Harnessing the Microcirculation to Increase Dialysis Efficiency

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Dear Sir,

Our efforts to increase the efficiency of the dialysis process have, so far, focussed on what happens within the dialyser. Augmenting such parameters as blood and dialysis fluid flowrates and dialyser surface area enhances small solute clearance. [1, 2] The hitherto neglected aspect is that the real membrane exchange area is not within the dialyser but within the microcirculation. Even using optimised dialysis parameters, the achieved Kt/V during a dialysis session falls short of its potential because of solute rebound. The discrepancy is greater the shorter and more powerful the dialysis.

Apart from the equilibration lag due to the molecular size, the dialysis process may induce vasoconstriction due to the changes in the concentration of electrolytes. Thus the correction of raised levels of hydrogen, potassium and magnesium ions may cause the pre-capillary sphincters to constrict thereby reducing access to the exchange surface area. This would explain why the urea rebound is higher when a low dialysate (K+) is used [3]. A cool dialysate would lower body temperature in turn producing further vasoconstriction.

At rest the capillaries are mostly collapsed further limiting the exchange between the intravascular and the intracellular compartments. This exchange is essential for the removal of solutes if we are concerned with not just clearance from the blood but also from the tissues particularly the muscles. It is not surprising that our average dialysis patient who is cold and lying still, but otherwise haemodynamically stable, is not getting the most out of dialysis in the given time.

There are two levels of dialysis going on – at the capillary membrane and the dialyser membrane. The dialyser membrane will only clear as much as what is made available across the membrane between the intravascular and the intercellular compartments.

Exercise increases blood flow to the tissues (especially the muscles where most of the solutes are stored) thereby opening up the latent exchange surface area. It has been shown that exercising during dialysis can reduce the rebound of urea, creatinine and potassium [4]. An hour of cycling during a 3–4 h dialysis increased the equilibrated urea KT/V by 14%, which is equivalent to an extra 20 min of dialysis. Just as important patients report that they feel good at the end of dialysis.

This beneficial effect of exercise deserves consideration when planning a patient’s dialysis. Given the pressure to dialyse more patients and to deliver a higher Kt/V [5] within the economic constraints it would make sense to capitalise on this.

References