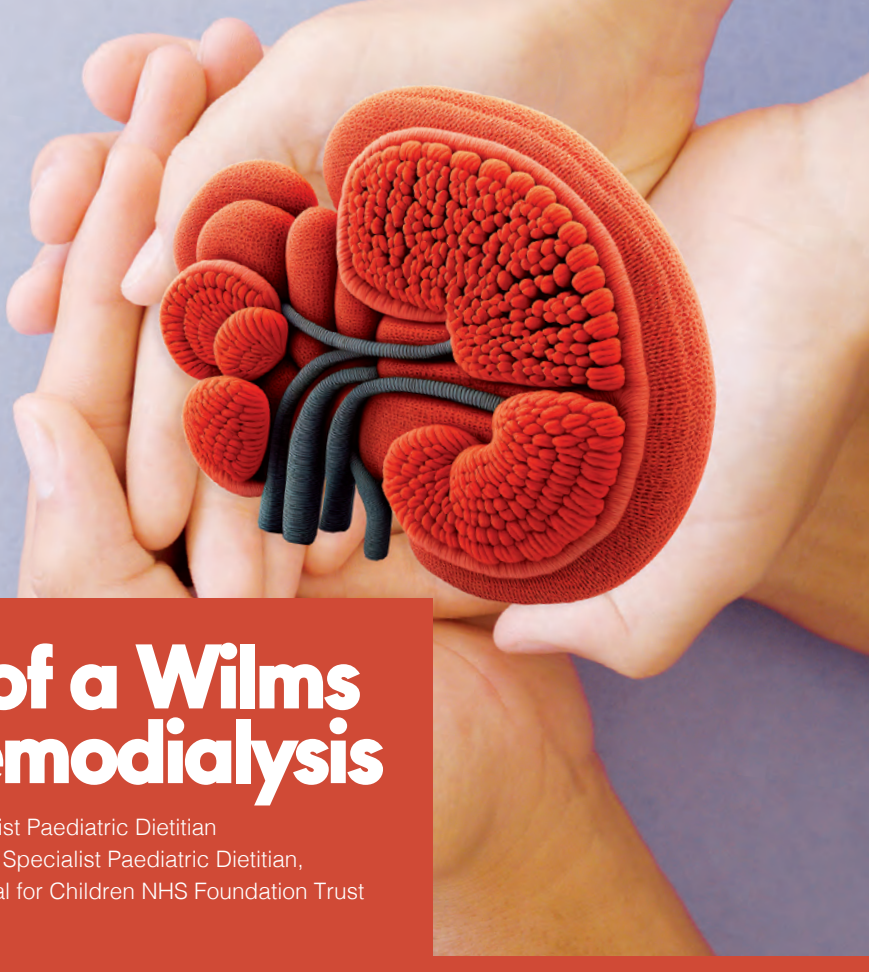


The Dietetic Management of a Wilms Tumour on Haemodialysis

Alisa Morris, Highly Specialist Paediatric Dietitian
& **Breeana Gardiner,** Highly Specialist Paediatric Dietitian,
Great Ormond Street Hospital for Children NHS Foundation Trust

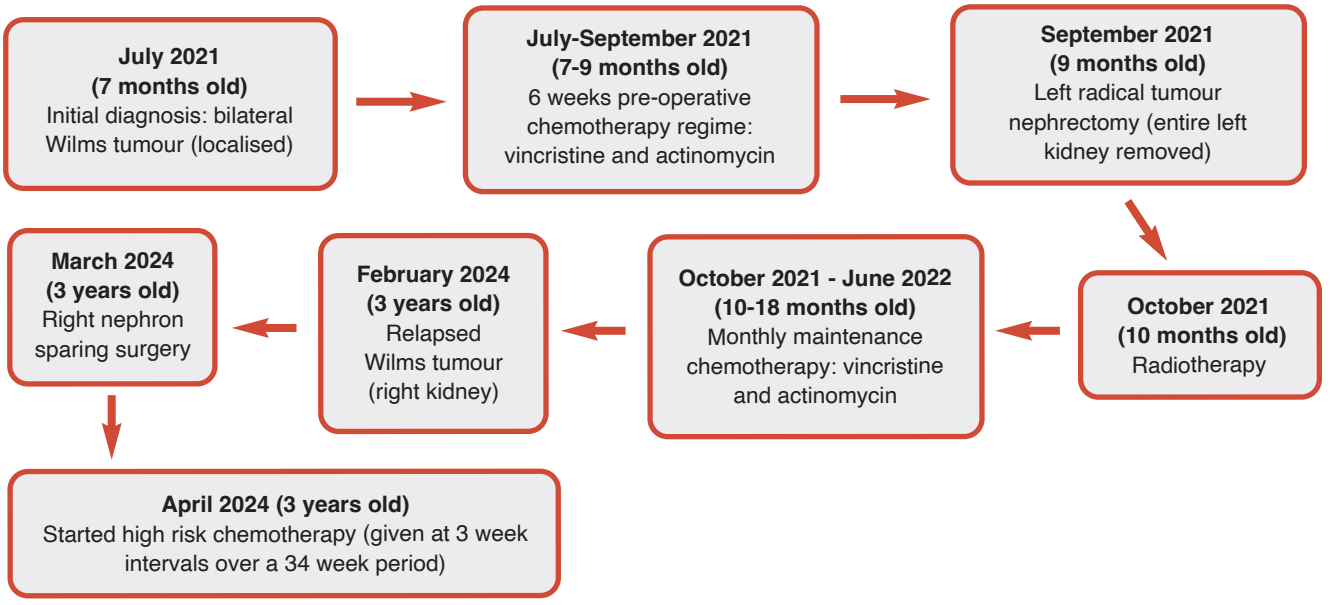
Renal tumours account for about 7% of all childhood cancers,[1] with Wilms tumour (nephroblastoma) being the most common type of renal tumour.[2] About 90 children in the UK are diagnosed with a Wilms tumour each year. It most often affects children under the age of seven.[3] The main treatment for Wilms tumour is chemotherapy and surgery, although some children also require radiotherapy.[2] About 90% of children with Wilms tumour are successfully treated.[2]

The patient

Patient A is a 3-year-old male with relapsed Wilms tumour and a decline in renal function. He was initially diagnosed with bilateral Wilms tumour aged 7 months old in July 2021, and was treated as per the Children's Cancer & Leukaemia Group (CCLG) renal tumour guidelines (2020),[6] receiving chemotherapy, radiotherapy and a left radical nephrectomy (entire left kidney removed). He finished treatment in June 2022, aged 18 months. Unfortunately, 18 months later he relapsed when a new right-sided Wilms tumour was discovered in February 2024. **Figure 1** shows Patient A's treatment journey.

This case study will explore the dietetic management of patient A, post right nephron sparing surgery, where 80% of one kidney remained. He received post-operative chemotherapy and was commenced on haemodialysis due to a decline in renal function.

Figure 1: Patient A's treatment journey



Most children can retain a normal kidney function even with one kidney (see **Table 1** for a description of the role of the kidney). However, due to multiple factors, including an acute kidney injury (AKI) and infection, Patient A's kidney function started to decline rapidly from August 2024, placing him in chronic kidney disease (CKD) stage 4. He was admitted to hospital at the end of September 2024 to receive his next cycle of chemotherapy, where his kidney function continued to deteriorate and his eGFR dropped to around 8 ml/min/1.73m^2, reflecting that his kidneys were working at around 8%.

Table 1: Role of the kidney

Roles of the kidney[4, 5]	Method of action[4, 5]
Acid-base balance	Excreting bicarbonate via urine
Removal of electrolytes (namely potassium, phosphate)	Excretion of electrolytes via urine
Removal of waste products (e.g. urea)	Excreting urea via urine
Activation of inactive vitamin D	Hydroxylation of 25-hydroxycholecalciferol to 1α, 25-dihydroxycholecalciferol
Red blood cell creation	Creation of the hormone, erythropoietin, which stimulated red blood cell production in the bone marrow
Removal of excess fluid	Creation of urine
Regulating blood pressure	Creation of urine Production of hormones angiotension II and renin

The decision to start dialysis is not dependent on a patient's eGFR, but on the following indications:[7, 8]

- Hyperkalaemia that cannot be managed by diet or medications
- Fluid overload
- Hypertension that cannot be managed by diet or medications
- Symptoms of uraemia (e.g. extreme fatigue, nausea, vomiting).[9]

A few days after he was admitted for chemotherapy, it was decided that Patient A should start dialysis due to fluid overload and uraemia that were not being controlled with diuretic medication or diet. It was felt that he would be unable to undergo chemotherapy in his current clinical state due to the nephrotoxicity of the chemotherapy,[10] and he would likely have difficulties clearing the hyperhydration that is prescribed alongside chemotherapy. One study reports that 15% of children with bilateral Wilms tumour will start dialysis, but only 1 in 20 Wilms tumour cases are bilateral,[11] highlighting how rare Patient A's need was to start dialysis.

Interventions

Figure 2 (over page) provides an overview of events, medical treatments, changes in biochemistry and dietetic management.

Table 2 (over page) shows the theoretical nutritional requirements.

Outcomes/results

Assessing nutritional status, especially when patients have extreme fluid overload, can be difficult. Despite Patient A's weight being measured daily, changes in weight were most likely to be due to fluid, rather than actual weight. Therefore, we could not fully assess the efficacy of our nutritional interventions. Mid-upper arm circumference (MUAC) is recommended as a proxy measure for nutritional status by the Paediatric Renal Nutrition Taskforce.[15] In this case, a reduction in MUAC was observed over 13 days, which reflects a decline in nutritional status. There was a 41% increase in energy and a 99-121% increase in protein provision of oral nutritional supplements (ONS)/nasogastric tube (NGT) feeds between time point 1 and time point 5, including a significant rise in both once a NGT was inserted.

Some improvements in biochemistry were observed, which may be related to adaptions in the energy, electrolyte and protein content of feeds. Urea levels improved from time point 2 due to the increased energy provision of feeds, reducing the catabolic effect on urea.[13] Feeds were adjusted from time point 3 to provide higher amounts of protein, phosphate and potassium due to the increased dialytic losses of these molecules.[13, 16, 17] This is reflected in the biochemical results at time point 5, where serum phosphate is in range and serum urea is at a level considered acceptable for a patient on dialysis.

Discussion

What were the dietetic issues?

- Chemotherapy side effects
- Constipation
- Poor appetite
- Fluid overload and hypertension requiring strict fluid restriction
- Poor renal function; hyperphosphataemia, raised serum urea, previous hyperkalaemia
- Limited suitable ONS options prior to starting dialysis and a dislike of those that were suitable
- Limited time outside of haemodialysis to accommodate NGT feeds and oral intake
- Food safety restrictions whist immunocompromised.

Patient A's reduction in appetite and oral intake was likely multifactorial. His mother reported that his fluid overload was making him breathless, making it more difficult to eat. Additionally, appetite reduction, anaemia and fatigue are common side effects of his chemotherapy agents, carboplatin and etopside.[18, 19] Chemotherapy is also known to cause other side effects that can limit oral intake, such as mucositis, taste changes and nausea, but thankfully these were not experienced by Patient A.[20] Constipation is likely to have also contributed to his poor appetite. Constipation could have been caused by his fluid restriction, as there is less fluid available to soften the stools.[21] His oral intake continued to decrease, even after starting dialysis, and therefore the aim of NGT feeds were to provide the majority of his nutritional requirements.

Despite his parents initially objecting to a NGT as they felt Patient A would not tolerate one unless it was inserted under general anaesthetic, they agreed to inserting a NGT due to an ongoing reduction in oral intake and fatigue drinking the carbohydrate module. The NGT allowed for feeds to be administered that were not tolerated orally and thus also reduced the pressure of taking ONS orally. This was crucial at this time, as Patient A's urea continued to climb and administration via the NGT guaranteed a source of calories to help minimise the effect of catabolism on urea levels. The flexibility in the feed plan for either 3 or 4 feeds per day allowed for fluctuations in his oral intake and remaining fluid restriction.

Prioritising nutrition whilst fluid restricted is difficult, as there is only a limited volume of fluid daily that can be utilised to provide nutrition. Balancing this with the patient's quality of life and their desire to drink other fluids that are more thirst quenching or palatable is another consideration.

Additionally, at some time points up to half of his fluid restriction was taken up by blood product transfusions and intravenous medications, making it more difficult to ration the remaining amount for ONS feeds. To compensate, Patient A's feeds were concentrated to maximise the calorie density. For example, at time point 4, when his fluid restriction was further decreased to 500 ml, a carbohydrate module was added to a compact feed and increased as tolerated, providing 2.5 kcal/ml.

It is not recommended for some patients receiving haemodialysis to eat and drink whilst on the machine as it can affect blood pressure. Patient A was on dialysis 6 times per week, for around 5 hours per day. Therefore, the timing of his NGT feeds and oral intake needed careful consideration to optimise nutrition intake.

Patient A's poor oral intake was likely compounded by multiple dietary restrictions, including potassium, phosphate and food safety restrictions that are routinely advised to oncology patients to minimise the risk of foodborne infection.[22] Before commencing dialysis, Patient A had raised serum urea and phosphate, indicating a need for ONS and food choices that were low in phosphate as to not further exacerbate serum phosphate levels. Patient A's urea level was likely raised due to catabolism secondary to a poor oral intake, with the treatment for this being to optimise calorie intake. Additionally, Patient A was already restricting dietary potassium to maintain their serum potassium levels within normal limits, due to hyperkalaemia during a previous admission. These dietary restrictions limited the suitability of many ONS and NGT feed options, as the aim for ONS was to be high in calories and low in phosphate and potassium. This is well demonstrated at time point 1, prior to the NGT being inserted.

Although polymeric ONS are preferable, especially when a child is not meeting nutritional requirements orally as ONS will provide additional protein and micronutrients, Patient A disliked the only two suitable polymeric ONS options. Therefore, fat emulsions and carbohydrate modules were used as they are low in potassium and phosphate. Additionally, both of these products fitted well within the fluid restriction as fat emulsions are a very concentrated energy source necessitating small volumes and the carbohydrate module could be mixed into fluids Patient A was already drinking.

Thankfully, when Patient A started dialysis, most of these dietary restrictions were relaxed. This is because electrolytes are cleared via dialysis, with small molecules like potassium being cleared more effectively.[16] This is well demonstrated from time point 3-5; despite his dietary potassium intake gradually increasing from NGT feeds, dialysis was too effective in removing potassium, resulting in hypokalaemia.

Learning points

- Multidisciplinary team (MDT) and cross-speciality working is essential to create optimal patient-centred care.
- Creative solutions and flexibility within feeding plans are needed to adjust to the constantly changing patient journey!
- Quality of life is so important in this patient cohort and should always be considered alongside the need for adequate nutrition.

In summary

Aside from the dietetic issues, there were several challenges to managing this patient. Due to rapid changes in medical management, biochemistry and nutrition, from a dietetic perspective, Patient A required daily monitoring and review. Very close liaison between oncology and renal teams, including dietitians, was paramount to ensure joint decision-making and management. For example, the usual dietetic management of an undernourished paediatric oncology patient is to ensure feeds are tolerated in context with the side effects of chemotherapy and are meeting elevated energy and protein requirements, rather than having to consider electrolyte restrictions from a renal perspective.

Moreover, the need to balance Patient A's quality of life with the need to optimise nutrition became apparent. This was especially relevant when his fluid restriction was reduced to 500 ml, as the aim was to allow a large proportion of his fluid allowance for drinks that he enjoyed, which meant concentrating his feeds into smaller volumes, risking gastrointestinal tolerance.

Table 2: Theoretical nutritional requirements

	Dietary Reference Values (DRV)[12]	Renal Nutrition Taskforce Suggested Dietary Intakes (SDI)[13]
Energy	EAR 3 yrs boy: 82 kcal/kg* = 1230 kcal	3 yrs boy: 80-82 kcal/kg = 1200-1230kcal
Protein	Pre dialysis – RNI 1-3 yrs: 14.5 g/day or 1.2 g/kg = 18 g On dialysis – RNI 1-3 yrs: 16 g/day or 1.3 g/kg = 19.5 g	Pre dialysis – 4-6 yrs: 0.85-0.95 g/kg = 12.8-14.3 g On dialysis – 4-6 yrs: 0.95-1.05 g/kg = 14.3-15.8 g

*calculated using estimated dry weight of 15 kg

Nutritional requirements: When Patient A started dialysis, an additional 0.1 g/kg was added to his protein requirements to account for protein losses via dialysis fluid.[1]

References: **1.** Brok J, *et al.* (2016). Biology and treatment of renal tumours in childhood. Eur J Cancer.; 68: 179-195. **2.** Spreafico F, *et al.* (2021). Wilms tumour. Nat Rev Dis Primers.; 7(1): 75. **3.** Children's Cancer and Leukaemia Group (CCLG). (2022). Wilms Tumour. Children's Cancer and Leukaemia Group (CCLG). Accessed online: www.cclg.org.uk/wilms-tumour (Nov 2024). **4.** Leila Qizalbash, Shelley Cleghorn, Louise McAlister. Kidney Diseases. In: Vanessa Shaw. (Ed). Clinical Paediatric Dietetics. 5th ed. London: John Wiley & Sons Ltd, 2020; 238-286. **5.** Kumar R, Tebben PJ, Thompson JR (2012). Vitamin D and the kidney. Arch Biochem Biophys.; 523(1): 77-86. **6.** CCLG: The Children & Young People's Cancer Association (2020). Clinical Management Guidelines Renal Tumours. Accessed online: www.cclg.org.uk/write/MediaUploads/Member%20area/Treatment%20guidelines/Umbrella_Clinical_Ma (Nov 2024). **7.** National Institute for Health and Care Excellence. (2018). Renal replacement therapy and conservative management NICE guideline [NG107]. Accessed online: www.nice.org.uk/guidance/ng107/chapter/Recommendations#indications-for-starting-dialysis (Jan 2025). **8.** Nehus E, Mitsnefes MM (2019). When to Initiate Dialysis in Children and Adolescents: Is Waiting Worthwhile? Am J Kidney Dis.; 73(6): 762-764. **9.** Zemaitis MR, Foris LA, Katta S, *et al.* Uremia. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025. **10.** Chiruvella V, Annamaraju P, Guddati AK (2020). Management of nephrotoxicity of chemotherapy and targeted agents: 2020. Am J Cancer Res.; 10(12): 4151-4164. **11.** Falcone MP, *et al.* (2022). Long-term kidney function in children with Wilms tumour and constitutional WT1 pathogenic variant. Pediatr Nephrol.; 37(4): 821-832. **12.** Great Ormond Street Hospital for Children NHS Trust. Nutritional Requirements in Health and Disease. 8th ed. London: Great Ormond Street Hospital for Children NHS Trust, 2022, 8-14. **13.** Shaw V, *et al.* (2020). Energy and protein requirements for children with CKD stages 2-5 and on dialysis-clinical practice recommendations from the Pediatric Renal Nutrition Taskforce. Pediatr Nephrol.; 35(3): 519-531. **14.** KDOQI Work Group (2009). KDOQI Clinical Practice Guideline for Nutrition in Children with CKD: 2008 update. Executive summary. Am J Kidney Dis.; 53(3 Suppl 2): S11-104. **15.** Nelms CL, *et al.* (2021). Assessment of nutritional status in children with kidney diseases-clinical practice recommendations from the Pediatric Renal Nutrition Taskforce. Pediatr Nephrol.; 36(4): 995-1010. **16.** Desloovere A, *et al.* (2021). The dietary management of potassium in children with CKD stages 2-5 and on dialysis-clinical practice recommendations from the Pediatric Renal Nutrition Taskforce. Pediatr Nephrol.; 36(6): 1331-1346. **17.** McAlister L, *et al.* (2020). The dietary management of calcium and phosphate in children with CKD stages 2-5 and on dialysis-clinical practice recommendation from the Pediatric Renal Nutrition Taskforce. Pediatr Nephrol.; 35(3): 501-518. **18.** Cancer Research UK. (2023). Carboplatin. Accessed online: www.cancerresearchuk.org/about-cancer/treatment/drugs/carboplatin (Nov 2024). **19.** Cancer Research UK. (2023). Etoposide (Etopophos). Accessed online: www.cancerresearchuk.org/about-cancer/treatment/drugs/etoposide (Nov 2024). **20.** Kestler SA, LoBiondo-Wood G (2012). Review of symptom experiences in children and adolescents 351 with cancer. Cancer Nursing. 2012;35(2):E31-E49.352 **21.** Wan M, *et al.* (2023). Gutted: constipation in children with chronic kidney disease and on dialysis. Pediatric Nephrology.; 38(11): 3581-3596. **22.** Morris A, O' Connor G, Renshaw G (2023). A Cross-sectional Survey to Review Food Safety Practices Within Pediatric Oncology and Stem Cell Transplant Centers in the United Kingdom. J Pediatr Hematol Oncol.; 45(4): e471-e478.

Figure 2: Timeline of events

	Time point 1: 27.09.24 Admitted for chemotherapy	Time point 2: 2.10.24 Nasogastric tube (NGT) inserted	Time point 3: 4.10.24 Dialysis commenced	Time point 4: 7.10.24	Time point 5: 9.10.24
Weight Estimated dry weight: ~15 kg (25th centile)	**Weight:** 17.3 kg (27.09.24) 50th-75th centile **Height:** 103 cm (25.09.24) 50th centile **MUAC:** 15.4 cm (13.09.24) 25th centile	**Weight:** 18.9 kg (1.10.24)	**Weight:** 17.5 kg (3.10.24)	**Weight:** 18.5 kg (7.10.24)	Nil new weight or height **MUAC:** 15 cm (9.10.24) (9th-25th centile)
Blood results Reference ranges: • Urea 2.5-6 mmol/L • Creatinine 23-37 umol/L • Potassium 3.5-5.5 mmol/L • Phosphate 1.20-1.80 mmol/L Red = high Blue = low	Urea 26.1 mmol/L Creatinine 345 umol/L Potassium 5.0 mmol/L Phosphate 2.63 mmol/L	Urea 44.9 mmol/L Creatinine 418 umol/L Potassium 4.3 mmol/L Phosphate 3.08 mmol/L	Urea 40.4 mmol/L Creatinine 411 umol/L Potassium 3.8 mmol/L Phosphate 2.79 mmol/L (obtained hours prior to starting dialysis)	Urea 30.4 mmol/L Creatinine 340 umol/L Potassium 3.4 mmol/L Phosphate 2.43 mmol/L	Urea 16.6 mmol/L Creatinine 216 umol/L Potassium 2.7 mmol/L Phosphate 1.64 mmol/L
Feed plan	Fluid restriction 1 L **Feed 1:** 15% carbohydrate module **Route:** Oral **Volume:** Aim for minimum 200 ml, can have more within allowance **Provides per day (200 ml):** 114 kcal, 0 g protein, 0 mmol potassium, 0 mg phosphate **Feed 2:** Fat emulsion **Route:** Oral **Volume:** aim for 10 ml x 3/day **Provides per day (30 ml):**135 kcal, 0 g protein, 0 mmol potassium, 0 mg phosphate Provides 20% of energy EAR, 0% of protein RNI	Fluid restriction 1 L NGT inserted due to poor oral intake on 30.9.24 **Feed:** Low potassium 2 kcal/ml feed **Route:** NGT **Volume:** 100 ml x 3-4/day **Provides per day (300-400 ml):** 600-800 kcal, 12-16 g protein, 2.7-3.6 mmol potassium, 105-140 mg phosphate Provides 49-65% of energy EAR, 67-110% of protein RNI	Fluid restriction 1 L **Feed:** 50% low potassium 2 kcal/ml feed + 50% paediatric 2.4 kcal/ml compact feed **Route:** NGT **Volume:** 100 ml x 3/day **Provides per day (300 ml):** 660 kcal, 15.9 g protein, 11.3 mmol potassium, 263 mg phosphate Provides 54% of energy EAR, 82-99% of protein RNI	Fluid restriction 500 ml **Feed:** 96% paediatric 2.4 kcal/ml compact feed + 2% carbohydrate module **Route:** NGT **Volume:** 100 ml x 3/day **Provides per day (300 ml):** 712 kcal, 19.3 g protein, 19.1 mmol potassium, 402 mg phosphate Provides 58% of energy EAR, 99-121% of protein RNI	Fluid restriction 500 ml **Feed:** 96% paediatric 2.4 kcal/ml compact feed + 5% carbohydrate module **Route:** NGT **Volume:** 100 ml x 3/day **Provides per day (300 ml):** 748 kcal, 19.3 g protein, 19.1 mmol potassium, 402 mg phosphate Provides 61% of energy EAR, 99-121% of protein RNI

Key: MUAC = mid-upper arm circumference; NGT = nasogastric tube; EAR = Estimated Average Requirements; RNI = Reference Nutrient Intake