Enterocutaneous fistulas are not a minor problem in gastrointestinal tract surgery. Significant reductions of mortality and morbidity have been attained but they still remain high. We reported 16 clinical cases of iatrogenic enterocutaneous fistulas in which 14 were successfully treated by injecting cyanoacrylate glue into the fistulous tracts. We believe that the method we use may play a role in the management of iatrogenic enterocutaneous fistulas.

Key words: Fistula, therapeutic embolization; Fistula, gastrointestinal tract; Iatrogenic; Cyanoacrylate glue

Enterocutaneous fistulas are a common problem in GI tract surgery, causing considerable mortality and morbidity with inherent human and economic costs. Prevention should be the first priority, but even in optimal circumstances these complications can still occur. Over the last few decades, management of this problem has been conservative that relies mainly on nutritional support and control of sepsis. Immediate re-operation is no longer advised although surgery still plays a major role either as an adjuvant measure or as a definite therapeutics. Mortality and morbidity have been noticeably reduced but complications and mortality rates are still high enough to be concerned with. The author deals these complications with surgical glue (N-Butyl-2-Cyanoacrylate) injected through a catheter placed into the internal opening and fistulous tract to achieve complete occlusion of the enterocutaneous tract.

MATERIAL AND METHOD

The 16 cases presented here, though with different underlying causes (Table 1), all have an iatrogenic (post operative) enterocutaneous fistula. All 16 patients, 14 with enterocutaneous fistulas and 2 with gastrocutaneous fistulas, were operated in our institution. Reoperation was not considered as the treatment of choice due to various reasons. The conservative approach, despite the absence of sepsis and nutritional support provided, seemed to fail after a reasonable time had elapsed. As there was no easy and effective solution for these patients, we were called upon to deal with this condition.

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<th>Underlining cause of the enterocutaneous fistulas</th>
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<td>Pancreatitis</td>
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<td>Gastric carcinoma</td>
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<td>Biliary stone</td>
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<td>Gastric ulcer</td>
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<td>Gastric ulcer with perforation</td>
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<td>Cervical carcinoma</td>
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All the embolization procedures were performed under fluoroscopic guidance (Integris V5000, Philips). The fistulous tract was first identified using hydrophilic catheter (Cobra Visceral, Cook) (Fig. 1a). Mixture of surgical glue (N-Butyl-2-Cyanoacrylate, B-Braun) with oily contrast media (Lipiodol Ultra-Fluid, Guerbet) for radiopacity, was injected into the opening and fistulous tract while slowly withdrawing the catheter (Fig. 1b). The ratio of surgical glue to lipiodol is usually 1:1, but varies depending on the caliber of the fistulous tract. The catheter was irrigated with 5% glucose water before injection of surgical glue to prevent solidification of glue within the catheter.

Fistulous tracts with multiple communications were carefully identified (Fig 2a) and embolized one by one (Fig. 2b).

**RESULT**

Fourteen patients were successfully treated with surgical glue embolization. There were 2 failures. Ten of the 14 patients were successfully treated in one session and 4 patients in multiple sessions due to recanalization of the fistulous tract.

For simple and uncomplicated enterocutaneous fistulas, 0.5-1ml of cyanoacrylate was used to achieve therapeutic result (Fig. 1). When dealing with larger fistulous tract (Fig. 3a, 3b), increased dosage of cyanoacrylate glue was used to achieve therapeutic result (Fig. 3c).

One patient with the gastroenterocutaneous fistulous tract underwent three sessions of embolization. In the first two sessions, cutaneous approach was performed and recurrent discharge from the cutaneous

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**Figure 1.** 76Y/O male patient underwent partial gastrectomy due to gastric cancer. a. Fistulogram revealed a gastrocutaneous fistula. b. Cyanoacrylate glue in the fistulous tract.

**Figure 2.** 23Y/O male patient underwent debridement due to acute pancreatitis with post surgical duodenocutaneous fistula. a. Fistulogram reveal multiple drainage catheter insertions. b. Each fistulous tract was embolized one by one.
opening was noted indicating recanalization of the fistulous tract (Fig. 4a). The cause of recanalization was due to rapid flow of gastric content from the inner opening of the fistulous tract that washed away the glue before it was casted. In the third session, a guiding wire was inserted into the stomach through

**Figure 3.** 69Y/O female patient with gastric ulcer post surgical status with post surgical gastrocutaneous and colocutaneous fistula. a. Fistulogram revealed enterocutaneous fistula involving duodenum. b. Fistulogram also revealed enterocutaneous fistula involving colon. c. Cyanoacrylate glue in the fistulous tract.

**Figure 4.** 42Y/O female patient suffered abdominal trauma involving stomach post surgical status with gastrocutaneous fistula. a. Fistulogram revealed gastrocutaneous fistula. b. A biliary stone basket inserted through the fistulous tract (arrow) to retrieve guiding wire (arrow head). c. Post embolization radiograph revealed retention of cyanoacrylate glue in fistulous tract.
naso-gastric approach. A biliary stone basket (Meditech, Boston Scientific) was inserted into the stomach through the fistulous tract from the cutaneous approach to retrieve the guiding wire (Fig. 4b). The guiding wire was then pulled into and through the fistulous tract to the cutaneous opening. Embolization of the fistulous tract was performed through nasogastric and cutaneous approach and permanent occlusion of the fistulous tract was achieved (Fig. 4c).

There was one case in which recanalization was iatrogenically induced during post-embolization follow up fistulogram. Excessive pressure exerted onto the contrast media filled syringe caused dislodgement of the casted glue from the fistulous tract. Repeated embolization was performed and complete occlusion was achieved.

One patient was diagnosed of duodenal and colonic cutaneous fistulous tract by fistulogram and two embolization procedures were performed to occlude them.

In the failure group, one patient with duodenocutaneous fistula (Fig. 5a) underwent four embolization procedures and recanalization persisted (Fig. 5b, 5c). The causes of failure are due to large caliber of the inner opening and the fistulous tract. The cause of failure in the other patient was due to insufficient length of the fistulous tract for the glue to adhere. Surgical intervention was performed on both patients to resolve this problem.

Adhesion of the hydrophilic catheter to the cutaneous opening of the fistulous tract at the end of embolization had occurred in our earlier cases. There was no post-procedural complication.

**DISCUSSION**

Gastrointestinal fistulas continue to carry a high mortality rate (6-20%) despite the advances in parasurgical care, nutritional support, antibiotics, and intensive care [1]. Human and economic costs are high. Formerly, most fistulas were spontaneous in nature and were due to carcinoma, inflammatory or infectious disease, ischemia and irradiation [2-5]. Present-day, most fistulas are iatrogenic (postoperative), and according to various authors they represent 75% to 85% of all cases [6-9]. In a classic paper published in 1960, Welch and coworkers [10] identified sepsis, electrolyte disturbance and malnutrition as the three major causes of death in patients with fistulas. Since then, attention has been focused on the correction of these adverse factors. Total parenteral nutrition (TPN) and care improvement in ICU were the major contributions in the management of this fearsome complication. In ideal conditions with TPN and proper controls of sepsis, only 50% of the iatrogenic enterocutaneous fistulas eventually heal [1]. Re-operation is now

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**Figure 5.** 80Y/O male patient underwent cholecystectomy due to gall stone impaction. a. Fistulogram revealed duodenocutaneous fistula. b. Fistulogram after second embolization revealed recanalization of the fistulous tract. c. Recanalization of the fistulous tract after fourth embolization procedure.
indicated, either as a complementary procedure (abscess drainage) or as the definitive solution if the conservative approach has failed but has still created optimal metabolic and nutritional conditions. Standard approaches are frequently not viable and often failing, requiring expensive and complex health care during the hospital stay, leaving the patient to worsen and die and causing intense suffering for the patient and his family. Medical and nursing staffs experience considerable stress. It is therefore necessary to find better solutions for this difficult problem.

Cyanoacrylate derivatives, first synthesized by Ardis in 1949, have been successfully employed in industry and everyday life for their good adhesive properties, and have attracted medical and surgical interest as far back as the early 1960s.

Starting from basic cyanoacrylate, several varieties can be prepared by altering the alkoxy carbonyl group of the molecule. Cyanoacrylate is synthesized by reacting formaldehyde with alkyl cyanoacetate to obtain a prepolymer that immediately polymerizes with an exothermic reaction in a weak alkaline medium such as the extracellular space. As it changes from liquid to solid state, it achieves a strong bond with tissues, which decreases as the length of the alkyl side chain increases [11, 12].

The median lethal dose for butyl and isobutyl cyanoacrylate was determined in rats as 230 mg/kg and 196 mg/kg, respectively, and these values are considered to be more than safe for clinical employment [13]. Further more, various tests carried out in vitro and in vivo have failed to detect any carcinogenic properties of these tissue adhesives [13], and extensive clinical experience over more than 30 years with no report of the development of a malignancy allow us to regard them not carcinogenic [14, 15].

Polymerization time of N-butyl-2-cyanoacrylate can be controlled, allowing good control and handling of the product. Polymerization time is adjustable by adding lipiodol, which ranges from 0.2 to 5 seconds [16].

A potential complication of the endovascular use of glue has always been the possibility of permanently gluing a delivery catheter into the vessel being embolized [17]. This is also true when embolizing an enterocutaneous fistula. With careful attention to the details, this complication can be largely avoided by stopping the embolization and withdrawing the catheter when the polymerizing glue approaches the catheter tip. The advent of hydrophilically coated microcatheters has suggested that the risk of permanent catheter adhesion during embolization might be decreased [16].

Inadequate amount of cyanoacrylate may cause recanalization of the fistulous tract. For simple and uncomplicated fistulous tract, 0.5-1 ml of cyanoacrylate glue is sufficient. Increased dosage may be needed for larger fistulous tract. Cyanoacrylate glue may not be effective when dealing enterocutaneous fistulous tracts with complex channeling or communications.

In conclusion, our findings provide evidence that n-butyl-2-cyanoacrylate may be considered safe for interventional management of iatrogenic enterocutaneous fistulas. In this study, we confirmed its effectiveness as an reinforcement for high-risk anastomoses upon which the glue yields an immediate sealing of the tissues and supports the physiological wound healing process.

REFERENCES


以簡單便宜的方法來治療醫源性腸胃皮膚瘻管：組織粘膠的價值

余益榮 楊斐適 黃榮貴

馬偕紀念醫院 放射線部

腸胃道開刀後引發的腸胃皮膚瘻管並不是個小問題，雖然其引發的死亡率暨罹病率已有明顯的降低，但還是不夠低。

我們報告16個臨床病例，利用組織粘膠來治療因開刀後引起的腸胃皮膚瘻管，14例成功治癒。我們相信這種治療方法對於開刀後引起的腸胃皮膚瘻管其後續非開刀介入性處理會有貢獻。

關鍵詞：瘻管，栓塞治療；瘻管，胃腸道；組織粘膠