Diverting Ostomy: For Whom, When, What, Where, and Why

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Abstract

Fecal diversion is an important tool in the surgical armamentarium. There is much controversy regarding which clinical scenarios warrant diversion. Throughout this article, we have analyzed the most recent literature and discussed the most common applications for the use of a diverting stoma. These include construction of diverting ileostomy or colostomy, ostomy for low colorectal/coloanal anastomosis, inflammatory bowel disease, diverticular disease, and obstructing colorectal cancer. We conclude the following: diverting loop ileostomy is preferred to loop colostomy, an ostomy should be used for a pelvic anastomosis $<$ 5 to 6 cm including coloanal anastomosis and ileo-anal-pouch anastomosis, severe perianal Crohn's disease frequently requires diversion, a primary anastomosis with diverting ileostomy in the setting of diverticular perforation is safe, and a diverting stoma can be used as a bridge to primary resection in the setting of an obstructing malignancy.

Keywords
- diversion
- low colorectal/coloanal anastomosis
- Crohn's disease
- diverticulitis

Throughout centuries, the dilemma of surgical diversion has been a daunting task to mankind. The first known accounts of ostomy construction dates back to 350 BC. Praxagoras of Kos attempted to construct an ostomy to treat an enterocutaneous fistula. However, it was not until the latter half of the 18th century when Dr. M. Pillore constructed the first surgical colostomy for an obstructing rectal cancer. As the years have progressed, we have come to acknowledge that the ostomy is a tool that improves, palliates, and facilitates several complex situations and plays an integral role in surgical decision making. With the advent of various techniques in ostomy construction, including minimally invasive surgery, we provide patients with improved quality of life. In addition, many conditions no longer necessitate permanent stomas. There are several areas of controversy regarding indications for ostomy. In this article, our goal is to discuss the role of fecal diversion in the most commonly encountered situations in colorectal surgery. These include construction of defunctioning ileostomy or colostomy, ostomy for low colorectal/coloanal anastomosis, inflammatory bowel disease, diverticular disease, and obstructing colorectal cancer.

Diverting Ileostomy versus Diverting Colostomy

Best choice of diversion with ileum or use of colon has been widely debated. Typically, a loop ileostomy or loop transverse colostomy is the most commonly performed. Indications for defunctioning ostomy vary but are most frequently used for low pelvic anastomosis or obstruction. Several articles have argued in favor of one or the other, but the most recent literature indicates that loop ileostomy is favored. A large meta-analysis by Geng et al found that there was a lower incidence of sepsis, prolapse, and parastomal hernia in those who had a diverting ileostomy rather than those with diverting colostomy. Ileostomy reversal demonstrated less wound infection and incisional hernias.[1] Another meta-analysis by Rondelli et al also concluded that prolapse and

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sepsis were more common with loop colostomy. Despite higher incidence of dehydration in these patients, loop ileostomy is still favored since dehydration is not as morbid as sepsis or prolapse.[2] The reversal of loop colostomies has also been fraught with more complications compared with loop ileostomy closure. A study by Klink et al supports the increased incidence of dehydration in loop ileostomy (15% in ileostomy group vs. 0% in colostomy group); however, the rate of wound infection was much greater in the colostomy group (27% in colostomy and 8% in ileostomy) after closure. They also found that return of bowel function was quicker and hospital stay was shorter after ileostomy reversal compared with colostomy closure.[3] There are situations where surgeons prefer a loop colostomy such as in patients with preexisting renal insufficiency and in those in which stoma reversal is unlikely.

Low Colorectal/Coloanal Anastomosis

Diverting ileostomy for low colorectal or coloanal anastomosis has long been used as a method of "protecting" the anastomosis. Although several studies have demonstrated that there is no difference in the leak rate between patients who are diverted and those who are not, the consequences related to pelvic sepsis are certainly reduced with diversion. In a recent retrospective cohort by Ihnát et al, overall 30-day morbidity rates were significantly lower in patients with diverting ileostomy (23.3 vs. 42.3%). Symptomatic anastomotic leakage occurred more frequently in patients without diverting ileostomy (9.6 vs. 2.5%) and surgical intervention was needed in 6.8% of this group of patients.[4] They concluded that the benefit of preventing septic complications outweighed the risks of having a stoma. If not diverted, it is important to consider that a mortality rate up to 50% can occur in this population after a leak. Other consequences of anastomotic leak included poor functional outcome, stenosis, need for further reoperation, and fistula formation.

It has been widely verified in the literature that one of the most consistent risk factors for anastomotic leakage is the level of the anastomosis. To establish more concrete criteria in deciding on diverting stoma in these cases, one must understand the definition of a low anastomosis as well as the potential adverse events of stoma formation. The definition of low pelvic anastomosis has been a shifting debate. Typically, anywhere below 8 cm from the anal verge is a low anastomosis, and thus consideration for protective diverting ostomy is warranted. However, there is some consensus in most recent literature that less than 6 cm from the anal verge should undergo diversion. In a prospective trial involving proctectomy for patients with rectal cancer, the overall leakage rate in patients with diverting stoma was 5.8% compared with 16.3% in those without diversion. They concluded that anastomoses below 6 cm, particularly in males, should have a loop ileostomy constructed.[5] Previously reported in a 1998 study, a retrospective analysis of patients undergoing low pelvic anastomosis concludes that any anastomosis <5 cm should be diverted.[6] Articles have documented the rates of anastomotic leakage as high as 25% in low anastomosis, with an average of $\sim$11%.[7] Therefore, stronger consideration for diversion should be made when performing an anastomosis 5 to 6 cm from the anal verge.

Diverting ileostomy does not come without complications and risks. Despite its use as a tool to allow healing, consequences related to ileostomy construction and reversal are well documented. In the literature, the most common complication of an ileostomy is related to skin issues, which range in incidence from 18 to 55%. It is likely underreported by surgeons due to the fact that enterostomal nurses more commonly treat this, or simply surgeons do not acknowledge it as a complication.[8] Rates of dehydration and acute kidney injury have been reported up to 16% and continue to cause significant morbidity, increased hospital stay, readmissions, and electrolyte abnormalities.[9] Parastomal hernias have long been a common complication of stoma construction occurring in 15 to 40% of cases.[10] Although asymptomatic in most cases, it can certainly lead to incarceration, pain, obstruction, disfiguration, and prolapse. There is some evidence that defunctioning stomas are used more often than necessary. In a large retrospective analysis involving 1,791 patients, Nurkin et al state that stomas provided no real benefit in low anterior resection. Analyzing the National Surgical Quality Improvement Program data, they found these patients had higher incidence of renal injury, increased hospitalizations, and added morbidity from the reversal. However, in cases of coloanal anastomosis, a stoma was significantly associated with lower rates of respiratory complications, transfusion requirements, septic shock, and the need for reoperation.[11] Chow et al reviewed 48 studies evaluating the complications associated with reversal of diverting ileostomy and reported a morbidity rate of 17.3% with a mortality rate of 0.4%. Ileostomy-related complications include small bowel obstruction (7.2%), wound sepsis (5%), need for relaparotomy (2.5%), incisional hernia of the stoma site (1.8%), leakage (0–8.3%), prolonged ileus (0.8–13.8%), fistula (0–8.6%), bleeding (0–4%), and intra-abdominal abscess (0–1.4%).[12] When taking into account all these factors, it is important to thoughtfully consider each patient individually, weighing potential risks and benefits of diverting stoma and reversal.

Perianal Crohn's Disease

Perianal Crohn's disease (CD) has long been an arduous journey for both patient and surgeon. It is widely accepted that drainage of infection is the mainstay of first-line treatment. Thoughtful decision making regarding complex fistulas, rectovaginal fistulas, and recurrent uncontrolled perineal infection has been the source of multidisciplinary debate. More specifically, in which patients should fecal diversion be considered and what are the long-term outcomes for these patients.

As stated, the first step is controlling active infection. If not established, medical therapy should be optimized as a next step. Ostomy can prove necessary in cases of active proctitis and fecal incontinence.[13] Yamamoto et al looked at fecal diversion alone for the treatment of perianal CD for perianal sepsis, anal ulcer, complex anorectal fistula, and

rectovaginal fistula. Twenty-five per cent of patients had long-term remission, but only 10% were able to undergo restoration of intestinal continuity.[14] These results are not surprising, yet other studies do not show improved rates of restoring bowel continuity with the addition of multimodal treatment and biologics. The combination of diverting ostomy and immunosuppressive medication has shown some benefit in patients' overall recovery. It has also avoided or delayed extensive resections. In contrast, some studies could not find any positive effect of biologics (such as tumor necrosis factor [TNF]-α inhibitors) on healing rates and no benefit regarding stoma closure.[15] Although patients undergoing fecal diversion for perianal CD have symptomatic improvement, they have <20% likelihood of restoration of intestinal continuity. This is not improved with biological therapy in the retrospective study by Hong et al.[16]

The need for ostomy in severe perianal CD ranges between 31 and 49%. Additionally, stoma closure rates are as low as 20 to 50% in patients with perianal CD. This is mainly related to the persistence of proctitis or the recurrence of fistulas. Fistula healing is markedly reduced to 27% in case of active proctitis. In case of transient ostomy, stoma closure can be performed safely 8 to 12 weeks after the definitive operation.[15,16] Galandiuk et al prospectively studied 86 patients with perianal CD. Forty-two patients (49%) ultimately required permanent diversion. Of these patients, 21 of 32 patients (66%) had anal stricture, while 12 of 20 women (60%) with rectovaginal fistula. Permanent fecal diversion was more frequently necessary for patients with colonic CD and anal stenosis.[17] Other studies found that the subset of patients most likely to require proctectomy and permanent stoma were those with complex fistulas associated with abscesses, recurrent sepsis, colonic or perineal disease, refractory proctitis, and anal stenosis.[18] A retrospective analysis of 10 patients who underwent intersphincteric proctectomy with colostomy for perianal CD concluded that this was ineffective surgery for perianal disease with coexisting proctitis. Severe and early endoscopic recurrence in the proximal colon occurred in 9 of 10 patients at a median time interval of 9.5 months, and completion colectomy was necessary in 5 patients. Despite a normal appearance of the proximal colon, a proctocolectomy with end ileostomy was ultimately deemed the best and most definitive surgical approach.[19] Thus, intersphincteric proctectomy with end colostomy for anorectal CD results in early and severe proximal colonic recurrence.

Crohn's Colitis

In the era of multiple immunosuppressive and biologic regimens for medical management of CD, diverting loop ileostomy to "cool down" Crohn's colitis has been proposed as a bridge to achieving optimal medical therapy and colonic salvage. There are small series looking specifically at the effectiveness of diversion for Crohn's colitis. Early symptomatic relief was achieved in the majority of patients. However, relapse and recurrence of symptoms were common despite optimal medical therapy. Overall, less than 20 to 27% remained symptom free with bowel continuity restored.[20,21] In our experience, patients with refractory Crohn's colitis managed by diverting ileostomy have shown a dismal salvage rate, ultimately requiring total proctocolectomy and permanent ileostomy.

Immunosuppression

Corticosteroid use has long been implicated in anastomotic complications, particularly patients on corticosteroid steroid dose equivalent to 20 mg of prednisolone or more, with anastomotic complications reported up to 20%.[22] In a recent review, 12 studies with a total of 9,564 patients were included that looked at corticosteroids as a risk for anastomotic leak. Six of the 12 studies showed an increased risk for anastomotic leakage in the corticosteroid group. Overall, the anastomotic leakage rate was roughly double (6.77% in the corticosteroid group compared with 3.26% in the noncorticosteroid group).[23] Other studies suggest preoperative treatment with anti-TNF therapy or immunomodulators have not been shown to increase risk of anastomotic leak and should not be a contraindication to primary anastomosis.[24,25]

Ileal Pouch Anal Anastomoses

As discussed previously, very low pelvic anastomoses warrant diversion. Ileal pouch anal anastomoses (IPAA) are not exception. The question of whether to consider two-stage or three-stage surgery for these patients has long been deliberated and left for surgical judgment. Performing total proctocolectomy and IPAA in patients with a long disease course or a combination of corticosteroid and biological therapy conveys a significantly increased risk of anastomotic leakage. Sahami's group has shown that steroid use alone or anti-TNF therapy alone within 3 months of pouch surgery also warrants consideration for three-stage procedure.[26] These patients should undergo subtotal colectomy with end ileostomy as their first surgery, subsequent completion proctectomy, pouch formation with loop ileostomy, and finally ileostomy reversal. A body mass index (BMI) > 25 kg/m^2 and an American Society of Anesthesiologists score > 2 conferred an increased risk of anastomotic leak in completing proctectomy with IPAA. In addition, greater BMI increases risk for pelvic sepsis in IPAA patients.[27]

Diverticulitis

The prevalence of diverticulosis is 50% in those over 60 years of age in the United States. Of those, 10 to 25% experience acute diverticulitis. The overall rate for emergent surgical intervention for those with all classifications of diverticulitis is ~14%.[28] There are constantly evolving guidelines regarding timing and indication for operative intervention in this group of patients. American Society of Colon and Rectal Surgery (ASCRS) guidelines recommend that each case should be individualized. A topic that has been emphatically debated is laparoscopic lavage. With the advancement of laparoscopic surgery, laparoscopic lavage has been a tool that has been studied since 1997

where Franklin, Jacobs, and Plasencia performed laparoscopic lavage on 18 patients with favorable results. All patients were treated in the acute phase and only three eventually required elective surgery after.[29] As these practices expanded, several have continued to question its utility. A meta-analysis of three large randomized controlled trials and four comparative studies found that laparoscopic lavage has a higher rate of intra-abdominal abscess postoperatively and increased long-term emergency operations. However, the patients had shorter hospital stay, fewer wound complications, less cardiovascular events, and less required an ostomy both emergent and long term.[30] Of patients who underwent initial laparotomy, 90% had stomas with colonic resection, of whom 74% underwent stoma reversal within 12 months. Of those who underwent laparoscopic lavage, 14% required a stoma; 48% obtaining gut continuity within 12 months. Thus, bowel continuity overall was greater in the laparoscopic lavage group. The LOLA trial, however, was a randomized controlled trial that had to be stopped early due to the high morbidity of the laparoscopic lavage group. Their conclusion was that laparoscopic lavage was not superior to sigmoidectomy.[31] The evidence has not clearly led to a consensus among surgeons, and the role of lavage continues to remain a controversy in the colorectal surgery world.

Temporary diversion has become a tool in the armamentarium of the surgeon when dealing with complex diverticulitis. Performing a primary anastomosis with a diverting loop ileostomy in the acute setting has become more common in practice. Surgeon preference seems to play a role in choosing an ostomy for feculent/purulent peritonitis according to Benlice et al.[32] Using diversion not only allows the high-risk anastomosis to heal but also increases the chances of restoring bowel continuity. Only 57% of Hartmann's patients eventually undergo stoma reversal, while those with a diverting ileostomy have 90% reversal rate. Those with primary anastomosis and diversion had decreased serious complications, shorter operating time, shorter hospital stay, and lower costs.[33] In the multicenter randomized DIVERTI trial, they confirmed that stoma reversal rate was much higher with primary resection and diversion rather than Hartmann's reversal (96 vs 65%, respectively). Although no significant difference in the morbidity and mortality was found on initial operation, the morbidity of the reversal operation was 12% for a loop ileostomy versus 21% for Hartmann's reversal.[34,35] The construction of a primary anastomosis with a diverting ileostomy with Hinchey III or IV is certainly an attractive option and should be considered for selected patients.

Obstructing Malignancy

Despite the fact that colonoscopy has been a routine practice and decreased the rate of mortality from colon cancer, 15% of newly diagnosed colon cancers present with obstruction. Generally, a poor prognostic factor obstruction is now dealt with in one of three ways: primary resection and end colostomy, diversion followed by primary resection, or stent. We will not discuss colonic stenting, as it is not within the scope or purpose of this discussion. Malignant obstruction is often in the setting of metastatic unresectable disease; however, there is a group of patients who are cured and eventual restoration of bowel continuity is possible. The use of a diverting ostomy can allow decompression and give the patient a chance to undergo an elective resection, or receive neoadjuvant therapy if necessary. In a systematic review encompassing 2,424 patients compared those who had a diverting colostomy followed by resection with those who underwent primary resection with end colostomy. In the diversion group, significantly more patients had continuity of bowel eventually restored.[29]

Conclusion

The use of diversion encompasses many clinical scenarios and needs to be carefully considered and individualized. In this article, we have discussed the most common scenarios that colorectal surgeons face daily. We conclude the following: diverting loop ileostomy is preferred to loop colostomy, an ostomy should be used for a pelvic anastomosis < 5 to 6 cm including coloanal anastomosis and IPAA, severe perianal CD frequently requires diversion, a primary anastomosis with diverting ileostomy in the setting of diverticular perforation is safe, and a diverting stoma can be used as a bridge to primary resection in the setting of an obstructing malignancy. Fecal diversion can be used in several other situations such as radiation proctitis, traumatic injury, infectious colitis, chronic wounds, and bowel care for paraplegics and after anastomotic leak. Surgeons must consider the indications for diversion and understand its consequences to most appropriately treat these complex patients.

Conflict of Interest
None declared.

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References

1 Geng HZ, Nasier D, Liu B, Gao H, Xu YK. Meta-analysis of elective surgical complications related to defunctioning loop ileostomy compared with loop colostomy after low anterior resection for rectal carcinoma. Ann R Coll Surg Engl 2015;97(07):494–501
2 Rondelli F, Reboldi P, Rulli A, et al. Loop ileostomy versus loop colostomy for fecal diversion after colorectal or coloanal anastomosis: a meta-analysis. Int J Colorectal Dis 2009;24(05):479–488
3 Klink CD, Lioupis K, Binnebösel M, et al. Diversion stoma after colorectal surgery: loop colostomy or ileostomy? Int J Colorectal Dis 2011;26(04):431–436
4 Ihnát P, Guňková P, Peteja M, Vávra P, Pelikán A, Zonča P. Diverting ileostomy in laparoscopic rectal cancer surgery: high price of protection. Surg Endosc 2016;30(11):4809–4816
5 Mrak K, Uranitsch S, Pedross F, et al. Diverting ileostomy versus no diversion after low anterior resection for rectal cancer: a prospective, randomized, multicenter trial. Surgery 2016;159(04):1129–1139
6 Rullier E, Laurent C, Garrelon JL, Michel P, Saric J, Parneix M. Risk factors for anastomotic leakage after resection of rectal cancer. Br J Surg 1998;85(03):355–358

7 Hanna MH, Vinci A, Pigazzi A. Diverting ileostomy in colorectal surgery: when is it necessary? Langenbecks Arch Surg 2015;400 (02):145–152
8 Baker ML, Williams RN, Nightingale JM. Causes and management of a high-output stoma. Colorectal Dis 2011;13(02):191–197
9 Wong NY, Eu KW. A defunctioning ileostomy does not prevent clinical anastomotic leak after a low anterior resection: a prospective, comparative study. Dis Colon Rectum 2005;48(11):2076–2079
10 Nastro P, Knowles CH, McGrath A, Heyman B, Porrett TR, Lunniss PJ. Complications of intestinal stomas. Br J Surg 2010;97(12): 1885–1889
11 Nurkin S, Kakarla VR, Ruiz DE, Cance WG, Tiszenkel HI. The role of faecal diversion in low rectal cancer: a review of 1791 patients having rectal resection with anastomosis for cancer, with and without a proximal stoma. Colorectal Dis 2013;15(06):e309–e316
12 Chow A, Tilney HS, Paraskeva P, Jeyarajah S, Zacharakis E, Purkayastha S. The morbidity surrounding reversal of defunctioning ileostomies: a systematic review of 48 studies including 6,107 cases. Int J Colorectal Dis 2009;24(06):711–723
13 Seifarth C, Kreis ME, Gröne J. Indications and specific surgical techniques in Crohn's disease. Viszeralmedizin 2015;31(04): 273–279
14 Yamamoto T, Allan RN, Keighley MR. Effect of fecal diversion alone on perianal Crohn's disease. World J Surg 2000;24(10):1258–1262, discussion 1262–1263
15 Mueller MH, Geis M, Glatzle J, et al. Risk of fecal diversion in complicated perianal Crohn's disease. J Gastrointest Surg 2007;11 (04):529–537
16 Hong MK, Craig Lynch A, Bell S, et al. Faecal diversion in the management of perianal Crohn's disease. Colorectal Dis 2011;13 (02):171–176
17 Galandiuk S, Kimberling J, Al-Mishlab TG, Stromberg AJ. Perianal Crohn disease: predictors of need for permanent diversion. Ann Surg 2005;241(05):796–801, discussion 801–802
18 Nordgren S, Fasth S, Hultén L. Anal fistulas in Crohn's disease: incidence and outcome of surgical treatment. Int J Colorectal Dis 1992;7(04):214–218
19 van Overstraeten DeB, Wolthuis AM, Vermeire S, et al. Intersphincteric proctectomy with end-colostomy for anorectal Crohn's disease results in early and severe proximal colonic recurrence. J Crohn's Colitis 2013;7(06):e227–e231
20 Toh JW, Stewart P, Rickard MJ, Leong R, Wang N, Young CJ. Indications and surgical options for small bowel, large bowel and perianal Crohn's disease. World J Gastroenterol 2016;22(40): 8892–8904
21 Prabhakar LP, Laramee C, Nelson H, Dozois RR. Avoiding a stoma: role for segmental or abdominal colectomy in Crohn's colitis. Dis Colon Rectum 1997;40(01):71–78
22 El-Hussuna A, Andersen J, Bisgaard T, et al. Biologic treatment or immunomodulation is not associated with postoperative anastomotic complications in abdominal surgery for Crohn's disease. Scand J Gastroenterol 2012;47(06):662–668
23 Eriksen TF, Lassen CB, Gögenur I. Treatment with corticosteroids and the risk of anastomotic leakage following lower gastrointestinal surgery: a literature survey. Colorectal Dis 2014;16(05):O154–O160
24 Myrelid P, Marti-Gallostra M, Ashraf S, et al. Complications in surgery for Crohn's disease after preoperative antitumour necrosis factor therapy. Br J Surg 2014;101(05):539–545
25 Gu J, Remzi FH, Shen B, Vogel JD, Kiran RP. Operative strategy modifies risk of pouch-related outcomes in patients with ulcerative colitis on preoperative anti-tumor necrosis factor-α therapy. Dis Colon Rectum 2013;56(11):1243–1252
26 Sahami S, Bartels SA, D'Hoore A, et al. A multicentre evaluation of risk factors for anastomotic leakage after restorative proctocolectomy with ileal pouch-anal anastomosis for inflammatory bowel disease. J Crohn's Colitis 2016;10(07):773–778
27 Kiran RP, da Luz Moreira A, Remzi FH, et al. Factors associated with septic complications after restorative proctocolectomy. Ann Surg 2010;251(03):436–440
28 Etzioni DA, Mack TM, Beart RW Jr, Kaiser AM. Diverticulitis in the United States: 1998-2005: changing patterns of disease and treatment. Ann Surg 2009;249(02):210–217
29 Power N, Atri M, Ryan S, Haddad R, Smith A. CT assessment of anastomotic bowel leak. Clin Radiol 2007;62(01):37–42
30 Franklin ME Jr, Dorman JP, Jacobs M, Plasencia G. Is laparoscopic surgery applicable to complicated colonic diverticular disease? Surg Endosc 1997;11(10):1021–1025
31 Penna M, Markar SR, Mackenzie H, Hompes R, Cunningham C. Laparoscopic lavage versus primary resection for acute perforated diverticulitis: review and meta-analysis. Ann Surg 2018;267(02): 252–258
32 Vennix S, Morton DG, Hahnloser D, Lange JF, Bemelman WA; Research Committee of the European Society of Coloproctocology. Systematic review of evidence and consensus on diverticulitis: an analysis of national and international guidelines. Colorectal Dis 2014;16(11):866–878
33 Oberkofler CE, Rickenbacher A, Raptis DA, et al. A multicenter randomized clinical trial of primary anastomosis or Hartmann's procedure for perforated left colonic diverticulitis with purulent or fecal peritonitis. Ann Surg 2012;256(05):819–826, discussion 826–827
34 Bridoux V, Regimbeau JM, Ouaissi M, et al. Hartmann's procedure or primary anastomosis for generalized peritonitis due to perforated diverticulitis: a prospective multicenter randomized trial (DIVERTI). J Am Coll Surg 2017;225(06):798–805
35 Amelung FJ, Mulder CL, Verheijen PM, Draaisma WA, Siersema PD, Consten EC. Acute resection versus bridge to surgery with diverting colostomy for patients with acute malignant left sided colonic obstruction: systematic review and meta-analysis. Surg Oncol 2015;24(04):313–321