

Supplementary Table 3: Perfusion assessment in colorectal surgery

Ref. No.	Author	Country	Journal	Year	Study design	Patient selection		Fluorogenic agent	Dose	Imaging techniques			Endpoint measures			Adverse effects	Learning curve	Cost analysis	Other comments	Ref. detail	
						Subject	N			Imaging system	Quantitative measurement	Main endpoints	Imaging accuracy/success rate	Clinical impact, changes in intraoperative decision-making	Clinical impact, advantages in postoperative outcomes						
1	Kudrass	Germany	Langenbecks Arch Surg	2010	Retrospective case control	Lap and open Rt. colectomy, Lt. colectomy and proctectomy	201 (+201 controls)	ICG	0.2-0.5 mg/kg	IV	NA	IC-View®, Pulsion Medical Systems AG	Trends of fluorescence intensity	Changes in transection point, incidence of anastomotic leak and postoperative surgical revision, hospital stay	NA	16.4% changes in surgical procedure	4% reduction of surgical revision (3.5% vs 7.5%)	None	NA	NA	Kudrass A, Kuehn M, Gellert M, et al. Intraoperative near-infrared fluorescence imaging of colorectal surgery: a noninvasive analysis to reduce the rate of anastomotic leakage. <i>Langenbecks Arch Surg</i> . 2010;395(6):614-619.
2	Sherwiner	US	Surg Laparosc Endosc Percutan Tech	2012	Prospective case series	Sigmoidectomy and proctectomy	7	ICG	1mL	IV	Transanal approach	PiaPoint System (NOVADAQ, Canada)	NA	Feasibility (mucosal perfusion on and around the staple line)	100% technical success	NA	0%	None	NA	NA	Sherwiner DA. Transanal near-infrared imaging of colorectal anastomotic perfusion. <i>Surg Laparosc Endosc Percutan Tech</i> . 2012 Oct;22(5):433-6.
3	Carus	Germany	Surg Technol Int	2012	Retrospective case series	Laparoscopic colorectal anastomoses and gastric sleeve	49	ICG	0.2 mg/kg	IV	After colorectal anastomosis or after stapler resection of the stomach (depending on the procedure performed)	Karl Storz (the authors are not more specific)	NA	Assess perfusion intraoperatively	47 out of 49 (96%)	In two patients (4%), ICG-VA showed delayed perfusion and led to resection.	All patients recovered uneventfully	NA	NA	NA	Carus T, Dammer R. <i>Surg Technol Int</i> . 2012 Dec;22:27-32.
4	Jafari	US	Surg Endosc	2013	Retrospective case control	Robotic proctectomy	16 (+24 controls)	ICG	6-8 mg	IV	After dissection	Fierfly TM, Intuitive Surgical Inc.	NA	Changes in transection point, incidence of anastomotic leak	NA	19% changes in transection point	12% reduction of anastomotic leak (6% vs 18%)	None	NA	NA	Jafari MD, Lee KH, Halabi WJ, et al. The use of indocyanine green fluorescence to assess anastomotic perfusion during robotic assisted laparoscopic rectal surgery. <i>Surg Endosc</i> . 2013;27(6):3003-3008.
5	Bae	Korea	Yonsei Med J	2013	Retrospective case series	Robotic proctectomy	3	ICG	2.5-5 mg	IV	Prior to transection	Fierfly TM, Intuitive Surgical Inc.	Trends of fluorescence intensity	Identification of the IMA, Blood supply to the distal rectum	100% (IMA), 67% (perfusion)	NA	NA	None	NA	NA	Bae SH, Bae SH, Lee H, Bae SH, Kim NK, Min BS. Intraoperative near infrared fluorescence imaging in robotic low anterior resection: three case reports. <i>Yonsei Med J</i> . 2013 Jul;54(4):1066-9.
6	Sherwiner	US	Colorectal Dis	2013	Prospective case series	Lap proctectomy	20	ICG	1mL	IV	Transanal approach	PiaPoint System (NOVADAQ, Canada)	NA	Feasibility (mucosal perfusion), anastomotic leak	100% technical success	10% addition of protective loop ileostomy	2.4 patients with abnormal angogram leaked	None	NA	NA	Sherwiner DA, Gallagher J, Dowlat T. Intraoperative transanal near infrared imaging of colorectal anastomotic perfusion: a feasibility study. <i>Colorectal Dis</i> . 2013 Jun;15(1):91-6.
7	Hellan	US	Surg Endosc	2014	Prospective case series	Robotic Lt. colectomy and proctectomy	40	ICG	10 mg	IV	After complete colorectal mobilization	Fierfly TM, Intuitive Surgical Inc.	NA	Change of the proximal transection location, operation time, anastomotic leak	NA	40% changes in transection line	5% with change in transection line leaked	None	NA	NA	The use of fluorescence imaging to assess the location of bowel transection during robotic left-sided colorectal surgery. <i>Surg Endosc</i> . 2014;28(5):1695-1702.
8	Ris	UK	Surg Endosc	2014	Prospective case series	Lap Rt. colectomy, Lt. colectomy and proctectomy	30	ICG	2.5 mg/mL	IV	Immediately after anastomosis construction	PiaPoint System (NOVADAQ, Canada)	NA	Feasibility, anastomotic leak	97% technical success	10% avoidance of defunctioning stoma	0% anastomotic leak	None	NA	NA	Ris V, Hampre R, Cunningham C, et al. Near-infrared (NIR) perfusion angiography in minimally invasive colorectal surgery. <i>Surg Endosc</i> . 2014;28(7):2221-2226.
9	Kin	US	Dis Colon Rectum	2015	Retrospective case control	Lap and Open Lt. colectomy and proctectomy	173 (+173 controls)	ICG	1mL, followed by a 10 ml saline flush	IV	NA	SPY Imaging System (Novadaq Technologies Inc, Bonita Springs, F)	NA	Anastomotic leak within 60 days and whether angiography changed surgical management were the main outcomes measured	NA	4.6% additional colon resection	1.1% increase of anastomotic leak (7.5% vs 6.4%)	None	NA	NA	Kin C, Ye H, Wehler L, et al. Efficacy of intraoperative fluorescence angiography on colorectal anastomotic leaks. <i>Dis Colon Rectum</i> . 2015;58(6):582-587.
10	Jafari	US	J Am Coll Surg	2015	Prospective multicenter study	Lap Lt. colectomy and proctectomy	139	ICG	3.75-7.5 mg	IV	Just before extraction or resection and anastomosis	PiaPoint System (NOVADAQ, Canada)	NA	Feasibility, safety, incidence of use of fluorescence angiography to aid in surgical decision making, anastomotic leak	99% technical success	8% changes in surgical plans	1.4% anastomotic leak	None	NA	NA	Jafari MD, Wexner SD, Martz JE, et al. Perfusion assessment in laparoscopic left-sided anastomosis resection (PELLAR-III): a multi-institutional study. <i>J Am Coll Surg</i> . 2015;220(2):282-291.
11	Watanabe	Japan	Int J Colorectal Dis	2015	Prospective case series	Lap and open Lt. colectomy and proctectomy	119	ICG	0.5 mg/kg	IV	After extraction of the specimen	FLUORO-1 system by Olympus (Novadaq Systems Corporation (Tokyo, Japan) and Tokyo, Japan)	NA	Visualization of the blood flow at the marginal artery near the rectosigmoid junction	Classification of the blood flow into 4 types	NA	5.9% anastomotic leak	None	NA	NA	Watanabe K, Minami H, Nagahara K, Ishikawa Y, Endo E. Evaluation of the intestinal blood flow near the rectosigmoid junction using the fluorescence camera. <i>Int J Colorectal Dis</i> . 2015;40(12):1637-1641.
12	Protyniak	US	Am Surg	2015	Retrospective	Laparoscopic colon resection for carcinoma or benign disease	77	ICG	NA	IV	During resection and prior to anastomosis	SPY Elite	Trends of fluorescence intensity	Assess colon perfusion	NA	ICG-VA changed the transection point in four patients (5%); these four patients did not experience postoperative complications	Two patients developed anastomotic leakage and required resection; one of the two died from sepsis	None	NA	NA	Protyniak B, Dinallo AM, Boyan WP Jr, Drossner EM, Aronowitz ML. <i>Am Surg</i> . 2015 Jun;81(6):586-4. doi: 10.1177/000313481508100621.
13	Kim	Korea	Int J Med Robot	2016	Retrospective case control	Robotic proctectomy	123 (+131 controls)	ICG	10mg	IV	After full mobilization	Fierfly TM, Intuitive Surgical Inc.	NA	Bowel perfusion, safe anastomosis and lymph node assessment	NA	Fluorescent imaging correctly determined completion of the bowel adjacent to the anastomosis in 13 patients (10.6%) who were possibly susceptible to anastomotic site ischemia.	4.6% reduction of anastomotic leak (0.8% vs 5.4%)	None	NA	NA	Kim J, Lee J, Yoon S, Austin AS, Kim J. Utility of indocyanine green fluorescent imaging during robot-assisted sphincter-saving surgery on rectal cancer patients. <i>Int J Med Robot</i> . 2016;10(1):1-7.
14	Boni	Italy	Surg Endosc	2016	Prospective case series	Lap Rt. colectomy, Lt. colectomy and proctectomy	107	ICG	0.2 mg/kg (twice)	IV	1) After the division of the mesentery and colon, but before anastomosis, 2) After completion of the anastomosis	Karl Storz image1 fluorescence system (Karl Storz, NA Tullingen, Germany)	NA	Feasibility, anastomotic leak	100% technical success	3.7% changes in anastomosis	0.9% anastomotic leak	None	NA	NA	Boni L, David G, Dionigi G, et al. Indocyanine green-enhanced fluorescence to assess bowel perfusion during laparoscopic colorectal resection. <i>Surg Endosc</i> . 2016;30(7):2736-2742.
15	Boni	Italy	Surg Endosc	2017	Retrospective case control	Lap proctectomy	42 (+38 controls)	ICG	5mL	IV	After the division of the mesentery at the level of planned transection	Karl Storz image1 fluorescence system (Karl Storz, NA Tullingen, Germany)	NA	Changes in transection point, incidence of anastomotic leak	NA	4.7% changes in anastomotic level	5.2% reduction of anastomotic leak (0% vs 5.2%)	None	NA	NA	Boni L, Cassiotti E, Indocyanine green fluorescence angiography during laparoscopic low anterior resection: results of a case-matched study. <i>Surg Endosc</i> . 2017 Feb;31(2):248-254.
16	Wada	Japan	Surg Endosc	2017	Retrospective case series (prospectively maintained database)	Lap Lt. colectomy and proctectomy	112	ICG	5mg	IV	After distal transection of the bowel, the specimen was extracted extracorporeally and then the proximal color perfusion was evaluated	PDE-neo system; Hamamatsu Photonics K.K., Hamamatsu, Japan	F max, T max, T 1/2, and Slope	Changes in transection point, incidence of anastomotic leak	Sensitivity and specificity of Fmax for the prediction of AL were 100 and 92.5%, respectively.	16.1% changes in transection line	4/18 patients who had changes in transection line based on fluorescence imaging developed anastomotic leak. Only 1/94 patients who didn't have changes in transection line leaked.	None	NA	NA	Wada Y, ICG fluorescence imaging for quantitative evaluation of colonic perfusion in laparoscopic colorectal surgery. <i>Surg Endosc</i> . 2017 Feb;31(2):248-254.
17	Kim	Korea	Dis Colon Rectum	2017	Retrospective case control	Robotic proctectomy	310 (+347 controls)	ICG	10mg	IV	Immediately after colorectal mobilization	Fierfly TM, Intuitive Surgical Inc.	Trends of fluorescence intensity	Anastomotic leak and stricture	NA	NA	4.6% reduction of anastomotic leak (0.6% vs 5.2%)	None	NA	NA	Kim J, Lee J, Yoon S, Wada T, Takahashi R, Hsiamon S, Hida K, Sakai Y. Evaluation of intestinal perfusion by ICG fluorescence imaging in laparoscopic colorectal surgery with DST anastomosis. <i>Surg Endosc</i> . 2017 Mar;31(3):1061-1069.
18	Kawada	Japan	Surg Endosc	2017	Prospective case series	Lap Lt. colectomy and proctectomy	68	ICG	5 mg	IV	After distal transection of the bowel and extracorporeal extraction of the specimen	PDE-neo system; Hamamatsu Photonics K.K., Hamamatsu, Japan	NA	Changes in transection line, anastomotic leak, factors affecting poor intestinal perfusion	NA	26.5% changes in transection line	4.5% anastomotic leak	None	NA	NA	Kawada Y, ICG fluorescence imaging for quantitative evaluation of colonic perfusion in laparoscopic colorectal surgery with DST anastomosis. <i>Surg Endosc</i> . 2017 Mar;31(3):1061-1069.
19	Ris	Switzerland, UK, Ireland	Br J Surg	2018	Prospective single arm multicenter study	Any elective colorectal operation with anastomosis	504	ICG	7.5 mg	IV	After the surgeon had decided on the proximal site of division	PPPOINT® Endoscopic Fluorescence Imaging System (Styker, Kalamazoo, Michigan, USA)	NA	Fluorescent signal quality, duration of the ICG procedure, anastomotic leak	100% technical success	5.8% changes in the site of bowel division	2.4% anastomotic leak	None	NA	NA	Note of the 29/504 patients who had changes in the site of bowel division leaked RAS. Near-Infrared Anastomotic Perfusion Assessment Network V00B. Multicentre phase II trial of near-infrared imaging in elective colorectal surgery. <i>Br J Surg</i> . 2018 Sep;105(10):1359-1367.
20	Mizahi	US	Tech Coloproctol	2018	Retrospective	Transanal total mesorectal excision for rectal cancer	54	ICG	0.1 to 0.3 mg/kg	IV	Twice: Before transection and after anastomosis	PPPOINT (Novadaq)	NA	Effect of ICG-VA use in predicting anastomotic leakage	NA	ICG-VA changed the proximal resection margin in 10 patients (18.5%)	One of the patients whose proximal resection margin was changed experienced anastomotic leakage postoperatively and required loop ileostomy; one patient without a change in the proximal resection margin also experienced	None	NA	NA	Mizahi I, de Lacy FH, Anagnostou M, Fernandez LM, Otero A, Sands DR, Lacy AM, Wexner SD. <i>Coloproctol</i> . 2018 Oct;22(10):785-791. doi: 10.1007/s10151-018-1860-z

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Ref. No.	Author	Country	Journal	Year	Study design	Patient selection		Fluorogenic agent	Dose	Route	Imaging techniques			Endpoint measures			Adverse effects	Learning curve	Cost analysis	Other comments	Ref. detail		
						Subject	N				Imaging system	Quantitative measurement	Main endpoints	Imaging accuracy/success rate	Clinical impact, changes in intraoperative decision-making	Clinical impact, advantages in postoperative outcomes							
21	Brescia	Italy	Updates Surg	2018	Retrospective	Laparoscopic colorectal surgery (both benign and malignant neoplasms)	182 (107 did not receive ICG-VA and 75 received ICG-VA)	ICG	0.25 mg/kg	IV	Prior to resection	SPHS (Karl Storz)	NA	Assess whether ICG-VA reduces postoperative complications	NA	In 6.6% of ICG-VA cases, the reading caused the surgeon to change the planned resection line	The anastomotic leakage rate was 9.0% in the group that did not receive ICG-VA and zero in the group that received ICG-VA; however, other postoperative complications did not differ between the two groups	None	NA	NA	Ishizuca Y, Pevzner M, Komuro Y, Casapullina M, Pridmore F, Dhillon AJ, Gasparini M, Lazer F. Updates Surg. 2018 Dec;70(4):427-432. doi: 10.1007/s13304-018-05888-9. eprint arXiv:1811.04477v1 [medRxiv].		
22	Bornstein	US	J Surg Res	2018	Prospective	Open or laparoscopic-assisted bowel resection	72 bowel end segments from 49 patients	ICG	NA	IV	After mesenteric division	SPY Elite	Trends of fluorescence intensity	Compare intraoperative assessment by surgeon and by imaging system	NA	Disparity between surgeon assessment and ICG-VA analysis was found in 11 of 72 cases (15%)	Clinical outcomes were not assessed in this study	NA	NA	NA	Ferguson TB, Baeer JJ. J Surg Res. 2018 Dec;232:179-185. doi: 10.1016/j.jss.2018.08.026.		
23	Mirzahi	US	Tech Coloproctol	2018	Retrospective	Laparoscopic low anterior resection for rectal cancer	30 patients who received ICG-VA and ICG 30 who did not	ICG	0.1 to 0.3 mg/kg	IV	Twice: Prior to bowel resection and after anastomosis	PNPOINT (Novada)	NA	Assess whether ICG-VA reduces anastomotic leakage	NA	ICG-VA changed the treatment plan in four patients (13.3%); these patients did not experience anastomotic leakage	Rate of anastomotic leakage was 6.7% in patients who did not receive ICG-VA and zero in patients who received ICG-VA	NA	NA	NA	Fernandez LM, Portucci A, Wolf J, Saadi DR, Wecker SD. Tech Coloproctol. 2018 Jul;22(7):535-540. doi: 10.1007/s10151-018-0271-6.		
24	Kim	Korea	J Surg Oncol	2019	Retrospective	Robot-assisted anterior resection in colorectal cancer	968 (699 received ICG-VA)	ICG	NA	IV	NA	Firefly TM, Intuitive Surgical Inc.	NA	Effect of ICG-VA use on anastomotic complications	NA	NA	Use of ICG-VA reduced anastomotic complications	NA	NA	NA	Use of ICG-VA reduced anastomotic complications	Kim J, Lee J, Kim W, Lam S, Ahn J, Lee H, Park SH. J Surg Oncol. 2019 Dec;120(8):1450-1445. doi: 10.1002/jso.25476.	
25	Hayami	Japan	Tech Coloproctol	2019	Prospective	Laparoscopic surgery for colorectal cancer	22 (patients at high risk for anastomotic leakage were selected specifically)	ICG	5 mg/2 mL	IV	After anastomosis	D-light P system, Karl Storz	Trends of fluorescence intensity	Effect of ICG-VA use in predicting anastomotic leakage	NA	In one case, the leakage was identified by delayed fluorescence in ICG-VA	Four patients experienced anastomotic leakage	NA	NA	NA	NA	Kawai M, Hasegawa S, Okada K, Miyazawa M, Tamura K, Mizumoto Y, Kitahara Y, Mizumoto Y, Yamane K. Tech Coloproctol. 2019 Oct;23(10):973-980. doi: 10.1007/s10151-019-02089-5.	
26	Ogino	Japan	J Surg Res	2019	Prospective	Colorectal surgery	74	ICG	5 mg	IV	After dividing the mesentery and central vessels along the planned transection line and before completing anastomosis	Photodynamic Eye System, Hamamatsu Photonics	NA	Intraoperative determination of anastomotic hypoperfusion	100%	Transection line was changed in six patients (8.1%)	One patient experienced postoperative anastomotic leakage; all other patients healed uneventfully	NA	NA	NA	NA	Use of ICG-VA is effective in detecting anastomotic hypoperfusion	Ogino T, Hara T, Kawada J, Okano M, Kim Y, Okuyama M, Tsubanaka T. J Surg Res. 2019 Dec;244:265-271. doi: 10.1016/j.jss.2019.06.050.
27	van den Bos	The Netherlands	Surg Endosc	2019	Prospective	Anastomotic colorectal cancer surgery (laparoscopic or robotic)	30	ICG	0.2 mg/kg (three times)	IV	After bowel devascularization, before transection, and after anastomosis	D-light P system, Karl Storz	Fluorescence was scored subjectively from 1 to 5 by the surgeon; intensity was then measured postoperatively by the software from the recordings	Effect of ICG-VA use in predicting anastomotic leakage	60% (in 19 out of 30 patients, all three ICG-VA sessions were successful)	In six patients (20%), the dissection location was changed from ICG-VA readings. One of these six patients developed anastomotic leakage	Five patients developed anastomotic leakage	NA	NA	NA	NA	van den Bos J, Jongen ACM, Melnhout J, Broekink SO, Louwers K, Schol RM, Bouvy ND, Stassen JPS. Surg Endosc. 2019 Nov;33(11):1766-1774. doi: 10.1007/s00464-019-06073-6.	
28	Higashijima	Japan	J Med Invest	2019	Retrospective	Laparoscopic anterior resection	24	ICG	7.5 mg	IV	After resection of the rectal cancer	Hyper Eye Medical System (HEMS, Mituba Medical)	NA	Intraoperative determination of blood flow in the remnant colon	100%	Two of the 24 patients (8.3%) experienced anastomotic leakage and exhibited delayed fluorescence time; additional resection was then performed	NA	NA	NA	NA	NA	Higashijima J, Yamana M, Komawa A, Miyama T, Tokunaga T, Nishi M, Kashiwara H, Takasa C. J Med Invest. 2019;96(6):2365-69. doi: 10.1155/2019/236569.	
29	Wada	Japan	Int J Clin Oncol	2019	Retrospective	Laparoscopic low anterior resection in rectal cancer	149	ICG	5 mg	IV	After dividing the colonic mesentery at the planned transection site	PDE-sys system, Hamamatsu Photonics KK, Hamamatsu, Japan	NA	Effect of ICG-VA use in reducing anastomotic leakage	NA	Thirteen patients (9%) underwent additional colon resection following ICG-VA	Leakage occurred in four of these 13 patients, but in only one of the 35 patients whose ICG-VA readings did not change the course of the operation	NA	NA	NA	NA	Wada T, Kawada K, Hashino N, Hasegawa S, Yoshitomi M, Hida K, Sakai Y. Int J Clin Oncol. 2019 Apr;24(4):394-402. doi: 10.1007/s10147-018-1365-5.	
30	Dinallo	US	Am J Surg	2019	Retrospective	Colorectal surgery	234 who received ICG-VA and 220 who did not receive ICG-VA	ICG	2 mL	IV	Before anastomosis	SPY Elite	The software grades the intensity of fluorescence from 0 to 246	Effect of ICG-VA use in reducing anastomotic leakage	NA	ICG-VA altered the planned treatment in 13 patients (6%)	Leakage rates did not vary between patients who received and did not receive ICG-VA	NA	NA	NA	NA	ICG-VA can alter intraoperative decisions but not the clinical outcome in colorectal surgery	Dinallo AM, Kolanick P, Boyan WP, Proyniak B, James A, Dressner RM, Aravanto ML. Am J Surg. 2019 Jul;218(1):133-139. doi: 10.1016/j.amjsurg.2018.10.027.
31	Son	Korea	Surg Endosc	2019	Prospective	Laparoscopic colorectal surgery	86 (laparoscopic low anterior resection: 55; anterior resection: 31)	ICG	0.25 mg/kg	IV	After mesenteric division	IMAGE1 S (Karl Storz)	Trends of fluorescence intensity	Predict anastomotic complications from ICG-VA patterns	NA	NA	Incidence of anastomotic complications was 7% (six patients)	NA	NA	NA	NA	Son GM, Kwon MS, Kim Y, Kim J, Kim SH, Lee JW. Surg Endosc. 2019 May;33(5):1640-1649. doi: 10.1007/s00464-018-6439-y.	
32	Chang	Hong Kong	Surgon	2019	Prospective	Left-sided colorectal resection	110	ICG	5 mg	IV	Prior to resection and anastomosis	SPY Elite	The software grades the intensity of fluorescence from 0 to 255	Differences between planned resection site and actual resection site as a function of ICG-VA during the operation	NA	Transection site was revised in 34.5% of cases; median distance between planned and actual site was 2.3 cm (range: 1-17 cm); three patients (2.7%) were spared from a diversion stoma following ICG-VA	Leakage rate was 6 out of 100 patients (5.5%); only one required surgery	NA	NA	NA	NA	Chang YK, Foo CC, Yip J, Wei R, Ng KK, Lo O, Cho HK, Lam WL. Surgon. 2019 Oct;17(2):270-79. doi: 10.1016/j.surg.2018.08.006.	
33	Spinelli	Italy/Switzerland	Colorectal Disease	2019	Retrospective	Rectal pouch and anastomosis (PPAA)	32 (+ 32 matched controls)	ICG	0.25 mg/kg	IV	During pouch construction and enlightening maneuvers, after anastomosis (transally)	PNPOINT® Endoscopic Fluorescence Imaging System (Stryker, Kalamazoo, Michigan, USA)	Fluorescence was scored subjectively by the surgeon	Fluorescent signal quality, duration of the ICG procedure, anastomotic leak	100% technical success	1 case, intraoperative recto-pouch construction and anastomosis	0% anastomotic leak (1 case in the control group) p=NS	None	NA	NA	NA	Spinelli A, Carvello M, Kente P G, Maroli A, Montoni I, Manera M, Busca NG, Ris F. Rectal pouch-anal anastomosis with fluorescence angiography: a case-matched study. Colorectal Dis. 2019 Jul;21(7):827-832.	

NA, not available or not assessed