

## Surgery for post-operative entero-cutaneous fistulas: is bowel resection plus primary anastomosis without stoma a safe option to avoid early recurrence? Report on 20 cases by a single center and systematic review of the literature

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**SUMMARY:** Surgery for post-operative entero-cutaneous fistulas: is bowel resection plus primary anastomosis without stoma a safe option to avoid early recurrence? Report on 20 cases by a single center and systematic review of the literature.

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**Background.** A review was performed on entero-cutaneous fistula (ECF) repair and early recurrence, adding our twenty adult patients (65% had multiple fistulas).

**Methods.** The search yielded 4.098 articles but only 15 were relevant: 1.217 patients underwent surgery. The interval time between fistula's diagnosis and operative repair was between 3 months and 1 year. A bowel resection with primary anastomosis was performed in

1.048 patients, 192 (18.3%) underwent a covering stoma: 856 patients (81.7%) had a fistula takedown in one procedure.

**Results.** The patients had 14.3% recurrence and 13.1% mortality rate. In our experience 75% were surgically treated after a period equal or above one year from fistula occurrence: surgery was very demolitive (in 40% remnant small bowel was less than 100 cm). We performed a bowel resection with a hand-sewn anastomosis (95%) without temporary stoma. In-hospital mortality was 0% and at discharge all were back to oral intake with 0% early re-fistulisation.

**Conclusions.** Literature supports our experience: ECF takedown could be safely performed after an adequate period of recovery from 3 months to one year from fistula occurrence. In our series primary repair (bowel resection plus reconnection surgery without temporary stoma) avoided an early recurrence without mortality.

KEY WORDS: Entero-cutaneous fistula - Small bowel - Primary anastomosis - Recurrence.

## Introduction

Post-operative entero-cutaneous fistula (ECF) is an abnormal communication between the bowel and the skin following an abdominal operation and represents one of the most dreadful complications for both the patient and the surgeon to deal with. These patients are often on daily TPN (total parenteral nutrition), affected by oral intake limitations and frequent episodes of sepsis and/or occlusion: moreover, in case of an entero-atmospheric fistula ("open abdomen"), they are confined in an hospital ward totally depending upon health

care staff. Due to the high post-operative morbidity and mortality rate, many retrospective and few prospective series have tried to elucidate the right surgical strategy to be applied on this patient population, but so far the debate is still on regarding: "which" is the ECF to be treated surgically, "who" is the right candidate, "where" is the appropriate institution to perform these kind of operations, "when" to treat the patient and "what (how)" to do during the surgical procedure in order to avoid early recurrence of ECF, a classical complication seen very often after this kind of surgery in the early perioperative period. Some consensus has been achieved on "Which, Who, Where and When" (1-7): the presence of a Foreign body, prior Radiation exposure, the diagnosis of Inflammatory bowel disease or ongoing Infection, the presence of an Epithelialized fistula tract, a Neoplasm, the presence of a Distal obstruction or Sepsis/Steroids all are factor that make it unlikely for these fistulas to close spontaneously, so requiring surgical intervention ("Which"); sepsis and malnutrition make the patient not a suitable candidate for fistula takedown ("Who"); the operation should be performed in national referral centres with some experience on this kind of surgery

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(“Where”) (8) and an adequate period of recovery after the previous surgery represents the right time to take-down the ECF in order to avoid an early recurrence or to avoid a very difficult abdominal closure in an already damaged abdominal wall (“When”). On the contrary, the scientific community has not achieved an agreement on “What” (“How”) to do during the ECF takedown in order to avoid an early recurrence in the perioperative period (9-14) and there is no consensus if it should be performed during one procedure with bowel resection and primary anastomosis without stoma, or over a two-step staged operation with bowel resection and creation of a temporary stoma followed later by reconnection surgery. Moreover, there is still no consensus on the safe use of mesh for closing the abdomen (15, 16). We performed a systematic literature review examining available data on published randomized controlled studies, observational trials and case series assessing the relationship between type of ECF repair and early recurrence. Moreover we reported our experience with ECF takedown from January 2001 up to December 2013 of a single established national referral center for surgical bowel rehabilitation (Chronic Intestinal Failure Center and Intestinal/Multivisceral Transplant Unit, “St Orsola” University Hospital, Bologna, Italy), based on the series performed by two main operators (A.D.P. and A.L.) working with a multidisciplinary team and dealing with the surgical treatment of twenty cases of post-operative ECF.

## Methods of systematic literature search and study selection

A systematic literature review was performed examining available data on published randomized controlled studies, observational trials and case series assessing the relationship between type of ECF repair and early recurrence in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards (17).

The research question is “What” or “How” to do during the ECF takedown in order to avoid an early recurrence in the perioperative period.

The systematic literature search was conducted using the PubMed search engine up to January 17<sup>th</sup>, 2017 employing the terms “enterocutaneous” and “fistula”, used in combination with the following other search terms: “recurrence”, “surgery” or “management” and “short bowel syndrome”.

The literature search was performed without restriction of the language. When multiple articles were published from a single study group and overlapping study periods were reported, only the most recent article was considered as to avoid duplication of data (18). The Pubmed func-

tion “related articles” was used to broaden each search, and the reference list of all potentially eligible studies was analysed. To minimize retrieval bias, a manual search method including the Science Citation Index Expanded, Scopus and Google Scholar databases was performed. The final decision on eligibility was reached by consensus between the 2 screening authors.

To be included in our review, the publication had to describe the relationship between type of ECF repair and early recurrence. The assessment of methodological quality of the included studies was carried out using the quality checklist of the National Institute for Health and Clinical Excellence (19).

## Results of systematic literature search

The PRISMA flow diagram for the systematic review is presented in Figure 1.

The initial search yielded 4.109 potentially relevant articles. After screening titles and abstracts for duplication and irrelevance, 4.098 further articles were eventually excluded leaving 24 papers eligible for assessment: 9 articles were excluded because inclusion criteria were partially reported and not fully available (4, 5, 20-26) (Table 1).

Only 15 studies (1, 2, 8, 11, 12, 15, 27-35) were analysed in our systematic review: overall they included a total of 1.509 enrolled patients; of these, 1.217 (80.6%) underwent surgery. Most of the studies (ten) were observational retrospective, few studies (five) were observational prospective (Table 2).

The methodological quality assessment of the included studies proved good methodological quality of the selected items evaluated with the NICE checklist (mean score of 5.5/8 points) (Table 3).

In twelve studies the criteria for definition of an ECF as high output fistula were reported, but they were very heterogeneous: in eight studies (72.7 %) a high output ECF was defined as the output was > 500 mL/day, only few studies reported different definitions (one study >1.000 mL/day and three studies > 200 mL/day).

The best interval time between diagnosis of the fistula and operative repair was very heterogeneous as well and reported as > 6 weeks (one study), > 3 months (one study), > 6 months (three studies), 9 months (one study), < 1 year (one study) and > 1 year (two studies): six studies out of nine (66.6%) reported as appropriate a period of recovery between 3 months and one year before fistula takedown.

Overall 1.217 patients underwent surgery, a bowel resection with primary anastomosis was performed in 1.048 patients but in 192 (18.3%) a covering stoma was performed: 856 patients (81.7%) had a fistula takedown in one step. Few patients required a diverting stoma or end stoma without bowel resection.

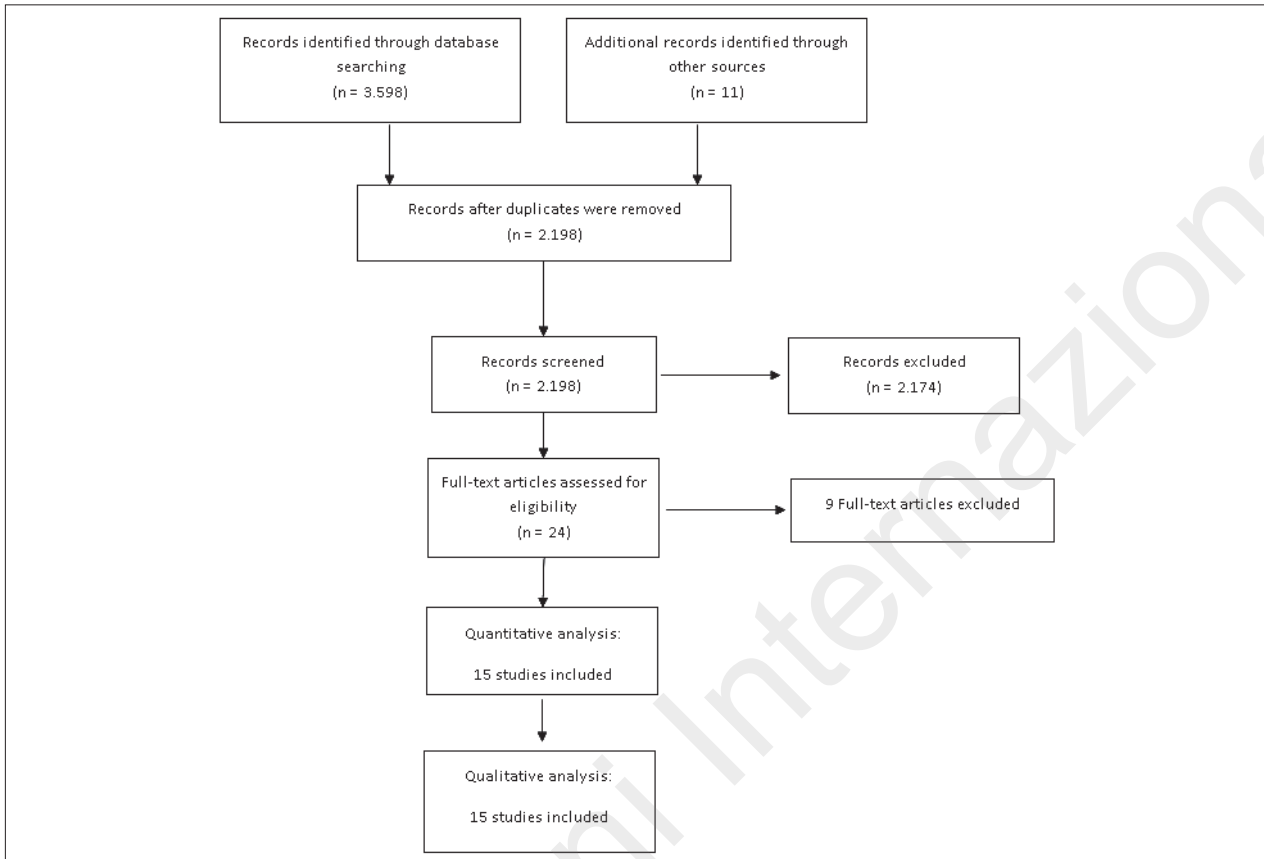


Figure 1 - PRISMA flow diagram.

TABLE 1 - EXCLUDED STUDIES AFTER ELIGIBILITY ANALYSIS.

Authors	Nation, year of publication	Number of patients enrolled	Reason for exclusion
21. Kumar et al.	India 2011	41	To avoid duplication of data: overlapping study periods with a most recent article
20. Atema et al.	The Netherlands 2016	179	The data of our review are not available, there is a mix of different types of gastrointestinal fistulas
22. Njeze et al.	Nigeria 2013	60	The authors don't describe the different types of treatments
25. Runström et al.	Sweden 2013	101	The data of our review are not available, there is a mix of different types of gastrointestinal fistulas
4. Redden et al.	USA 2013	35	The authors don't describe the number of bowel resections
5. Bradley et al.	USA 2013	111	The authors don't describe the different types of treatments
26. Visschers et al.	Netherlands 2008	135	To avoid duplication of data: overlapping study periods with a most recent article
23. Sriussadaporn et al.	Thailand 2006	6	The authors don't describe the number of bowel resections
24. Wind et al.	Netherlands 2009	32	The data of our review are not available, there is a mix of different types of treatments

The recurrence and mortality rate were available only for the overall number of patients, data were not available when related to the different subgroup analysis: high versus low output fistulas, bowel resection with or without covering stoma, etc. Overall, 170 out of 838 operated

patients had fistula recurrence, 3 studies did not report the data (379 patients); the rate of recurrence was (14.3%). Mortality was reported in 123 out of 1.069 operated patients (13.1%) but 2 studies did not report the data (148 patients). The interval time between the ope-

TABLE 2 - ANALYSIS OF INCLUDED STUDIES (1).

Author, nation, year of publication	Type of study	Number of enrolled patients with enterocutaneous fistulas/number of patients undergone surgery	High output enterocutaneous fistulas (Definition/number of patients)	Best interval time between diagnosis of the fistula and operative repair	Bowel resection (patients with all types of output/with only high output)		Diverting stoma or end stoma without bowel resection (patients with all types of output/with only high output)
					Primary anastomosis without covering stoma	Temporary stoma	
27. Kumar, India 2015	Prospective observational study	80/31	>1.000 mL/day (16 patients)	NR	3/NR	0	22/NR
1. Rahbour, UK 2013	Retrospective observational study	177/165	>500 mL/day (99 patients)	> 1 year	100/NR	49	0
2. Owen, USA 2013	Retrospective observational study	153/153	>500 mL/day (80 patients)	< 1 year	153/NR	0	0
15. Krpata, USA 2013	Prospective observational study	37/37	NR	NR	37/NR	0	NR
28. Ravindran, Australia 2014	Retrospective observational study	41/41	>500 mL/day (8 patients)	All times	29/NR	11/NR	1/NR
8. Murphy, UK 2013	Retrospective observational study	41/19	NR	NR	16/NR	3/NR	0
11. Martinez, Mexico 2012	Prospective observational study	71/71	>500 mL/day (39 patients)	All times	37/NR	21/NR	0
12. Visschers, Netherlands 2012	Prospective observational study	79/49	>500 mL/day (NR)	>6 weeks	49/NR	0	0
29. Gyorki, Australia 2010	Retrospective observational study	33/21	>500 mL/day (11 patients)	>6 months	13/NR	6/NR	2/NR
30. Datta, UK 2010	Prospective observational study	55/35	>500 mL/day (33 patients)	> 6 months	20/NR	15/NR	0
31. Brenner, USA 2009	Retrospective observational study	135/135	NR	>9 months	135/NR	0	0
32. Dionigi, Italy 2008	Retrospective observational study	19/13	>200 mL/day (13 patients)	Adequate nutritional status achieved	0	13/13	0
33. Draus, USA 2006	Retrospective observational study	106/77	> 200 mL/day (31 patients)	>3 months	77/21	0	0
34. Hollington, Australia 2004	Retrospective observational study	277/167	>500 mL/day (103 patients)	>6 months	129/NR	38/NR	0
35. Lynch, USA 2004	Retrospective observational study	205/203	> 200 mL/day (NR)	>1 year	58/NR	36/NR	19

NR = not reported

rative repair and recurrence was reported only in three studies (in two papers was three months and in another one 8 days) without clearly defining an “early” recurrence (perioperative period before discharge from hospital) (Table 4).

## Methods and results of our experience

Twenty adult patients (mean age 51.3 years, 60% males) with established ECF were treated surgically in our unit over a twelve-year period (2001-2013). We excluded from this report the patients admitted in our service with: 1) short bowel syndrome and ECF, later transplanted in our center using an intestinal/multivisceral graft for TPN complications, and 2) ECF treated conservatively without surgery. Seventy-five per cent of the surgically treated patients were referred to our national service from outside our region (Emilia-Romagna region-

Italy): one patient (5%) developed spontaneous fistulation secondary to Crohn’s disease (9 years after the previous surgery) while the remaining nineteen patients (95%) developed fistulae as a result of previous abdominal surgeries (mean number of prior surgeries= 3.3 /patient). The time between previous surgeries in other institutions and ECF surgical takedown in our unit was equal or above one year in most of the cases (75%), due to a delayed referral to our unit or an adequate period of nutritional/sepsis recovery. Sixty-five per cent of the patient population had multiple fistulae, with 30% of them identified as having colo/gastro-cutaneous ECF and 15% an entero-atmospheric fistula (“open abdomen”) as well. Forty-five per cent had high output fistulae (defined by us as fistula with output > 500cc/day) and 55% of them were malnourished at admission in our service (albumin level < 3.5 g/dl): all of them (100%) were on TPN. ASA score of our patients was mainly (65%) III and IV, the surgical procedures were performed by two main ope-

TABLE 3 - EVALUATION OF METHODOLOGICAL QUALITY OF THE INCLUDED STUDIES.

Items/author*	27. Kumar 2015	1. Rahbour 2013	2. Owen 2013	15. Kpata 2013	28. Ravindran 2014	8. Murphy 2013	11. Martinez 2012	12. Visschers 2012	29. Gyorki 2010	30. Datta 2010	31. Brenner 2009	32. Dionigi 2008	33. Draus 2006	34. Hollington 2004	35. Lynch 2004
Case series collected in more than one centre, i.e. multi-centre study	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Is the hypothesis/aim/objective of the study clearly described?	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Are the inclusion and exclusion criteria (case definition) clearly reported?	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Is there a clear definition of the reported outcomes?	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Were data collected prospectively?	1	0	0	1	0	0	1	1	0	1	0	0	0	0	0
Is there an explicit statement that patients were recruited consecutively?	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0
Are the main findings of the study clearly described?	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Are outcomes stratified? (e.g., by disease stage, abnormal test results, patient characteristics)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
<b>Total Score</b>	<b>7</b>	<b>5</b>	<b>5</b>	<b>6</b>	<b>6</b>	<b>6</b>	<b>7</b>	<b>7</b>	<b>5</b>	<b>6</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>5</b>

rators (70% A.D.P. and 30% A.L.) and the technique to takedown the fistula is reported in Figures 2-4: we used a lateral surgical approach via the circumference of the ECF (Figure 2) in order to avoid the hostile and granulated abdominal tissue surrounding the fistula, which is densely attached to the intra-peritoneal organs. Immediately after entering the abdomen, we mobilized the bowel under direct vision up to retroperitoneum and toward the midline, and, when the whole bowel was completely free from adhesions from Treitz to ileocecal valve, we lifted up the ECF (Figure 3) and resected "en-masse" the involved loops (Figure 4) taking down the ECF, and re-established intestinal continuity with a primary entero-enteric handsewn (95%) anastomosis, reconnecting proximal and distal bowel during the same operation. Two cases were later defunctionalized performing a definitive stoma (10%) due to useless residual rectal stump and repeated bowel resection for segmental intestinal infarction. The length of remnant small bowel

after fistula takedown was less than 100 cm in 40% of the cases. Mean operative time for definitive surgery was 5 hours and 30 minutes, with 50% intraoperative transfusion rate. The abdominal closure was mainly performed by single layer or component separation technique but in 25% of the patients we closed the abdomen using a mesh (prosthetic or biological as available). We experienced a 20% rate of re-operations: causes were gastrointestinal bleeding, ileal perforation, duodenal perforation with abscess drainage and the already cited segmental intestinal infarction. The wound infection rate was 65% and 30% of the patients required the use of V.A.C. (Vacuum Assisted Closure) therapy to close the abdomen, in two cases combined later with a skin graft performed by plastic surgeons. The statistical analysis of our data did not show any significance ( $p=NS$ ), probably due to the low number of patients considered: notwithstanding, in-hospital mortality rate was 0% and, at discharge (mean hospital stay was 43.4 days), all pa-



TABLE 4 - ANALYSIS OF INCLUDED STUDIES (2).

Author, nation, year of publication	Interval time between the operative repair and recurrence (median)	Fistula recurrence rate			Post-operative mortality (patients with all types of output/with only high output)
		Patients with all types of output/with only high output)	Patients with bowel resection plus primary anastomosis without or with covering stoma	Patients with diverting stoma or end stoma without bowel resection	
27.Kumar, India 2015	NR	1/NR	1/NR	0	8/NR
1.Rahbour, UK 2013	NR	23/10	5/3	NR	0
2.Owen, USA 2013	NR	45/NR	0	0	6/NR
15.Krpata, USA 2013	NR	4/NR	NR	NR	1/NR
28.Ravindran, Australia 2014	3 months	2/NR	NR	NR	0
11.Martinez, Mexico 2012	NR	22/NR	NR	NR	14/NR
12.Vischers, Netherlands 2012	8 days	11/NR	0	0	6/NR
29.Gyorki, Australia 2010	NR	6/NR	NR	NR	2/NR
30.Datta, UK 2010	NR	4/NR	NR	NR	1/NR
31.Brenner, USA 2009	NR	NR	NR	NR	11/NR
32.Dionigi, Italy 2008	NR	6/6	NR	NR	NR
33.Draus, USA 2006	NR	NR	NR	NR	NR
34.Hollington, Australia 2004	NR	NR	NR	NR	30/NR
35.Lynch, USA 2004	3 months	42/NR	NR	NR	42/NR
8.Murphy UK 2103	NR	4	NR	NR	2

NR = not reported

tients were back to oral intake with no recurrence of fistulae (0% early re-fistulization rate). Tables 5, 6 and 7 summarize our data.

## Discussion

International literature is full of reports taking care of fistula management under the medical, radiological, endoscopic or surgical point of view (36-69). Fistula take-down is a complex surgical procedure requiring excellent skills and previous experience in managing ECF patients. The anaesthesiology management is extremely difficult, in view of the fact that the patients admitted in operating room have an high ASA score and their nutritional and septic conditions (low serum albumin reflects not only malnutrition but also a systemic inflammation in these patients) may have improved since admission but very often not completely. It is a time-

consuming surgery due to the presence of numerous adhesions related to previous operations, it is very demolitive towards the involved bowel because often there are multiple fistulae involving multiple intestinal segments, and usually it requires numerous blood transfusions intra-operatively. Abdominal closure is moreover considered a separate procedure due to the number of previous surgeries damaging the abdominal wall and skin, sometimes requiring the support of N.P.W.T. (negative pressure wound therapy) like V.A.C. or moreover plastic surgery for definitive closure (skin graft), and a prolonged antibiotic therapy to overcome the frequent wound infections. Early re-operation rate before discharge is extremely high because of early fistula recurrence as well as for bowel complications related to the extensive surgery, prolonging the already complex hospital stay. There is no consensus if repair should be performed during one procedure with bowel resection plus primary anastomosis after an adequate period of

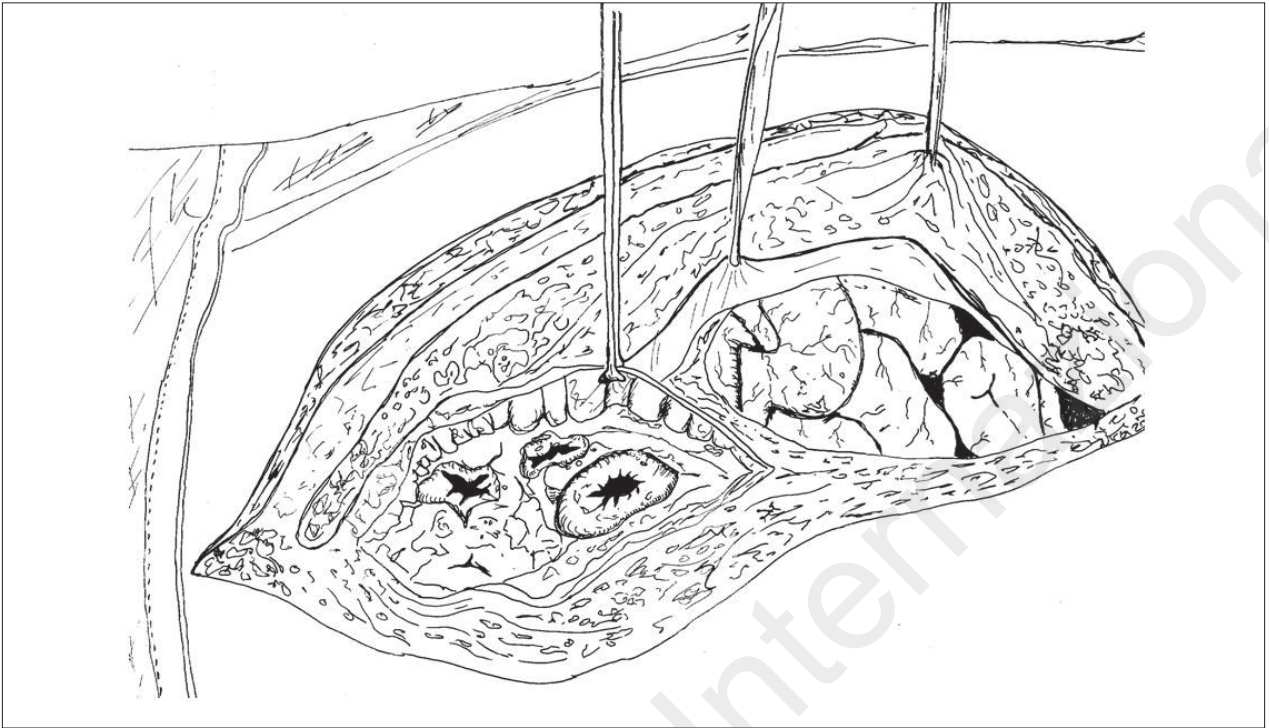


Figure 2 - Surgical access to abdominal cavity, surrounding entero-cutaneous fistula.

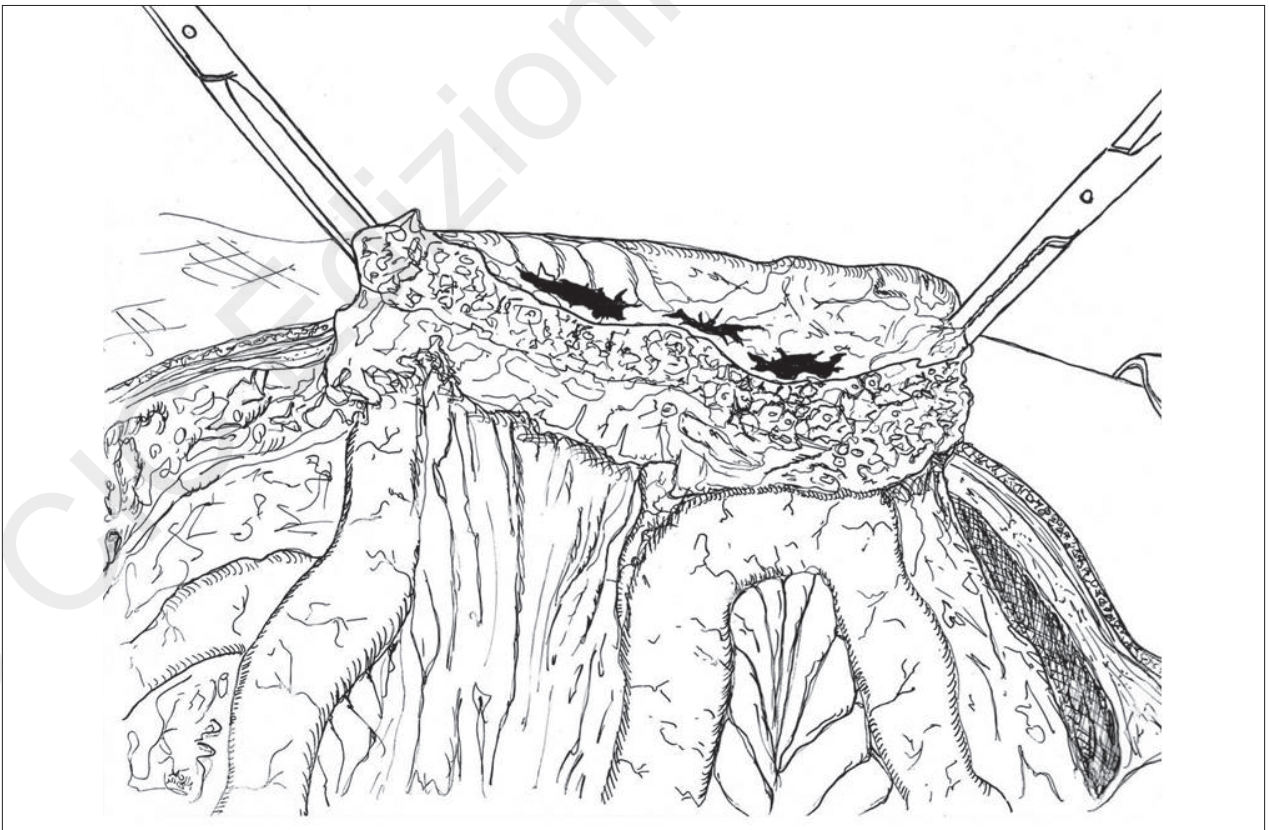


Figure 3 - Exposure of entero-cutaneous fistula before fistula takedown.



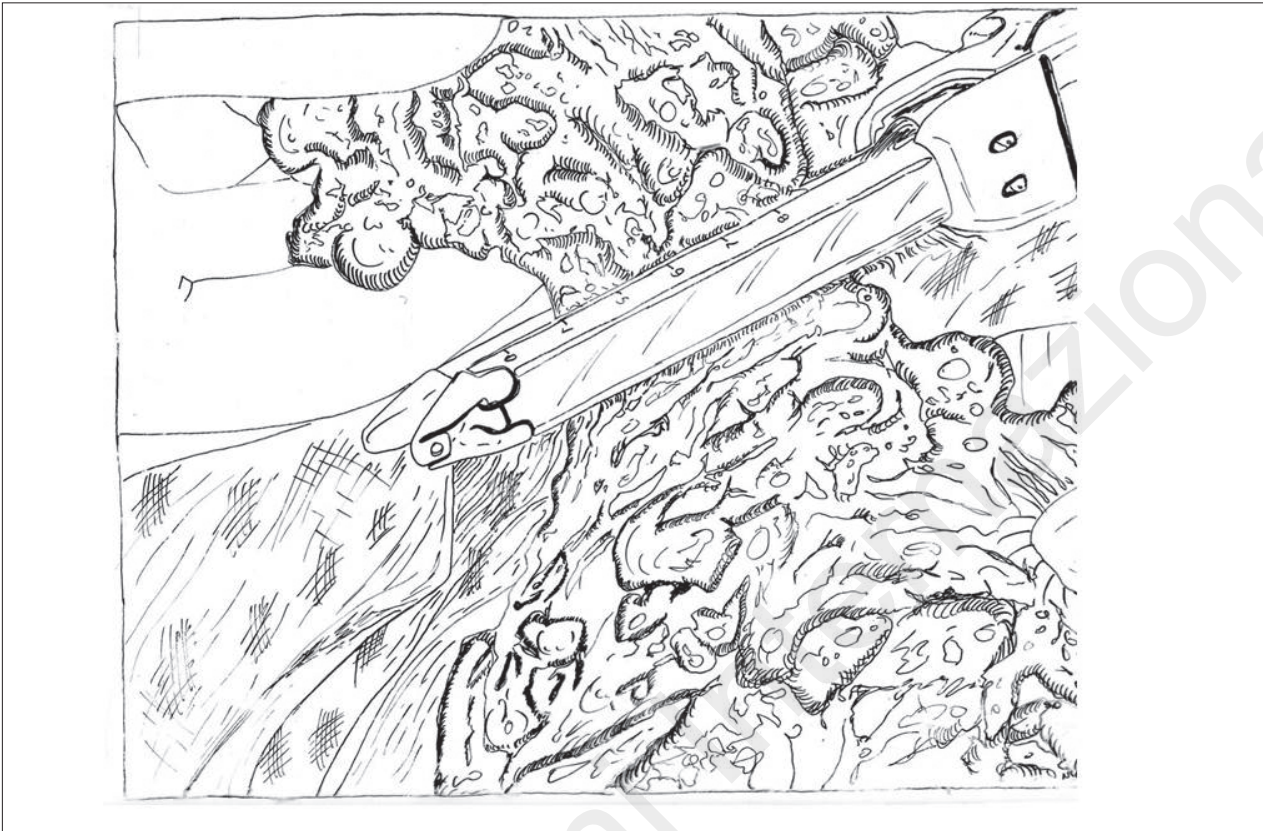


Figure 4 - Resection by stapler of entero-cutaneous fistula with involved bowel loops.

recovery time, or over a two-step staged operation at first with bowel resection plus creation of a temporary stoma followed later by reconnection surgery. Some authors (25) have advocated the use of a staged operation for fistula takedown (bowel resection plus stoma followed by reconnection surgery few months later) to reduce high early re-operation and mortality rate affecting this surgical procedure, attempting to avoid the very frequent early anastomotic dehiscence (early EFC recurrence) or inadvertent bowel lesion seen in malnourished patients with an almost frozen abdomen and impaired bowel healing capacity. Although difficult to extract from previous reports, post-operative failure rate (early fistula recurrence) after the first reconstructive operation seems to range from 21% to 36% (26, 34, 35) but in our systematic review was lower as 14.3%, independently by the type of surgery, probably due to the deep selection of the eligible papers for our specific purpose, and taking into account that a clear definition of “early” was never encountered. Mortality rate was reported as 13.1% in our systematic search, due to the dramatic conditions of patient/peritoneum/affected bowel: the best interval time between diagnosis of the fistula and operative repair was very heterogeneous in inter-

national literature, six studies showed as adequate a period between 3 months and 1 year. Our experience dealt with a complex surgical population: most of them had many previous surgeries, were affected by multiple post-operative fistulae or “open abdomen” and malnourished with high ASA score, requiring a prolonged operative time with 50% intra-operative transfusion rate and 25% intra-operative mesh positioning rate. Our report showed a 20% re-operation and 65% wound infection rate: 30% post-operative V.A.C. therapy rate was required in order to close the abdomen. In our series in-hospital mortality was 0% and ECF early recurrence rate at discharge was 0%, with 100% oral intake recovery after an average of more than one month hospital stay: even if in 40% of our cases surgery was very demolitive (less than 100 cm of remnant small bowel after the procedure), due to the multiple fistulae affecting multiple bowel segments, in all cases we were able to perform in one surgical procedure a bowel resection with primary anastomosis without stoma, forced to perform later an end stoma in two cases only- but never for an early anastomotic leakage or a bowel lesion. A Manchester study has advocated the high risk in using mesh when closing the abdomen after ECF takedown (70), reporting a 24%



*Surgery for postop entero-cutaneous fistulas*

TABLE 5 - PRE-OPERATIVE CHARACTERISTICS.

Patient ID, gender and age	Transferred from outside hospital (year and Region of Italy)	Year, type and number of prior abdominal operations	Fistula classification (primary disease ,output, anatomy, complexity)	Albumin at admission (minimum 3.5 g/dl)	Pre-TPN at admission
1. F.G. male,45 years	2001-MOLISE	1992 small bowel resection for occlusion + 0 redo-surgeries	Crohn's disease, >500cc/day, small bowel→skin and colon, multiple	4 g/dl	YES
2. M.M. female,55 years	2002-UMBRIA	2001 adhesiolysis for occlusion + 6 redo-surgeries	None, >500cc/day,small bowel→skin and colon→skin, multiple	3.4 g/dl	YES
3. B.S. male,57 years	2003-UMBRIA	2002 adhesiolysis for occlusion + 1 redo-surgery	None, <500cc/day,small bowel→skin, multiple	2.5 g/dl	YES
4. V.E. male,57 years	2003-EMILIAROMAGNA	2003 adhesiolysis for occlusion + 2 redo-surgery	None, <500cc/day,small bowel→skin and small bowel→small bowel, multiple	3.7 g/dl	YES
5. C.A. male,68 years	2003-LOMBARDIA	2003 mesh repair for incisional hernia + 1 redo-surgery	None, <500cc/day,small bowel→skin, multiple	2.7 g/dl	YES
6. G.A. male,67 years	2003-ABRUZZO	2002 reconnection surgery for stoma + 2 redo-surgery	Diverticulitis, >500cc/day, small bowel→skin, multiple	4.4 g/dl	YES
7. A.V. male,32 years	2004-LOMBARDIA	2003 splenectomy for trauma + 6 redo-surgeries	None, <500cc/day,small bowel→skin, multiple	3.1 g/dl	YES
8. R.D. male,41 years	2006-LIGURIA	2005 small bowel resection for trauma+ 2 redo-surgeries	None, <500cc/day,small bowel→skin, multiple	3.1 g/dl	YES
9. S.MT.female,66 years	2006-UMBRIA	2001 mesh repair for incisional hernia + 2 redo-surgery	None, <500cc/day,small bowel→skin and small bowel→colon, multiple	4.3 g/dl	YES
10. M.M.male,39 years	2010-LIGURIA	2009 small bowel resection for trauma+ 0 redo-surgeries	None, <500cc/day,small bowel→skin, single	2.9 g/dl	YES
11. S.G. male,55 years	2010-EMILIAROMAGNA	2009 small bowel resection for ischemia+ 2 redo-surgeries	Diverticulitis, <500cc/day,small bowel→skin and small bowel→colon, single	3.8 g/dl	YES
12.T.MG. female,59 years	2010-EMILIAROMAGNA	2010 small bowel resection for occlusion + 1 redo-surgery	None, >500cc/day,small bowel→skin, multiple	2.7 g/dl	YES
13. T.R. male,35 years	2010-LIGURIA	2009 exploratory laparotomy for occlusion+ 0 redo-surgery	None, >500cc/day,small bowel→skin, single	3.6 g/dl	YES
14. S.U.female,43 years	2011-EMILIAROMAGNA	2010 gastric banding for obesity+ 2 redo-surgeries	None, >500cc/day,small bowel→skin, single	2.3 g/dl	YES
15. M.I. male,61 years	2011-LIGURIA	2011 gastric surgery for perforated ulcer+ 3 redo-surgeries	Acute and chronic ischemia, <500cc/day, stomach→skin and colon, multiple	2.8 g/dl	YES
16. P.AC. female,48 years	2012-UMBRIA	2011 mesh repair for incisional hernia + 2 redo-surgery	None, >500cc/day,small bowel→skin, multiple	4.7 g/dl	YES
17. F.L.female,45 years	2013-LOMBARDIA	2012 small bowel resection for occlusion + 2 redo-surgery	None, <500cc/day,small bowel→skin, single	3.0 g/dl	YES
18. M.M. female, 65 years	2013- EMILIAROMAGNA	2012 strangulated hernia (occlusion) + 3 redo-surgeries	None, <500cc/day,small bowel→skin, single	3.4 g/dl	YES
19. T.R. male,37 years	2013 -TOSCANA	2013 occlusion + 1 redo-surgery	None, >500cc/day,small bowel→skin and colon→skin, multiple	4.3 g/ dl	YES
20. G.C.female,52 years	2013 -LAZIO	2008 hysterectomy+ 9 redo-surgeries	Secondary CIPO, >500cc/day, small bowel→skin, single	4.2 g/dl	YES
<b>60% males</b> <b>Mean age = 51.3 years</b>	<b>75% out of EmiliaRomagna</b>	<b>Mean n. of previous surgeries= 3.3</b> <b>Time of last surgery (= / &gt; 1 year) = 75%</b>	<b>65% multiple fistulas</b> <b>45% high output fistulas (&gt;500cc/day)</b> <b>5% secondary to Crohn</b> <b>30% colo/gastro-cutaneous fistulas</b>	<b>55% malnourished patients (&lt; albumin 3.5 g/dl)</b>	<b>100% pre-operative TPN</b>

TPN= total parenteral nutrition

TABLE 6 - INTRA-OPERATIVE CHARACTERISTICS.

Patient ID and ASA score	Operative time and blood transfusions	First Operator	Entero-atmospheric fistula ("open abdomen")	Type of anastomosis	Closure of abdomen	Bowel defunctioned after operation
1. F.G. II	5 h / no	AD.P.	NO	HANDSEWN	SINGLE LAYER	NO
2. M.M. III	8 h/ yes	AD.P.	NO	HANDSEWN	SINGLE LAYER	NO
3. B.S. II	7 h/ yes	AD.P.	NO	HANDSEWN	SINGLE LAYER	NO
4. V.E. II	9 h /yes	AD.P.	NO	HANDSEWN	SINGLE LAYER	NO
5. C.A. IV	5h30min /no	AD.P.	YES	HANDSEWN	COMPONENT SEPARATION TECHNIQUE	NO
6. G.A. II	6 h/ no	AD.P.	NO	HANDSEWN	SINGLE LAYER	RIGHT COLOSTOMY
7. A.V. IV	5h30min /yes	AD.P.	YES	HANDSEWN	COMPONENT SEPARATION TECHNIQUE	NO
8. R.D. III	4h30min /no	A.L.	NO	HANDSEWN	SINGLE LAYER	NO
9. S.MT. III	4h30min /yes	AD.P.	NO	HANDSEWN	SINGLE LAYER	NO
10. M.M. III	3 h/ no	AD.P.	NO	HANDSEWN	SINGLE LAYER	NO
11. S.G. III	4 h/ no	AD.P.	NO	STAPLED	SINGLE LAYER	NO
12. T.MG. III	5 h/ yes	AD.P.	NO	HANDSEWN	SINGLE LAYER	NO
13. T.R. III	3 h/no	AD.P./A.L.	NO (Bricker)	HANDSEWN	MESH	NO
14. S.U. IV	4h30min /yes	AD.P.	YES	HANDSEWN	MESH	NO
15. M.I. IV	7 h/yes	AD.P.	NO	HANDSEWN	SINGLE LAYER	NO
16. P.AC. II	7 h/no	A.L.	NO	HANDSEWN	SINGLE LAYER	NO
17. F.L. III	6 h/yes	A.L.	NO	HANDSEWN	SINGLE LAYER	NO
18. M.M. III	6 h / no	A.L.	NO	HANDSEWN	MESH	NO
19. T.R. II	7 h / yes	AD.P./A.L.	NO	HANDSEWN	MESH	NO
20. G.C. II	6 h 30 min / no	A.L.	NO	HANDSEWN	MESH	END JEJUNOSTOMY ( 50 cm from Treitz)
<b>65 % ASA III and IV</b>	<b>Mean operative time: 5h 30 min</b> <b>50% intraoperative transfusion rate</b>	<b>70% AD.P.</b> <b>30% A.L.</b>	<b>15% Entero-atmospheric fistula</b>	<b>95% handsewn anastomosis</b>	<b>25% mesh rate</b>	<b>10% post-operative ostomy rate</b>

AD.P. and A.L. = main surgeons; Bricker = Bricker operation

*Surgery for postop entero-cutaneous fistulas*

TABLE 7 - POST-OPERATIVE CHARACTERISTICS.

Patient ID and second abdominal operation	Wound complications	Post-operative V.A.C. therapy and/or skin graft to close the abdomen	Length of remnant small bowel	Post-operative oral intake	Early post-operative re-fistulization rate (at discharge)	Length of hospital stay	In-hospital mortality
1. F.G. NO	NO	NO	105 cm	YES	NO	11 days	NO
2. M.M. GI BLEEDING	INFECTION	NO	150 cm	YES	NO	21 days	NO
3. B.S. NO	INFECTION	NO	125 cm	YES	NO	38 days	NO
4. V.E. NO	INFECTION	NO	80 cm	YES	NO	22 days	NO
5. C.A. NO	INFECTION	NO	(>100 cm)	YES	NO	26 days	NO
6. G.A. NO	INFECTION	NO	70 cm	YES	NO	11 days	NO
7. A.V. NO	NO	NO	105 cm	YES	NO	47 days	NO
8. R.D. NO	NO	NO	95 cm	YES	NO	18 days	NO
9. S.MT. NO	NO	NO	(>100 cm)	YES	NO	20 days	NO
10. M.M. NO	NO	NO	(>100 cm)	YES	NO	20 days	NO
11. S.G. NO	NO	NO	70 cm	YES	NO	22 days	NO
12. T.MG. NO	INFECTION	VAC	55 cm after STEP	YES	NO	114 days	NO
13. T.R. NO	INFECTION	NO	(>100 cm)	YES	NO	12 days	NO
14. S.U. ILEAL PERFORATION	INFECTION	VAC+SKIN GRAFT	(>100 cm)	YES	NO	81 days	NO
15. M.I. DUODENAL PERFORATION and ABSCESS DRAINAGE	INFECTION	VAC+SKIN GRAFT	(>100 cm)	YES	NO	95 days	NO
16. P.AC. NO	NO	NO	(>100 cm)	YES	NO	18 days	NO
17. F.L. NO	INFECTION	VAC	135 cm	YES	NO	20 days	NO
18. M.M. NO	INFECTION	VAC	80 cm	YES	NO	55 days	NO
19. T.R. NO	INFECTION	NO	45 cm	YES	NO	23 days	NO
20. G.C. SEGMENTAL INTESTINAL INFARCTION	INFECTION	VAC	80 cm	YES	NO	194 days	NO
<b>20% re-operation rate</b>	<b>65% infection rate</b>	<b>30% V.A.C. to close the abdomen</b>	<b>40% less than 100 cm (remnant bowel length)</b>	<b>100% post-operative oral intake</b>	<b>0% early re-fistulization rate at discharge</b>	<b>Mean length of hospital stay= 43.4 days</b>	<b>0% in-hospital mortality</b>

STEP = serial transverse enteroplasty; V.A.C. = vacuum-assisted closure

early re-fistulation rate (and none when the abdomen could be sutured): our experience showed indeed that the mesh (either prosthetic or biological) could be safely used on 25% our patients with no ECF recurrence in 100% of them.

## Conclusions

Data reported by international literature are very heterogeneous, reporting a postoperative rate of ECF recurrence and related mortality respectively as 14.3% and 10.1 % independently by the type of surgery, but they seem to support our experience suggesting that ECF take-

down could be safely performed after an adequate period of recovery ranging from 3 months to one year from fistula occurrence. In our series primary repair (bowel resection plus reconnection surgery without temporary stoma) avoided an early recurrence in the perioperative period without mortality but our data need to be supported by a higher number of patients.

### Conflict of interest

None.

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