

High-output stoma after small-bowel resections for Crohn's disease

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SUMMARY

Background A 56-year-old Caucasian woman with a history of Crohn's disease and multiple bowel resections resulting in a loop jejunostomy was referred to our Nutritional Unit from a neighboring district general hospital for further management. She was first seen in October 2001, and initial assessment indicated that she was malnourished with fluid depletion, evidenced by the high volume of stomal fluid produced. There had been no sudden change in her medication, her Crohn's disease was quiescent and there was no evidence of any intra-abdominal sepsis. Despite a high calorific intake through her diet, she continued to lose weight.

Investigations Serum urea and electrolytes; magnesium; C-reactive protein; full blood count; urinary spot sodium; anthropometric measurements.

Diagnosis High-output stoma with malabsorption as a consequence of repeated small-bowel surgery.

Management The patient was treated with oral hypotonic fluid restriction (0.5 l/day), 2 l of oral glucose-saline solution per day, high-dose oral antimotility agents (loperamide and codeine phosphate), a proton-pump inhibitor (omeprazole) and oral magnesium replacement. A year later, the patient's loop jejunostomy was closed and an end ileostomy fashioned, bringing an additional 35 cm of small bowel into continuity; macronutrient absorption improved but her problem of dehydration was only slightly reduced. She was stabilized on a twice-weekly subcutaneous magnesium and saline infusion and daily oral 1 α -hydroxycholecalciferol.

KEYWORDS Crohn's disease, high-output stoma, jejunostomy, malnutrition, management

CME

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THE CASE

A 56-year-old Caucasian woman with problems of dehydration, hypomagnesemia and weight loss, due to a large stomal output (emptying bag 8–10 times/day), was referred to our Nutritional Unit from a neighboring district general hospital for further assessment in October 2001. She had undergone four operations for Crohn's disease over the preceding 25 years. The operations were a right hemicolectomy, two anastomotic resections and, 5 months prior to the consultation, a subtotal colectomy with ileorectal anastomosis and a defunctioning loop 'ileostomy' 120 cm from the duodenojejunal flexure. According to the treatment advice given several days before, she was taking loperamide (8 mg four times daily) to reduce her stomal output, and was having weekly intravenous magnesium replacement and Peptamen® (Nestlé Corporation, Switzerland) supplements.

At referral, the patient's BMI was 18.2 kg/m². She had lost 20.9% of her body weight since the colectomy and looked thin; she was assessed as grade B according to SUBJECTIVE GLOBAL ASSESSMENT.¹ Her blood pressure was 120/75 mmHg lying and 104/69 mmHg standing. Her stomal output was 1,900 ml/day while taking a normal diet (2,600 kcal/day) and about 2 l of hypotonic fluid. Routine laboratory investigation revealed an elevated serum urea and creatinine, and decreased serum magnesium (Table 1). Her random urine sodium was 10 mM.

A normal white-cell count, C-reactive protein, serum albumin and body temperature made sepsis unlikely. Endoscopic examination through her stoma showed quiescent Crohn's disease. The patient's dehydration, hypomagnesemia and undernutrition were attributed to having a relatively short length of remaining functioning small bowel. She was treated by restricting her intake of hypotonic fluid to 0.5 l daily and

Table 1 Results of the patient's blood chemistry compared with normal values.

Component	Patient's value	Normal values
Sodium	140 mM	133–144 mM
Potassium	3.4 mM	3.3–5.3 mM
Urea	11.2 mM	2.5–6.5 mM
Creatinine	121 μ M	60–120 μ M
Magnesium	0.61 mM	0.70–1.00 mM
C-reactive protein	<5 mg/l	0–10 mg/l

providing 2 l of GLUCOSE–SALINE SOLUTION/day, oral magnesium oxide tablets 12 mmol at night, omeprazole 40 mg once daily, continuation of loperamide at 8 mg four times daily, codeine phosphate 60 mg four times daily instead of cocodamol, and a high-calorie, high-protein diet, avoiding excessive fiber, with Peptamen® supplements.

The patient was reviewed 2 weeks later and had noticeable improvement in her stomal output (reduced and thickened) and hydration (no postural hypotension). Her BMI had increased to 19.9 kg/m². Over the course of next few months, however, her compliance with the hypotonic fluid restriction was a problem, and she frequently needed additional intravenous saline and magnesium (1 l every 2–4 weeks). Her BMI had decreased to 17.3 kg/m² in December 2001.

In order to improve her absorption of water, sodium and magnesium, the patient had further surgery 1 year later in our hospital. Her loop jejunostomy was closed and an end ileostomy fashioned giving her an additional 35 cm of small bowel. She had 7 days of supplemental parenteral nutrition preoperatively, followed by 3 months of nasogastric feeding with extra sodium chloride added to the feed postoperatively. Over the course of the next 12 months her BMI increased to 20.9 kg/m², but she still had fluid depletion and hypomagnesemia despite taking 24 mmol/day of magnesium oxide. She was commenced on twice-weekly home subcutaneous saline (1 l) and magnesium (4 mM) infusion, together with the addition of oral 1 α -hydroxycholecalciferol (500 ng/day). On this regimen she maintained her hydration and serum magnesium levels.

DISCUSSION OF DIAGNOSIS

Patients with jejunostomy after extensive small-bowel resection have major problems

with water, sodium and magnesium depletion. They rapidly become dehydrated if appropriate treatment is not given. These patients are often labeled as having 'ileostomy diarrhea'. The situation is the same for a patient with a high enterocutaneous fistula without abdominal sepsis. The problems of fluid balance dominate the clinical situation and must be addressed immediately. The clinical manifestation after an intestinal resection depends upon the remaining length of small bowel rather than the length removed. In the present case, the patient's dehydration, hypomagnesemia and weight loss were due to a high-output stoma and malabsorption following small-bowel resections for Crohn's disease.

High-output stoma

Normally, in a healthy adult, about 4 l of intestinal secretions (0.5 l saliva, 2 l gastric acid and 1.5 l pancreaticobiliary secretions) are produced in response to food and drink each day. Some of these secretions will be lost if there is a high-output jejunostomy. Even in the fasting state there is an obligatory loss of intestinal secretions associated with the MIGRATING MYOELECTRIC COMPLEX. Stomal output can be further increased by gastric-acid hypersecretion and rapid liquid gastric emptying due to a lack of negative feedback from PEPTIDE YY.²

The jejunal mucosa is unable to concentrate the luminal contents and sodium diffuses freely into the lumen through leaky intercellular junctions. The concentration of sodium in jejunostomy fluid is about 100 mM (range 90–140 mM). Hypomagnesemia occurs in approximately 60% of patients as a result of secondary hyperaldosteronism (sodium absorbed in a renal tubule in exchange for magnesium and potassium),³ loss of magnesium-absorbing gut (ileum and colon) and unabsorbed fatty acids binding free magnesium.

GLOSSARY

SUBJECTIVE GLOBAL ASSESSMENT

Assessment of a patient's nutritional status which involves details of medical history and physical examination results

GLUCOSE–SALINE SOLUTION

A solution of 3.5 g sodium chloride, 2.9 g sodium bicarbonate or sodium citrate, 20 g glucose and 1 l water; gives a 90 mM sodium concentration

MIGRATING MYOELECTRIC COMPLEX

Waves of depolarization moving at regular frequency from stomach to ileocecal valve during the interdigestive period; cleanse the bowel of secretions

PEPTIDE YY

Peptide distributed throughout the distal small and large intestine; thought to act as an ileal and colonic brake to slow bowel transit

Potassium problems are unusual and a net loss occurs only if <50 cm of jejunum is present.⁴ Hypokalemia was not present in our patient and usually results from urinary loss caused by secondary aldosteronism, and/or dysfunction of the Na/K-ATPase pump in the kidney which is caused by hypomagnesemia.

Undernutrition

Because of the reduction in the length and absorptive surface of the small bowel, jejunostomy patients suffer from malabsorption and are often malnourished. This patient's estimated requirements to maintain weight were only 1,660 kcal/day (Schofield equation⁵); she was taking 2,600 kcal/day, yet she was still losing weight. In general, parenteral nutrition is needed when less than 35% of the diet is absorbed (<75 cm jejunum remaining).

DIFFERENTIAL DIAGNOSIS

Other causes of a high stomal output should always be considered, including partial or intermittent obstruction, abdominal sepsis, recurrent disease, drug withdrawal or administration, and enteritis.

Partial/intermittent obstruction

When an episode of small-bowel obstruction is resolving, a patient's stomal output can increase. Such obstruction or adhesions can be caused by Crohn's disease, but were considered unlikely in our patient because of her lack of history of colicky abdominal pain.

Abdominal sepsis

Crohn's disease patients are frequently on corticosteroids and immunosuppressants, and are thus prone to sepsis and infection, which are common reasons for a temporary high stomal output. Because of the duration of the patient's problems and the lack of abdominal symptoms, the diagnosis of sepsis was unlikely in our patient.

Active Crohn's disease

Active Crohn's disease can increase stomal output; however, there was no evidence of this clinically, hematologically, biochemically or at ileoscopy in our patient.

Drug withdrawal or administration

Abruptly stopping opiate (e.g. codeine phosphate) or corticosteroid treatment can increase stomal

output, as can administration of a prokinetic agent (e.g. metoclopramide or erythromycin). The patient had not been withdrawn from opiates or corticosteroids or administered a prokinetic agent—this diagnosis was therefore excluded.

Enteritis

Enteritis can cause high stomal output; however, in this patient, stool cultures and tests for *Clostridium difficile* toxin were negative.

Other

An internal fistula can rarely cause a high stomal output and can be detected by means of a contrast examination.

TREATMENT AND MANAGEMENT

Clinical assessment

To detect dehydration, patients should be asked if they are thirsty or feel dry. Examination looks for dry mucous membrane, reduced skin turgor, postural systolic hypotension, a rapid fall in body weight and a reduction in urine volume. Levels of serum urea and creatinine might be raised, and magnesium levels low. A random urinary sodium concentration of <10 mM is a good indicator of sodium depletion. In general, a stomal output >2 l/day is likely to result in dehydration, and sodium and magnesium depletion.

Knowledge of the remaining small-bowel length can be used to predict the clinical outcome. This measurement is either done at surgery or from a small-bowel meal film using an opisometer.⁶ In general, patients with a jejunostomy and less than 100 cm of remaining functioning small bowel are likely to need parenteral nutrition. For those with 100–200 cm, often an oral glucose–saline solution and nutrient drinks will suffice. Our patient's initial small-bowel length to the loop jejunostomy was 120 cm.

Monitoring during treatment includes daily measurement of body weight, fluid balance (including stomal effluent) and postural blood pressure. Serum magnesium, urea and creatinine levels and weekly random urinary sodium levels are the most important measures. The aim is to keep the urinary sodium concentration >20 mM and daily urinary volume >800 ml.

Nutritional assessment

Current body weight and height, and usual weight in health, allow BMI and percentage weight loss to be calculated. Subjective global

assessment is a more detailed initial assessment when a patient's history, symptoms and physical parameters are included. Anthropometric measurements are useful and provide a measure of muscle mass; however, these measurements are prone to interobserver variability.

Treatment

Restrict oral fluids

It is a misconception that patients with high stomal output can quench their thirst by drinking large volumes of hypotonic solution (e.g. tea, coffee and fruit juice). As the jejunal mucosa is 'leaky', when a solution <90 mM is drunk, there will be a net efflux of sodium from serum into the bowel lumen. This process continues until the luminal sodium concentration reaches 90–100 mM. As more hypotonic fluid enters the jejunum, sodium and water losses through the stoma are greater.

For such patients it is often quicker and simpler to keep them 'nil by mouth' for 24 h, giving intravenous saline to reduce the stomal output and correct the dehydration. The next step is to restrict oral hypotonic fluids to <500 ml daily. The rest of the fluid requirement is made up of glucose–saline solution.⁷

Glucose–saline solution

Sodium absorption in the jejunum is coupled with glucose absorption; therefore, patients are advised to sip 1 l or more of a glucose–saline solution (sodium concentration 90–120 mM) throughout the day.⁸ In this case the patient was encouraged to drink 2 l of glucose–saline solution daily.

Antimotility drugs

Loperamide before meals, even at high doses, is preferred to codeine phosphate as it is nonaddictive, nonsedative and does not impair pancreaticobiliary secretions. Both are effective in reducing the weight and sodium content of the ileostomy output by 20–30%.⁹ Because of the degree of our patient's stomal output, both loperamide and codeine phosphate were used in combination. Cocodamol should not be used because it contains inadequate amounts of codeine and was thus discontinued in our patient.

Antisecretory drugs

Antisecretory drugs can cause a marked reduction (0.5–2.0 l/day) in stomal output in NET SECRETOR patients. The proton-pump inhibitor omeprazole

at 40 mg/day is as effective as intravenous octreotide 50 µg twice daily, providing the patient has at least 50 cm of jejunum.¹⁰

Magnesium supplements

The correction of sodium depletion can be the single most important factor in treating hypomagnesemia. Oral magnesium oxide can be given to a total of 12–24 mmol/day and does not appear to increase stomal output. This treatment is taken at night when intestinal transit is at its slowest, allowing more time for absorption. The patient took 12 mmol oral magnesium oxide at night.

Oral 1α-hydroxycholecalciferol can be given to increase both intestinal absorption (directly) and renal absorption (indirectly via parathyroid hormone) of magnesium. The dose of 0.25–9 µg daily is gradually increased (every 2–4 weeks at 0.25 µg increments) while ensuring that hypercalcemia does not occur.¹¹ Some patients might need regular intravenous or subcutaneous saline and magnesium infusions.

Nutritional requirements

Specific dietary restrictions in jejunostomy patients haven't been shown to be of benefit; such patients need a large oral energy intake of a polymeric, iso-osmolar diet that is relatively high in fat and with added salt. Hyperphagia is encouraged to compensate for malabsorption. Additional oral sip-feed can be given. The osmolality of any feed is kept low (300 mOsm/kg) by using large molecules such as polysaccharides, protein and triglycerides, and extra sodium is added to give a concentration of 90–120 mM.^{12,13} In patients with Crohn's disease, if obstructive symptoms are present, a low-residue diet is recommended. Peptamen® was chosen in this case mainly because of its low osmolality, which shouldn't worsen fluid and sodium loss through the stoma. Our patient supplemented her diet with four cartons of Peptamen® per day (giving 800 kcal).

Surgical treatment

Despite adequate medical and nutritional therapy, our patient remained undernourished, and suffered from frequent fluid depletion and persistent hypomagnesemia. Her last operation was to close the loop jejunostomy and bring back an extra 35 cm of small bowel in the hope that it will increase absorption. She improved nutritionally but still remains dependent on regular subcutaneous saline and magnesium infusions.

GLOSSARY

NET SECRETOR

A patient losing more water and sodium from their stoma than is taken in by mouth; such patients tend to have <100 cm of residual jejunum

GLOSSARY

GLUCAGON-LIKE PEPTIDE 2

An enterocyte-specific growth hormone with a distribution similar to Peptide YY that causes small-bowel and large-bowel villi or crypts to grow in mice

Competing interests

The authors declared they have no competing interests.

In some specialized centers, surgical procedures that slow intestinal transit have been successful. One example is the construction of antiperistaltic segments (about 10 cm of small bowel is reversed), which act as 'physiologic valves' by causing retrograde peristalsis and disrupting the motility of proximal intestine. This technique has been reported to result in improvement in up to 80% of patients.¹⁴ In some centers reconstructive surgery to lengthen the small bowel has been performed in children whereby the dilated remaining small bowel (diameter >4 cm) is divided longitudinally and anastomosed end to end.

Future therapies

There is no evidence of structural or functional adaptation in patients with jejunostomy. GLUCAGON-LIKE PEPTIDE 2, a trophic growth factor, stimulates mucosal proliferation and is found at low levels in jejunostomy patients. When this molecule or an analog are injected daily into such patients, an increase in mucosal growth, in energy absorption (by 3.5%) and in body weight (of 1.2 kg) have been observed over a 35-day period, as well as an 11% reduction in stool weight.¹⁵ Growth hormone is licensed for use in patients with short bowel in the US; however, the data from randomized double-blind placebo controlled trials are conflicting.

CONCLUSION

Patients who have a high-output stoma following bowel resections for Crohn's disease have problems of water, sodium and magnesium depletion. The aim of treatment is to reduce stomal output and provide water, sodium and magnesium replacement.

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