

# Optimising Phosphate Removal: Is an Extended Dialyser the Answer?

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**Disclosure:** The authors have declared no conflicts of interest.

**Keywords:** Blood volume processed, dialyser membrane, dialyser surface area, haemodialysis, hyperphosphataemia, phosphate clearance, phosphate removal.

**Citation:** EMJ Nephrol. 2025;13[1]:45-46.  
<https://doi.org/10.33590/emjnephrol/OROQ4399>.

## BACKGROUND AND AIMS

Hyperphosphataemia is a significant contributor to morbidity and mortality in patients undergoing haemodialysis.<sup>1,2</sup> While dietary phosphate restriction and the use of phosphate binders remain foundational in management, effective phosphate removal through dialysis is equally essential.<sup>3-6</sup>

This study aimed to investigate the key factors influencing phosphate elimination, with a focus on dialyser membrane type and surface area, session duration, serum phosphate levels, and purified blood volume.<sup>7</sup>

## MATERIALS AND METHODS

Eight patients on chronic haemodialysis (3 females and 5 males) with pre-dialysis serum phosphate levels  $\geq 2.0$  mmol/L were enrolled. Each patient underwent two midweek bicarbonate dialysis sessions: one using a high-flux polysulfone membrane (ultrafiltration coefficient: 55 mL/h/mmHg) with surface areas of 1.8 m<sup>2</sup> or 2.1 m<sup>2</sup> (n=4 per group), and a subsequent session using an extended haemodialysis setup with a medium-permeability polyarylethersulfone membrane (ultrafiltration coefficient: 59 mL/h/mmHg) with surface areas of 1.8 m<sup>2</sup> or 2.0 m<sup>2</sup>. Each patient served as their own

control. The average treatment time was 263.12 $\pm$ 23.97 minutes, with a dialysate flow of 550 mL/min. All patients had an arteriovenous fistula as vascular access.

Phosphate removal (MPO4) was calculated based on dialysate and blood phosphate concentrations, session duration, and total phosphate cleared using the formula for estimating MPO4 during haemodialysis. The formula is as follows:  $MPO4 = 0.1 \cdot t - 17 + 50 \cdot C_{ds60} + 11 \cdot C_{b60}$ , where 't' is treatment time in minutes,  $C_{ds60}$  and  $C_{b60}$  are dialysate and plasma phosphate concentrations at 60 minutes in mg/dL, respectively, and MPO4 is the estimated amount of phosphate removed in mg/treatment.<sup>8</sup> Statistical analysis assessed the relationship between MPO4 and key variables, including plasma phosphorus levels, dialyser membrane and surface area, blood volume processed, and session length.

## RESULTS

The results demonstrated a strong positive correlation between phosphate removal and both pre-haemodialysis serum phosphate levels and purified blood volume ( $p=0.001$ ). However, no significant association was found with dialyser membrane type (high-flux: 32.67 $\pm$ 9.5 mmol/session versus extended medium-flux: 34.94 $\pm$ 10.01 mmol/session;  $p=0.29$ ), surface area ( $p=0.67$ ), or treatment time ( $p=0.15$ ). Multivariate regression analysis confirmed that only pre-dialysis phosphate levels and blood volume processed were independent predictors of MPO4.

## CONCLUSION

Pre-dialysis serum phosphate levels and purified blood volume are the main determinants of phosphate clearance in haemodialysis. Dialyser type, membrane surface area, and session duration appear to have minimal impact, suggesting that

enhancing blood volume processed may provide greater benefit in managing hyperphosphataemia than using extended or alternative dialyser designs alone.

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