# The phosphate intake of haemodialysis patients in a metropolitan city of China

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## I : Introduction

The University of Hong Kong - Shenzhen Hospital (HKU-SZH) is a reforming and experimental hospital set in the city of Shenzhen (SZ). The city is a metropolitan city made of immigrants and residents who have come from both the northern and southern province of China. In 2016, the metropolitan area population was 17 million. In the UK dialysis units, dieticians play a crucial role in the regimen of dialysis patients but these services are not available in most HD and PD centers in China. The poor phosphate control is a major risk factor for cardiovascular calcification and other serious consequences in dialysis patients. In order to get a better understanding of the current situation, we asked all 131 of our chronic patients to complete a 3-day food diary to enable us to estimate their protein and phosphorus intake. We also checked the serum phosphate and recorded their phosphate binder use in 45 of them.

## II : Method

All chronic stable patients who were attending the HKU-SZH dialysis center were asked to complete a 3-day food diary after consent was obtained. In addition, the serum phosphate and binders use were extracted from 45 patients that were attending the afternoon shift. The study was approved by the research and ethics committee of the Hospital and all patients signed a consent form to participate.

All patients had received standard dietetic advice given by the dialysis nurses regarding phosphorus restriction for at least 3 months. Patients were instructed how to complete the 3-day food diary on return and the result was analysed by a certified nutritional doctor. In the subgroup of patients (45) attending the afternoon dialysis shift, more in depths analysis were carried out including the energy intake in terms of kcal using a food composition program (Zhending Hospital Nutrition and Dietary Management Information System) and normalised to ideal body weight (IBW). The pre-dialysis serum phosphate level was obtained within 7 day of the food diary. The total and normalized dietary energy, protein and phosphorus intake, and phosphorus to protein ratio (mg/g) were calculated. The dialysis adequacy was calculated using standardized Kt/V.

## III : Statistical analysis

All analyses were carried out with the SPSS 16.0 for Windows statistical software (SPSS, Inc., Chicago, IL, USA). Data were presented as mean ± SD for normally distributed variables. p value < 0.05 was considered statistically significant. Differences between the two groups were assessed by independent samples t test for normally distributed variables, or Chi square test for categorical variables.

## IV : Results

All 45 patients were receiving either haemodialysis (HD) or haemodiafiltration (HDF), using a high flux dialyzer, 4 hours (h) thrice weekly. The average kcal intake/ ideal body weight (IBW in kg) was 28.8 kcal/kg (IBW). 31 of the 45 patients were receiving less than the recommended (30) kcal intake per day according to the ideal body weight (IBD). Only 7 patients had an energy intake in excess of 35 kcal/Kg (IBW). The mean protein intake was 1.10 g/kg IBW per day. One patient had a very low protein intake at 0.39 g/kg IBW.

The results were stratified into high (> 1.6 mmol/L) or normal (< 1.6 mmol/L) serum phosphorus group based on the Kidney Disease Improving Global Outcomes (KDIGO) guideline and illustrated in table 1. Table 2 showed the dietary intake according to the residual renal function. The anuric patients showed a significantly lower overall protein and phosphorus intake.

Table1 Dietary protein and phosphorus intake and distribution in HD patients with high (> 1.6 mmol/l) versus normal (< 1.6 mmol/l) serum phosphorus level.

| | Normal serum phosphorus (n =21) | High serum phosphorus(n = 24) | p value |
|---|---|---|---|
| Kt/V | 1.73 ± 0.26 | 1.68 ± 0.24 | 0.507 [a] |
| IBW | 56.06 ± 5.91 | 58.31 ± 5.03 | 0.175 [a] |
| Total energy intake (kcal/ day) | 1712.40 ± 414.26 | 1576.06 ± 430.29 | 0.287 [a] |
| Total energy intake kcal/kg IBW/day | 30.48 ± 6.44 | 27.54 ± 7.74 | 0.178 [a] |
| Total Protein intake (g/kg IBW/ day) | 1.19 ± 0.37 | 1.04 ± 0.29 | 0.142 [a] |
| Total protein intake/ day (g) | 66.92 ± 20.61 | 60.45 ± 16.14 | 0.244 [a] |
| % high quality protein | 58.40 ± 9.60 | 57.40 ± 10.10 | 0.747 [a] |
| Potassium intake (mg/ day) | 1014.65 ± 324.73 | 967.64 ± 307.61 | 0.621 [a] |
| Phosphorus/kcal intake(mg/kcal/day) | 487.32 ± 86.63 | 494.37 ± 85.96 | 0.786 [a] |
| Phosphorus intake(mg/day) | 833.33 ± 222.79 | 756.40 ± 194.62 | 0.223 [a] |
| Phosphorus/protein intake (mg/g/day) | 12.61 ± 1.06 | 12.57 ± 0.91 | 0.879 [a] |
| Number of patients on a phosphate binder (%) | 18 (85.7%) | 21 (87.5%) | 0.86 [b] |

a t-test, b x2-test, Data are presented as mean +/- SD for normally distributed variables, X2-test chi-square test; IBW = ideal body weight

Table 2 HD patients with residual renal function versus anuric patients

| | Anuric patients (n =30) | Patients with RRF (n =15) | p value |
|---|---|---|---|
| Serum phosphorus (mmol/l) | 1.68±0.59 | 1.64±0.43 | 0.821 [a] |
| Energy intake (kcal day) | 1559.88±351.02 | 1799.29±517.71 | 0.074 [a] |
| Energy intake kcal/kg IBW/ day | 27.54±6.09 | 31.66±8.70 | 0.071 [a] |
| Protein intake g/ kg /IBW | 1.04±0.26 | 1.25±0.43 | 0.042 [a] |
| Total protein intake (g) | 59.31±15.15 | 71.78±21.96 | 0.031 [a] |
| High quality protein（%） | 57.66±10.37 | 58.28±10.37 | 0.850 [a] |
| Potassium intake (mg/day) | 936.18±304.21 | 1096.38±312.79 | 0.106 [a] |
| Phos intake(mg/day) | 745.43±185.58 | 886.05±228.94 | 0.032 [a] |
| Phos/Kcal | 487.09±90.79 | 499.05±75.65 | 0.663 [a] |
| Phos/protein | 12.61±0.93 | 12.55±1.09 | 0.836 [a] |

a t-test , Data are presented as mean +/- SD for normally distributed variables. IBW = ideal body weight; RRF = residual renal function; phos = phosphorus

Overall, 26 of the 45 patients were on calcium binder alone, 3 were on sevelamer alone, 8 were on calcium and sevelamer, 1 on calcium and lanthanum; only 7 were not on any binders. There was no direct link between the phosphate binder use and serum phosphate level.

## V : Discussions

It is proven difficult for HD patients to achieve adequate amount of high quality protein intake while restricting phosphorus. In the UK, with the emphasis on the role of renal dieticians strengthened with new drug and dialytic regimen and therapies, it has become possible to control the serum level of parathyroid hormone (PTH), calcium and phosphate simultaneously in 50% of the HD patients according to the UK Renal Association. This is not the case in our experience in Shenzhen.

### a) Traditional Chinese diet

It is known that traditional Chinese diet contains excessive amount of salt, cholesterol and purine. The International Study on Macronutrients and Blood Pressure (INTERMAP) showed a marked dietary variation in phosphorus intake between the north and south of China. People from south of China is accustomed to eating rice, grain, soybean, and chicken or pork broth whereas those from northern China prefers “mantou”, a name given to the Chinese steamed bun. In comparison with the INTERMAP data, the overall phosphate/ 1000 kcal intake of our patients was leaning on the high side.

### b) Source of Protein and Phosphorous

Many Chinese HD patients were relying on staple food as a source of energy and protein, yet protein derived from rice, mantou and soy protein are of low quality. The leavening agents, additives and condiments including soy sauce were common source of dietary phosphorus in our patients. The intake of high quality protein was not always sufficient. High quality protein such as pork, fish and dairy were consumed in variable amount.

### c) Small steps

The Chinese cultural and belief of maintaining the traditional diet for the harmony of the body and social behaviour may be hard to change even for the dialysis patients with special dietary need. However, small steps could be taken such as cutting back the phosphorus-containing condiments to begin with. Better phosphate level had been demonstrated by the PD group from Shanghai JiaoTong University Hospital by reducing protein intake. Like the Shanghai group, we have noted that our anuric patients consumed less protein and phosphorus.

### d) Phosphate binders and therapy adherence

In our group of 45 patients, the use of phosphate binders was very variable. Most of our patients received a high dialysis clearance with an average Kt/V in excess of 1.4 over a four-hour HD or HDF session. Sevelamer and lanthanum (non calcium-containing phosphate binder) had become available in China since 2014 but these drugs are expensive and are self-financed items. Poor adherence to phosphate binders was a likely contributor to the poor phosphate control.

### e) Practical Application

Our limited study has added further information that the phosphate control at present era in a metropolitan and immigrant Chinese City such as Shenzhen is inadequate even though the dialytic therapy, Kt/V targets and the availability of binders are comparable to the west, the emphasis of dietary phosphate control remains inadequate in practice. According to the British renal workforce recommendation, each HD patient should receive 2 hours of renal dietetic advice in the first one month of commencing HD, then 8 hours per year. This opens the debate whether professional dietetic input should be considered as an essential component in the successful operation of a dialysis service in China.

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