



Ileostomy: Early and Late Complications

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Abstract

Introduction Ileostomy formation is performed for multiple purposes related to intestinal pathology, such as obstructive malignant or benign tumors, inflammatory bowel diseases, intestinal ischemia, and, for the most part, as a protective stoma in high-risk anastomosis. The creation of this surgical opening, despite being considered a simple procedure, is undoubtedly followed by complications in certain cases.

Materials and Methods We conducted an electronic literature search in the MEDLINE database using the PubMed search engine. A total of 43 articles were included in the present review.

Results/Discussion Over the course of the present work, we were able to explore different types of complications that can arise in patients with an ileostomy. High-output stomas were found to be associated with dehydration and electrolyte imbalance. Skin-related morbidity was shown to be present in a great percentage of patients. More severe complications, such as peristomal pyoderma gangrenosum and necrosis, are less frequent and require urgent management. Several risk factors were identified in cases of retraction, obstruction, prolapse, and parastomal herniation.

Conclusion Even though ileostomies may present numerous benefits in certain patients, they are also associated with many complications, which should be avoided and quickly managed, because they can severely affect the quality of life of the patients. Surveillance and follow-up by a multidisciplinary team is strongly advisable, bearing in mind that a good performance on the part of the responsible surgeon is also a key factor.

Keywords

- ▶ ileostomy
- ▶ loop ileostomy
- ▶ end ileostomy
- ▶ stoma complications

Introduction

The formation of an ileostomy consists in bringing the lumen of the small bowel into the abdominal wall through a surgically created hole, more often on the right side of the abdomen. It is often performed with an end-purpose of protecting a low colorectal anastomosis, minimizing the consequences of complications from anastomotic leakage or dehiscence. These

procedures have been found to be very useful in cases of inflammatory bowel diseases, such as Crohn disease and ulcerative colitis. Regardless of the underlying pathology, an ileostomy should aim to improve the quality of life of the patient with the least number of limitations possible.¹ Two types of ileostomies can be performed: loop and end ileostomy. Diverting or loop ileostomies are normally useful in

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cases in which a low anterior resection is required due to rectal cancer, or in patients with ulcerative colitis who have undergone a restorative proctocolectomy with ileal pouch-anal anastomosis. This will enable the optimal healing process for the anastomosis and avoid many septic complications or leakage. Most ileostomies tend to be temporary; however, they may become permanent in specific cases of metastasis relapse, adjuvant chemotherapy, and perianal and anastomosis complications. End ileostomies can be created when temporary ileostomies fail to protect a recently-formed anastomosis, when the length of the small bowel is insufficient for the performance of an ileal pouch-anal anastomosis, or when the perianal area is highly compromised.²⁻⁴

Despite being considered a simple procedure, it is often followed by a full panoply of complications.⁵ According to the literature, the incidence of stoma-related complications ranges from 21% to 70%.⁶ These complications can arise from multiple factors, namely patient comorbidity and profile, surgeon experience, location of the stoma, and the elective or urgent character of the stoma formation. Out of all ostomies, ileostomies have the higher rate of complications, which tend to appear during the first 5 years postoperatively. Be that as it may, more delayed complications should not be discarded.^{1,6,7} Since they are noticeable, when present, these complications can have a huge impact on the mental health of the patients by lowering their self-esteem and altering their self-image. Thus, psychiatric disorders such as anxiety and depression may be found after hospitalization.^{8,9} Early complications are expected during the first 30 days after surgery, and they include: necrosis, retraction, skin irritation, dehydration/electrolyte imbalance, and leakage. Late complications occur after 30 days and can comprise of prolapse, obstruction, varices, parastomal hernia, adenocarcinoma, and pyoderma gangrenosum.^{6,9}

Therefore, the present article seeks to review the most frequent complications related to ileostomies.

Materials and Methods

An electronic literature search was performed in the PubMed/MEDLINE database for articles published until December 31st, 2022. The following search terms were used: *ileostomy complications* or *stoma complications* and *loop ileostomy* or *end ileostomy*. The inclusion criteria for the present study were systematic reviews and meta-analysis, narrative reviews, retrospective observational studies, and randomized controlled trials. Case reports were not included. A language filter was used to obtain only articles written in English or Portuguese. Nonetheless, it was necessary to research specific subtopics to achieve a more solid and sustainable narrative.

Results and Discussion

High-Output Stoma

A recently formed ileostomy is expected to present a daily output that can vary between 200 mL and 700 mL over a 24-

hour period depending on the patient's oral intake and body mass; fasting patients may present outputs ranging between 50 mL and 100 mL, for example. First, the excreted content consists of watery stools which, with time tend to be more thick and less abundant.^{10,11} Shortly after the surgery, 16% of the patients will present an elevated output through the stoma, and an estimated 7% of these patients will maintain high outputs for a prolonged time. There is no consensus regarding the definition of a high-output stoma, but many authors consider that values greater than 1,000 mL over 1 day or 1,200 mL over 2 consecutive days are responsible for causing fluid and electrolyte imbalances that lead to serious clinical effects.¹⁰⁻¹² It has been shown that dehydration is responsible for 40% to 62% of all hospital readmissions after an ileostomy, causing an enormous impact on the economy.¹³ Considering this, it is of the utmost importance to identify and take preventive actions regarding possible groups at risk. Liu et al.¹⁴ performed a meta-analysis and identified 8 risk factors for dehydration-related readmissions: age > 65 years (relative risk [RR]: 1.68; 95% confidence interval [95%CI]: 1.10–2.59), diabetes mellitus (RR: 1.64; 95%CI: 1.34–2.00), body mass index (BMI) > 30 Kg/m² (RR: 1.34; 95%CI: 1.05–1.71), hypertension (RR: 1.58; 95%CI: 1.34–1.87), renal disease (RR: 3.36; 95%CI: 1.52–7.45), diuretic use (RR: 3.33; 95%CI: 1.60–6.93), J-pouch procedure (RR: 1.92; 95%CI: 1.35–2.72), and length of stay during the index admission (mean days: 0.69 days; 95%CI: 0.28–1.10).

On the one hand, high-output stomas are often associated with extensive small bowel resections, in which less than 200 cm are preserved.^{7,11,15} Therefore, patients presenting jejunostomies are at high risk of developing a high-output stoma due to an anatomical short bowel syndrome. On the other hand, patients without bowel shortness can also present high-output stomas caused by radiation or infectious enteritis, intra-abdominal sepsis, Crohn disease activity, sudden cessation of corticosteroids, or the use of prokinetic drugs.¹²

Since this complication is common after an ileostomy and can lead to severe conditions such as dehydration, electrolyte depletion, tetanism, extreme fatigue, and acute kidney injury, healthcare professionals should be able to properly manage these situations.

A prospective study by Arenas Villafranca et al.¹⁵ demonstrated a very effective protocol to detect and manage high-output stomas that prioritizes the identification and treatment of the underlying cause before any action is taken. After that, the first approach consists in restricting oral fluid intake of more than 1,000 mL per day, giving preference to isotonic drinks, with the administration of intravenous hydration if needed, prescription of loperamide 2 mg 4 times a day (before breakfast, lunch, dinner and at night), assessment of complete blood analysis (including the levels of sodium, magnesium, potassium, calcium, vitamin B12), and then proceeding to any electrolyte supplementation that may be required. During this process, bodyweight, fluid balance and stoma output must be continuously monitored. In more refractory cases, pharmacological

treatment with cholestyramine, omeprazole, and codeine may be added to the previous measures.

Skin

Skin-related problems are by far the most common complications of an ileostomy, affecting around 25% to 43% of the patients.¹⁶ After gaining function, ileostomies will expel large amounts of watery stools with greater alkalinity and enzymatic levels because the colon's absorptive role is being bypassed. This process can unquestionably be very irritative and toxic for the skin, and will perpetuate damage and morbidity.^{7,16} Therefore, a valid method to avoid these complications may be attaching a spout measuring 2 cm to 3 cm to the ileostomy and avoiding any direct contact between the fluid and the skin. Furthermore, surgeons should aim to create a well-elevated stoma. Thus, it is of great importance to educate new ostomates about the correct management of the pouch and assure that the minimum contact between stools and skin is secured.^{10,16}

A retrospective study using a multivariable analysis by Maeda et al.¹⁷ evaluated the influence of certain risk factors on the emergence of skin complications; the authors concluded that a low-height stoma (odds ratio [OR]: 3.2; 95%CI: 1.6–6.3) and a high BMI (OR: 3.6; 95%CI: 1.5–8.6) are directly correlated with skin morbidity.

Skin complications can be caused by multiple factors such as trauma, mucocutaneous separation, adhesive manipulation, and infections. A mechanical trauma event associated with a warm and moisture environment around the stoma will provide conditions for an infection. Usually, fungal infections are the ones who tend to thrive more in those cases, and *Candida albicans* was found to be the most common agent associated with peristomal skin infection. These infections are frequently accompanied by intense pruritus, white pustules, and soreness; the treatment should consist of antifungal topical creams or nitrate miconazole 2% powder.^{10,16,18,19}

Contact dermatitis is the most common peristomal skin complication, and in 77% of the cases it is related to leakage that will irritate the skin.¹⁹ However, in certain cases, contact dermatitis can be secondary to an allergic reaction caused by any ostomy products, such as adhesives, creams, powders, belts or skin barriers. In those situations, the allergen must be quickly identified by experimentation and then ceased. To provide extra relief to the patient, certain topical steroids or oral antihistamines may be helpful.¹⁰

Occasionally, peristomal skin breakdown and irritation can be a consequence of an inappropriate position of the stoma.^{6,20} In fact, other complications such as leakage and poor visualization of the stoma may arise due to an inadequate position of the ileostomy. Hence, marking the stoma site before the surgery has been proven to diminish stoma-related complications. This strategy should be performed by a certified ostomy nurse, an enterostomal therapist or a surgeon during an extra patient visit before surgery.¹⁰

Zwiep et al.²⁰ developed a 17-step protocol on preoperative site marking: the patient is invited to a consultation in which the ostomy nurse or the surgeon will preview the abdomen in standing, sitting and dorsal decubitus positions;

then, the marking site will be placed between the beltline and the waistline, on the center of the imaginary diagonal line that unites the iliac crest and the umbilicus. It goes without saying that striving for a flat area and avoiding any skin scars, creases, hernias, and bony prominences is highly recommendable. The future stoma must be visible and reachable by the patient for an effortless management so we must include BMI in our decision.^{10,20}

Peristomal Pyoderma Gangrenosum

Pyoderma gangrenosum was first described as a skin ulceration. Nowadays, it is considered a neutrophilic dermatosis that causes severe pain and skin ulceration.^{21,22} Its etiology is still unknown, and few studies²³ have been performed on this subject. This dermatosis has displayed fast dissemination and a tendency to affect various body parts, such as the head, neck, back, abdomen, chest, and incision sites. In a systematic review, Afifi et al.²² found that in around 15% of the cases, pyoderma gangrenosum emerges from peristomal sites and, in those cases, 78% of the affected stomas are ileostomies. This harmful and unpredictable complication was found to have a profound association with inflammatory bowel diseases, malignancy states, and autoimmune pathology.²¹ Actually, pyoderma gangrenosum is the second most frequent dermatological condition in patients with inflammatory bowel disease.²³ Peristomal pyoderma gangrenosum can occur in any time frame throughout the life of an ostomate, which can be weeks or years after the stoma creation, with an incidence ranging from 1.5% to 4.3%.^{6,21}

Wang et al.²³ performed a retrospective case-control study on 123 patients with previously diagnosed with Crohn disease or ulcerative colitis, in which they sought to identify risk factors for the development of pyoderma gangrenosum; the female sex, elevated BMI, and the use of a pouch belt were found to be associated with a higher incidence of cases of pyoderma gangrenosum.

This complication usually begins with pustules and papules; then ulcerative and necrotic processes start. Characteristically, the area of the lesion arises with well-defined, undermined, and violaceous borders.²⁴ Due to its lower incidence, pyoderma gangrenosum is often unrecognized by healthcare professionals, causing late or missed diagnoses. A final diagnosis of pyoderma gangrenosum may be established by a multidisciplinary team with a dermatologist performing a key role.²⁵ In some cases, biopsy and wound culture may be helpful to confirm the diagnosis but their accuracy remains challenging. In terms of treatment, there is still no consensus, but surgical or medical therapies are available. A step-up strategy using as the initial approach topical therapies (steroids, calcineurin inhibitors or antibiotics) followed by systemic therapies should be attempted.^{22,25} Anti-tumor necrosis factor (anti-TNF) agents such as infliximab and adalimumab have shown great efficacy and response rate.²²

Necrosis

Stomal necrosis consists in the death of stomal tissue and, in most cases, it occurs due to ischemia.^{7,18} Therefore, avoiding

an ischemic process should be the very basis of a well-performed ileostomy. Immediately after the surgery, a stoma may acquire an edematous look due to venous stasis, but, with time, it is supposed to achieve a normal appearance.^{6,26} However, in certain cases, an underlying arterial insufficiency can be present, and ischemia will arise from an insufficient blood supply. Therefore, searching for possible signs of necrosis in the operating room can be very useful and avoid further interventions; when present, actions such as trimming excessive mesenteric fat or enlarging the opening should be considered.²⁷ It is advisable that the surgeons identify the bowel segment that will be used for the ileostomy and continuously check and track any signs of ischemia.^{26,27}

Superficial necrosis has been shown to occur in up to 20% of new ostomates after surgery, and more serious and deep necrosis, in up to 3%.²⁷ Certain risk factors such as emergency surgery, excessive mesenteric and epiploic fat resection, late bowel segment mobilization, and inadequate small openings in the fascia may be associated with those cases. It is known that obesity will elevate the chances of stoma necrosis by seven times.²⁶ Thus, in obese patients, a more superior site position might be beneficial to the irrigation of the stoma, since the upper quadrants of the abdomen are thinner and, as such, less adipose, and mesenteric tissue needs to be dissected to elevate the stoma during the surgery.²⁷

Regarding ileostomies, stoma necrosis is less commonly associated with the creation of a loop ileostomy than an end ileostomy, since the former receives a dual blood supply from the two branches.²⁶

Retraction

Stoma retraction is more likely to occur shortly after surgery, but it also can be found months or years after the stoma formation.¹⁰ This complication is usually associated with loop ileostomies, and it may occur months after surgery in 11% to 24% of all ileostomies.^{28,29} Excessive stoma tension related to obesity, poor site selection or inadequate bowel mobilization were found to be triggers for the onset of retraction and to be associated with stoma necrosis.³⁰ Smoking, diabetes, steroid use and malnutrition may also be related to the incidence of retraction.^{10,31} On the one hand, in certain cases, retraction will not enable the pouch to be properly sealed around the stoma, resulting in skin irritation due to site contamination. On the other hand, more exuberant retractions will lead to urgent and extreme situations, in which fecal diversion might come into contact with innermost tissues such as the peritoneum.³¹ These situations require strict surveillance, since a septic state is more likely to emerge and immediate surgery may be mandatory.

For many years, some surgeons have been using stoma rods as a supportive bridge for the two branches of the loop ileostomy. These rods are used in an attempt to prevent early retraction of the stoma, but there is no real consensus in the recent literature about their efficiency and duration of use.^{29,32}

Whiteley et al.³¹ performed a large prospective study involving 515 patients, and they demonstrated that retraction is a rare complication that is not affected by rod support. This study showed no decrease in stoma retraction when rods were applied for 3.5 days. Furthermore, other postoperative complications, such as peristomal skin irritation, were more prevalent when supportive rods were used.

Obstruction

Stomal obstruction consists in the presence of a blockage at the stoma outlet, and it affects around 6% to 26% of all ostomies.^{33,34} In cases in which outlet narrowing becomes significant, the onset of audible noises during flatus passage can be very common and found to be very disturbing and embarrassing for the ostomates. This complication occurs more often in patients who underwent a temporary ileostomy than in patients with a colostomy.³⁴

This obstruction is usually noticed when an absence of fecal discharge after surgery exists or in the presence of mechanical ileus is.³⁵ Due to these phenomena, patients will present abdominal distension, nausea, vomiting, and ileal bowel dilatation. Furthermore, obstruction can be confirmed by computed tomography or simply by inserting a finger into the outlet. In a retrospective study, Tamura et al.³⁵ analyzed 230 patients who underwent laparoscopic low anterior resection with simultaneous derivative ileostomy. They found that thickness of subcutaneous fat at the stomal site greater than 20 mm was a significant risk factor for outlet obstruction. A 7% incidence of outlet obstruction among all patients was also documented.

Okada et al.³⁶ reported a higher risk of outlet obstruction in patients with ulcerative colitis and loop ileostomy creation. However, no evidence that patients with stoma obstruction are more likely to develop small bowel obstruction was found.

Stomal Prolapse

Stomal prolapse is found when the proximal segment of the bowel becomes intussuscepted and slides to protrude through the stoma site. This complication is significantly more frequent in loop colostomies, but it also can occur in approximately 3% of ileostomies. This can be very alarming for the patient, who will need an explanation about what is happening.³⁷⁻³⁹ Prolapse of the stoma may be intermittent or permanent, and it is often associated with multiple complications, such as parastomal hernia, skin excoriation, bleeding, and stoma management problems.³⁸ In certain cases, severe strangulation of the protruded stoma will lead to ischemia, requiring emergency surgical treatment.

Several etiologic factors have been associated with a higher incidence of stomal prolapse, such as obesity, pregnancy, conditions causing elevated abdominal pressure, chronic obstructive lung disease, and large surgical incisions.^{7,38,39}

Different grades of severity of a prolapse can be identified using a classification well described by Maeda,³⁹ which defines as grade 1 cases of reducible and asymptomatic prolapse; grade 2 refers to recurrent prolapse after manual

reduction; Grade 3 is represented by more serious conditions that affect daily activities and present high-intensity symptoms, such as severe pain and unmanageable stoma; and grade 4 consists in life-threatening situations following a stoma prolapse. This classification can be helpful in terms of the choice of treatment. In certain cases of grade-3 prolapse, the performance of an elective surgery might be adequate; regarding cases of grade-4 prolapse, an emergency surgical correction may be required. In terms of surgery methods, many techniques can be used to repair the prolapse; however, they should aim at fixing the intestine, shortening the intestine or repairing the stoma outlet.^{38,39}

Parastomal Hernia

Parastomal hernias are incisional hernias formed in the stoma site or directly adjacent to the stoma, where the intra-abdominal organs protrude through the previously-created trephine due to constant centrifugal forces.^{10,40} Typically, a physical examination is sufficient for the diagnosis of a parastomal hernia, but, in certain cases, a computed tomography (CT) scan or ultrasound are required to obtain a better view.^{40,41} In general, parastomal hernias do not originate vigorous symptomatology; however, some difficulties regarding appliance fitting and social embarrassment due to an increased size can be present. More serious complications, such as strangulation, obstruction, and perforation are less likely to occur.^{6,40} The incidence of parastomal hernias was found to be of around 6.7% in end-ileostomies and of 1.3% in loop ileostomies.⁴⁰

In literature review, Śmietański et al.⁴² (European Hernia Society) proposed a brand-new classification to describe parastomal hernias in which size, the presence of coexisting incisional hernia, and recurrence were the variables considered. According to this classification, 4 subtypes were identified, and the main cut-off to distinguish small hernias from large hernias is a parastomal hernia of 5 cm in size. The measurement should be performed intraoperatively even though a CT scan may also be useful to evaluate size and conditions before the surgical correction.⁴² This classification aims to achieve a consensus among surgeons toward parastomal hernias and enable better efficiency whenever a discussion on treatment strategy arises.

Several studies^{6,40,41} have identified many patient-related risk factors associated with the development of parastomal hernias, such as: age >60 years; obesity; waist circumference >100 cm; diabetes; smoking; chronic obstructive pulmonary disease; and Crohn disease.

Regarding surgery-related risk factors, the urgency of the surgery, preoperative stoma site selection, trephine size, surgeon experience and stoma size are correlated with the incidence of parastomal hernia.^{6,40} Furthermore, data⁴⁰ indicates that time is a key factor for the formation of hernias, with an incidence of parastomal hernia of around 59% to 76% after 20 years. Since it is a matter of time until herniation occurs, many surgeons are in favor of performing prophylactic measures, which include the use of a mesh upon stoma

construction. However, current studies^{40,43} have not shown significant benefits regarding the use of these meshes in ileostomies. To avoid a herniation process, surgeons must create a stoma aperture with the minimum size possible without compromising its perfusion. In fact, there is no consensus in the literature about the ideal size of the fascial aperture; nevertheless, the use of trephines shorter than 3 cm has shown lower incidence rates of parastomal hernia.^{40,41,43}

In terms of surgical repair, a laparoscopic or an open correction should be performed when signs of strangulation, obstruction, perforation, incarceration are detected, or when the excessive size of the hernia is hampering the management and visualization of the stoma.⁴⁰ Repairing the hernia aperture is more likely to succeed when a mesh is included in the surgical approach than when only a simple suture method is applied.⁴³ Also, if a laparoscopic procedure is chosen, surgeons should know that the Sugarbaker technique has been associated with lower recurrence rates in comparison with keyhole mesh repairs.⁴⁰ More recently, the Sandwich technique, which combines the Sugarbaker technique with a keyhole mesh, was found to be highly effective.^{40,43}

Conclusion

Throughout the years, ileostomies have shown great usefulness in protecting recently-performed anastomoses and in the management of certain cases of bowel obstruction. However, this surgical procedure comes with a considerable risk of postoperative morbidity and complications. Since those complications are relatively frequent, many studies^{6,10,11,15} have been able to provide reliable evidence about their predictors, risk factors and how they can be approached. It is of the highest importance to use this information to improve surgical planning and minimize the risks. General practitioners and healthcare professionals ought to be able to identify most of the ostomy-related problems. In some cases, such as those in which a necrotic or ischemic process is present, time will be a precious factor regarding the resolution of the complication. Thus, we must strive for an early diagnosis to reduce postoperative morbidity associated with stoma complications. A multidisciplinary team should be involved whenever an ileostomy is planned, and it should always strive to provide good quality of life for the patient. As aforementioned previously, when possible, every candidate to an ileostomy should be followed by an ostomy nurse specialist for an adequate preoperative stoma site marking and proper training about the care and requirements of a brand-new stoma. Great care and commitment on the part of the surgeons are recommended when performing any ileostomy, since it is very susceptible to complications. Avoiding ileostomy-related problems must be a major goal in the clinical practice, since their consequences can be disastrous. Given the high incidence of stoma complications and the fact that their onset is directly related to time, on the one hand, temporary ileostomies should be, according to the

conditions and morbidity of the patient, maintained for as little as possible. On the other hand, in patients whose ileostomies tend to be permanent, prophylactic measures, such as an adequate site selection, a proper surgical technique, and an experienced surgeon or even an additional abdominal wall surgeon just for the stoma construction, can provide good outcomes. Undergoing an ostomy has major impacts on the quality of life (regarding the social, sexual, and psychological aspects) of every patient, so it is in our best interest to make sure that stoma complications do not contribute to extra morbidity.

Conflict of Interests

The authors have no conflict of interests to declare.

References

- Ma H, Li X, Yang H, Qiu Y, Xiao W. The Pathology and Physiology of Ileostomy. *Front Nutr* 2022;9:842198
- Amiot A, Gornet JM, Baudry C, et al. Crohn's disease recurrence after total proctocolectomy with definitive ileostomy. *Dig Liver Dis* 2011;43(09):698–702
- Fonseca T, Campos E, Castro MM, Costa S, Azevedo A, Barbosa E. Defunctioning loop ileostomy in rectal cancer surgery: The experience of a referral center. *Rev Port Cir* 2022;2(53):27–36
- Tsujinaka S, Suzuki H, Miura T, Sato Y, Shibata C. Obstructive and secretory complications of diverting ileostomy. *World J Gastroenterol* 2022;28(47):6732–6742
- Pandiaraja J, Chakkarapani R, Arumugam S. A study on patterns, indications, and complications of an enteric stoma. *J Family Med Prim Care* 2021;10(09):3277–3282
- Shabbir J, Britton DC. Stoma complications: a literature overview. *Colorectal Dis* 2010;12(10):958–964
- Babakhanlou R, Larkin K, Hita AG, Stroh J, Yeung SC. Stoma-related complications and emergencies. *Int J Emerg Med* 2022;15(01):17
- Tripaldi C. Sexual function after stoma formation in women with colorectal cancer. *Br J Nurs* 2019;28(16):S4–S15
- Krishnamurthy DM, Blatnik J, Mutch M. Stoma Complications. *Clin Colon Rectal Surg* 2017;30(03):193–200
- Bafford AC, Irani JL. Management and complications of stomas. *Surg Clin North Am* 2013;93(01):145–166
- Baker ML, Williams RN, Nightingale JMD. Causes and management of a high-output stoma. *Colorectal Dis* 2011;13(02):191–197
- Baker M, Greening L. Practical management to reduce and treat complications of high-output stomas. *Gastrointest Nurs* 2009;7(06):10–17
- Liu C, Bhat S, O'Grady G, Bissett I. Re-admissions after ileostomy formation: a retrospective analysis from a New Zealand tertiary centre. *ANZ J Surg* 2020;90(09):1621–1626
- Liu C, Bhat S, Sharma P, Yuan L, O'Grady G, Bissett I. Risk factors for readmission with dehydration after ileostomy formation: A systematic review and meta-analysis. *Colorectal Dis* 2021;23(05):1071–1082
- Arenas Villafranca JJ, López-Rodríguez C, Abilés J, Rivera R, Gándara Adán N, Utrilla Navarro P. Protocol for the detection and nutritional management of high-output stomas. *Nutr J* 2015;14(01):45
- Steinhagen E, Colwell J, Cannon LM. Intestinal Stomas-Postoperative Stoma Care and Peristomal Skin Complications. *Clin Colon Rectal Surg* 2017;30(03):184–192
- Maeda S, Ouchi A, Komori K, et al. Risk factors for peristomal skin disorders associated with temporary ileostomy construction. *Surg Today* 2021;51(07):1152–1157
- Maglio A, Malvone AP, Scaduto V, Brambilla D, Denti FC. The frequency of early stomal, peristomal and skin complications. *Br J Nurs* 2021;30(22):1272–1276
- O'Flynn SK. Care of the stoma: complications and treatments. *Br J Community Nurs* 2018;23(08):382–387
- Zwiep TM, Helewa RM, Robertson R, et al; Canadian Society of Colon and Rectal Surgeons and Nurses Specialized in Wound, Ostomy and Continence Canada preoperative stoma marking position statement task force. Preoperative stoma site marking for fecal diversions (ileostomy and colostomy): position statement of the Canadian Society of Colon and Rectal Surgeons and Nurses Specialized in Wound, Ostomy and Continence Canada. *Can J Surg* 2022;65(03):E359–E363
- Wu XR, Mukewar S, Kiran RP, Remzi FH, Hammel J, Shen B. Risk factors for peristomal pyoderma gangrenosum complicating inflammatory bowel disease. *J Crohn's Colitis* 2013;7(05):e171–e177
- Affi L, Sanchez IM, Wallace MM, Braswell SF, Ortega-Loayza AG, Shinkai K. Diagnosis and management of peristomal pyoderma gangrenosum: A systematic review. *J Am Acad Dermatol* 2018;78(06):1195–1204.e1
- Wang J, Prenner J, Wang W, et al. Risk factors and treatment outcomes of peristomal pyoderma gangrenosum in patients with inflammatory bowel disease. *Aliment Pharmacol Ther* 2020;51(12):1365–1372
- Hughes AP, Jackson JM, Callen JP. Clinical features and treatment of peristomal pyoderma gangrenosum. *JAMA* 2000;284(12):1546–1548
- Toh JWT, Young CJ, Rickard MJFX, Keshava A, Stewart P, Whiteley I. Peristomal pyoderma gangrenosum: 12-year experience in a single tertiary referral centre. *ANZ J Surg* 2018;88(10):E693–E697
- Murken DR, Bleier JIS. Ostomy-Related Complications. *Clin Colon Rectal Surg* 2019;32(03):176–182
- Kwiat M, Kawata M. Avoidance and management of stomal complications. *Clin Colon Rectal Surg* 2013;26(02):112–121
- Strong SA. The Difficult Stoma: Challenges and Strategies. *Clin Colon Rectal Surg* 2016;29(02):152–159
- Speirs M, Leung E, Hughes D, et al. Ileostomy rod—is it a bridge too far? *Colorectal Dis* 2006;8(06):484–487
- Kim JT, Kumar RR. Reoperation for stoma-related complications. *Clin Colon Rectal Surg* 2006;19(04):207–212
- Whiteley I, Russell M, Nassar N, Gladman MA. Outcomes of support rod usage in loop stoma formation. *Int J Colorectal Dis* 2016;31(06):1189–1195
- Mohan HM, Pasquali A, O'Neill B, Collins D, Winter DC. Stoma rods in abdominal surgery: a systematic review and metaanalyses. *Tech Coloproctol* 2019;23(03):201–206
- Ohira G, Miyauchi H, Hayano K, et al. Incidence and risk factor of outlet obstruction after construction of ileostomy. *J Anus Rectum Colon* 2018;2(01):25–30
- Sasaki S, Nagasaki T, Oba K, et al. Risk factors for outlet obstruction after laparoscopic surgery and diverting ileostomy for rectal cancer. *Surg Today* 2021;51(03):366–373
- Tamura K, Matsuda K, Yokoyama S, et al. Defunctioning loop ileostomy for rectal anastomoses: predictors of stoma outlet obstruction. *Int J Colorectal Dis* 2019;34(06):1141–1145
- Okada S, Hata K, Emoto S, et al. Elevated risk of stoma outlet obstruction following colorectal surgery in patients undergoing ileal pouch-anal anastomosis: a retrospective cohort study. *Surg Today* 2018;48(12):1060–1067
- Güenaga KF, Lustosa SAS, Saad SS, Saconato H, Matos D. Ileostomy or colostomy for temporary decompression of colorectal anastomosis. Systematic review and meta-analysis. *Acta Cir Bras* 2008;23(03):294–303

- 38 Mittal R, Jalouta T, Luchtefeld M, Ogilvie J Jr. Surgical management of stomal prolapse - Is there a superior approach to repair? *Am J Surg* 2020;220(04):1010-1014
- 39 Maeda K. Prolapse of intestinal stoma. *Ann Coloproctol* 2022;38(05):335-342
- 40 Styliński R, Alzubedi A, Rudzki S. Parastomal hernia - current knowledge and treatment. *Wideochir Inne Tech Malo Inwazyjne* 2018;13(01):1-8
- 41 Pu YW, Yang XD, Gong W, Xing CG. Etiological analysis of parastomal hernia by computed tomography examination. *Wideochir Inne Tech Malo Inwazyjne* 2019;14(03):387-393
- 42 Śmietański M, Szczepkowski M, Alexandre JA, et al. European Hernia Society classification of parastomal hernias. *Hernia* 2014;18(01):1-6
- 43 Antoniou SA, Agresta F, Garcia Alamino JM, et al. European Hernia Society guidelines on prevention and treatment of parastomal hernias. *Hernia* 2018;22(01):183-198