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# Acute Dehydration in Nephrotic Syndrome: A Case Report

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## Abstract

The management of acutely dehydrated children with relapsed nephrotic syndrome (NS) can be challenging when edema and intravascular volume depletion are present simultaneously. In that condition the excess in body fluid, typically associated with NS, may be inappropriately low, with regard to albumin level, and the excess in fluid is not promptly shifted into the vascular bed because of the low plasma protein concentration. This peculiar condition exposes the child to a greater risk of acute kidney injury (AKI) particularly if albumin infusion is provided. Here in a case of dehydration in ongoing NS is described in order to highlight the danger of infusing albumin when dehydration coexists. The present case report provides a framework for discussing an unusual and preventable pathophysiological mechanism of AKI related to the inappropriate administration of albumin infusion.

## Keywords

Acute Kidney Failure, Nephrotic Syndrome, Dehydration, Albumin, Hemodialysis

## 1. Introduction

The management of acutely dehydrated children with relapsed nephrotic syndrome (NS) can pose special clinical problems and may be a therapeutic challenge for the physicians involved in the early treatment decisions. Indeed, it may seem unusual that an edematous child could require rehydration, but the paradox arises from the fact that the fluid excess in the extravascular system may be inappropriately low with respect to the level of albumin. This particular condition exposes the child to a greater risk of acute kidney injury (AKI), which is oth-

erwise a rare complication of idiopathic childhood NS [1]-[6].

The following case report describes the clinical course of a child with relapsed NS and associated dehydration, and provides a framework for discussing an unusual pathophysiological mechanism of AKI possibly related to albumin infusion.

## 2. Case Report

This 13-year-old Filipino girl with idiopathic steroid-dependent NS was admitted to our Pediatric Department because of vomiting, diarrhea, abdominal pain and oliguria. She was on steroid therapy, which had been increased two days before the hospitalization from 40 mg/m$^2$ of body surface area (bsa) every other day to 60 mg/m$^2$ daily because of NS relapse. On admission the clinical examination revealed puffy eyes and mild edema at the lower extremities; her weight was 38.5 kg (proteinuria-free baseline weight was 37 kg) and her blood pressure was normal (117/79 mmHg). Laboratory tests, performed on admission, showed an ongoing AKI with BUN of 40.7 mg/dL and sCr of 1.88 mg/dL, serum total proteins of 37 g/L, WBC of 37,600/mm$^3$ with high normal inflammatory indices (PCR 7 mg/dl), HCT was 54% and urinary protein (mg/dL)/urinary creatinine (mg/dL) ratio (uPr/uCr) was 14.3.

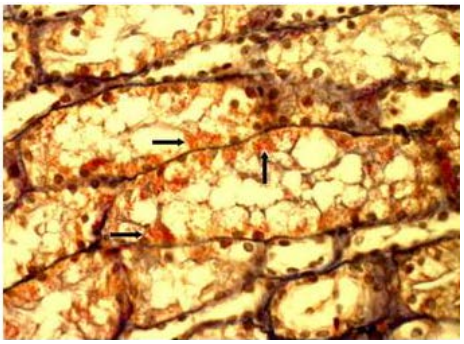
An i.v. infusion of albumin 20% (300 ml/24 h) was started immediately after admission while an infusion of saline 700 ml/24 hrs was added only five hours later; because of vomiting the incoming oral fluid in the first 24 hrs was below 500 ml. On the second day, severe oliguria was present (urine output 260 ml/24 h) and the patient's weight had increased to 39.7 kg. Renal function worsened (creatinine 2.78 mg/dl), urinary protein excretion increased (uPr/uCr up to 42), and hypertension developed (156/96 mmHg).

Albumin 20% (50 ml/24 h) was continued, and the oral intake and i.v. infusion of fluids were utterly restricted (total intake 950 ml/24 h). Dopamine 2.9 mcg/kg/min, i.v. furosemide 180 mg, and spironolactone 150 mg were added. Nevertheless, oliguria persisted and renal failure worsened (sCr 5.4 mg/dL on day 9); the girl became drowsy, and had severe headache and persistent hypertension (168/105 mmHg) requiring antihypertensive treatment (amlodipine 5 mg/24 h).

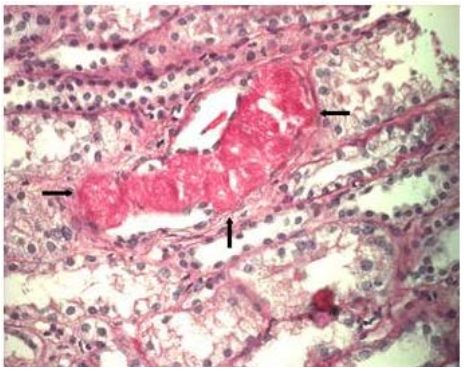
Microscopic urine examination showed severe isomorphous microhematuria and cylindruria, with a large number of tubular cells.

A renal biopsy performed at this time did not reveal any significant glomerular or vascular abnormality, but showed severe and diffuse damage of the tubular epithelium, with vacuolization, cytoplasmic protein microinclusions (**Figure 1(a)**), and the precipitation of several protein casts in the tubular lumina associated with tubular necrosis in some areas (**Figure 1(b)**).

The patient underwent two hemodialysis sessions on days 9 and 10, which were followed by a progressive increase in urine output (850 ml/24 h on day 13) and improved renal function (sCr 1.63 mg/dl on day 19). NS (uPr/uCr 25) with weight gain, generalized edema and ascites persisted. On day 20, i.v. pulse methylprednisolone 20 mg/kg/day was started and continued for three consecutive



(a)



(b)

**Figure 1.** Dilated tubular structures and severe vacuolation of epithelial cells cytoplasm due to protein resorption (a) and micrograph showing a normal glomerulus, dilated tubules lined by little epithelium or desquamation and necrosis of tubular cells, and the precipitation of protein casts in the lumina (b).

days, followed by oral prednisone 30 mg/m$^2$ bsa daily, without response; cyclophosphamide 2 mg/kg/day was therefore added on day 30 and continued for twelve weeks, at the end of which proteinuria (>1 g/24 hours) still persisted with normal renal function. The patient's urine was protein free on day 180, only after cyclosporine (5.5 mg/kg/day) has been introduced (day 120).

## 3. Discussion

The management of dehydration in patients with NS must consider some particular pathophysiological aspects of the underlying condition, including the serum albumin concentration and the amount of proteinuria. In normal subjects, the increased oncotic pressure related to acute dehydration and the consequent increase in plasma protein concentrations shift water from the interstitial compartment to the vascular bed in proportion to the absolute increase of plasma protein concentration. In a child with NS, an equal loss of water leads to a smaller increase in absolute plasma protein concentration and in oncotic pressure. The result of this altered pathophysiology is a reduced shift of water into the vascular system regardless of the excess fluid in the extravascular system. This implies that the hemodynamic condition of patients with ongoing NS is more precarious, thus making them a lot more susceptible to AKI [1] [2] [7] [8].

It may seem paradoxical to consider a child with edema and 1.5 kg of esti-

mated water excess (baseline weight was 37 kg) as being dehydrated. However, in our opinion, this overweight was disproportionately low with respect to the relatively low protein level (37 g/L) and the high amount of proteinuria (uPr/uCr 14.3).

The pathophysiology of AKI in NS patients can include one or more of the following mechanisms: low renal perfusion pressure in the case of severe hypoprotidemia, acute tubular necrosis, high intratubular pressure, interstitial nephritis and interstitial edema [1] [2] [3] [4] [5] [9].

It may seem reasonable to treat a dehydrated child with severe hypoprotidemia by administering albumin to mobilize the sequestered fluids thus avoiding to further increase the already existing water excess [10] [11] [12] [13]. It must be kept in mind that administered albumin will eventually lead to a massive increase in protein loss into the tubules [3] [14] [15]. The disproportion between hypoalbuminemia (NOT in nephrotic range) and protinuria (IN nephrotic range) should be considered an indicator of a possible dehydration and discourage the clinician to approach the child with NS recurrence and mild edema by administering albumin as the first line treatment. As already reported by Koomans *et al*. [16], in the dehydration and antidiuresis condition, a massive infusion of albumin may induce a very high tubular protein concentration, with tubular clogging and precipitation of protein casts in the tubules. This process may also be favored if acidosis and aciduria coexist as commonly observed in dehydrated children [17].

In our case, renal histology showed severe and diffuse tubular epithelial damage, likely attributable to the generous albumin infusion, without appropriate water administration, in the first hours after the patient hospitalization.

In conclusion, we suggest using albumin infusion with caution in dehydrated patients with relapsing NS; a more rational approach is perhaps to simply administer a saline solution, followed by albumin infusion only in case of severe generalized edema, but never the other way around.

## References

[1] Vande Walle, J., Mauel, R., Raes, A., *et al.* (2004) ARF in Children with Minimal Change Nephrotic Syndrome May Be Related to Functional Changes of Glomerular Basal Membrane. *American Journal of Kidney Diseases*, **43**, 399-404. https://doi.org/10.1053/j.ajkd.2003.10.039

[2] Harris, R.C. and Ismail, N. (1994) Extrarenal Complications of the Nephritic Syndrome. *American Journal of Kidney Diseases*, **23**, 477-497. https://doi.org/10.1016/S0272-6386(12)80369-6

[3] Venkataseshan, V.S., Faraggiana, T., Grishman, E., *et al.* (1993) Renal Failure Due to Tubular Obstruction by Large Protein Casts in Patients with Massive Proteinuria. *Clinical Nephrology*, **39**, 321-326.

[4] Agarwal, N., Phadke, K.D., Garg, I. and Alexander, P. (2003) Acute Renal Failure in Children with Idiopathic Nephrotic Syndrome. *Pediatric Nephrology*, **18**, 1289-1292. https://doi.org/10.1007/s00467-003-1259-1

[5] Rheault, M.N., Zhang, L., Selewski, D.T., *et al.* (2015) AKI in Children Hospitalized with Nephrotic Syndrome. *Clinical Journal of the American Society of Nephrology*,

**10**, 2110-2118. https://doi.org/10.2215/CJN.06620615

[6] Pstrusinska, K., Zwolinska, D. and Musial, K. (2000) Acute Renal Failure in Children with Idiopathic Nephrotic Syndrome. *Polski Merkuriusz Lekarski*, **8**, 462-464.

[7] Koomans, H.A. (2003) Pathophysiology of Oedema in Idiopathic Nephrotic Syndrome. *Nephrology Dialysis Transplantation*, **18**, vi30-vi32. https://doi.org/10.1093/ndt/gfg1063

[8] Yaseen, A., Tresa, V., Lanewala, A.A., Hashmi, S., *et al.* (2017). Acute Kidney Injury in Idiopathic Nephrotic Syndrome of Childhood Is a Major Risk Factor for the Development of Chronic Kidney Disease. *Renal Failure*, **39**, 323-327. https://doi.org/10.1080/0886022X.2016.1277743

[9] Lowestein, J., Schacht, R.G. and Baldwin, D.S. (1981) Renal Failure in Minimal Change Nephrotic Syndrome. *The American Journal of Medicine*, **70**, 227-233. https://doi.org/10.1016/0002-9343(81)90754-3

[10] Loghman, A.M., Siegler, R.L. and Pysher, T.J. (1997) Acute Renal Failure in Idiopathic Nephrotic Syndrome. *Clinical Nephrology*, **47**, 76-80.

[11] Sakemi, T., Uchida, M., Baba, N., *et al.* (1991) Renal Failure with Nephrotic Syndrome: Reversal with Large Doses of Furosemide. *Nippon Jinzo Gakkai Shi*, **33**, 59-64.

[12] Na, K.Y., Han, J.S., Kim, Y.S., *et al.* (2001) Does Albumin Preinfusion Potentiate Diuretic Action of Furosemide in Patients with Nephrotic Syndrome? *Journal of Korean Medical Science*, **16**, 448-454.

[13] Bircan, Z., Kervancioglu, M., Katar, S. and Vitrinel, A. (2001) Does Albumin and Furosemide Therapy Affect Plasma Volume in Nephrotic Children? *Pediatric Nephrology*, **16**, 497-499. https://doi.org/10.1007/s004670100576

[14] Guglielminotti, J. and Guidet, B. (1999) Acute Renal Failure in Rhabdomyolysis. *Minerva Anestesiologica*, **65**, 250-255.

[15] Zager, R.A. (1988) Precipitable Tissue Proteins Can Cause Experimental Acute Renal Failure. *Laboratory Investigation*, **59**, 798-808.

[16] Koomans, H.A. (2001) Pathophysiology of Acute Renal Failure in Idiopathic Nephrotic Syndrome. *Nephrology Dialysis Transplantation*, **16**, 221-224. https://doi.org/10.1093/ndt/16.2.221

[17] Bank, N. and Better, O.S. (1991) Acid-Base Balance and Acute Renal Failure. *Mineral and Electrolyte Metabolism*, **17**, 116-123.