Impact of dialysate flow rates on dialysis adequacy: a systematic review and meta-analysis

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1. INTRODUCTION

•Patients with kidney failure receiving hemodialysis (HD) require the adequate removal of uremic toxins.
•One marker of "Dialysis adequacy" is typically defined by Kt/V which is the dialyzer clearance of urea X duration of hemodialysis divided by volume of distribution of urea.
•The relative impact of dialysis flow rates on measures of dialysis adequacy in vivo have not been fully characterized.

2. AIM

•We performed a systematic review and meta-analysis on the impact of lower dialysate flow rates, compared to higher dialysis flow rates, on dialysis adequacy as measured by Kt/V and patient important outcomes including symptoms, cognition, physical function, quality of life and mortality.

3. METHODS

•Our population of interest was adult patients (age ≥18 years) with kidney failure on chronic HD (≥90 days).
•The setting of HD treatments could be either facility-based HD or home HD.
•The interventions were a low dialysate flow rate of ≤300mL/min and a high dialysate flow rate ≥ 800mL/min.
•The comparator was a dialysate flow rate of 500mL/min.
•The primary outcome was dialysis adequacy measured by Kt/V, (either single-pool, double-pool, equilibrated, or standard Kt/V), URR and the secondary outcomes included all-cause mortality and patient reported outcome measures.
•We included randomized controlled trials (RCTs) and observational studies in English without any restrictions on size
•Two reviewers independently screened abstracts and full texts and extracted relevant data.
•Two reviewers independently assessed the internal validity of the included studies using the Cochrane Risk of Bias tool
•We performed random effects meta-analysis employing the generic inverse variance method to estimate mean differences and related 95% confidence intervals
•Statistical heterogeneity was quantified using the I^2 statistic with significance assed with the X^2 test.

4. RESULTS

Figure 1: PRISMA flow diagram

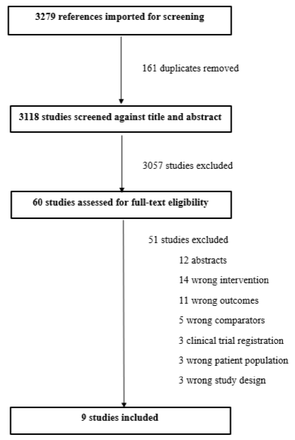

Table 1: Study characteristics

First Author , Year	Country	Age (Mean, SD)	Dialysis Dose (mL/min)		N (intervention/ comparator)	Setting	Duration (Mean, SD)	Outcome	
			Intervention	Comparator				Primary Outcomes	Secondary Outcomes
Ahrenholz *et al.* (2012)	Germany	Adult Population	a.300 b.800	500	18 (18/18)	HD	3 weeks	spKt/V	
Alayoud *et al.* (2012)	Morocco	49 ± 17	700	500	33 (33/33)	HD	3 weeks	Kt/V	
Albalate *et al.* (2015)	Spain	78	a.400 b.700	500	31 (31/31)	HD	27 weeks	Kt	
Azar, Ahmad (2009)	Egypt	50.51± 15.12	800	500	138 (138/138)	HD	32.14 ± 28.72 months	Kt/V, URR	
Azar, Ahmad (2009)	Egypt	48.21±13.38	800	500	134 (134/134)	HD	3 months	Kt/V, URR	
Molano-Trivino et al. (2019)	Colombia	62.5	400	500	71	HD	5 Years	Kt/V	
Panagoutsos et al. (2009)	Greece	52.6± 14.5	560	500	34 (34/34)	HD	2 years	Kt/V, URR	Body weight, Blood Pressure, Nutritional Status, Anemia and Quality of Life
Wang et al. (2008)	Canada	56	800	500	18 (12/12)	HD	12 weeks	Kt/V	
Ward et al. (2011)	United States	50	800	500	33 (33/33)	HD	NR	Kt/V, spKt/V, eKt/V	

Abbreviations: NR, Not Reported

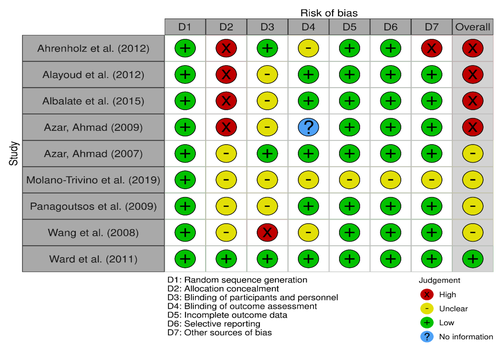

Figure 2: Risk of bias (revised Cochrane-risk-of-bias tool)

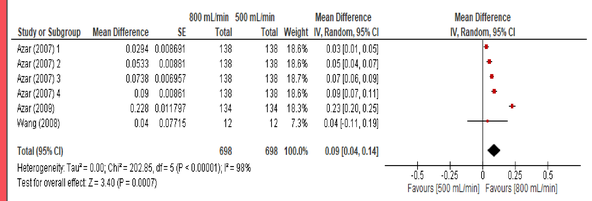

Figure 3: Random effects meta-analysis for Kt/V – 800mL/min vs 500mL/min

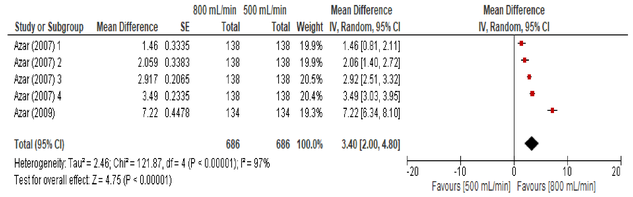

Figure 4: Random effects meta-analysis for URR – 800mL/min vs 500mL/min

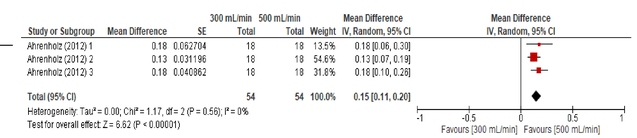

Figure 5: Random effects meta-analysis for spKt/V – 500mL/min vs 300mL/min

5. DISCUSSION

• In this systematic review and meta-analysis of 9 RCTs involving 510 adult patients receiving chronic HD, increased dialysis flow rates were associated with increased dialysis adequacy as measured by URR and Kt/V
•The impact of increased dialysis flow rates on other patient important outcomes including symptoms, cognition and physical function is unclear
•The strengths of this study include its novelty, comprehensive search strategy and the use of standard systematic review/meta-analysis methodology
•Limitations include the lack of inclusion of the grey literature, no comparisons between dialysate flow rates other than 300ml/min, 500ml/min and 800ml/min, lack of standardization of urea assays and Kt/V methodology, and most studies were of low quality with high or unclear risk of bias due to under-reporting of randomization sequences , allocation concealment and blinding
•Tradeoffs between dialysis flow rate, water consumption and its environmental impact must be balanced by its effect on increasing dialysis adequacy as measured by URR and Kt/V

6. CONCLUSIONS

•Increasing dialysis flow rates in adult patients receiving chronic HD appears to increase dialysis adequacy in vivo as measured small molecule clearance
•Additional research is needed in this area including high quality appropriately blinded parallel or crossover RCTs across a spectrum of dialysis flow rates that include small molecule clearance but also patient important outcomes such as symptoms, cognition and physical function

7. CONTACT INFORMATION

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