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HOW I DO IT

Managing Refractory Postoperative Fistulas as Chronic Wounds Using Video-Assisted Hydrodebridement (VAHD)

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Abstract

Postoperative fistula formation remains a serious complication following abdominal surgical procedures. Refractory fistulas requiring further surgical intervention delay adjuvant chemotherapy and functional recovery. Here, we present six cases of refractory fistulas and describe a new management technique, which we call video-assisted hydrodebridement. We postulate that refractory fistulas are a type of chronic wound, for which hydrodebridement may be used to hasten wound healing. In all cases, patients had undergone a prolonged period of conservative management and surgical intervention was not considered appropriate. Here, we describe the steps of the procedure in detail. We achieved timely closure of the refractory fistula in five of six cases. The median duration of attempted conservative management was 122 days (63–346 days) and median time to fistula closure after the procedure was 35 days (22–64 days) in the five successful cases. The findings during each procedure are discussed. We suspect that this procedure applies the same benefits to refractory fistulas that hydrodebridement provides to chronic wounds. The combination of endoscopic exploration and hydrodebridement can elucidate barriers to fistula resolution while creating a clean base for wound healing. This technique may be a useful tool to reduce the morbidity of refractory fistula management.

Keywords Postoperative fistula · Hydrodebridement · Chronic wound

Introduction

Postoperative fistula formation remains a serious complication following many abdominal surgical procedures. While most of these can be managed conservatively with percutaneous catheter drainage (PCD), antibiotics, and nutritional repletion,[1] a small number continue to drain for an extended period of time, thereby prolonging recovery as well as delaying adjuvant chemotherapy for surgical oncology patients. By current standards of practice, fistulas are considered refractory to conservative management if resolution is not achieved within 6 weeks, at which point surgical management is considered. Those fistulas with enteric communications, multiloculated fluid collections, multiple serpiginous tracts, or associated tissue necrosis are less likely to resolve with simple PCD alone, and these complex fistulas often require multiple drains, prolonged drainage, or surgical management.[2]

Here, we present six consecutive cases of patients with complex cutaneous fistulas including pancreatic, colonic, gastric, and ventral hernia mesh, who failed conservative management. The technique we have termed "video-assisted hydrodebridement" (VAHD) began as a diagnostic interrogation of a refractory fistula performed in the operating room in an attempt to understand the causes of failure to heal. This evolved into a coordinated effort with interventional radiology (IR) to achieve safe hydrodebridement in the radiology suite using fluoroscopic guidance along percutaneous drain tracts. We adapted techniques from minimally invasive retroperitoneal necrosectomy procedures used to treat necrotizing pancreatitis.[3] In each case, previously unsuspected causes that

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may have contributed to poor fistula healing were identified endoscopically or, in some cases using a 5-mm nephroscope. We postulate that these refractory fistulas could be considered a type of chronic nonhealing wound, for which hydrodebridement may be a helpful tool to hasten healing.[4–6]

Methods

Patient Selection

All patients in this series had undergone a prolonged period of conservative management using PCD, including source identification, infection control, nutritional repletion, and functional rehabilitation. Surgical intervention was undesirable, either due to patient risk factors or the patient's personal decision not to undergo further surgery at that time.

Fistula Tract Exploration and Video-Assisted Hydrodebridement

The steps of this procedure are summarized in Table 1. In preparation for VAHD, the existing percutaneous fistula drain was upsized by IR, typically to a 16-22Fr straight catheter 1–2 weeks prior to the procedure date. With the patient under general anesthesia, IR performed a diagnostic fistulogram that served as a map for video-assisted exploration. Contrast was drained and a 0.035-in. stiff guidewire was inserted through the existing drain to the apex of the tract to serve as a guide for insertion of the endoscope. The drain was then removed. Rigid dilators were used to dilate the abdominal wall segment of the existing fistula tract, bringing it to a size suitable for endoscope insertion. A flexible pediatric upper endoscope (2–7 mm) was selected so that the scope would occupy less than 2/3 of the lumen of the fistula. This allowed sufficient space for debris to be flushed out along the sides of the endoscope with the irrigation fluid. Cystoscopy drapes and buckets were used to catch the effluent. The endoscope was gently inserted, following the path of the wire all the way to the apex of the cavity. If the tract was straight, a 5-mm nephroscope offered excellent optics, as well as a reasonable grasper and snare. The endoscope has the advantage, commonly needed, of being able to navigate serpiginous paths and, by connection with the electrically powered irrigator, modest pressures can be generated without concern for tissue injury. As the scope was gradually withdrawn, each space that had been identified on the prior fistulogram was explored under continuous visualization. Irrigation was continued until no further debris was identified and the walls were debrided down to healthy granulation tissue. The length of the tract was then measured using the inserted endoscope. A self-retaining Cope loop catheter of the largest size that would comfortably fit (12–18) was inserted to the base. A closed suction drainage bulb was then attached.

Catheter Management

Patients were instructed to flush the drain twice daily with a syringe prefilled with 10 mm of saline. A fistulogram was performed by IR 2–3 weeks after the VAHD procedure and the drain was replaced via over-the-wire exchange when appropriate. Once the enteric communication healed, the catheter was pulled back a few centimeters at a time over the course of several weeks. In each case, the catheter eventually fell out on its own and the superficial wound closed secondarily.

Results

The VAHD technique resulted in timely closure of the refractory fistula in five out of six consecutive cases in which it was attempted. The median patient age was 62 years. All patients had a prolonged attempt at conservative management of their postoperative fistula, with a median duration of 122 days (63–346 days). Median operative time was 115 min, and median time to fistula closure after VAHD was 35 days (22–64 days) in the five successful cases. No complications have resulted from this procedure to date.

The details of these cases are summarized in Table 2. In each case, video-assisted exploration revealed abundant debris or previously unidentified pockets within the fistula. In the case of patient A, extensive fibrinous material had accumulated adjacent to the pancreatic stump. We used an endoscope with biopsy forceps to remove the debris and irrigate out the fistula to clear remaining exudate back to clean healthy granulation tissue. The large abdominal collection that developed over the mesh in patient B was found to be made up of several small pockets. The endoscope was able to easily take down the septations to create one large cavity that was then effectively drained and the cavity quickly healed. In patient D, access to the origin of the fistula at the gastric staple line was obstructed by granulation tissue that had formed within the tract. The endoscope was used to gently dilate this area of the tract and clear the debris that had accumulated behind the granulation tissue. The wire was advanced to the fistula source and a new drain was placed under fluoroscopic guidance. Abundant fibrinous and necrotic debris was cleared from the fistulous connections into the stomach and small bowel in patient F, and the percutaneous drain was advanced into the lumen of the stomach and capped as a G-tube. A separate endoscopic double pigtail catheter was placed through the existing gastric defect to allow the fistula cavity to drain internally. The G-tube was downsized and removed and the pigtail self-extruded.

Table 1 Steps of the VAHD procedure

Pre-VAHD management	Exhaust PCD management*
	Nutritional repletion
	Drain upsized by IR 1–2 weeks before procedure
VAHD procedure	Perform fistulogram
	Place guidewire through PCD tract to fistula base
	Remove drain over the wire under fluoroscopy
	Dilate tract segment within abdominal wall
	Pass pediatric endoscope along wire path
	Irrigate to remove debris and expose granulation tissue
	Explore and irrigate all fistula pockets
	Insert drain to fistula base under fluoroscopy
Post-VAHD management	Flush drain twice daily with 10 ml saline
	Fistulogram 2–3 weeks after VAHD procedure
	Pull back drain 2 cm every 1–2 weeks
	Drain falls out once the tract has nearly closed
	Superficial wound closes secondarily

VAHD video-assisted hydrodebridement, *PCD* percutaneous catheter drainage

*Tract well-formed, cavities drained, source control achieved, infection resolved

The rapid resolution of the fistula after VAHD in patient C was most surprising. Patient C had developed multiple serpiginous tracts throughout the psoas muscle related to an ischemic anastomotic fistula of the right colon after a major pancreatic and colonic resection. The fistula continued to drain feculent material for almost 1 year after his operation, while we worked to replete his nutrition and functional status. During endoscopic exploration, small bits of stool and debris were flushed out of each pocket of the complex fistula. The walls of the fistula were hydrodebrided down to healthy appearing granulation tissue and a drain was left in the fistula tract, which measured 8 cm from skin. A fistulogram undergone 1 month after the VAHD procedure showed that the drain had been pushed back to just below the skin and the fistula had healed (Fig. 1).

VAHD did not result in timely closure of the fistula in the case of patient E, whose course was hastened due to the urgency of initiating chemotherapy. This patient remained undernourished at the time of the procedure and chemotherapy was started 41 days later, further impeding the patient's ability to heal. The fistula did eventually heal once chemotherapy was completed and the patient was able to eat a normal diet. Because of this sequence of events, it is not clear whether the VAHD procedure had any effect on the resolution of the fistula.

Discussion

Refractory postoperative fistula formation remains a significant complication of many abdominal surgical procedures. Although the principles of conservative postoperative fistula management are successful in the vast majority of cases, the rare cases in which conventional approaches fail often require additional surgical intervention. We used endoscopy via the established percutaneous tract as an adjunct to PCD to both gain an understanding of the barriers to healing and to try to hasten fistula closure using hydrodebridement, which has been used in the treatment of chronic cutaneous wounds. The approach was adapted from techniques that have been used successfully in the management of pancreatic necrosis,[3] and here are applied to refractory postoperative fistulas. We speculate that resolution may be related to reactivation of wound healing pathways that had previously become dormant.

Chronic Wound Theory

Like nonhealing wounds in other parts of the body, a fistula may be arrested in a particular phase of the wound healing process.[7] Chronic wounds have been shown to be biochemically distinct from acute wounds,[8] containing cells that are resistant to growth factors and that produce exudate, thereby maintaining the inflammatory phase of healing. Fibrinous exudate and necrotic tissue may act as foreign bodies within the wound. Hydrodebridement serves to remove loose material and clear out bacteria, which may be sufficient to allow the wound to reenter the acute healing process.[9]

Several applications of hydrodebridement have been described, including reducing debridement time for burns,[4] hastening resolution of necrotic skin wounds,[5] and promoting formation of granulation tissue in chronic wounds.[6] In a randomized control trial comparing conventional wound management to suction assisted pulsed lavage, chronic wounds

Table 2 VAHD case details in order of occurrence

	Patient	Cutaneous-fistula communication	Conservative management duration	VAHD to closure duration	Post-VAHD course	Suspected barrier to healing
A	72 F	Peripancreatic stump collection after distal pancreatectomy	75 days	29 days	VAHD procedure halfway through 20 day hospitalization	Large fibrinous collection adjacent to pancreatic stump
B	57 M	Infected abdominal wall collection after mesh ventral hernia repair	245 days	63 days	Overnight admission for observation	Several walled-off pockets within the larger cavity
C	67 M	Anastomotic leak collection with serpiginous psoas tracts after ileocecectomy and total pancreatectomy	346 days	35 days	7 day hospitalization due to comorbid condition	Small loose debris within serpiginous tracts
D	63 M	Peripancreatic collection with secondary gastric staple line fistula after pancreatico-duodenectomy	161 days	22 days	Same day discharge	Granulation tissue obstructing access to undrained pocket
E	61 F	Anastomotic leak collection after hemigastrectomy	84 days	292 days*	Same day discharge	Debris obstructing access to fistula source
F	45 M	Peripancreatic collection with secondary gastric and small bowel fistulas after distal pancreatectomy	63 days	64 days	Overnight admission for observation	Abundant fibrinous and necrotic debris

*Failed to achieve timely closure

VAHD video-assisted hydrodebridement, *F* female, *M* male

treated with daily lavage had significantly faster healing rates and reduced size.[10] It has been suggested that in addition to the benefits of removal of necrotic tissue and clearance of infectious or foreign debris, hydrodebridement further stimulates healing through its mechanical effects on the tissue itself.

Hydrodebridement for Refractory Fistulas

Video-assisted hydrodebridement can be accomplished using either laparoscopic instrumentation if the drain tract is straight or, more commonly, a flexible endoscope to navigate a serpiginous tract(s). The goal is to provide access the source of the fistula at the base of the wound, which is often a considerable distance from the cutaneous communication, thereby avoiding other methods of mechanical debridement that require extensive surgical exploration. The wound bed is left with clean healthy tissue that is has been stimulated to reinitiate the wound healing process.

In each of the cases presented, video-assisted exploration of the fistula revealed barriers to fistula healing within the tract that had to be mechanically removed. In one case, circumferential growth of granulation tissue blocked optimal positioning of drains and dilation was needed to achieve source control, and in 2 other cases, adherent debris was trapped within walled-off pockets that required debridement. The combination of video-assisted exploration and hydrodebridement allowed us to access and clear every pocket of the fistulous tracts, providing a clean base for wound healing.

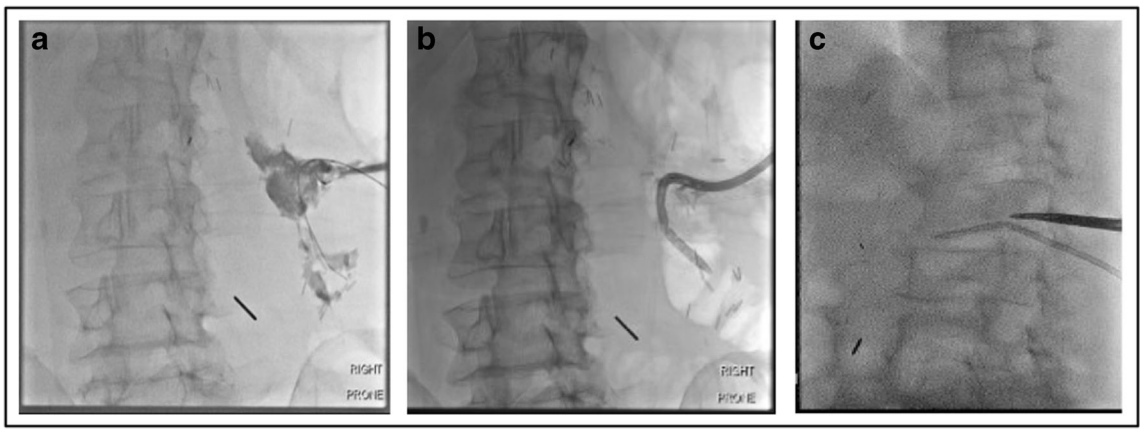

Fig. 1 Fistulogram illustrating the anastomotic fistula of Patient C. **a** A guidewire is inserted to the fistula base, dye fills the multiple tracts of the complex the fistula before video-assisted hydrodebridement (VAHD). **b** After VAHD a drain is inserted to the base of the fistula. **c** One month after VAHD, the anastomotic communication has sealed and the drain has backed out until the tip was in the abdominal wall

In several cases, the presence of debris within the tract seems to have acted as foreign bodies preventing the resolution of the fistula. One patient that was found to have feculent debris in the serpiginous drain tracts also had previously received radiation treatment, which may have contributed to persistence of the fistula. It is possible that VAHD both cleared the foreign bodies and stimulated blood flow or cell-mediated wound healing in damaged tissue, and the relative contributions of these factors are unknown. Further experience is needed to clarify the potential of this technique to overcome classic barriers to fistula healing such as irradiated tissue.

Of note, the operating surgeon performed all of the endoscopies in collaboration with interventional radiologists, who provided important guidance regarding the timing of the intervention as well as expertise in the interpretation of fluoroscopic images to identify the expected source of the fistula. In recent cases, IR has initiated the addition of VAHD when they feel a fistula has "stalled" with percutaneous catheter management. Gastroenterologists assisted in the last two cases, allowing visualization and catheter manipulation from inside the GI tract, effectively internalizing the fistulas with subsequent resolution. While we are gaining experience with this new array of techniques, the expertise of a multidisciplinary team is very helpful, and, no doubt, will limit exportability to low resource settings. Ultimately, with more widespread adoption, the optimal timing and approach for different types of refractory fistulas should become clearer, and management algorithms can be revised accordingly.

We were surprised at the success of this simple procedure in resolving these seemingly disparate and complex cases. Due to the small number of cases presented in this series, the limitations of this technique have not yet been defined. In the case in which the procedure appeared to have little effect, the fistula healed after the patient regained her lost body weight, suggesting that malnutrition was a contributing factor despite normal prealbumin and albumin levels. There may be particular fistula characteristics that would be less amenable to hydrodebridement that we have not yet encountered.

We have not identified any complications that have resulted from this procedure, and the optimal timing for this intervention as well as the expected recovery time remains to be determined. Based on our experience using this technique for pancreatic necrosis in which enteric fistulas are common, we are mindful of the volume of fluid used and the need for suction through a nasogastric tube if the upper gastrointestinal tract is filling with fluid. Since most refractory fistulas have a small caliber enteric communication, VAHD requires less than 3 l of fluid. Four of our six patients went home the same day or the following day, and this would seem appropriate for patients without significant comorbidity.

VAHD of postoperative enterocutaneous tracts clearly requires a well-formed tract to avoid organ damage, whereas video-assisted interrogation of a pre-fascial cavity associated with ventral hernia mesh infection may be able to be safely approached at an earlier time point. Thus, in our current practice, we are using VAHD as an adjunct to percutaneous drainage rather than waiting until a patient has been deemed to have "failed conservative management." In recent cases, we have interrogated the drain tract as soon 4–6 weeks after the fistula has been diagnosed, as soon as a tract has formed and progress toward resolution has slowed. We employ this technique early especially if the collection or tract appears complex, suggesting the presence of necrotic tissue or exudative debris. Patients have been able to go home the day of the procedure with an expected recovery similar to the typical "IR tube check and exchange." We hope that this communication will stimulate others to report additional modifications and innovations so that we can collectively reduce the morbidity associated with these serious postoperative complications.

Author Contributions All authors contributed to the conception of this study and the drafting of this manuscript.

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