," to test the robustness of the data.

Convergence of Hazard Ratios: Regardless of the prior assumption used, the posterior Hazard Ratios (HR) consistently converged around 1.00 (specifically within the 0.95–1.05 range).

Validation of Original Trial: These consistent results re-confirm that the findings of the original trial were not due to chance and are highly reliable

Is Cooling meaningless?

Limitation of MyTEMP

Control Temperature Selection

- The control group was set at **36.5°C**, which is already lower than the conventional **37°C**. The relatively cool control group **may already have the benefits** of cool dialysis.

Lack of Blinding

The study was **open-label**, raising the possibility that clinicians may have unconsciously intervened. For example, more adjusted dry weight in the control group.

Lack of data

BP data : only 1% of whole dialysis session.
Use Self reported Sx. in some center. It may cause bias.
No evaluation of Kt/V in cool dialysis.

Merits of Cool dialysis beyond the prevention of IDH

Impact of cooled hemodialysis for preservation of residual kidney function among Egyptian patients

Mohamed E. Ibrahim, El Metwally L. El Shahawy, Dina A. Yonis, Saddam A.A. Hassan

Journal of The Arab Society for Medical Research 2021, 16:9–16

(1) Cool dialysis (CD, n = 50) to less than or equal to 36°C *and with a stepwise decrease in td by 0.5°C as long as cooling was* ***tolerated down to 35°C.***

(2) ***Standard dialysis (ST, n = 50)*** *individualized to the same degree of the patient's CBT measured before the HD session.*

Table 4 Differences in residual kidney functions between the two study groups

Characteristic	Median	Cool HD	Standard HD	*P*
Median residual kidney function (eGFR) (ml/min/1.73 m^2)				P_1
First month	Median	9.7 (5.6–14.8)	9.6 (5.7–14.6)	0.12
Fourth month	Median	8.4±2.9	7.1±2.78	0.059
Eighth month	Median	6.8±2.34	4.9±2.78	0.032
12th month	Median	6.2±1.89	4.6±1.74	0.043

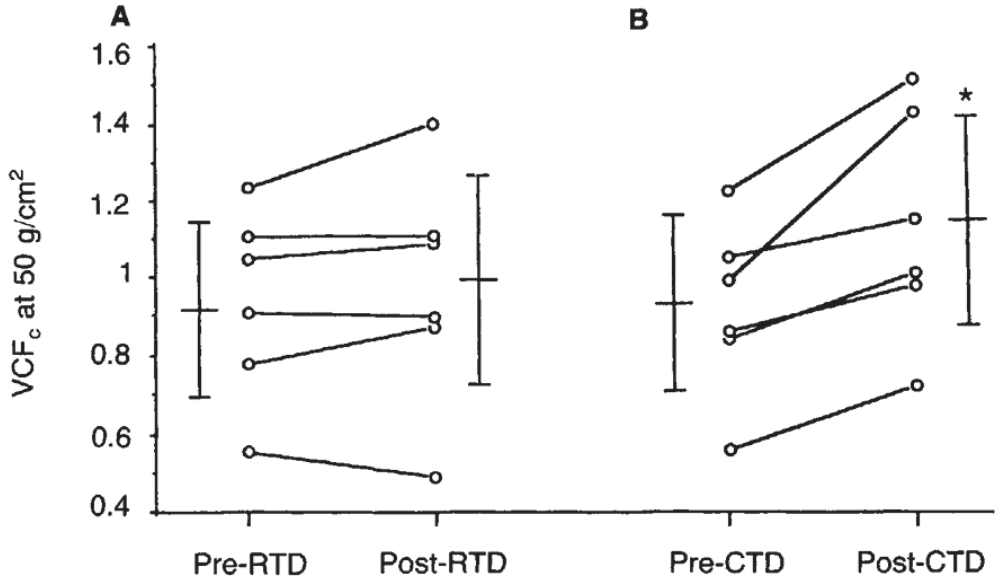
Merits of Cool dialysis beyond the prevention of IDH

Kidney International, Vol. 41 (1992), pp. 961–965

Improved left ventricular contractility with cool temperature hemodialysis

FREDA L. LEVY, PAUL A. GRAYBURN, CHARLES J. FOULKS, M. ELIZABETH BRICKNER, and WILLIAM L. HENRICH

Department of Internal Medicine, Divisions of Nephrology and Cardiology, Veterans Affairs Medical Center and University of Texas Southwestern Medical School, Dallas, Texas, USA



Study Design

6 patients were analyzed
regular temp dialysate at 37°C versus **cool dialysate at 35°C. were compared.**
Cardiac Echo performed.

Key Findings
Post-dialysis Vcf0 was significantly higher for CTD than for RTD (P = 0.0004).

→ **cool temperature dialysis increases left ventricular contractility** in hemodialysis patients, which **may be a potential mechanism of hemodynamic tolerance.**

Merits of Cool dialysis beyond the prevention of IDH

CLINICAL RESEARCH www.jasn.org

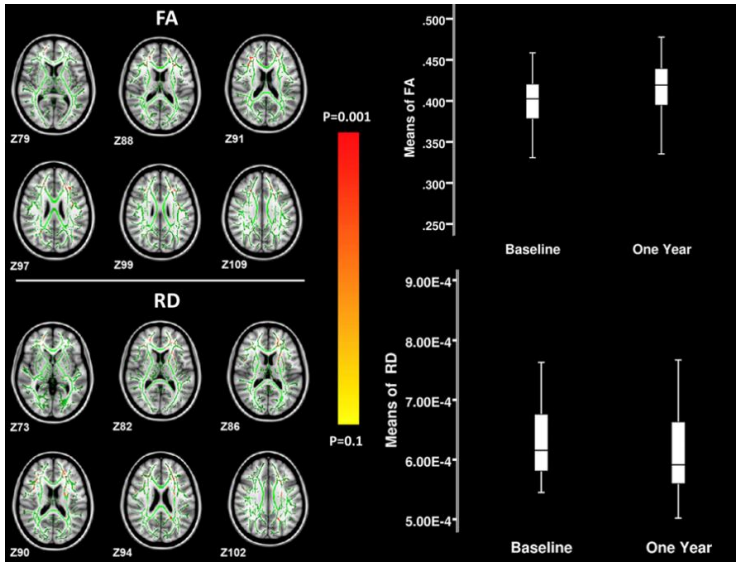
Randomized Clinical Trial of Dialysate Cooling and Effects on Brain White Matter

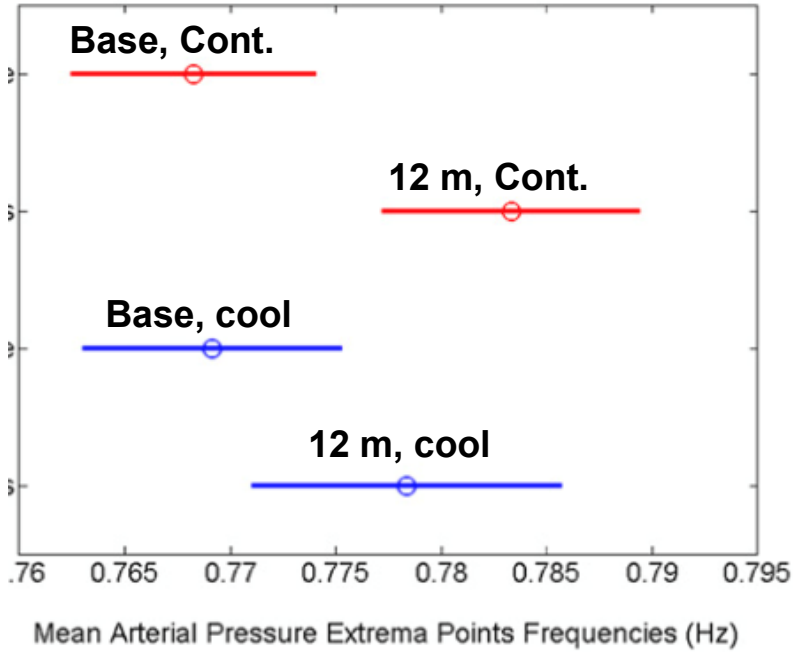
Mohamed T. Eldehni, Aghogho Odudu, and Christopher W. McIntyre

Division of Medical Sciences and Graduate Entry Medicine, School of Medicine, University of Nottingham, Nottingham, United Kingdom

1. Study Design
A total of **38 hemodialysis patients** were enrolled and **continue for 12 months.**
37°C (control) vs. 0.5°C below each patient's core temperature.(cool) were compared.

2. Methods
MRI (DTI) and quantifying mean arterial pressure (MAP) extreme point were evaluated.

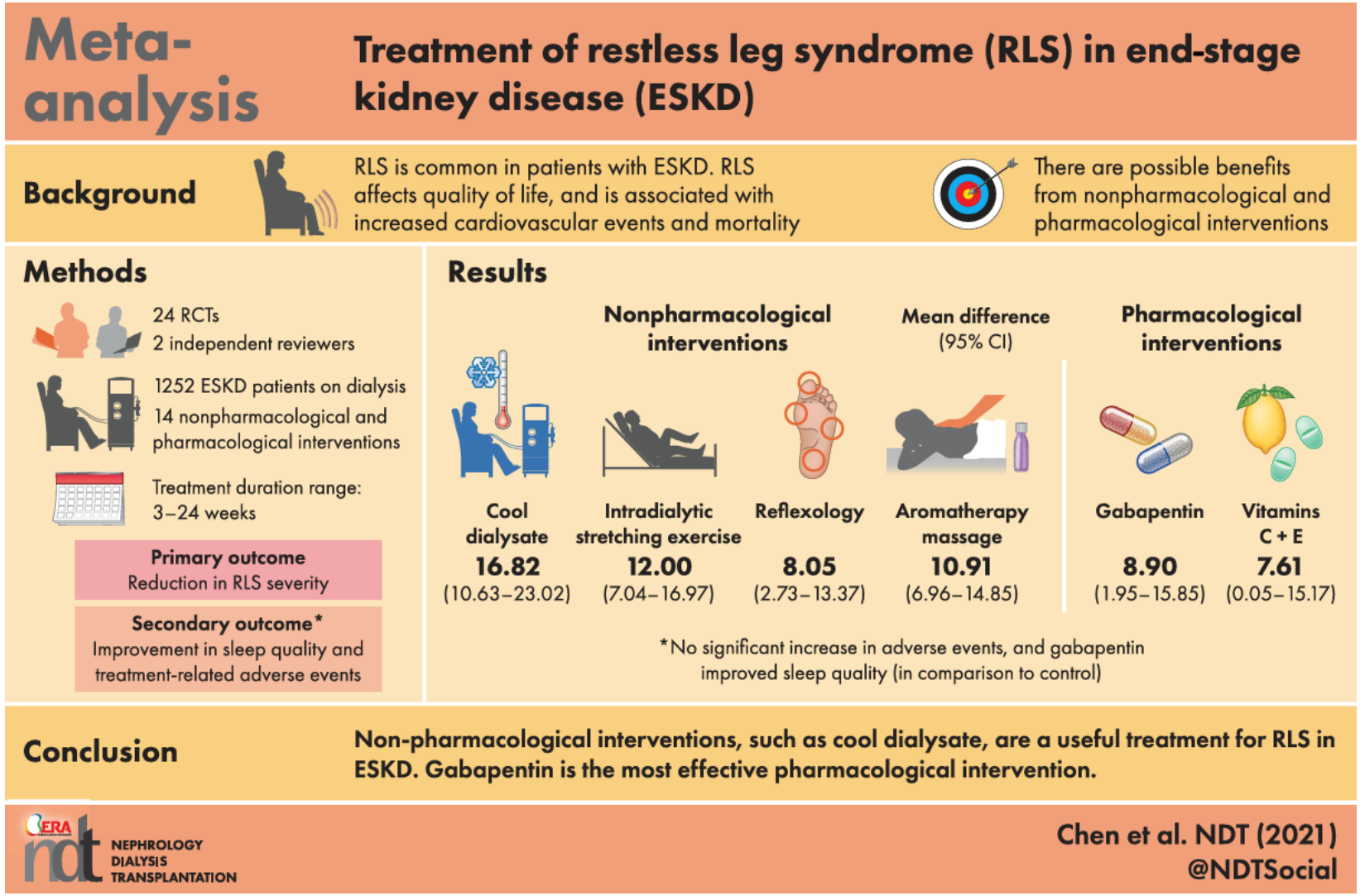




3. Key Findings
Control (37°C) dialysate showed **progression of ischemic-type white-matter injury** — manifested by increased fractional anisotropy(FA) and reduced radial diffusivity(RD).
MAP extreme points at 12 month after Cool dialysis is significantly reduced compared to Control dialysis.

4. Interpretation..
Cool dialysis provide favorable effect on brain white matter injury in HD pts.

Merits of Cool dialysis beyond the prevention of IDH



Merits of Cool dialysis beyond the prevention of IDH

J. Sleep Res. (2007) **16,** 42–50

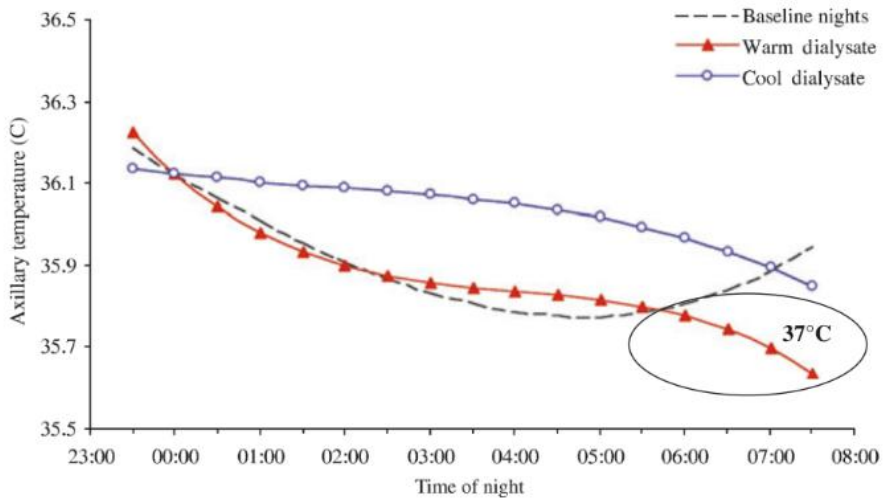
Lowering dialysate temperature improves sleep and alters nocturnal skin temperature in patients on chronic hemodialysis

KATHY P. PARKER[1,2], JAMES L. BAILEY[3], DAVID B. RYE[2,1], DONALD L. BLIWISE[2,1] and EUS J. W. VAN SOMEREN[4,5]

[1]Nell Hodgson Woodruff School of Nursing, [2]Department of Neurology, Emory HealthCare Program in Sleep, [3]Renal Division, Emory University, Atlanta, GA, USA [4]Department of Sleep and Cognition, Netherlands Institute for Neuroscience, Amsterdam and [5]Department of Neurology, Clinical Neurophysiology and Medical Psychology, VU University Medical Center, Amsterdam, The Netherlands

Accepted in revised form 23 October 2006; received 7 July 2006

Study Design
7 stable HD patients were enrolled.
It is a 3-phase crossover study.
Standard vs. 37°C vs. 35°C were compared.
Polysomnography (PSG) and axillary temp. continuously monitored for 42 hours were performed.



Key results.

the 35°C HD session resulted in higher nocturnal skin temperatures

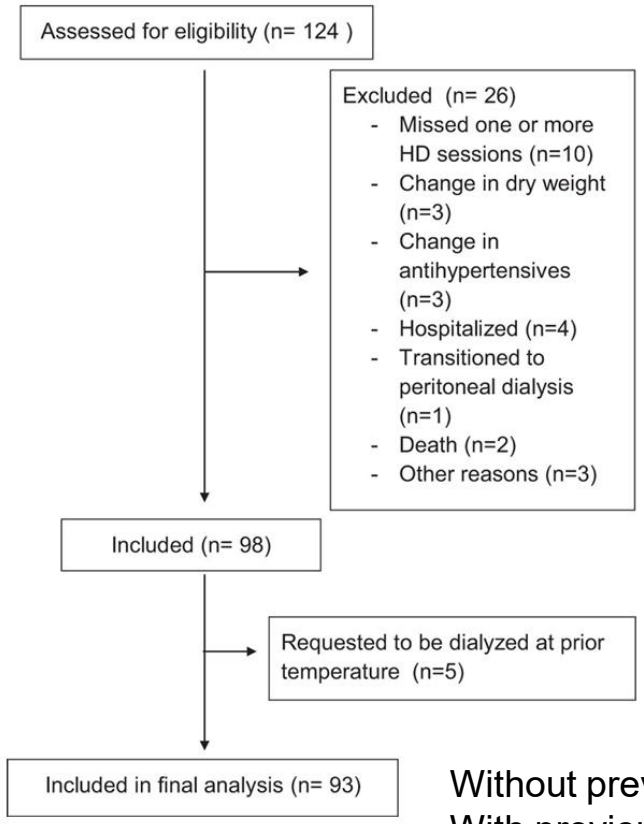
However, Following the 37°C HD session, **core body temperature remained elevated for several hours post-dialysis.** Subsequently, **a rapid decline in skin temperature occurred during the early morning hours**, which was associated with an **increased probability of wakefulness**.

Benefit is on selected groups..

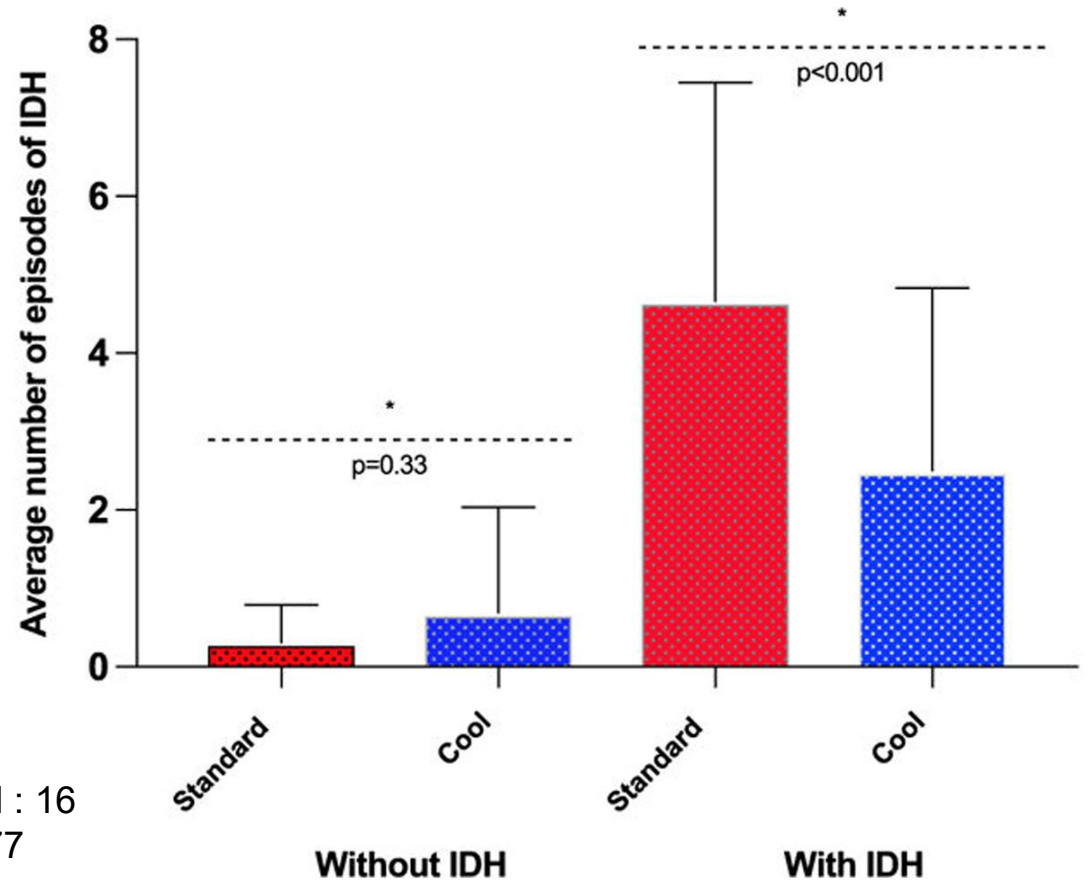
Individualized Cool Dialysate as an Effective Therapy for Intradialytic Hypotension and Hemodialysis Patients' Perception

Alexander Bullen[1], **Dena Rifkin**[1,2], and **Danuta Trzebinska**[1]

Ther Apher Dial. 2019 April ; 23(2): 145–152. doi:10.1111/1744-9987.12761.



Without previous IDH : 16
With previous IDH : 77



Without IDH
suffer from COLD sensation in Cool dialysis

With IDH
no differences in COLD sensation between Standard and Cool.

Benefit is on selected groups..

The Protective Effect of Cool Dialysate Is Dependent on Patients' Predialysis Temperature

Adrian Fine, MD, FRCP(C), and Brian Penner, MD, FRCP(C)

American Journal of Kidney Diseases,
Vol 28, No 2 (August), 1996: pp 262-265

128 patients,
predialysis temperatures **below 36°C (hypothermic), and above 36.5°C ("euthermic")**
Patients with temperatures 36°C to 36.5"C were excluded.

Table 1. The Effect of Dialysate Temperature on the Incidence of Symptomatic Hypotension During Hemodialysis

	Dialysate Temperature				
	35°C	37°C	Odds Ratio	95% Confidence Interval	Probability Value
All patients	5.5%	11.2%	1.813	1.286-2.556	0.001
Euthermic patients	7.0%	7.6%	1.082	.702-1.667	0.72
Hypothermic patients	3.4%	15.9%	4.743	2.521-8.925	0.0001

It is not a question of "To Cool or Not to Cool,“ but rather "Who to Cool, How to Cool”

Who to Cool?

High Responders

- Frequent symptomatic IDH.
- Significant post-dialysis fatigue.
- Cardiovascular instability.
- Relatively low baseline core temperature

Caution Required

- Elderly / Frail patients (thermoregulatory defects).
- Patients with Raynaud's phenomenon.

How to cool..

Initially, Maggiore and colleagues in the 1981 *EDTA* study employed extracorporeal blood cooling at **approximately 34°C.** Although it is effective in intradialytic hypotension (IDH), it was accompanied by **cold sensation and shivering.**

Subsequent investigations (eg, Adrian, Schneditz) demonstrated that using “cool dialysate” **around 35°C preserved the hemodynamic benefits with less cold-related symptoms.**

Throughout the 1990s and 2000s, **researchers** such as Jost, Fine, and Kaufman continued to **use a fixed dialysate temperature of about 35°C,** consistently documenting reductions in IDH, increases in total peripheral resistance, and evidence of myocardial and cerebral protection. **However**, **patient intolerance and chills remained recurrent concerns**.

Odudu and Eldehni (*Clin J Am Soc Nephrol*, 2015) **adopted individualizing dialysate temperature to 0.5°C below each patient’s core temperature**. **Compared with 37°C, individualized cooling suggests potential mitigation of HD-induced cardiomyopathy with excellent tolerability.**

Defining the Temperatures

Standard Dialysis

36.5°C - 37.0°C

For general HD patients. especially no history of IDH episode

Cooled Dialysis

0.5°C below or more

From baseline core temperature.

lower limit 35 °C

Summary

Standard (36.5~37°C) is often "Too Warm“, it may cause thermal accumulation and vasodilation.

Cooling Works have **definite physiological and short-term evidence** for hemodynamic stability.

However, as MyTEMP showed us, broad policies does not improve survival;
So, we focus on high-risk patients.

Individualize is essential.

Thank you for your attention.