Intestinal stomas

Dominic Thompson
Glynnis Morris
Rhiannon Harries

Abstract

An intestinal stoma is an opening created surgically connecting the bowel to the skin for predominantly diversion of faeces it remains essential in gastrointestinal surgery. The main types of intestinal stoma are ileostomy and colostomy, they are classified by anatomical site, configuration, duration and function. Indications for stoma include decompression of bowel, faecal diversion or enteral feeding in conditions such as inflammatory bowel disease, malignancy or trauma. Techniques for stoma formation include open, trephine, laparoscopic or robotic. Each technique includes careful and adequate mobilization of bowel, preserving good quality blood supply and constructing a tension free stoma. Complications occur in around 40% of cases, early complications include ischaemia or retraction, and late complications include parastomal hernia and stenosis. Effective stoma care involves education and psychological support from specialist stoma nurses and has been demonstrated to significantly improve quality of life in this patient cohort. Minimally invasive robotic techniques are emerging along with other technological innovations such as three-dimensional (3D)-printed appliances and artificial intelligence (AI)-supported online care. These are improving both recovery in the postoperative phase and comfort in the longer term.

Keywords Colorectal surgery; colostomy; ileostomy; intestinal stoma; parastomal hernia

Introduction

The word stoma in a medical context is defined as "an artificial opening made in an organ of the body".[1] An intestinal stoma is an opening made connecting the bowel to the skin predominantly for diversion of faeces.[2] The first successful stoma was formed as early as 1793 and currently the most common intestinal stomas used are ileostomy and colostomy.[3] Despite significant advances in anastomotic techniques and perioperative management, intestinal stomas remain an essential aspect of gastrointestinal surgery. This review will provide an overview of intestinal stomas, focusing on types, indications, surgical techniques for creation and reversal, associated complications and stoma care.

Dominic Thompson ***MBBCh BSc MRCS*** *is a speciality trainee in Colorectal and General surgery at Glangwili Hospital, Carmarthen, UK. Conflicts of interest: none declared.*

Glynnis Morris ***BSc*** *is a Specialist stoma nurse in Morriston Hospital, Swansea, UK. Conflicts of interest: none declared.*

Rhiannon Harries ***BMBS MD FRCS*** *is a consultant Colorectal and General Surgeon at Morriston Hospital, Swansea, UK. Conflicts of interest: none declared.*

Types and classification of intestinal stomas

Stomas can be classified in several ways including anatomical site, structural configuration, intended duration and function (Table 1). The anatomical site of a stoma is defined in relation to the segment of bowel used for the opening. Small bowel stomas are most commonly ileostomies, fashioned from ileum in the right lower quadrant of the abdomen (Figure 1). Jejunostomies are derived from jejunum, are less common and usually created in specific circumstances such as enteral feeding or proximal obstruction. The output of small bowel stoma is liquid, rich in digestive enzymes and electrolytes, output volume will vary depending on stoma location and reason for formation, ideally it should be <1.5 litres/day. A colostomy is a stoma made from large bowel, often placed in the left lower quadrant of the abdomen (Figure 2). If transverse colon is used, they may be found in the upper abdomen however they are notorious for prolapsing. Colostomy output consistency is of more formed stool, lower in digestive enzymes, electrolytes and volume.

Assessment of the structural configuration of a stoma can be done by direct visualization. The three main types of configurations are an end, a loop or a double-barrelled stoma. Configuration is closely related to the intended duration and function of the stoma. An end stoma is formed when the bowel continuity is divided, and the proximal end is brought out to the skin. The distal portion of the bowel may be closed or removed. End stomas are utilized in the emergency and elective setting. Two common elective examples is an end colostomy in an abdominoperineal excision of rectum (APER) or an end ileostomy in a panproctocolectomy, in both situations' bowel continuity cannot be restored as the distal bowel has been removed. A common emergency example is an end colostomy formed during Hartmann's procedure, where bowel continuity cannot be restored due to patient instability or high risk of anastomotic leak.

A loop stoma is formed by bringing a loop of small or large bowel out through the abdominal wall to the surface of the skin, the bowel is incompletely transected and there will be two openings, the proximal end will discharge effluent. Loop stomas can be formed from small or large bowel and most commonly from ileum or sigmoid colon they are also used in the elective and emergency setting. A loop ileostomy can be used to defunction the anastomosis in a low anterior resection. A loop sigmoid colostomy may be used to defunction an obstructing rectal or rectosigmoid lesion. A double-barrelled stoma utilized in both the emergency and elective setting is important to differentiate from a loop stoma, they are created by completely transecting the bowel and bringing both limbs to the skin, either as separate stomas or through a single facial defect.[2] This type of stoma can be used in a patient with inflammatory bowel disease where there is concern there may be a distal stump blow out peritoneal contamination and subsequent sepsis, thus the distal limb is made into a mucous fistula. It may also be used in the setting of an anastomotic leak following a right hemicolectomy, with the proximal small bowel and distal colon brought out as a double barrelled stoma. In trauma where the patient is unstable or the field is grossly contaminated a section of colon may be resected and a double-barrelled stoma constructed. Urostomy is a stoma formed to excrete urine in the event of removal of bladder and prostate. A section of small bowel is used to plumb the

Indications for stoma formation

Jejunostomy	
Feeding jejunostomy	For enteral feeding where oral/gastric route not available, e.g. malignancy involving proximal gastrointestinal tract oesophagus, stomach duodenum
Decompressive jejunostomy	Proximal small bowel obstruction, e.g. adhesions, malignancy
Ileostomy	
End ileostomy	Total colectomy for inflammatory bowel disease, e.g. Chron's disease or ulcerative colitis – which has not responded to medical therapy/toxic megacolon or perforation Total colectomy for hereditary bowel cancer, e.g. familial adenomatous polyposis, hereditary nonpolyposis colorectal cancer, MUTYH-associated polyposis, juvenile polyposis
Defunctioning loop ileostomy	Diversion for distal obstruction (in the event of an incompetent ileocaecal valve) allowing neoadjuvant oncological treatment or planning of definitive management, e.g. malignant or benign disease Protection of a distal anastomosis, e.g. low anterior resection, any high-risk anastomosis Emergency setting, e.g. anastomotic leak
Colostomy	
End colostomy	Rectal or anal cancer where anastomosis not appropriate/possible or complete excision of sphincters required, e.g. abdominoperineal excision of rectum Emergency setting Hartmann's procedure e.g. diverticular or malignant perforation, traumatic large bowel injury
Defunctioning loop colostomy	Divert faeces from a distal obstruction to allow neoadjuvant treatment or planning of definitive management, e.g. malignant or benign disease Emergency setting, e.g. anastomotic leak, perianal sepsis, necrotizing fasciitis, rectal trauma
Miscellaneous	
ACE (antegrade colonic enema)	A stoma or channel created most often using the appendix to allow regular administration of irrigation as treatment of severe constipation or faecal incontinence
Kock pouch (continent ileostomy)	Formation of a small bowel pouch with a one-way valve intra-abdominally to allow a catheter to be inserted to allow bowel contents to be eliminated, in patients who have previously had their colon and anus removed and wish to avoid an ostomy bag

Table 1

Figure 1 End ileostomy.

ureters on and divert out via the skin. Urostomies will not be covered further in this review.

The intended duration and function of a stoma is directly linked. Stomas can be permanent, or temporary and the function may be defunctioning or terminal. Permanent stomas will not be reversed, temporary stomas may be reversed with a further

Figure 2 End colostomy.

operation. Permanent stomas are formed when the lower rectum and anus are removed so they cannot be reversed. If the anus is preserved, all other stomas can theoretically be reversed although this may not be appropriate in certain situations.[2]

Surgical techniques for stoma formation

The formation of an intestinal stoma should include patient optimization, preoperative planning, preoperative marking and specialist nurse counselling and selection of a suitable operative approach (open, laparoscopic or robotic). These steps are critical to reduce complications and improve patient outcomes.

Preoperative planning and optimization

A multidisciplinary approach to preoperative planning and decision-making should be implemented wherever possible in both the emergency and elective setting. There is clear evidence for multidisciplinary team (MDT) decision-making in relation to cancer.[4] This includes surgeons, stoma nurse specialist, oncologists where appropriate, anaesthetists and other MDT members. Specialist nurses can help guide stoma type and site selection helping to plan for patient education and guidance. Input from different surgeons ensures that different types and configurations are considered. Oncologist involvement helps to plan for neoadjuvant therapy which may guide type of stoma. Anaesthetic involvement helps evaluate co-morbidities which affect whether different surgical approaches are appropriate, some patients with significant cardiorespiratory dysfunction may be unsuitable for laparoscopic or robotic approaches. Clinical optimization is essential, with resuscitation prioritized in emergencies and nutritional status electively.

In the elective and if possible in the emergency setting patients should be counselled by a specialist nurse on living with a stoma. Specialist nurses can site the stoma on a flat area of skin away from scars, creases and bony prominences allowing the patient to see and manage the appliance more easily. Patient lifestyle factors are also taken into consideration such as work or physical activity garments. If the patient is a wheelchair user then they should be sited in it. Evidence suggests that early involvement of specialist stoma nurses enhances patients' quality of life by alleviating anxiety and promoting adherence to postoperative care.[5]

Key principles applicable to all techniques

There are several key principles which are applicable to all operative techniques of jejunostomy, ileostomy and colostomy formation. An appropriate section of bowel should be selected. Meticulous care and attention ensuring good haemostasis and a clean field helps reduce risk of postoperative infection improving post operative healing. The chosen bowel segment must be mobilized sufficiently ensuring the blood supply is not compromised to reach the anterior abdominal wall and under no tension. Tension on the stoma can cause retraction and ischaemia. Conversely over mobilization may compromise mesenteric blood supply or predispose internal herniation of bowel.[2] An appropriately sized fascial aperture should be fashioned to permit passage of the bowel, ensuring a defect proportional to bowel diameter, typically 2–3 cm for ileostomy and 3–4 cm for colostomy, this minimizes risk of venous congestion or parastomal hernia (Figure 3a). Whilst forming the stoma tract care not to damage adjacent structures must be ensured, damage to epigastric vessels increases risk for bleeding and haematoma. Ensuring that the tract is straight and perpendicular to the abdominal wall reduces risk of twisting in the bowel which can lead to obstruction or ischaemia.[5]

Whilst bringing the bowel through the stoma tract the anatomical lie of the mesentery and orientation of the bowel must be reviewed to ensure that the mesentery is not twisted thus compromising the blood supply to the stoma (Figure 3b and 3c) The bowel should be fixated using absorbable sutures

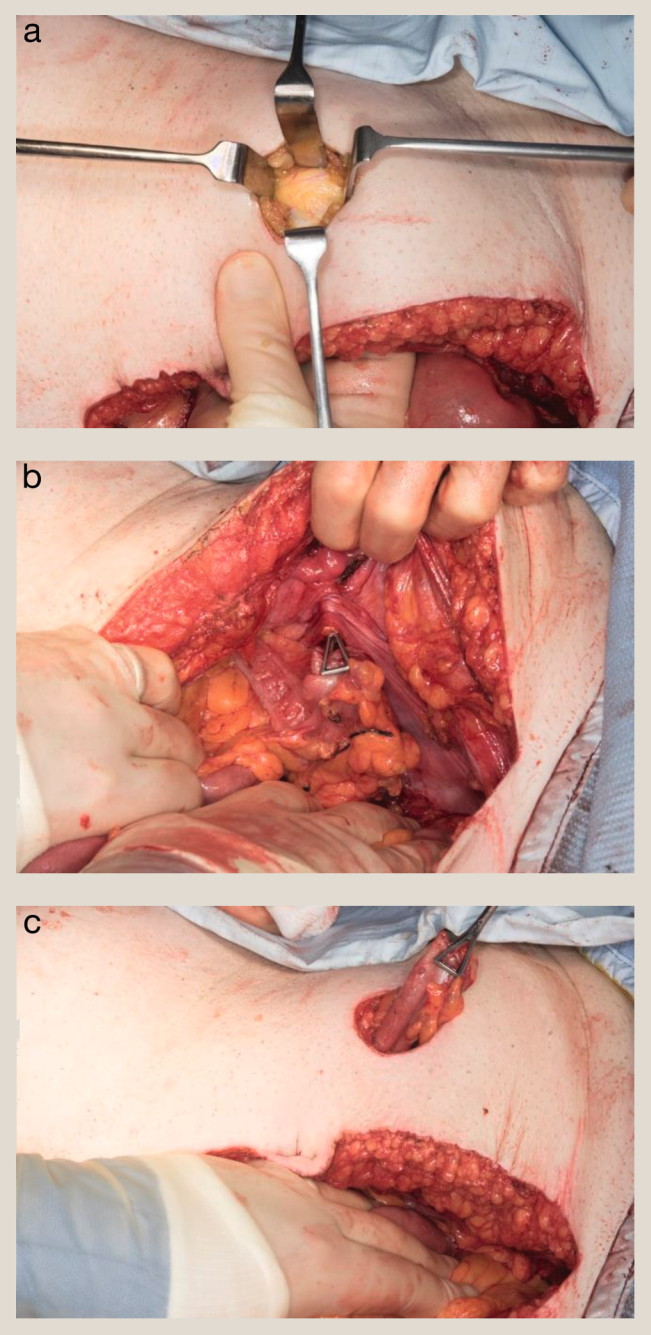

Figure 3 (**a**) Making the trephine. (**b**) Delivering the bowel via trephine. (**c**) Delivering the bowel via the trephine.

between to the skin (subcuticularly to avoid granuloma formation) and full thickness on the bowel. Peristomal dead space should be minimized, this reduces the risk of peristomal abscess or seroma formation. Ileostomies should be spouted around 2 −3 cm above skin level to reduce small bowel effluent contacting skin. It is optimal for colostomies where possible to be slightly everted.[5]

Open or trephine stoma formation

Open stoma formation is the most widely practised technique for forming all types of stomas. In patients who are undergoing other procedures or have had previous abdominal surgeries a midline laparotomy might be required. A laparotomy allows for open mobilization and direct visualization of the bowel orientation as well as tactile feedback for tension on the bowel leading to the stoma. They do however lead to increased pain, risk of ileus, wound complications and increased risk of other morbidity due to immobility and longer recovery postoperatively.[6]

A trephine stoma is used in patients who do not require a laparotomy but need a defunctioning stoma. A trephine incision is a small incision at the planned site for the stoma through which a section of bowel can be brought to the abdominal wall. The benefits of this are that it has some advantages of minimal invasive approach without full laparoscopic or robotic set-up, it may be more suitable for high-risk patients who will not tolerate pneumoperitoneum. However, correct orientation and location of the bowel can be difficult to ensure, and intra-abdominal exploration is not possible. This technique may not be possible in obesity or patients with intra-abdominal adhesions.[6]

Laparoscopic stoma formation

Laparoscopic stoma formation is a commonly used minimally invasive technique used to form any type of stoma. The bowel can be directly visualized, mobilized if needed and a trephine stoma brought out. After the stoma has been brought out through the abdominal wall the pneumoperitoneum can be reintroduced and stoma orientation checked. The benefits to this technique are reduced post operative pain, reduced wound complications and faster recovery with lower rates of ileus. This results in a shorter hospital stay and faster return to function. However, in patients who have adhesions or extensive surgical history this technique may not always be possible.

Robotically assisted stoma formation

Robotically assisted stoma formation is an emerging technique in elective colorectal surgery it can be used to form any type of stoma. Robotic ports are placed ensuring optimized access and visualization of the bowel. The bowel can be mobilized with the assistance of the robot and with clear three-dimensional (3D) visualization of mesenteric vessels and other surrounding structures. The stoma can be matured externally as with other techniques or with the option of intracorporeal maturation. The benefits of the robot demonstrated are improved 3D visualization and tissue handling of bowel and mesentery. There has been evidence that patients who undergo robotic resections with stoma formation have reduced length of stay, but evidence specifically related to independent stoma formation has not yet been demonstrated.[7] There are limitations due to time in theatre needed, cost and lack of robot availability and ongoing research looking specifically at isolated robotic stoma formation is required.

Complications: early and late

Despite stoma formation being a well-established procedure with clear evidence-based techniques complication rates are still around 40%, with a large proportion of these complications requiring return to theatre for stoma revision.[8] These complications can be divided into early (within 30 days postoperatively) and late (within the following months to years).

Early complications can be impacted by both technical errors and patient related factors. Ischaemia and subsequent necrosis of the stoma can be seen with dark or dusky looking mucosa, loss of bleeding on touch or necrotic looking tissue. This issue is usually caused by compromised mesenteric blood flow to the stoma due to excessive tension on the proximal limb, a tight fascial opening causing mesenteric compression or a twisted mesentery. Superficial necrosis may be managed conservatively however full thickness necrosis or necrosis below the abdominal fascia requires urgent stoma revision. Stoma retraction or mucocutaneous separation can also be related to tension on the proximal limb due to inadequate mobilization of the bowel. Patient-related factors can also play a role; stoma retraction is more commonly seen in obese patients and mucocutaneous separation in patients with poor nutritional status or those receiving corticosteroid therapy. Mild retraction can be managed with convexly shaped appliances, but severe cases will require revision. Similarly small mucocutaneous separations may be managed conservatively and heal with time, larger defects require revision. Another early complication is haemorrhage; this can be mucosal or mesenteric, minor bleeding can be managed with local pressure and or cautery, however uncontrolled mesenteric bleeding requires return to theatre. The peristomal skin can become irritated in the early stages particularly post ileostomy formation, this can be related to poor appliance fitting or inadequately spouted ileostomy. Often the combination of optimizing the fit of the appliance with the stoma specialist nurses and utilizing barrier creams can protect skin.[8]

A common late complication with significant morbidity and mortality is parastomal hernia which is reported to effect up to 50% of patients[8] (Figure 4). Clinically a parastomal hernia is seen as a bulge around the stoma which may cause a poor seal of the appliance or more significantly incarceration of small bowel, obstruction or ischaemia and perforation. The cause of a parastomal hernia is multifactorial with impact from surgical techniques and patient related factors. An oversized fascial opening, obesity, smoking, poor quality tissue related to nutritional status or long-term immunosuppression can increase the risk of development of hernia. Parastomal hernia can be managed conservatively with hernia belt/support garments but may require emergency or elective surgical intervention with repair of hernia and or resiting of stoma. Recurrence rates following parastomal hernia repair are disappointingly high.[9]

Later peristomal skin complications may manifest in several ways. Parastomal abscesses and peristomal fistulae typically arise from chronic infection, inadequate mucocutaneous opposition, or separation secondary to deficient fixation technique.

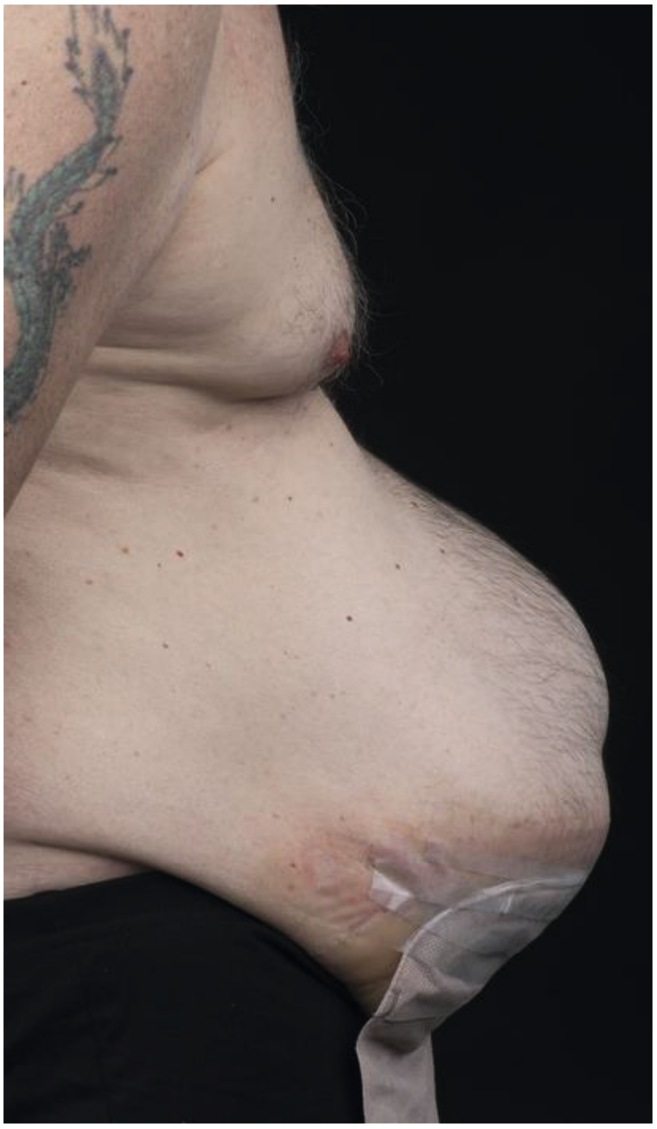

Figure 4 Large parastomal hernia.

Parastomal abscess can be managed with local drainage, systemic antibiotics but will occasionally require stoma resiting. Contact dermatitis can be related to both poor fitting appliances causing effluent leakage, early involvement of specialist stoma nurses can help to prevent leakage with better fitting appliances. In the case of persistent surrounding dermatitis, pyoderma gangrenosum should be ruled out with a biopsy. Stomal stenosis can be seen in up to 15% of patients it presents clinically with a narrowed lumen and more commonly effects end stomas.[8] Stenosis can cause reduced stoma output leading to pain, abdominal distension, nausea and vomiting. Stenosis may also be related to surgical technique causing ischaemia, excessive tension or recurrent inflammation and infection. However, stenosis can be caused by other factors such as Chron's disease or radiation. Management of stenosis includes dilatation of stomal opening but will sometimes require stomal revision.

High output stoma is usually seen in those with ileostomy or more commonly with jejunostomy, it can affect up to 20% of patients with a small bowel stoma.[10] High output ileostomy is defined as output sufficient to cause water and electrolyte disturbance. Clinically this may result in acute kidney injury and more long term, chronic renal impairment, as well as symptomatic electrolyte abnormalities such as hypomagnesemia. Management of high output stoma includes fluid resuscitation, minimization of electrolyte losses and consideration of reversable causes. These reversable causes include obstruction, infection, bile acid malabsorption or recurrence of inflammatory bowel disease such as Chron's. Once these are excluded medical management can be implemented utilizing loperamide, codeine, a proton pump inhibitor, and fluid intake restriction in a stepwise manner. In the early stages often high output stoma will reduce in output as the cells of the retained small bowel segment become more effective at retaining water. However, if high output stoma is a chronic problem, then reversal should be considered. In patients in which reversal is not possible short bowel syndrome should be considered and referral to specialist centres may be required.[10]

Stoma care: quality of life implications

Implications of having a stoma on a patient's quality of life has physical and emotional implications. Historically, leakage leading to peristomal skin irritation significantly limited patients' daily activities. However, modern advances in stoma appliance design and fitting have greatly reduced these issues, ongoing support from specialist stoma care nurses continues to improve comfort, confidence and overall improves quality of life.[5]

There is significant variation in psychological response in patients with stoma. The key themes demonstrated in the literature are change in body image and anxiety around complications which if not managed effectively can lead to social isolation. It is important to ensure patients receive good education to ensure they are capable of effective self-care. There is good evidence for ongoing stoma nurse support providing psychological support.

Stoma reversal

Reversal of stoma should be discussed with all surgically fit patients where anatomy allows, especially in those experiencing complications relating to their stoma. Reversal of a loop or double barrelled stoma is often less surgically complex than reversal of an end stoma. Reported rates of anastomotic leak in ileostomy reversal are around 1%, whereas they are up at 5% for reversal of Hartmann's.[11,12] A loop stoma can often be mobilized utilizing the available opening, a stapled or hand sewn anastomosis made and returned into the abdominal cavity. Reversal of an end stoma can be surgically much more complex as often one end of the bowel will be inside the abdomen or pelvis, historically this meant a laparotomy for mobilization of bowel was required however more minimally invasive techniques are being utilized more frequently.[6]

Innovations and future changes to stomas

Innovations around surgical creation of stoma and stoma care are ongoing; there has been evidence they are improving both clinical outcomes and patient quality of life. There is ongoing development of minimally invasive and robotic techniques

allowing for precise and careful tissue handling, smaller incisions aiming to improve recovery rate particularly in more surgically complex patients.[7]

There have been advances in appliance technology with 3D-printed stoma pouches and more customisable devises which are better fitting, reduce leak rates and peristomal complications improving quality of life. Online technology including the use of artificial intelligence (AI) has started to improve patient care and support. These developments are helping to ensure stoma management is less burdensome for patients improving both physical and psychological well-being.[13]

Conclusion

Intestinal stomas play a vital role in gastrointestinal surgery. Ensuring good patient outcomes requires careful selection of stoma type and configuration with suitable site selection. Meticulous surgical technique is required ensuring a tension free stoma with adequate blood supply is constructed. Early and late complications remain clinically significant such as necrosis, retraction, high output stoma and parastomal hernia. Management of complications requires careful surgical intervention and multidisciplinary involvement. Specialist stoma nurses are fundamental in preoperative planning, patient education and provision of ongoing support improving both physical and psychological quality of life. Advances in minimally invasive surgery offer potentially faster recovery and improved patient outcomes. Other innovations in appliance design improve patient comfort and help reduce complications. Integration and utilization of technology have helped to improve patient centred care. It is important that surgical innovation and stoma care continues to evolve to help minimize morbidity and mortality and improve long term physical and psychological wellbeing of patients with stoma. ◆

REFERENCES

1 Oxford Learners Dictionaries. Stoma. 2025. https://www.oxfordlearnersdictionaries.com/definition/english/stoma (accessed 22 October 2025).

2 Mulita F, Lotfollahzadeh S. Intestinal stoma. Florida: Treasure Island StatPearls Publishing, 2025.

3 Littre A. Histoire de l'Academie Royale des Sciences, Paris, (1710), 1732; 36–7.

4 Richardson B, Preskitt J, Lichliter W, et al. The effect of multidisciplinary teams for rectal cancer on delivery of care and patient outcome: has the use of multidisciplinary teams for rectal cancer affected the utilization of available resources, proportion of patients meeting the standard of care, and does this translate into changes in patient outcome? *Am J Surg* 2016; **211:** 46–52.

5 Kim YM, Jang HJ, Lee YJ. The effectiveness of preoperative stoma site marking on patient outcomes: a systematic review and meta-analysis. *J Adv Nurs* 2021; **77:** 4332–46.

6 Hellinger MD, Al Haddad A. Minimally invasive stomas. *Clin Colon Rectal Surg* 2008; **21:** 53–61.

7 Goldstone RN, Francone T, Milky G, et al. Outcomes comparison of robotic-assisted versus laparoscopic and open surgery for patients undergoing rectal cancer resection with concurrent stoma creation. *Surg Endosc* 2024; **38:** 4550–8.

8 Murken DR, Bleier JIS. Ostomy-related complications. *Clin Colon Rectal Surg* 2019; **32:** 176–82.

9 Mäkäräinen-Uhlbäck E, Vironen J, Falenius V, et al. Parastomal hernia: a retrospective nationwide cohort study comparing different techniques with long-term follow-up. *Word J Surg* 2021; **45:** 1742–9.

10 Nightingale J, the BIFA Committee. Managing a high output stoma. In: British Intestinal Failure Alliance (BIFA) Top Tips Articles Series, 2018.

11 Luglio G, Pendlimari R, Holubar SD, et al. Loop ileostomy reversal after colon and rectal surgery: a single institutional 5-year experience in 944 patients. *Arch Surg* 2011; **146:** 1191–6.

12 Hallam S, Mothe BS, Tirumulaju RMR. Hartmann's procedure, reversal and rate of stoma-free survival. *Ann R Coll Surg Engl* 2018; **100:** 506–10.

13 Wang J, Zhuang Z, Zhou Z, et al. 3D printing and intelligent technology increase convenience, reliability, and patient acceptance of ostomy nursing: a randomized controlled trial. *Updates Surg* 2024; **76:** 2211–9.

