

The first nocturnal home haemodialysis patient in Hong Kong

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We report our experience of the first use of nocturnal home haemodialysis in Hong Kong. The patient, a 40-year-old man with end-stage renal failure, was recruited into the Nocturnal Home Haemodialysis Programme at Princess Margaret Hospital in 2006. He received haemodialysis at home on alternate nights (3.5 sessions per week) for 5.5 to 6 hours per session. After 1 year of nocturnal home haemodialysis, his recombinant human erythropoietin requirement had been reduced by more than 50%. His serum phosphate level decreased by 35% and calcium phosphate product by 34%. After nocturnal home haemodialysis, his blood pressure control has been excellent and he was able to cease taking anti-hypertensive medications soon after commencing nocturnal home haemodialysis. Regression of his left ventricular hypertrophy has also been noted, with a 39% decrease in his left ventricular mass index. The haemodialysis adequacy index, weekly single-pool Kt/V, increased by 59% after switching to nocturnal home haemodialysis and his quality-of-life indices also showed significant improvement. Nocturnal home haemodialysis holds promise as an alternative dialytic therapy for patients on chronic haemodialysis in Hong Kong.

Introduction

Conventional haemodialysis involves performing a dialytic therapy two or three times a week in sessions of 4 to 5 hours each, either in-centre or at a satellite centre. This dialysis schedule means the interdialytic interval is long, and rapid solute and fluid removal is needed during each dialysis session, resulting in significant side-effects and morbidities. Nocturnal home haemodialysis (NHH), performed at home 6 or 7 nights a week during 6 to 12 hours of sleep, was first introduced by Uldall et al¹ and Pierratos et al,² as a more desirable alternative to conventional haemodialysis since it allows an increase in both the frequency of dialysis and treatment duration.

We report here our experience of the first end-stage renal failure patient to be put on NHH in Hong Kong.

Case report

The patient is a 40-year-old man who has end-stage renal failure of unknown primary renal pathology. He was started on continuous ambulatory peritoneal dialysis in February 1993. Seven months later, he received a cadaveric renal transplant overseas but severe infection necessitated graft nephrectomy 10 days after. Thereafter, he was put on in-centre twice-weekly haemodialysis for 5 hours each session. His co-morbidities include hyperparathyroidism managed with a parathyroidectomy in 1993 and chronic hepatitis C infection. In June 2006, this patient was recruited to the Nocturnal Home Haemodialysis Programme at Princess Margaret Hospital. After 3 months of intensive NHH training, he started to have haemodialysis at home on alternate nights (3.5 sessions per week) for 5.5 to 6 hours using the Fresenius 2008B haemodialysis machine and F7HPS polysulfone capillary dialyser (Fresenius Medical Care, Bad Homburg, Germany). The dialyser blood flow rate was set at 240 mL/min and dialysate flow rate 300 mL/min. The dialysate sodium concentration was 142 mmol/L and a low calcium dialysate was used with a calcium concentration of 1.25 mmol/L. The bicarbonate component was contained in a powder form to be mixed with the electrolyte component within the haemodialysis machine. The bicarbonate concentration of the final dialysate was set at 35 mmol/L. A primary arteriovenous fistula was used for vascular access for the NHH and the patient cannulated himself. The patient's haemoglobin level, erythropoietin dose, serum phosphate level, calcium phosphate product, parathyroid hormone level, dry weight, blood pressure, ejection fraction, and left ventricular mass index (LVMI) as measured on echocardiogram, dialysis adequacy index, and quality-of-life indices were followed for 1 year after commencing NHH.

After 1 year of NHH, the patient's haemoglobin level rose to 138 g/L at 6 months

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香港首名使用家居血液透析法的病人

本文報告香港首次使用家居血液透析法的經驗。一名40歲男子，患有終末期腎衰，他於2006年參與瑪嘉烈醫院的家居血液透析計劃，隔晚在家中進行血液透析，每星期3.5節，每節5.5至6小時。一年後，病人的重組血細胞生成素已經減少超過一半，血磷水平下降了35%，鈣磷乘積則下降了34%。使用家居血液透析法後，病人控制血壓的情況相當理想，並在開始家居血液透析法後不久，便已停止服用降壓藥物。心臟左室肥厚也有逆轉，收縮系數減少39%，每週血液透析治療值 (single-pool Kt/V) 提高了59%，生活品質指標亦有顯著改善。家居血液透析法為需要長期接受血液透析的病人，提供另一種透析治療方法。

reduced significantly from 180 U/kg/week before starting NHHD to 82 U/kg/week at 12 months (Fig 1). The pre-dialysis serum phosphate level dropped from 2.41 mmol/L at baseline to 1.56 mmol/L at 12 months (Fig 2), while the calcium phosphate product decreased significantly from 5.04 to 3.34 mmol²/L² (Fig 2). His parathyroid hormone level remained unmeasurable (<0.32 pmol/L throughout the year due to the previous parathyroidectomy). The patient's blood pressure control improved after NHHD, and he was taken off anti-hypertensive medications within 1 week of starting NHHD. He gained 5 kg in dry weight steadily over the year of NHHD owing to an improved appetite. An echocardiogram was performed at baseline and 1 year after NHHD to assess his ejection fraction and LVMI. Although his ejection fraction showed no significant changes, his LVMI had decreased significantly from a baseline of 206 g/m² to 126 g/m².

The haemodialysis adequacy index, single-pool Kt/V (spKt/V), was calculated using the Daugirdas second-generation equation.³ The weekly spKt/V, measured when he was on conventional haemodialysis two times a week, was 3.68, whereas that during NHHD was 5.85. The quality of life (QOL) indices were assessed by questionnaire using the Haemodialysis Stressor Scale,^{4,5} Jalowiec Coping Scale,⁶ and Ferrans and Powers Quality of Life Index.⁷ The QOL indices assessed at 6 months after NHHD revealed an 85% decrease in the level of stressors, a 59% decrease in the severity of perceived stressors, a 70% decrease in the need to cope with stress, and an 8% improvement in satisfaction with QOL.

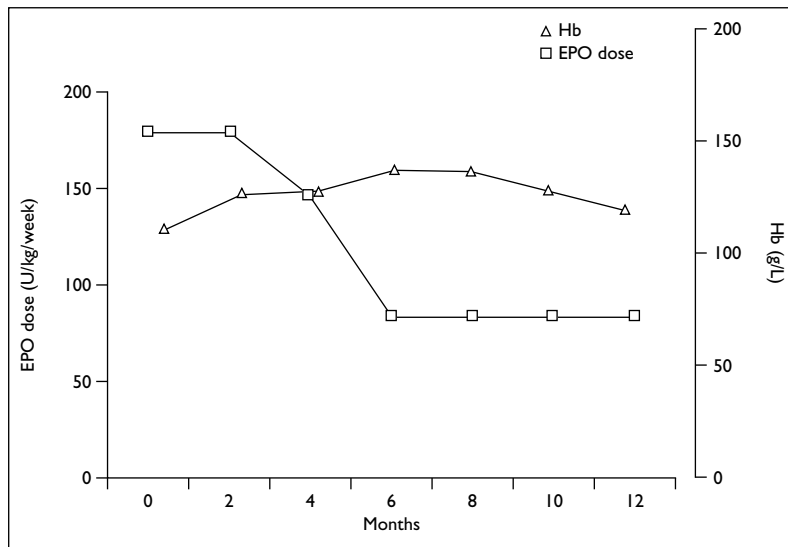


FIG 1. Haemoglobin level (Hb) and erythropoietin alpha (EPO) dose after nocturnal home haemodialysis

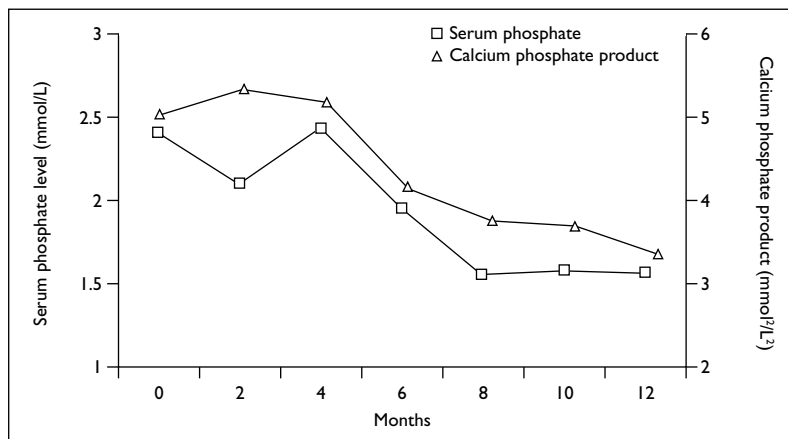


FIG 2. Pre-dialysis serum phosphate level and calcium phosphate product after nocturnal home haemodialysis

and was maintained at 120 g/L at 12 months after reduction of his erythropoietin alpha dose (Fig 1). The erythropoietin alpha dose requirement was

Discussion

Conventional haemodialysis given two or three times a week has been complicated by significant problems such as intradialytic hypotension, high interdialytic weight gain and fluid retention. Dialysis given for longer periods and with higher frequency has better outcomes.^{8,9} The ideal dialysis regimen should be longer, more frequent, and done at home at night during sleep. This rationale was used to design NHHD.¹⁰ Overnight dialysis was introduced by Baillod et al¹¹ as early as 1965. Charra et al,⁸ in Tassin, France, has dialysed patients using long, slow overnight in-centre dialysis three times a week since the mid-1970s. In 1993, Uldall et al¹ and Pierratos et al² first introduced the Nocturnal Home Haemodialysis Programme in Canada. Nocturnal home haemodialysis was performed at home 6 or 7 nights a week during sleep for a variable amount of time depending on the length of sleep (usually 6 to 12 hours). Partners were not required. Our patient was dialysed on alternate nights (3.5 sessions a week) instead of 6 or 7 nights a week because of the cost advantage and his personal preference.

Clearance of solutes is enhanced with NHHD. Even at a low dialysate flow rate, NHHD is able to provide an equilibrated Kt/V for urea of approximately one per session.² Our patient's weekly spKt/V increased by 59% after switching to NHHD of 3.5 sessions a week. A study of eight chronic haemodialysis patients has shown that serum phosphate levels are significantly lower in patients using NHHD rather than conventional haemodialysis. Despite an increase in phosphate intake, patients did not require phosphate binders after 4 months and more than 50% of patients required the addition of phosphate to the dialysate.¹² Our patient's serum phosphate level decreased by 35% after 12 months of NHHD using the same phosphate binder dose and his calcium phosphate product decreased by 34%. β_2 -Microglobulin removal is four times higher when NHHD is used (585 vs 127 mg/week) and the percentage reduction of serum β_2 -microglobulin was greater (39% vs 21%) than that achieved with conventional haemodialysis in one study.¹³

Blood pressure control is excellent in patients on NHHD, with almost all patients able to cease anti-hypertensive medications.¹⁰ In fact, our patient was able to stop anti-hypertensive drugs shortly after commencing NHHD. Nocturnal home haemodialysis is associated with regression of left ventricular hypertrophy^{14,15} and improvement in the ejection fraction.¹⁶ One year after NHHD, our patient achieved a 39% decrease in his LVMI.

Substantial increases in haemoglobin levels and decreases in recombinant human erythropoietin (rHuEPO) requirements have been reported after switching to NHHD.¹⁷ Our patient's haemoglobin concentration rose to 138 g/L after commencing NHHD, allowing a reduction in his rHuEPO requirement by more than 50%. Studies using a range of qualitative assessment tools to assess QOL have shown improvements in these measures as a result of switching to NHHD.^{15,18} Our patient's QOL was assessed with various tools and showed significant

improvements in terms of the incidence and severity of stressors, coping with stress and satisfaction.

Our patient was receiving 3.5 sessions of NHHD a week instead of the usual 6 or 7 nights a week mainly because of cost advantages and his personal preference. A report comparing NHHD 6 nights per week and NHHD on alternate night (3.5 sessions per week) showed that biochemical parameter benefits are also evident with NHHD given as 3.5 sessions a week. Although small molecule clearance and dietary freedoms are lower, phosphate control seems close to ideal without the added burden of phosphate replacement in the dialysate, as is required in NHHD given 6 nights a week.¹⁹ Our patient's serum phosphate level decreased to a near-normal level after NHHD without the need to add phosphate to the dialysate.

In Hong Kong, the annual recurrent cost per patient of in-centre haemodialysis is HK\$239 288 while that of NHHD is HK\$132 000 meaning NHHD yields a 45% reduction in recurrent costs.

There is, at present, no conclusive survival data from patients on NHHD. Pierratos²⁰ has reported 81% survival in 83 patients over 5 years. Prospective randomised trials that may provide information about the impact of NHHD on patient survival are currently under way. Our 1-year experience of NHHD demonstrated beneficial effects in terms of erythropoietin requirements, phosphate clearance, calcium phosphate product reduction, blood pressure control, regression of left ventricular hypertrophy, haemodialysis adequacy, and QOL. Nocturnal home haemodialysis is a promising alternative dialytic therapy for end-stage renal failure patients receiving chronic haemodialysis in Hong Kong.

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