ORIGINAL ARTICLE

Mechanical and Metabolic complications of Ileostomy: Prevention and management

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Abstract:
Ileostomy is an integral component of intestinal surgery performed for various indications. Complications following ileostomy are not uncommon and great care is required during its construction and in the post-operative period to prevent or identify local or systemic complications. These may be minor and easily treatable or significant enough to require multiple operations. Stomal complications are a frequent cause of morbidity and can be a significant financial burden on the patient. Ileostomy is constructed at the end of a surgical procedure and is often relegated to a junior staff or trainee. Stoma creation is not a trivial procedure and must be performed with utmost care and diligence. Creating a carefully located ostomy is the single most important predictor of an ostomate's quality of life. Stoma care should be part of general surgical residency programs. Here, we shall briefly review various sequelae of ileostomy, highlighting the importance of this subject for residents and practicing surgeons.

Keywords: Ileostomy, complications, pyoderma gangrenosum, retention colitis, ostomates

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Introduction:
Fecal diversion is required for a number of reasons in the form of colostomy or ileostomy. An end or loop ileostomy is commonly required for protecting a high-risk, low colorectal or coloanal anastomosis performed for inflammatory bowel disease, sigmoid volvulus, chronic constipation, polyposis coli, colorectal cancer and for various other conditions. It may be temporary or permanent. The idea behind it is to minimize septic complications in case of anastomotic failure.[1] Complications may arise in the immediate, early (<30 days) or late post-operative period (>30 days) and may reach a rate of 70%.[2] These include hemorrhage, ischemia, obstruction, retraction, separation, prolapse, rectal discharge, peristomal herniation and poor siting and skin related complications. Dehydration, nutritional deficiencies, renal and gallstones may also result. Ileostomy or any other stoma must not be regarded as a minor procedure as it can greatly influence a patient's quality of life. Minimizing its importance can result in a poor stoma and cause serious morbidity.[3]

The stoma can deeply impactpatient's psychology and socially isolate them, stigmatized by their stoma.[4] Closure is performed 8-12 weeks after the operation. Earlier closure is reported to prevent or minimize these complications.[5,6]

Discussion:
Although ileostomy is a simple procedure, its complications can seriously affect the patient's quality of life. Both mechanical and metabolic complications are invariably related to the technical aspects of ileostomy formation. Mechanical complications include hemorrhage, ischemic necrosis, abscess formation, poor siting, inappropriate size of the orifice, dermatitis, infection, dehydration, diarrhea, obstruction, anastomotic leakage or stricture, parastomal hernia and fistula formation, prolapse, retraction and stenosis.Metabolic complications include dehydration, electrolyte imbalance, deficiency of vitamin B-12 and essential nutrients, metabol-

ic acidosis/ alkalosis and gallstones and renal stones. Generally, loop ileostomy is considered a safe and effective procedure for temporary fecal diversion.[7] Stoma care is vital in order to prevent or minimize postoperative complications. Below is a concise description of these complication and their management that may help residents and practicing surgeons to take care of ostomates.[8,9]

Mechanical Complications:

Poor siting: Marking the correct ileostomy site pre-operatively is important for the prevention of most of its complications. It's a skill crucial to all surgeons, residents and nurses who deal with stomas. It improves the patient's quality of life and independence and decreases stoma care costs.[10] Exteriorizing the bowel at an inappropriate site can result in poor visualization, poor-fit, frequent dislodging, gas leakage and fecal soilingresulting in skin excoriation. These cause significant social, psychological and financial problems for the patients.[11] Stoma site must be marked preoperatively in lying, sitting and standing positions, preferably in the right lower quadrant and preferably through the rectus muscle. More than one stoma sites must be marked as the decision about siting may change during surgery. For clear visualization, the stoma should be above the infra-umbilical fat fold, above or below the belt-line to notinterfere with clothing. It must be away from umbilicus, skin creases and folds, midline incision, costal margin, iliac bone, pubic bone, pendulous breasts, hernias and scars of previous surgery, skin grafting, radiation andburns. The stoma site must have a circumferential clearance of atleast 4cm or three fingers to easily accommodate the flange of the appliance. The site may also be marked preoperatively by placing a stoma flange on the proposed site of stoma creation.In obese patients, the stoma is created above umbilicus where the pannus is thinner, stoma is easily constructed and clearly visible to the patient.[1,10,12] This protocol may not be possible in emergency situations where complications are more common. In emergency, the stoma maybe centered on a line between umbilicus and anterior superior iliac spine.[13]

Stomal Ischemia and Stenosis:Mild mucosal ischemia or complete stomal necrosis can result from arterial or venous insufficiency. Identification of the extent and length of ischemia is important for management. A pediatric proctoscope, flexible sigmoidoscope or a phlebotomy test tubeis inserted in the ileostomy and illuminated to evaluate the level of ischemic necrosis. The proximal extent of the ischemia must be determined above or below the fascial layers. The former can be observed unless the stoma is obviously necrotic or there is mucocutaneous separation requiring revision. Deeper ischemia needs urgent revision to avoid perforation and intraperitoneal sepsis.[10] Chronic mild stomal ischemia causes stenosis and retraction called Bishop-collar deformity. It results from inadequately mobilized intestine, especially in obese patient. It may require revision if it causes obstructive symptoms or pouching problems.[1] Excessive tension, trimming of fat and mesentery must be avoided while constructing a stoma. The trephine in the abdominal wall must be adequate enough not to cause constriction of the bowel.[10,14]

Skin complications:Peristomal skin conditions arecommonin early postoperative periodwhen the patient is still learning stoma-care butthey can occur anytime during the life-span of the stoma. They include mechanical, chemical, allergic and infectious problems. They arise from ill-fitting, poorly-sited or poorly-sized stomas exposing the skin to caustic effects of alkaline effluent. Leakage of stoma causes skin excoriationthat prevents adhesion of the flange. This starts a vicious circle of leakage and excoriation that worsens adhesion and further escalates the condition. Frequent appliance changes causesfurther stripping of the already excoriated skin.[15] Protective skin-barriers and topical stoma powdersare used to protect the superficial excoriation. Skin creases,folds and mucocutaneous separation and irregular skin contour may be filled with stoma-paste preventing leakage under the flange.[10]

Contact dermatitis results from an ill-fitting appliance exposing the peristomal skin to the irri-

tant effluent. Once at home, care-givers mayby default create an opening in the flange that is larger than the stoma, exposing the skin to the irritant effluent. Patient education plays an important role on how to apply a well-fitting appliance. The excoriated peristomal skin must be covered with hydrocolloid powder before applying the flange which should comfortably cover the entire skin around the stoma, allowing the affected skin to heal.

Appliance material and adhesives can themselves cause allergic dermatitis, occurring in area in contact with skin while irritant dermatitis occurs in the area in contact with the effluent. Allergic dermatitis is treated by removal of the irritant agent, use of corticosteroids and antihistamines. The moist and warm peristomal environment can lead to infectious dermatitis.[15] Candida albicans infection is treated by topical nystatin, miconazole or clotrimazole (for resistant infection) followed by a skin sealant. Staphylococcus aureus folliculitis is treated by cleansing with antibacterial soap, applying antibacterial powder and keeping the skin dry before appliance application.[16]

Pyoderma gangrenosum is characterized by painful peristomal ulcers associated with autoimmune disorders, rheumatoid arthritis, IBD and hematological malignancy. Common in females, it starts as a papule, rapidly progressing to painful undermined ulcers. Debridement of ulcers in combination with topical, intralesional or systemic steroids, antibiotics and meticulous stoma care may lead to healing. Systemic cyclosporine and infliximab maybe used in intractable cases. Stoma relocation maybe required if all else fails but pyoderma gangrenosum may also recur at the new site.[17]

Peristomal fistulae develop in patients with-Crohn's disease due toits recurrence.[18] These are multiple and can create severe pouching difficulties, mandating bowel resection and stoma reconstruction. Suturing the bowel with the dermis only and avoiding full-thickness skin-suture may minimize fistula occurrence.[8] The fistulae maybe incorporated in the stoma appliance when near the mucocutaneous junction.[1] Stomal relocation to another quadrant maybe warranted in severe conditions.

Ileostomy obstruction: Small bowel obstruction can occur after ileostomy due to adhesions, torsion around the ileostomy and parastomal herniation. Poorly digested foods like vegetable strings, popcorn, dried fruits and fruit-skin can cause bolus obstruction. This is treated conservatively with digital exam and saline irrigation breaking up the bolus. Other forms of obstruction may require surgical intervention if unresponsive to conservative treatment.[1,9]

Peristomal varices: Porto-systemic shunting at stoma-skin interfacecan lead to stomal varices in patients with chronic liver disease and portal hypertension. They appear as dilated submucosal veins,a peristomal purple ring or caput medusae, raspberry appearance of stomaand skin that bleeds easily. Fatal hemorrhage can occur. Treatment is individualized. Temporizing measures include manual compression, epinephrine-soaked gauze, injection sclerotherapy, silver nitrate application and ligation of bleeding vessels. Mucocutaneous disjunction and relocation of the stoma maybe required. Liver transplant is the ultimate treatment in select patients.[19] Various obliterative procedures, including TIPS, are reported for the treatment of bleeding varices depending upon whether the varices are focal or diffuse.[20]

Stoma Prolapse: A type of incisional hernia, prolapse is common with loop ileostomy and usually the distal limb prolapses. Raised intra-abdominal pressure and redundant bowel loop are considered as causes.[21] Fixation of bowel to the layers of abdominal wall and smaller stoma opening are proposed as preventive measures but without conclusive evidence. Stoma prolapse is managed conservatively unless complicated by ischemia. It maybe massaged back into the abdomen with gentle pressure. Edema is treated with local application of salt or sugar. Intractable or complicated prolapse needs surgical revision.[10]

Stoma Retraction: This results from pulling on the stomadue to inadequate mobilization of bowel. The retraction results in effluent being discharged at skin level, starting the vicious cascade of skin irritation, dislodgement of flange and further irritation. The treatment usually requires laparotomy to free the stoma-containing segment for tension-free exteriorization and relocation.[22]

Parastomal Hernia: Like all hernias, a parastomal hernia enlarges over time due to intraabdominal pressure and tissue atrophy. A small hernia may be found incidentally on imaging studies for unrelated indications. Large ones may contain bowel and omentum. It maybe asymptomatic or cause pain, discomfort, obstruction, strangulation or difficulty with appliance. Parastomal herniationis associated with increasing waist, stoma trephine size, abdominal wall thickness and age.[23] Treatment includesfacial-closure with or without prosthesis, and stoma relocation. Prophylactic mesh insertion has also been described with good results.[24]

Diversion proctocolitis: Colonic bacteria ferment indigestible complex carbohydrates to short-chain fatty-acids: butyrate, acetate and propionate. Butyrate is the main source of nutrition for colonocytes. Diversion of ileal contents from the colon decreases bacterial counts and depletes colonocytes of short-chain fatty-acids leading to atrophy of colonic mucosa.[25] Non-specific inflammatory changes follow prolonged diversion of the colon. The bacterial countsdecrease and mucosa and muscularis of the diverted colon undergo atrophyandreduction in all mucosal cells. This causes mucosal erythema, ulceration, nodularity and polyposis. Usually asymptomatic, diversion colitispresents with abdominal pain, tenesmus, mucus or bleeding per rectum. Treatment includes use of short-chain fatty-acids as enemas, administration of probiotics through the distal limband restoration of bowel continuity.[26]

Distal intestinal dysfunction: Atrophy of the mucosa and smooth muscle of the distal intestineresults in post-reversal dysmotility, impaired absorption, intestinal obstruction and may be responsible for anastomotic dehiscence.[27] Diverting ileostomy also delays transit time of the empty colon.[28]

Metabolic complications:

Ileostomy Diarrhea: Since the absorptive function of colon is lost, loss of fluids and electrolytes leads to a relative hypovolemia following ileostomy. High-output leads to dehydration, renal impairment, hyponatremia, hypokalemia, hypochloremia, metabolic acidosis and malnutrition. Clostridium difficile infection can also cause increased output. This infection can also occurafter closure of ileostomy.[29] High-output is directly proportional to the length of ileal resection.[30] Ileostomy starts functioning within 2-3 days post-operatively. Usual output ranges between 800-1200ml/day, requiring diligence in maintaining fluid and electrolyte balance. Severe hypovolemia, hypokalemia, hyponatremia, hypomagnesemia, hypocalcemia and nutritional deficiencies can occur. The output decreases to <800-1200ml/day after adaptation within two weeks. Hypotonic fluid intake is restricted to 500-1000ml/day. Oral rehydration solution helps limit sodium loss and maintains systemic electrolyte and intestinal osmotic balance. Patient is instructed to take smaller frequent meals and sips of fluids, instead of one large meal at once. Also avoid solid and liquid intake together to prevent a bolus effect.[31] Highfat and sugar intake must be avoided as they cause osmotic diarrhea. Bread, bananas and fiber supplement of 20-30mg/day thicken and reduce output, decreasing the risk of spillage and skin excoriation.[32] Antimotility agents loperamide, diphenoxylate and atropine 30 minutes before meals decrease intestinal transit time. Codeine and opium tincture may be used in intractable cases but have the potential for abuse. Antisecretory agents like H2-receptor or proton-pump inhibitors decrease stoma output by reducing gastric secretions. High output stomas of short-gut syndrome or very proximal stomas require fasting and total parenteral nutrition. Octreotide, teduglutide, steroids and human growth hormone have good results in high-output sto-

mas unresponsive to other measures.[33] Diverting ileostomy can result in metabolic acidosis or alkalosis, deficiency of bile acids, vitamin B-12, iron, selenium and zinc with respective sequelae.[34] Albumin levels must be corrected before ileostomy closure as prolonged ileostomy with serum albumin < 3.5g/dl increase morbidity after closure.[35]

Renal Stones: Patients with ileostomy can have recurrent renal stones. Theyhave decreased output of concentrated and acidic urinedue to excessive loss of water, electrolytes and bicarbonate in the effluent.[36] Intestinal transit in ileostomy is increased due to loss of functional ileocecal valve. This results in loss of more bile-acids in the effluent than can be re-absorbed in the entero-hepatic circulation, depleting the bile acid pool. This relative deficiency of bile acids results in malabsorption of fatty acids leading to steatorrhea. Fatty acids now bind calcium instead of oxalates, allowing free oxalates to get absorbed and crystalize in the kidneys. Loss of magnesium and citrate in effluent encourages calcium-oxalate stones as these inhibit crystallization of calcium and oxalate in urine. Similarly, loss of sodium bicarbonate combined with concentrated and acidic urine makes urine insoluble for uric acid causing its crystallization in urine. Treatment involves magnesium and calcium-supplements to bind oxalate, correction of hypovolemia, alkalinization ofurine to increase the solubility of uric acid and low fat and low oxalate diet.[37]

Gallstones: Like renal stones, patients with ileostomy can have gallstones due to impaired bile acid metabolism. Ileal disease, ileal resection orileostomy result in impairment of entero-hepatic circulation and depletion of bile acid pool.[38] This results in saturation of bilirubin or cholesterol in the bile causing their crystallization and stone formation.[39]

Conclusion:

Intestinal stomas significantly and negatively affect the lives of the ostomates. Stomal complications make things worse for them. Diligent surgical stewardship anddedicated nursing care not only decrease the risk of complications but also improve the quality of life of the ostomates. Stoma care should be part of general surgery residency program as a stoma therapist may not always be available, while surgeons will often encounter the need for a stoma procedure during their professional career. Patient education is also important for the successful outcome of a stoma. Surgical outpatient department must have stoma care clinics. Regular visits in such clinics should be integral to patient care in the pre-and-post-operative period. Pre-operative marking of the stoma site cannot be over emphasized. It reduces the risk of stoma-related complications and has a positive effect on the patient's quality of life. An unsightly stoma in anappropriate location is better than an elegant stoma in an inappropriate location.

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Zafar Ullah Khan, collected the data, references initial writeup and critically review the article.

Kamran Cheema, collected the data, references and also helped in discussin writing.

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