Clinical Vignettes

Oral Rehydration Therapy and Feeding Replaces Total Parenteral Nutrition: A Clinical Vignette

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A 27-year-old patient with spina bifida and a high output loss of water and electrolytes from her ileostomy was successfully liberated from dependency on total parenteral nutrition and intravenous fluid and electrolyte replacement by the use of a rice-based oral rehydration therapy (ORT). This allowed her to return home to the care of her mother. We suggest that ORT can be effective in the context of modern high-technology settings, as well as in resource-poor situations.

KEY WORDS: oral rehydration therapy; total parenteral nutrition; ileostomy.
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INTRODUCTION

Total parenteral nutrition (TPN), introduced in the 1960s, made it possible to replace intestinal water and electrolyte losses and provide nutrients in patients with short bowel syndromes (SBS), as well as diarrheal diseases. There are, however, serious complications of TPN, including central line infections, which can be associated with sepsis, and increased hepatic enzymes.[1] In addition to the nutrients provided by TPN, supplemental intravenous fluids and electrolytes are often needed to replace intestinal fluid losses and recurrent volume depletion. When an alternative to supplemental intravenous replacement is necessary, oral rehydration therapy (ORT) may be substituted. It can replace both water and electrolyte losses more safely and conveniently in patients with short bowel syndromes.[2] At present, ORT is being underutilized in our modern high technology medicine delivery systems. We report a case of a young woman with an ileostomy who was able to transition off TPN to a combination of enteral feeding and a rice hydrolysate oral rehydration therapy (ORT) (Ceralyte)[3] as a less troublesome, safer, and inexpensive alternative to intravenous therapies, allowing her to go home in the care of her mother.

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CASE

SH was a 27-year-old woman with cerebral palsy, spina bifida, paraplegia, and chronic intestinal dysmotility with paralysis of her colon (Ogilvie's syndrome), which required a diverting colostomy in December 2008. A gastrostomy tube was also placed at that time due to inadequate oral intake, and it was used for nutrition. She presented to the emergency room in June 2010 with diarrhea that was followed by 3 days of severe constipation, abdominal pain, and bloody colostomy output. Her hospital course was complicated by a right spontaneous pneumothorax, gastrointestinal hemorrhage, ileus, *Clostridium difficile* colitis, staphylococcal septicemia, septic shock, and ascites. Her left colon became distended and ultimately perforated, which required a laparotomy and an emergent right hemicolectomy. Following that, an ileostomy was done on 28 July 2010. Gastrostomy tube feedings were held during her complicated hospital course and she was admitted to our service on TPN. These complications resulted in respiratory failure, which required a tracheostomy and ventilator support. She was eventually transferred to our long-term acute ventilator specialty hospital for weaning off the ventilator and further care on 26 August 2010. She required daily supplemental intravenous saline in addition to TPN to replace major ileal losses of water and electrolytes. Due to decreasing serum albumin and pre-albumin, TPN was continued (Table 1) to support her nutrition. Intravenous saline was required to replace large continuing volume losses from her ostomy.

Table 1 Composition of Ceralyte 70, Isotonic IV Saline and TPN

Ceralyte 70	
Sodium	70 mEq/L
Potassium	20 mEq/L
Chloride	60 mEq/L
Citrate	30 mEq/L
Osmolarity	< 220 mosm/L
Rice digest	40 g/L (160 k cal)
Normal isotonic saline	
Sodium	154 mEq/L
Chloride	154 mEq/L
Osmolarity	308 mosmoles
TPN	
TPN	3000 ml/24 hr.
Calories	1200 K/cal
Amino acid solution	500 ml
Fat emulsion	50 g/L

Osmolite and Perative formulations can be found in product information manual of Abbott Nutrition or online http://static.abbottnutrition.com/cmsprod/abbottnutrition.com/img/Perative.pdf

Table 2. Average Fluid Intake and Ileostomy Output per 24 h

	Before ORT (26 Aug 2010–29 Aug 2010)	Transition phase (30 Aug 2010–9 Sept 2010)	Exclusive ORT-Period I (10 Sept 2010–31 Oct 2010)*	Exclusive ORT- Period II (1 Nov 2010–5 Nov 2010) †
TPN/IVF‡ (ml)	4000	3000	0	0
Perative®§ (ml)	960	1000	1000	1200
ORT Ceralyte® (ml)	0	1500	1500	600
Osmolite® (ml)	0	0	600	1500
Ileostomy Output (ml)	3600	2100	900	1300

**An extra 500 ml of Ceralyte® was given to the patient on 16 September 2010 as she seemed dehydrated. During this period, the patient was also getting 1000 ml of water daily on average*
† During this period, the patient was getting 1000 ml of water daily on average
‡ IVF: Intravenous Fluid (Isotonic saline)
§ Perative® is a form of enteral nutrition

We attempted to reduce ileal losses using octreotide, but it was not effective. We did not use anti-motility medications, as they are marginally useful in enhancing absorption of water and electrolytes.[4] Feeding via the gastrostomy tube was begun and did not reduce salt and water losses, so it was stopped. There was no evidence of recurrence of C. difficile in her remaining ileum. She was weaned from the ventilator over a period of 2 weeks, and we initiated a rice-digest–based oral rehydration solution (Ceralyte® 70) (Table 1) through her gastrostomy tube to replace volume losses. ORT relies on the glucose-sodium carrier mediated transport system of the small intestine,[4] and allows effective absorption of water and electrolytes. Rice-based ORT is more effective than glucose based formulations; it diminishes salt and water losses as well as replaces them. The ORT allowed us to discontinue supplemental intravenous saline.

We then transitioned from TPN to Osmolite® 1 Cal through her gastrostomy tube. Seventy-two days after admission, she was discharged home in the care of her mother with no intravenous fluid requirements or intravenous lines. Her sacral wounds were healing, and her mother was taught that the amount of ORT required was best judged by her urine output, which was maintained at between 1 and 2 l daily. In this patient's case, the ORT (Ceralyte® 70) could be administered via her gastrostomy tube.

Table 2 shows the daily intake and ileostomy output of our patient. Introduction of ORT was associated with a decrease in ostomy output, even though her daily intake initially increased during the transition phase (30 August 2010 to 9 September 2010). The output then remained low during the subsequent follow-up periods. In addition to ORT and enteral feeding, she received 1000 ml of water daily while off the TPN to prevent hypernatremia, and this also served the function of flushing the gastrostomy tube to prevent clogging.

DISCUSSION

Oral Rehydration Therapy (ORT) is based on the coupled transport of sodium and glucose.[5] Even in high output diarrheas such as cholera, a positive fluid and electrolyte absorption can be achieved. In conscious patients who are able to drink, ORT is a safe substitute for an intravenous infusion, making it possible to avoid the complications of central lines with associated hazards of insertion and central-line–associated bloodstream infections (CLABSI). About ORT, *The Lancet* mentions, 'the discovery that sodium transport and glucose transport are coupled in the small intestine, so that glucose accelerates absorption of solute and water, was potentially the most important medical advance this century.'[6] During an epidemic of cholera during an exodus of refugees from Bangladesh to India, it was demonstrated that mortality rate due to dehydration was 3.6 % in the refugee camps that relied on ORT as compared to between 30 and 40 % where no such replacement was available.[7] Moreover, a randomized controlled trial at University of Pennsylvania comparing ORT with intravenous rehydration in moderately dehydrated children found no difference between the rehydration strategies.[8] Our case demonstrates that ORT can effectively replace water and electrolytes in patients with high output ostomy losses, just as it is known to do in those with diarrhea.

Long-term TPN leads to increased risk of pancreatic atrophy, gall stones, impaired renal and hepatic function, and is linked with overfeeding, hyperglycemia, sepsis, and intestinal atrophy.[1] ORT, on the other hand, can avoid the pain of needles, the complications of central line insertion and infections, and is less expensive. It can be administered by family members at home without any technical assistance. It is estimated that about $1 billon per annum can saved by implementation of ORT if it were used in the US healthcare system.[9] Furthermore, feeding or use of complex-carbohydrate–based ORT can reduce intestinal fluid losses, thereby diminishing the volume that is required to be replaced.[10,11] In our patient, the ileal losses were higher while the patient was solely on TPN, and diminished as ORT and tube feedings were started (Table 2). This observation corresponds with prior observations noted in studies that showed decreased stool output with the use of digestible-polymer–based ORT in people suffering from diarrheal diseases.[12] However, there are limitations to drawing conclusions from a single clinical vignette. It is possible that the underlying cause for the high ostomy output might have resolved spontaneously. The fact that this coincided with the introduction of ORT makes this unlikely. Therefore, there is a need to conduct well-designed prospective studies with

an adequate sample size to test the benefits of ORT in patients with high ostomy losses. We also acknowledge that some patients with severe vomiting and nausea might not be able to tolerate ORT, and aspiration can be a hazard.

Since WHO recommended ORT as a first-line therapy for mild to moderate dehydration,[13] it has been accepted and implemented globally. However, ORT as a substitute for intravenous water and electrolyte therapy has been neglected in high technology healthcare delivery settings. Literature from North America rarely focuses on the use of ORT, and this therapy is principally restricted to childhood diarrheal illnesses. Recently, ORT has been shown to have successfully replenished fluid/electrolyte losses in two groups of adult patients. Milner et al. demonstrated that in patients with moderate burn injuries, introduction of ORT substantially reduced the requirement of continuing IV fluid therapy.[14] Moreover, a case series showed that ORT was associated with early discontinuation of TPN and improved fluid absorption in patients with short bowel syndrome.[15] With the emergence of antibiotic resistant organisms, we are now increasingly aware of complications of central venous lines, namely infections or "CLABSIs." Further, the cost of hospital admissions or readmissions for "dehydration" or volume depletion is substantial. For these reasons, it would be wise to educate health workers and caregivers about how to use ORT as a safe early intervention that could reduce, if not avert, needless emergency room visits and hospital admissions.

Our case demonstrates that a transition from hospital to home and physicians/nurses to family/ caregivers can be accomplished with the substitution of ORT and feeding for TPN and intravenous therapies.

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Conflict of Interest: *W.B. Greenough, III, MD is a shareholder and scientific advisor for Cera Products, Inc., which produces Ceralyte®. All other authors declare that they do not have a conflict of interest.*

Ethics Statement: *ORT is a safer, less costly method for hydration that in many cases can substitute for intravenous fluid therapy.*

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REFERENCES

1. **Jeejeebhoy KN.** Total parenteral nutrition: potion or poison? Am J Clin Nutr. 2001;74:160–3.
2. **Atia AN, Buchman AL.** Oral rehydration solutions in non-cholera diarrhea: a review. Am J Gastroenterol. 2009;104:2596–2604. doi:10.1038/ajg.2009.329.
3. **Hirschhorn N, Greenough WB 3rd.** Progress in oral rehydration therapy. Sci Am. 1991;264:50–6.
4. **Newton CR.** Effect of codeine phosphate, Lomotil, and Isogel on ileostomy function. Gut. 1978;19:377–83.
5. **Schultz SG, Curran PF.** Coupled transport of sodium and organic solutes. Physiol Rev. 1970;59:637–718.
6. Water with sugar and salt. Lancet. 1978;2:300–301.
7. **Mahalanabis D, Choudhuri AB, Bagchi NG, Bhattacharya AK, Simpson TW.** Oral fluid therapy of cholera among Bangladesh refugees. Johns Hopkins Med J. 1973;132:197–205.
8. **Spandorfer PR, Alessandrini EA, Joffe MD, Localio R, Shaw KN.** Oral versus intravenous rehydration of moderately dehydrated children: a randomized, controlled trial. Pediatrics. 2005;115:295–301.
9. **Ladinsky M, Lehmann H, Santosham M.** The cost effectiveness of oral rehydration therapy for U.S. children with acute diarrhea. Med Interface. 1996;9:113–9.
10. **Hahn S, Kim Y, Garner P.** Reduced osmolarity oral rehydration solution for treating dehydration caused by acute diarrhea in children. Cochrane Database Syst Rev. 2002;1:CD002847. doi:10.1002/14651858.CD002847.
11. **Carpenter CC, Greenough WB, Pierce NF.** Oral-rehydration therapy—the role of polymeric substrates. N Engl J Med. 1988;319(20):1346–8.
12. **Gregorio GV, Gonzales ML, Dans LF, Martinez EG.** Polymer-based oral rehydration solution for treating acute watery diarrhoea. Cochrane Database Syst Rev. 2009;15:CD006519. doi:10.1002/14651858.CD006519.pub2.
13. **World Health Organization.** The Treatment of Diarrhea: A Manual for Physicians and Other Senior Health Workers. Geneva: World Health Organization; 1995. **WHO/CDD/SER/80.2 Rev. 3**.
14. **Milner SM, Greenough WB 3rd, Asuku ME, et al.** From cholera to burns: a role for oral rehydration therapy. J Health Popul Nutr. 2011;29:648–51.
15. **Nauth J, Chang CW, Mobarhan S, Sparks S, Borton M, Svoboda S.** A therapeutic approach to wean total parenteral nutrition in the management of short bowel syndrome: three cases using nocturnal enteral rehydration. Nutr Rev. 2004;62:221–31.