The direct placement of an intravascular catheter in the right atrium is a common practice in paediatric cardiac surgery [3]. The procedure is technically simple, easily performed by any cardiac surgeon with no additional risks beyond those inherent to the thoracic procedure; the complications are mainly related to the general condition of the patient. In paediatric patients, the transthoracic catheter is always used on a temporary basis and removed by simple traction, without significant complications. The use of transthoracic intracardiac catheters for haemodialysis access has been reported only once before; in that report however, the catheter was frequently replaced due to recurrent infection episodes and was used for only a few months [4]. In the present case, the catheter has been functioning uninterruptedly for more than 36 months without any serious associated complications. A repeated sternotomy would be necessary for intracardiac catheter replacement or removal, should it become infected.

This is, as far as we are aware, the first report of an intracardiac catheter used as a permanent vascular access for dialysis, for more than 2 years [5,6]. We suggest that the intracardiac placement of a central venous catheter may be a safe and long-lasting option in cases of total vascular access exhaustion, allowing the maintenance of the patient on regular haemodialysis therapy.

*Conflicts of interest statement*. None declared.

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## Effect of L-carnitine administration on erythrocyte survival in haemodialysis patients

Sir,

Anaemia is a common finding in patients requiring maintenance haemodialysis (HD), and represents one of the leading causes of increased cardiovascular morbidity and mortality in these patients. While the main defect responsible for anaemia in chronic renal failure patients is inadequate production of erythropoietin, there is evidence that other factors may also be involved. Several studies have shown that L-carnitine (LC) supplementation may have a beneficial effect on renal anaemia [1], but the underlying mechanisms responsible for such an effect have not yet been elucidated.

In an attempt to obtain more conclusive evidence on the effect of LC on uraemic anaemia, a double-blind, placebo-controlled study was carried out in 29 stable HD patients with secondary LC deficiency. Patients received 20 mg/kg dry body weight of either LC or placebo (saline) i.v. after each dialysis, for 24 weeks. The primary endpoint of the study was improvement in red blood cell (RBC) survival in patients treated with LC. Exclusion criteria included: Hb <8 g/dl in past 2 months, change in rHuEPO dose in previous 4 weeks, serum ferritin <200 µg/l, urea reduction ratio <65%, PTH >60 pmol/l, blood pressure >160/105 mmHg, body weight >100 kg, or the presence of an infection, malignancy, or extrarenal cause of anaemia. Intravenous iron saccharate was used to maintain serum ferritin >200 µg/l and rHuEPO dose was adjusted in order to maintain a target pre-dialysis haematocrit between 30 and 35% throughout the entire study.

RBC survival was evaluated by the $^{51}$Cr labelling procedure, a gold standard methodology in RBC survival studies [2]. Autologous $^{51}$Cr-labelled RBCs were infused at week 0. Blood samples were taken three times a week pre-dialysis and the $^{51}$Cr activity corrected for elution and haematocrit. The $T_{1/2}$ of the labelled cells was calculated using linear regression. The study was repeated at week 24.

Two placebo patients withdrew (one underwent transplantation, one due to abdominal pain), and one LC patient receiving a blood transfusion was excluded from the analysis. There was no difference in RBC survival between placebo (mean $T_{1/2}$ 40.2 days, SD ± 8.9, median 41.0) and LC group (mean $T_{1/2}$ 39.1, SD ± 7.5, median 39) at baseline. As shown in Figure 1, RBC survival increased in the LC group from baseline to week 24 by a mean of 3.6 days (SD ± 10.6, median 1.0), compared with a decrease of 4.8 days (SD ± 11.1, median −8.0 days) in the placebo group. Estimate of the treatment difference was 8.5 days

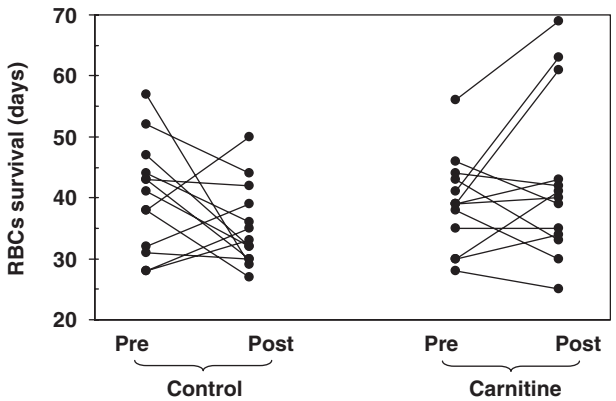


**Fig. 1.** RBC survival time before (pre) and after (post) 24 weeks of either placebo (saline; left panel) or L-carnitine (right panel) supplementation (20 mg/kg dry body weight i.v. after each dialysis session) to haemodialysis patients.

(95% CI 0.3, 17.2). The median erythropoietin dose (adjusted for body weight) decreased from baseline in the LC group, compared with an increase in the placebo group, although there were no statistically significant differences between the treatment groups. In the LC group, the haemoglobin concentration increased by 0.16 g/dl ($11.1 \pm 1.4$ *vs* $11.3 \pm 0.8$ g/dl) compared with a decrease of 0.65 g/dl ($11.1 \pm 1$ *vs* $10.4 \pm 1.2$ g/dl) in the placebo group, and the haematocrit increased by 0.48 ($33.8 \pm 4$ *vs* $34.3 \pm 3.6$) compared with a decrease of 1.35 ($33.6 + 3.1$ *vs* $32.3 + 3.4$) in the placebo group. There were fewer intradialytic hypotensive episodes in the LC group (1.3 *vs* 4.5), and no difference between the two groups in adverse event rate, C-reactive protein levels and serum ferritin.

The biophysical properties of the erythrocyte membrane and its cytoskeletal network are fundamental for RBC survival in the blood stream [3]. Indeed, RBCs must survive a variety of chemical and physical insults during their lifespan, and the loss of their elastic properties may severely compromise tissue oxygenation. Erythrocyte deformability has been found to be impaired in uraemia [4] and to correlate with shortened RBC survival time [5]. LC treatment of HD patients seems to alleviate their anaemic condition. A recent meta-analysis of the randomized LC trials performed before and after the advent of erythropoietin therapy shows a beneficial effect of LC supplements on anaemia control in maintenance HD patients [1]. This conclusion is consistent with the concept that LC may favourably affect the impaired rheological and metabolic properties of erythrocytes in HD patients [6]. Furthermore, LC has been shown to improve the visco-elastic properties of non-uraemic human RBCs [7].

Our present data show a clear tendency of LC, compared with placebo, to improve RBC survival. The statistical analysis performed on $T_{1/2}$ did not reach a *P*-value $<0.05$, reaching a borderline value of 0.058. However, due to the higher variability detected in the study than that assumed on sample size calculation, the study was under powered. Furthermore, relevant haematological values increased from baseline to week 24 in the LC group, compared with a small decline in the placebo group. This was despite a lower dose of erythropoietin in the LC group, as previously reported [8]. More direct experimental evidence for the beneficial effect of LC on RBC survival comes from an RBC conservation study [9]. In a paired cross-over study, the addition of LC to the preservation solution of packed RBCs reduced haemolysis during storage and increased subsequent *in vivo* recovery and survival of $^{51}$Cr-labelled RBCs. In this study, it was also shown that the membrane phospholipid fatty acid turnover, a key process in the repair of oxidatively damaged phospholipids, was favourably affected by the expansion of the intra-RBC LC pool. Additional evidence that this may occur in RBCs of HD patients was provided by de los Reyes *et al*. [10].

We report the first randomized controlled trial of the effects of LC on erythrocyte survival in HD patients. There was a strong trend towards improved RBC survival in the treated group ($P = 0.058$), and this mechanism might explain in part the reported benefit of LC supplements on anaemia control in HD patients.

*Conflict of interest statement*. A. Arduini is currently the Director of the Research and Development Department of Iperboreal Pharma Srl.

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## The pleiotropic effect of statins in haemodialysis patients is not the consequence of an inhibition of LDL oxidation by myeloperoxidase

Sir,

For at least 20 years, myeloperoxidase (MPO) has been studied as a marker of oxidative stress during haemodialysis (HD) [1]. Free MPO concentration increases during HD,