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Case Report

CASE REPORT

Repair of gastrocutaneous fistula utilizing thickened fluids: application of Poiseuille's Law to fistula healing

Simon P. Batterham*

The Maitland Hospital, 560 High St, Maitland, New South Wales 2320, Australia

*Correspondence address. The Maitland Hospital, 560 High St, Maitland, New South Wales 2320, Australia. Tel: +61-45-151-1203; E-mail: sbat1295@gmail.com

Abstract

Enterocutaneous fistulas are a rare occurrence after placement of a PEG tube. The key risk factor for their development is the time the PEG tube is *in situ*, giving time for the fistula tract to mature. Enterocutaneous fistulae are traditionally treated with parenteral nutrition or surgical management. We present a case of a 69-year-old woman who underwent surgical closure of an enterocutaneous fistula with a fibrin plug. The fistula recurred on post-operative Day 5, and the patient was placed on thickened fluids to increase the viscosity of the fluid exiting the fistula tract. This approach decreased the output and lead to subsequent closure of the fistula by outpatient follow up at 4 weeks. This case demonstrates an application of Poiseuille's law to closure of fistula tracts.

INTRODUCTION

Gastrostomy, as a method of providing nutrition or decompressing the stomach, was first performed by Sedillot in 1849 (with the patient dying of peritonitis shortly thereafter) [1]. Many surgeons tried to perfect the technique over the next 25 years, but it was not until 1875 did a patient survive the post-operative period. Gastrostomy continued to be performed in an open surgical manner until the first percutaneous endoscopic gastrostomy was performed in 1979, by Gauderer and Ponsky [2], as a method for providing nutrition to infants who were not able to feed secondary to neurological impairment.

Gastrocutaneous fistulas are a rare complication of PEG tube placement, occurring in ~1% [3] of those with a long-term PEG tube. The main risk factor for development of gastrocutaneous fistulas in this population is time, specifically if the tube had been *in-situ* for great than eight months. It should be noted however, that these figures are in the paediatric population, and minimal figures for incidence in the adult population exist, and thus, much less data exists for their management.

The general approach to closure of gastrocutaneous fistulas is to minimize fluid flow through the fistula. This is generally achieved using parenteral nutrition, though consideration may be made to enteral feeding if a tube can be passed distal to the fistula site. This method has been shown to lead to healing of fistulas of the gastrointestinal tract in 61%, and this generally occurs within 4–5 weeks [4].

Surgical closure is necessary when there is no reduction of output of the fistula. Surgical approaches are varied and can be as simple as application of fibrin glue to the inner orifice of the fistula [5]. Other techniques described are endoscopic clip placement and implantation of fibrogenic matrix materials to prompt healing [6].

CASE REPORT

A 69-year-old woman presented for elective repair of a gastrocutaneous fistula, occurring after long-term placement of a PEG tube. Of note, this patient was on a regimen of Mycophenolate,

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Prednisone and Tacrolimus, secondary to renal transplantation. The PEG tube was removed 6 months prior but failed to close spontaneously. Making the patient nil per oral was not trialled, due to a combination of patient and surgeon preference, and difficulties with obtaining appropriate formulations of anti-rejection medications. A fistulectomy was performed at the level of the facia, and the mucosa of the stomach was closed with a purse string. A fibrin plug was placed on the serosa of the stomach and was sutured in place. The overlying facia was closed with a mayo technique.

The patient was admitted to the ward, with a nasogastric tube *in-situ* for 5 days whilst being kept nil by mouth, to reduce burden of gastric contents on the healing repair, with exceptions made for medications. Medications were administered via the nasogastric tube, which was spigotted for 2 h post administration to prevent suction of immunosuppressive medication. Tacrolimus and mycophenolate levels where taken to ensure adequate absorption of these medications.

On Day 5 post operatively, the patient developed fluctuant mass lateral to the wound site. A CT abdomen was performed which noted contrast and gas locules in the subcutaneous tissues of the anterior abdominal wall, consistent with patent fistula. Soon afterwards, the wound began discharging gastric contents.

Decision was made to trial the patient on psyllium husk to thicken the gastric output, to reduce volume of fluid flow through the now patent fistula. A stoma bag was placed over the site to monitor output.

The output from the site slowly decreased on this regimen. Diet was gradually increased as tolerated by patient and by fistula outputs. The patient was discharged home on Day 19 post operatively, with <300mL of output from the fistula, with a normal diet. On outpatient follow up 4 weeks later, there was no output nor any clinical signs of abdominal wall collection

DISCUSSION

Gastrocutaneous fistulas are difficult to manage. Gastric juices and slow gastric transport time hardly provide an ideal environment for wound healing. In the above patient, an immunosuppressive regime further impaired this healing. Immunocompromised patients are well known to be at risk of infections [7–9], and this puts them at an increased risk of surgical site infections. Additionally, it is known that in patient taking glucocorticoids, wound healing is impaired, potentially leading to long, complex post-operative courses. The trade-off here is the risk of major side effects if the immunosuppression is ceased, such as disease flares, acute transplant rejection etc.

Non-surgical approaches to involve either intravenous or distal enteral feeding with the aim of decreasing volume of flow through the fistula. It should be noted that ~1000 mL of saliva is swallowed, as well as 1500 mL of stomach acid is produced, both passing through the stomach. These amounts will be lessened when fasting, but this still represents a large volume of thin fluid which could potentially pass through the fistula.

The above case represents an application of Poiseuille's law to fistula healing. Poiseuille's law describe the resistance to fluid flow through a tube, traditionally in medicine applied to blood vessels, but not expressly so. It states that the vessel resistance is proportional to the length of the vessel and the viscosity of the blood, and it is inversely proportional to the radius to the fourth power. It is often simplified as:

$$R \propto \frac{nL}{r^4}$$

where R is the resistance, n is the viscosity, L is the length of the pipe and r denotes the radius.

As we are not able to modify the length, and the reduction of radius is the goal of therapy, viscosity of fluid is the only variable we are able to control. Thickening of the fluids with psyllium husk increases the volume of fluid in the stomach, however, we can see above that the resistance to flowing through the relatively narrow fistula tract will be reduced, and that fluid will be far more likely to flow through the diametrically larger pylorus.

CONFLICT OF INTEREST STATEMENT

None declared.

REFERENCES

1. Baehr F H., Frehling S. The Spivack gastrostomy. *N Engl J Med* 1938;**219**:305–9. September 1, 1938.
2. Gauderer MW, Ponsky JL, Izant RJ. Gastrostomy without laparotomy: a percutaneous endoscopic technique. *J Pediatr Surg* 1980;**15**:872–5.
3. Shellito PC, Malt RA. Tube gastrostomy. Techniques and complications. *Ann Surg* 1985;**201**:180–5.
4. Rose D, Yarborough MF, Canizaro PC, Lowry SF. One hundred and fourteen fistulas of the gastrointestinal tract treated with total parenteral nutrition. *Surg Gynecol Obstet* 1986;**163**: 345–50.
5. Papavramidis TS, Kotzampassi K, Kotidis E, Eleftheriadis EE, Papavramidis ST. Endoscopic fibrin sealing of gastrocutaneous fistulas after sleeve gastrectomy and biliopancreatic diversion with duodenal switch. *J Gastroenterol Hepatol* 2008; **23**:1802–5.
6. Maluf-Filho F, Hondo F, Halwan B, de Lima MS, Giordano-Nappi JH, Sakai P. Endoscopic treatment of Roux-en-Y gastric bypass-related gastrocutaneous fistulas using a novel biomaterial. *Surg Endosc* 2009;**23**:1541–5.
7. Stuck AE, Minder CE, Frey FJ. Risk of infectious complications in patients taking glucocorticosteroids. *Rev Infect Dis* 1989;**11**: 954.
8. Dean PG, Lund WJ, Larson TS, Prieto M, Nyberg SL, Ishitani MB, et al. Wound-healing complications after kidney transplantation: a prospective, randomized comparison of sirolimus and tacrolimus. *Transplantation* 2004;**77**:1555.
9. Bardaxoglou E, Maddern G, Ruso L, Siriser F, Campion JP, Le Pogamp P, et al. Gastrointestinal surgical emergencies following kidney transplantation. *Transpl Int* 1993;**6**:148.