Early Stomal Complications

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ABSTRACT

The creation of intestinal stomas for diversion of enteric contents is an important component of the surgical management of several gastroenterologic disease processes. Despite the frequency with which these procedures are performed, complications of stoma creation remain common, despite extensive measures aimed at reducing them. Early postoperative complications (those seen less than one month postoperatively) can lead to significant cost, both financially and psychologically, and incur significant morbidity. Commonly seen early postoperative stomal complications include improper stoma site selection, vascular compromise, retraction, peristomal skin irritation, peristomal infection/abscess/fistula, acute parastomal herniation and bowel obstruction, and pure technical errors. The author reviews these early complications associated with stoma creation, discusses means of preventing them, and outlines the management strategy for such complications when they do occur.

KEYWORDS: Stomal complications, ileostomy complications, colostomy complications

Objectives: On completion of this article, the reader should be familiar with the recognition, diagnosis, management, and prevention of early complications arising from the creation of intestinal stomas.

The creation of intestinal stomas is an integral component of the surgical management of several disease processes involving the gastrointestinal tract. Despite extensive surgical experience, complications of intestinal stomas still occur with relative frequency. These complications result in high morbidity and incur significant cost, from economic, physiologic, and psychologic points of view. Complications of intestinal stomas may be subdivided into those occurring early in the postoperative period (less than one month postoperatively) and those occurring late.¹ In this article, I will review the early complications associated with intestinal stomas, discuss means of preventing them, and outline strategies for managing such complications.

OVERVIEW

Reported rates of stomal complications vary widely in the literature. Several reports focus solely on ileostomies or colostomies, making it even more difficult to make definitive conclusions about the overall incidence. Furthermore, conflicting data exists as to whether complication rates are equivalent with colostomies and ileostomies²⁻⁴ or are higher with ileostomies.⁵ Complication rates specific to loop ileostomies can be significant, ranging from 5.7% to 41%,⁶⁻⁸ and reoperation rates for loop ileostomies vary widely.⁸⁻¹¹

Complication rates obviously also vary depending on the circumstances surrounding stoma creation. Although it seems intuitive that emergency operations

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Table 1 Incidence of Stoma-Related Complications

Study	Year	n	Complication Rate %
Pearl et al ¹⁶	1985	610	25.9
Porter et al ¹²	1989	126	44.0*
Unti et al ²⁶	1991	229	13.1
Lodono-Schimmer et al ¹⁹	1994	203	51.2*
Park et al ⁵	1999	1616	34.0
Saghir ¹⁸	2001	121	67.5
Duchesne et al ³	2002	164	25.0
Arumugam et al ¹⁷	2003	97	50.5
Mahjoubi et al ¹³	2005	330	69.4*
Robertson et al ⁴	2005	408	23.5

*Indicates study included colostomies only.

with gross peritoneal soiling, gangrenous or perforated intestine, and creation of stomas in debilitated or malnourished patients would be associated with increased postoperative morbidity, this has not been borne out in several studies.^{2-4,12-14}

Table 1 summarizes complication rates from selected reports in the literature. The largest series in the literature reports a 34% complication rate in 1616 patients with stomas (including both ileostomies and colostomies) over a 20-year period at Cook County Hospital.⁵ Twenty-eight percent of complications in this series occurred early (< 1 month postoperatively), while the remaining 6% occurred late. Independent variables influencing the incidence of stomal complications included patient age, operating service (colorectal specialist versus general surgeon or other specialty), stoma type and configuration, and preoperative marking by an enterostomal (ET) nurse or therapist. Overall, the highest incidence of complications was seen with a loop ileostomy configuration (75%); the lowest incidence was seen with an end transverse colostomy configuration (6%). Interestingly, most early complications (those occurring less than one month from creation) were seen with a descending end colostomy configuration (60%), followed closely by a loop ileostomy configuration (59%). The most common early complications seen were skin irritation (12%) and poor stoma location (7%).

Carlstedt et al¹⁵ also reported a rate of stoma-specific complications requiring surgical revision in 34% of patients undergoing proctocolectomy with end ileostomy for ulcerative colitis and Crohn's disease, though most of these were late complications. A greater proportion of stoma-specific complications in this series were seen in patients with Crohn's disease.

Pearl et al¹⁶ reported a complication rate of 25.9% in 610 patients undergoing stoma creation. The most commonly seen early complication in this study was peristomal skin irritation (42.1%). Complications were more frequent with ileostomies than with colostomies,

and emergency stoma formation was associated with the highest complication rates. When stomas were created by colorectal specialists as opposed to general surgeons or other specialists, the complication rate was lower.

Duchesne et al³ described a complication rate of 25% in 164 patients with intestinal stomas over a 3-year period, with 39% of these occurring in the early postoperative period. No significant differences were seen in emergency cases, and stoma type (ileostomy versus colostomy) did not have a statistically significant impact on the incidence of postoperative complications. Obesity and the presence of inflammatory bowel disease were found to be independent predictors of stoma-related complications. The most commonly seen early complications were stomal necrosis (4.3% of all patients, 17.1% of complications), peristomal skin irritation (1.6% of all patients, 7.3% of complications), and stoma retraction (1.2% of all patients, 4.6% of complications).

In a series of 408 patients with intestinal stomas studied prospectively, Robertson et al⁴ reported an overall complication rate of 23.5%. Elective and emergency stomas had similar complication rates. The overall complication rates between ileostomies and colostomies did not differ, though the specific complications of leakage, skin excoriation, and soiling were more commonly seen with ileostomies.

Another prospective study, by Arumugam et al,¹⁷ reported complications in 50.5% of 97 intestinal stomas. When analyzed against the overall complication rate, age, body mass index, preoperative siting, emergency versus elective procedure, and type of stoma did not predict postoperative complications. However, when analyzed against individual complications with univariate logistic regression, a high body mass index was associated with a higher incidence of stomal retraction and early peristomal skin irritation. Emergency surgeries were associated with poor stoma siting. Multivariate logistic regression demonstrated that body mass index, diabetes, and emergency surgery were more commonly associated with postoperative complications. The most common early complications were retraction (23 patients), poor stoma site (18 patients), early skin excoriation (16 patients), and stomal detachment (12 patients).

Saghir et al¹⁸ reported a stoma-specific complication rate of 67.5% in 121 patients with intestinal stomas, though only 26% of these were considered "major." In this retrospective series, 69% of the complications occurred early in the postoperative period. Univariate analysis identified age greater than 65 years, American Society of Anesthesiologists (ASA) grade III or higher, and surgeon's specialty as predictive variables of major stomal complications, whereas a multivariate analysis identified age as the only independent predictor of stomal complications. The complication rate was 22% for stomas created by colorectal specialists and 40% for stomas created by general surgeons ($p < 0.05$).

Several studies look specifically at complications related directly to colostomies. Porter et al¹² reported a 44% complication rate in 130 end colostomies, with 15 (11.9%) requiring reoperation. Mahjoubi et al¹³ described a complication rate of 69.4% in 330 patients with end colostomies; early complications occurred with a relative frequency of 67.57%. Londono-Schimmer et al¹⁹ looked specifically at long-term complications in 203 patients with end colostomies and found a 58.1% actuarial risk of paracolostomy complications at 13 years.

The most common early complications of stoma creation include improper siting, vascular compromise, retraction, peristomal skin irritation, peristomal infection/abscess/fistula, acute parastomal herniation, and early postoperative bowel obstruction. Furthermore, pure technical errors, such as maturation of the wrong end of the stoma, should not be discounted. Each of these will be discussed individually.

IMPROPER STOMA SITE SELECTION

Improper stoma site selection is one of the most common, and most preventable, early complications of abdominal stoma surgery. Improper siting leads to difficulties in self-care and interferes with the ability to maintain a secure stoma appliance. Leakage from the appliance leads to skin irritation, furthering the difficulties encountered in keeping the appliance in place. In effect, this creates a vicious cycle of pouch leakage and skin irritation exacerbating each other. The resulting cost of stoma care in terms of utilizing stoma supplies, as well as the emotional stress of the patient, can be significant. The fear of stoma leakage may lead to social isolation.

Preoperative stoma site marking should be performed whenever possible.²⁰ This is usually a collaborative effort between the surgeon, ET nurse, and patient. Ideal site location should be within the belly of the rectus abdominis muscle to reduce the potential for later complications, such as stomal prolapse and parastomal herniation. The site should be centered on a flat area, away from scars, skin creases, and bony prominences and the surrounding skin should be healthy. A 2-inch flat surface surrounding the stoma is required to provide an adequate pouch seal. Areas in close proximity to proposed incision sites and open wounds should be avoided. The apex of the convex curvature of the infraumbilical fat fold should be used.

The abdominal wall should be inspected in several positions when choosing a stoma site preoperatively, including prone, sitting, standing, and leaning forward. Selection of the site after the patient is anesthetized on the operating room table prevents the anticipation of abdominal skin folds and their effects on appliance placement. Stomas placed within an abdominal skin fold are a major reason for pouch leakage and its ensuing morbidity.

The belt line should also be avoided if at all possible as stomas in this location are easily traumatized, and the belt line often corresponds to an abdominal fold. Ideally, the stoma should be sited below the belt line. However, there may not be sufficient space between the belt line and inguinal fold to provide an adequate pouching surface, especially in men. Stomas above the belt line often are visible through clothing and may require altering one's wardrobe. Siting of a transverse loop colostomy is often difficult due to inadequate distance between the costal margin and the beginning of the umbilical fat fold.

The stoma site must be in a location that is readily visible to the patient to allow for self-care, a factor that is all too often overlooked. If the individual cannot see the stoma, they will not be able to care for it appropriately. In obese patients, the stoma should be placed on the higher side of the convex curvature of the abdominal wall to allow for visualization. This usually requires placement of the stoma above the belt line in obese individuals. Similarly, in women with large, pendulous breasts, finding an appropriate site that is readily visible to the patient may present a challenge. In instances in which a second stoma (e.g., mucous fistula or ileal conduit) is required, both stomas should not be placed on the same horizontal plane, as belts used with the pouching system may traumatize an opposing stoma.

The analysis by Park et al⁵ of stomal complications emphasizes the importance of preoperative stoma marking. Of the 1616 patients with stomas in their series, only 26% of patients underwent preoperative marking by an ET nurse. However, logistic regression demonstrated that this did significantly decrease the incidence of stoma complications (OR = 0.567; 95% CI = 0.37–0.867; $p = 0.0089$) in these patients.

Another review by Bass et al emphasizes the need for preoperative stoma marking.²¹ In this study of 593 patients undergoing elective stoma creation, 49% were preoperatively marked by an ET nurse. The incidence of overall complications (32.5% versus 43.5%, $p < 0.0075$) and early complications (23.3% versus 31.6%, $p < 0.03$) was lower in the group preoperatively marked. The incidence of late complications, however, was not significant (9.25% versus 12%, $p < 0.34$). Poor stoma siting was seen in 10.3% of patients not marked preoperatively, but only in 4.5% of those who were marked. Peristomal skin problems were also more prevalent in patients not preoperatively marked (28% versus 13.7%, $p < 0.0008$).

Unfortunately, in many cases, very little can be done for a poorly sited stoma, other than reoperation and translocation. An ET nurse may be able to assist with nonoperative solutions, such as specially shaped appliances. Ultimately, if the patient's lifestyle is compromised because of difficulties in obtaining a secure pouch due to improper siting, the treatment of choice is

operative translocation with appropriate preoperative marking.

VASCULAR COMPROMISE

Vascular compromise of intestinal stomas ranges from mild ischemia due to operative tissue trauma or vasospasm with mucosal sloughing to infarction and intestinal necrosis due to ligation of arterial supply or inadequate collateral arterial circulation. Additionally, venous outflow obstruction may lead to significant venous congestion and compromised bowel perfusion, which may also lead to necrosis of the stoma. Vascular compromise represents the most serious early complication of stoma creation. The incidence of early stomal necrosis ranges in reported series from 2.3 to 17%.^{5,16,22-25}

Often, stomal ischemia is primarily due to interruption of segmental arterial supply to the exteriorized segment of bowel. In most instances, it is best to divide and complete preparation of the bowel well in advance of bringing the limb of intestine through the abdominal wall to allow time for demarcation in instances when the vascular supply is in question. When preparing the limb of intestine for an end ileostomy, the mesentery can usually be detached from the bowel for a distance of up to 5 cm without compromising arterial supply due to submucosal collaterals. At times, there may be a question of the adequacy of the blood supply of an ileostomy, as signs of ischemia may appear soon after exteriorizing the small bowel despite minimal devascularization. At this point, the tightness of the abdominal wall trephination and tension on the arterial supply should be considered.

Vascular compromise of an end colostomy most commonly develops due to division of collateral blood supply during efforts to create adequate length for a tension-free colostomy. If high ligation of the inferior mesenteric artery is performed, one should attempt to preserve the ascending branch of the left colic artery to prevent distal ischemia. Other possible sources of vascular compromise are inadvertent division of the marginal artery and inadequate collateral circulation from the middle colic vessels. Palpable mesenteric pulses adjacent to the distal-most aspect of the bowel essentially guarantee adequate vascular supply to the stoma. If there is any question as to the consequence of dividing an aspect of mesentery, application of an arterial bulldog clamp to that portion of mesentery for a short period of time may allow one to assess the adequacy of collateral circulation. Excessive trimming of epiploic fat or mesentery from the stapled end of bowel to be exteriorized should be avoided, as this may lead to localized distal ischemia.

In obese individuals, exteriorizing an ileostomy with an adequate blood supply can be quite challenging. The thickened, foreshortened mesentery often does not have enough length to reach the surface of the thickened

abdominal wall easily, especially when attempting to create a loop ileostomy. In creating an end ileostomy, the mesentery must often be detached from the bowel for too long of a length to maintain adequate blood supply. Dividing the mesentery further upstream in an effort to gain more length often further compromises the blood supply. In these instances, an end-loop configuration may allow the bowel to more easily reach the abdominal surface.²⁶ Enlarging the abdominal wall trephination also may aid in exteriorizing the small bowel; however, this may increase the likelihood of a postoperative parastomal hernia. If undue tension on the mesentery is present after exteriorizing the bowel, postoperative stomal retraction can be anticipated.

Recognition of stomal ischemia is usually not difficult. If the mucosa appears dark or grayish, it should be considered compromised. However, in most circumstances, the mucosa is not visible until the stoma is matured after the main incision is closed. If severe ischemia is present serosal changes will become apparent well before closure of the abdominal wound. If there is any question, scratch the serosa with a needle point; healthy serosal bleeding is a reassuring sign.

Venous congestion of a stoma may be due to bowel edema, a tight abdominal wall trephination, or excess tension on the bowel mesentery, resulting in dark, purple discoloration postoperatively. In extreme situations, venous congestion may compromise capillary and ultimately arterial perfusion, resulting in tissue loss. More commonly, the typical result is mucosal slough that may appear very concerning within the first few days. As venous outflow improves and edema decreases over subsequent days and weeks, the mucosa reepithelializes, usually resulting in a viable, well-functioning stoma.

When assessing the vascular integrity of a congested stoma postoperatively, transillumination with a flashlight will demonstrate viability. A flashlight placed in direct contact with a viable stoma will still transilluminate bright red, even in the face of venous congestion. Failure to transilluminate the surface of the stoma or nonviable appearing mucosa beneath the surface generally indicates that the stoma requires revision. If there is a question regarding viability below the stomal surface, a well-lubricated blood collection tube can be carefully passed into the stoma, below the fascia if possible. When a light is shone into the tube, viable mucosa will have a healthy, bright-red appearance. Darker hues or frank infarction require revision if the compromise extends below the skin level. Compromise below the fascia requires relaparotomy. Questionable stomas can also be evaluated with a pediatric proctoscope or flexible endoscope.

If there is any question regarding the vascular supply of a stoma at the time of initial operation, it should be revised immediately. Leaving the operating room with a stoma of questionable viability is inexcusable, as further

complications such as retraction, mucocutaneous separation, frank ischemia, and full-thickness necrosis are sure to follow. Alternatively, a stoma with small areas of questionable ischemia found within days following creation may be observed expectantly. Mucocutaneous separation may occur resulting in a small open wound that will usually heal by secondary intention if appropriate stoma care is employed. Poor vascular supply that does not cause acute complications may also lead to delayed complications, such as stomal stenosis and/or stricture.

RETRACTION

Retraction of a stoma in the immediate postsurgical period is usually a result of tension on the bowel or its mesentery due to inadequate mobilization. Also, in patients who are malnourished, obese, or on corticosteroid therapy, the stoma may retract due to poor wound healing and gravity. Mild distal stomal ischemia or stomal necrosis that is managed expectantly may eventually result in retraction with or without stenosis. Complete acute retraction with mucocutaneous separation can result in subcutaneous or subfascial contamination, peritonitis, and sepsis. In this case, immediate laparotomy and revision is advised.

More commonly, retraction is seen without complete mucocutaneous separation. The most significant problem in this instance is obtaining a secure seal between the stoma appliance and the abdominal wall, leading to fecal leakage and significant peristomal skin irritation. The majority of these stomas with significant retraction eventually require revision. The approach to a retracted stoma is similar to distal ischemia. If the mucosa is viable and there is no undue tension, local revision can often be performed by detaching the mucocutaneous junction, advancing the bowel and excising devitalized tissue, and resecuring viable mucosa to the skin using Brooke-type sutures. If this is not technically feasible, laparotomy and complete revision is required.

PERISTOMAL SKIN IRRITATION

The reported incidence of peristomal skin irritation ranges from 3 to 42%.^{5,16,27-29} The degree of irritation may range from that of a mild peristomal dermatitis to full-thickness skin necrosis and ulceration. The majority of these instances are due simply to stoma neglect and improper placement or fit of the appliance, resulting in appliance leakage. Often, the patient is not fully comfortable caring for the stoma independently at the time of discharge from the hospital. Every effort should be taken to ensure that appropriate predischarge teaching by an ET nurse is sufficient to prevent this.

In most instances, peristomal skin irritation is a direct result of (1) chemical dermatitis due to exposure to

the stoma effluent, and (2) desquamation of peristomal skin resulting from frequent appliance changes. Often, appliance leakage and local skin irritation result in the need for more frequent appliance changes, starting a vicious cycle. Ideally, the pouching system should completely and effectively prevent effluent contact with the skin. Application of antiinflammatory creams and ointments to the irritated peristomal skin is difficult because they prevent the pouch from adhering to the skin, allow continued spillage of enteric contents, and potentiate the skin irritation. Additionally, allergic reactions due to sensitivity to skin barriers, adhesives, and tapes are fairly common. Fungal irritation from *Candida albicans* colonization of the peristomal skin also is commonly seen. Antifungal powders may help alleviate this.

Irritation of the skin surrounding the stoma is more frequently seen with ileostomies than with colostomies due to the more liquid, caustic nature of the bilious small intestinal contents. Prevention centers on meticulous selection of the stoma site at the time of surgery as well as diligent postoperative attention to appliance fit and replacement at appropriate intervals. Changing of the appliance too frequently results in peristomal skin irritation due to the desquamation of peristomal skin. A stoma that is situated properly and has a height of at least 1 cm can usually be managed with a pouch change every 3 to 7 days. Conversely, patients with a stoma that is at skin level or those with a stoma retracted in a skin fold usually require more frequent pouch changes, often daily or several times a day, exacerbating the local skin irritation. If local skin irritation is problematic because of continued leakage and the need for frequent pouch changes, stoma revision should be strongly considered.

Once the nidus for peristomal skin irritation has begun, attempts to stem the progression should be aggressively employed. The first thing one should consider is the size of the appliance opening; stoma size may change with decreased postoperative edema and abdominal enlargement that accompanies weight gain. Patient education centering on stomal care and maintenance is essential. When properly seated, the opening in the appliance should exactly match the outer diameter of the stoma. There should be no exposed skin visible between the mucocutaneous junction and the cut edge of the appliance. If the appliance will not sit flush around the entire circumference of the stoma, stomal adhesive paste can be used as "caulking" to fill gaps and thereby prevent leakage. Alternatively, an appliance aperture that is too small will cut into the stoma and create other problems, such as bleeding and ulceration.

Solutions to peristomal skin complications often become the purview of the ET nurse. The ET nurse is well versed in patient education and the wide variety of products available to aid the patient in their own stomal maintenance. Several studies have demonstrated that

involvement of an ET nurse in the perioperative care, counseling, and teaching in patients with intestinal stomas decreases the complication rates.^{2,3,21}

PERISTOMAL INFECTION, ABSCESS, AND FISTULA FORMATION

In the early postoperative period, parastomal infections and abscesses are relatively uncommon, with a reported incidence of 2 to 14.8%.^{5,16,25} Although peristomal skin and soft tissue infections are rare, they can become extremely problematic in the instances when they do occur. Peristomal abscesses in the immediate postoperative period are most commonly seen in the setting of stoma revision or reconstruction of a stoma at the same site, mainly due to preoperative colonization of the peristomal skin and perioperative seeding of the surgical site. They may also be seen due to an infected hematoma or an infected suture granuloma.

When an abscess forms at a mature stoma site, it is often the result of local folliculitis or recurrent inflammatory bowel disease in the appropriate clinical setting. Iatrogenic perforation of a colostomy during irrigation is another less common cause of paracolostomy abscesses. Peristomal abscesses generally will not resolve unless the abscess cavity is drained surgically. Incision and drainage should be performed either at the mucocutaneous junction of the stoma or outside the border of the appliance wafer, if possible. Placement of a small penrose drain or mushroom-tipped catheter to facilitate drainage into the appliance itself or to the skin outside the appliance wafer is often beneficial.

After an abscess has been drained, subsequent development of a fistula is not uncommon. Peristomal fistulae become evident upon the issuance of enteric contents from the exposed abscess cavity with subsequent skin excoriation. Fistulae may also be seen as a result of seromuscular sutures that are placed too deep and penetrate the bowel lumen. In a patient with Crohn's disease, a peristomal fistula in conjunction with an ileostomy is almost invariably the result of recurrent Crohn's disease, as peristomal fistulae may occur in 7 to 10% of patients with an ileostomy in the setting of Crohn's disease.^{11,30,31} In patients with presumed ulcerative colitis who have undergone resection and ileostomy, development of a peristomal fistula should raise the possibility of misdiagnosed Crohn's disease. Treatment of a persistent peristomal fistula generally requires resection of the peristomal disease and construction of a new stoma, preferably at a different site to avoid the infection present at the former site.

A paracolostomy abscess resulting from a perforated colon is a much more serious problem. More often than not, these occur as late complications due to perforation of an incarcerated parastomal hernia. In

these instances, the potential for peritoneal soilage and peritonitis exists; thus, laparotomy and stoma revision with or without bowel resection and/or repair of a parastomal hernia are indicated. Often these are done as staged procedures in the presence of gross peritoneal spillage.

ACUTE PARASTOMAL HERNIA/BOWEL OBSTRUCTION

The incidence of early postoperative parastomal herniation and bowel obstruction ranges from 4.6 to 13%.^{16,28,29,32} When this occurs in the immediate postoperative period, it more often than not is a technical complication due to the creation of too large of a fascial defect to exteriorize the limb of intestine. Although the standard teaching is to create a fascial trephination large enough for two fingers to pass through easily, this is obviously difficult to standardize. One should use clinical judgment to assess how large the fascial opening should be. It needs to be large enough to not constrict the limb of bowel and its associated mesentery and cause vascular compromise. Alternatively, it must not be so large as to allow adjacent loops of bowel to pass through and become incarcerated. Often, when there is significant distention and edema present at the time of stoma construction, a larger trephination is required. As edema and distention resolve, the amount of "dead space" in the abdominal wall adjacent to the stoma limb increases, as does the likelihood of parastomal herniation.

As with any incarcerated hernia, the diagnosis is usually fairly obvious. There is usually the onset of nausea and emesis associated with a painful lump or mass adjacent to the stoma. Other clinical findings seen with bowel obstruction may be seen, such as leukocytosis, fever, and the presence of air-fluid levels on upright abdominal radiograph. Early in the postoperative period, treatment of acute parastomal herniation and bowel obstruction usually requires urgent reoperation, with reduction of the hernia, resection of nonviable bowel if present, and revision of the fascial opening. If the stoma is viable at the time of reoperation it can be isolated prior to reopening the midline incision, using either a Foley catheter with the balloon inflated within the lumen or sterile gauze secured with a sterile bio-occlusive dressing. Sutured stoma closure should be avoided to reduce stomal trauma.

Reducing the size of the trephination intraoperatively can be technically difficult. Simple tightening stitches may prevent acute reherniation, but are often ineffective in preventing recurrence over the long-term. If there is no intraabdominal contamination, synthetic mesh may be employed to encircle the trephination either from within the abdominal cavity or external to the fascia. A variety of mesh products are

available that purport themselves as being safe to place in direct contact with the bowel. If the stoma is not viable or if there is intestinal contamination present, foreign material should be avoided. Recently, "biologic" materials, such as cadaveric human skin and acellular porcine dermal xenografts, are being used with increasing frequency, especially in this clinical scenario. Although recreation of the stoma at a separate location with closure of the original trephination may be the most conservative and surest method, extensive reoperation in the immediate postsurgical period is often prohibitive.

TECHNICAL ERRORS

Fortunately, pure technical errors, such as maturation of the wrong limb of intestine and improper maturation techniques, are seen with exceeding rarity. Stoma formation often is performed as one of the last steps of a long surgical procedure; there may be a tendency at that point to rush the stoma creation or leave it to a junior member of the surgical team.³³ Attention to detail at this point will help minimize the incidence of complications and optimize stoma function.

Because a stoma usually will not function for a few days following surgery, a technical complication may not present itself immediately. An inadvertently closed stoma or a "wrong-end up" stoma will mimic a prolonged postoperative ileus or a distal bowel obstruction. A gentle water-soluble contrast enema via the stoma is a safe and effective method to determine if a technical error of this sort exists and warrants correction. When technical errors do occur, they should be acknowledged and remedied in an expedient fashion. Further delaying definitive treatment of a technical mishap is likely to lead to further morbidity.

SUMMARY

Although surgical procedures for the construction of intestinal stomas are common, potential morbidity looms along every step of the way. Extreme care and meticulous attention to technical detail should be employed to minimize the likelihood of postoperative complications and optimize stoma function. Reoperations for complications are required in 15 to 20% of patients with intestinal stomas,³³ emphasizing the impact of postoperative complications. Here I have provided an overview of the complications commonly seen in conjunction with the creation of intestinal stomas, focusing primarily on those seen in the early postoperative period, including causative factors, treatment options, and preventative strategies. Keeping these in mind, meticulous surgical technique and decision-making continue to remain the keys to successful stoma surgery.

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