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original article

Reconnection surgery in adult post-operative short bowel syndrome < 100 cm: is colonic continuity sufficient to achieve enteral autonomy without autologous gastrointestinal reconstruction? Report from a single center and systematic review of literature

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SUMMARY: **Reconnection surgery in adult post-operative short bowel syndrome < 100 cm: is colonic continuity sufficient to achieve enteral autonomy without autologous gastrointestinal reconstruction? Report from a single center and systematic review of literature.**

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A systematic bibliographic research concerning patients operated on for SBS was performed: inclusion criteria were adult age, reconnection surgery and SBS < 100 cm. Autologous gastrointestinal reconstruction represented an exclusion criteria. The outcomes of interest were the rate of total parenteral nutrition (TPN) independence and the length of follow-up (minimum 1 year) after surgery. We reviewed our experience from 2003 to 2013 with minimum 1-year follow-up, dealing with reconnection surgery in 13 adults affected by < 100 cm SBS after massive small bowel resection: autologous gastrointestinal reconstruction was not feasible. Three (out of 5168 screened papers) non randomized controlled trials with 116 adult patients were analysed showing weaning from TPN (40%, 50% and 90% respectively) after reconnection surgery without autologous gastrointestinal reconstruction. Among our 13 adults, mean age was 54.1 years (53.8 % ASA III): 69.2 % had a high stomal output (> 500 cc/day) and TPN dependence was 100%. We performed a jejuno-colonic anastomosis (SBS type II) in 53.8%, in 46.1% of cases without ileo-cecal valve, leaving a mean residual small bowel length of 75.7 cm. In-hospital mortality was 0%. After a minimum period of 1 year of intestinal rehabilitation, all our patients (100%) went back to oral intake and 69.2% were off TPN (9 patients). No one was listed for transplantation. A residual small bowel length of minimum 75 cm, even if reconnected to part of the colon, seems able to produce a TPN independence without autologous gastrointestinal reconstruction after a minimum period of 1 year of intestinal rehabilitation.

KEY WORDS: Short bowel syndrome - Total parenteral nutrition - Massive bowel resection - Intestinal rehabilitation.

Introduction

In adults, the massive resection of small bowel leaving less than 150 cm of intestine results in malabsorption and diarrhoea and defines the short bowel syndrome (SBS), and a small bowel length inferior to 100 cm is highly predictive of permanent intestinal failure and total parenteral nutrition (TPN) definitive dependence: after 5 years of TPN, probability of permanent intestinal failure is > 90% for this group of patients (1-2). Their stomal output is impressive (up to many litres per day) and an adequate TPN and fluid requirement is often difficult to be achieved, subsequently complications develop and the medical/surgical team is forced in listing the patients for intestinal transplantation, a procedure still affected by long term high morbidity and mortality. Indeed, clinical experience (3-7) indicates that patients affected by short bowel with a jejuno-colonic anastomosis (SBS type II) or better a jejuno-ileo-colonic anastomosis (SBS type III) show improved absorption capacity with time, after a proper period of intestinal rehabilitation, whereas patients with end-terminal jejunostomy without colon (SBS type I) do not, and the presence of remaining colon is associated with a lower dependence of TPN supply. Lengthening (8) or segmental reversal (9-11) procedures have been proposed in recent years in order to prolong the transit time of bolus and increase the absorptive capacity of remaining

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bowel but these procedures are still limited in few cases by anatomical obstacles like not dilated bowel or inadequate bowel vascular supply respectively. A systematic bibliographic research concerning patients operated on for SBS was performed through international literature, summarizing the important papers in order to support the experience of our multidisciplinary team in a single established Italian referral centre for surgical bowel rehabilitation ("St. Orsola" University Hospital, Bologna, Italy, dealing with reconnection surgery in 13 adults affected by short bowel syndrome after massive intestinal resection: in our patients, lengthening or segmental reversal procedures were not possible because the small bowel was not dilated enough for lengthening or its vascular supply was not able to support a segmental reversal, subsequently performing a straightforward reconnection surgery with colon in all cases.

Methods of systematic literature search and study selection

A systematic literature review (12-52) was performed examining available data on published randomized controlled trials, observational trials and case series assessing the reconnection surgery and short bowel syndrome < 100 cm in adult patients in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards (53).

The systematic literature review was conducted using the PubMed search engine employing the terms: "short bowel syndrome" used in combination with the following other search terms: "surgery", "massive intestinal resection" and "adults". 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 (54).

The Pubmed function "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 rate of parenteral nutrition independence" and the "length of follow-up" (minimum 1 year) after surgery. Autologous gastrointestinal reconstruction (intestinal bowel lengthening, segmental reversal procedure, etc.) represented exclusion criteria. 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 (55).

Results of systematic literature search

The systematic literature review was conducted from January 1965 up to March 29th, 2016. The PRISMA flow diagram for the systematic review is presented in Figure 1. The initial search yielded 5.168 potentially relevant articles. After screening titles and abstracts for duplication and irrelevance, 5.092 further articles were eventually excluded leaving 45 papers eligible for assessment: 42 articles were further excluded because inclusion criteria were partially reported and not fully available:

- data about patients with the length of residual small bowel inferior to 100 cm are mixed with length of residual small bowel > 100 cm (23 studies) (Table 1);
- data about patients with jejuno-colic anastomosis (type II) or jejuno-ileocolic (type III) anastomosis are mixed with enterostomy (type I) (1 study) (Table 2);
  - evaluation about the effects of growth hormone or nutrients on absorption of the remnant small bowel after massive intestinal resection (2 studies) (Table 2);
  - segmental reversal for the reconstructive surgery of the remnant small bowel (1 study) (Table 2);
  - data about the end of total parenteral nutrition are missing (1 study) and/or presence of paediatric patients (1 study) (Table 2).
- data about patients with the length of residual small bowel inferior to 100 cm are reported but they are not correlated with the different type of the reconstructive surgery of the remnant small bowel (jejuno-colic anastomosis type II, jejuno-ileocolic anastomosis type III or enterostomy type I) (4 studies) (Table 3);
- data not reported about the type of the reconstructive surgery of the remnant small bowel and/or presence of patients with enterostomy (7 studies) (Table 4).

Only 3 studies were analysed in our systematic review: overall they included a total of 116 patients, considering that the single sample size of the included studies was too small (range: 10 – 61 patients, 74 (64%) were male). The mean age ±SD or range was between 37.56 ± 14.30 and 47 ± 12. Time of enrolling patients was between 1986 and 2008 (Table 5).

The principal diagnosis of small bowel pathologies was mesenteric infarction (42 patients - 36.2%), volvulus (33 patients - 28.4%), Crohn's disease (5 patients - 4.3%) and radiation enteritis (3 patients - 3.3%).

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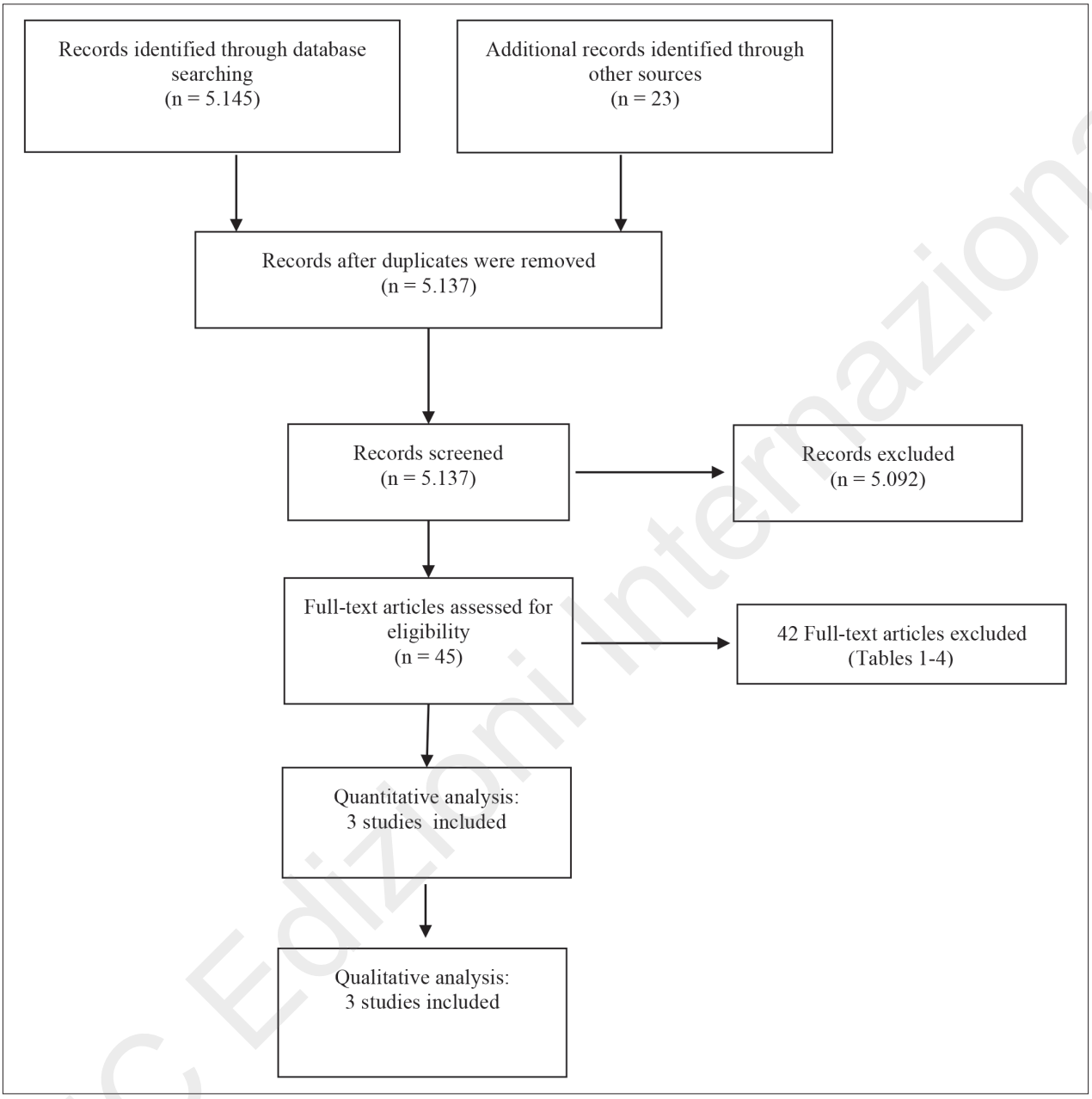

Figure 1 - PRISMA flow diagram.

The reconstructive surgery of the remnant small bowel was performed as jejunoileocolic anastomosis type III (78 patients - 67.2%), jejunocolic anastomosis type II (37 patients - 31.8%) and duodenocolic anastomosis (1 patient - 0.8%) .

The length of remnant small bowel and colon were very heterogeneous (Table 6).

All 3 studies reported a follow-up longer than 1 year and showed weaning from TPN (40%, 50% and 90% respectively) after reconnection surgery.

The methodological quality assessment of the included studies proved good methodological quality of the selected items evaluated with the NICE checklist (mean score of 6.3/8 points) (Table 7).

Methods and results of our experience

Data from our centre were collected retrospectively from 2003 to 2013, dealing with reconnection surgery

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TABLE 1 - EXCLUDED STUDIES: DATA ABOUT PATIENTS WITH THE LENGTH OF RESIDUAL SMALL BOWEL LOWER THAN 100 CM ARE MIXED WITH LENGTH OF RESIDUAL SMALL BOWEL > 100 CM.

Author, Year of publication	Country	Years of study	n. patients enrolled	Adult patients (pts) with TPN at surgery	*SBS < 100 cm at surgery*	Reconnection surgery with colonic continuity	TPN off after surgery	Minimum 1 year follow-up after surgery
Brandt[37] 2015	Denmark	1970-2011	188	100 TPN adult pts	***few pts > 100 cm***	82 pts enterostomy	not specified	not specified
Kong[39] 2015	China	2004-2014	335	335 TPN adult pts	***few pts > 100 cm***	57 pts enterostomy	not specified	< 1 year
Iturrino[38] 2015	USA	NR	8	8 TPN adult pts	***1 pt > 100 cm***	5 pts enterostomy	None	< 1 year
O'Keefe[43] 2013	Multicenter	NR	52	52 TPN adult pts	***few pts > 100 cm***	15 pts enterostomy	None	> 1 year
Jeppesen[36] 2013	Denmark	NR	86	70 TPN adult pts	***15 pts > 100 cm***	23 pts enterostomy	None	< 1 year
Jeppesen[35] 2012	Denmark	NR	86	86 TPN adult pts	***few pts > 100 cm***	33 pts enterostomy	None	< 1 year
Jeppesen[34] 2011	Denmark	NR	83	83 TPN adult pts	***few pts > 100 cm***	24 pts enterostomy	not specified	< 1 year
Jeppesen[33] 2009	Denmark	NR	11	11 adult pts (4 no TPN)	***9 pts > 100 cm***	9 pts enterostomy	not specified	2 years
Luo[40] 2008	USA	NR	21	21 TPN adult pts	***few pts > 100 cm***	7 pts enterostomy	not specified	< 1 year
Joly[17] 2009	France	2004-2006	12	12 adult pts (3 no TPN)	***12 pts < 100 cm***	12 pts col. continuity	not specified	2 years
Tangpricha[46] 2006	USA	1998-2003	23	23 TPN adult pts	***most pts > 100 cm***	7 pts enterostomy	not specified	< 1 year
Jeppesen[31] 2005	Denmark	NR	17	17 TPN adult pts	***9 pts > 100 cm***	11 pts enterostomy	not specified	< 1 year
Crenn[24] 2004	France	1993-1998	90	90 TPN adult pts	***few pts > 100 cm***	12 pts enterostomy	39 pts off	2.1 years
Byrne[21] 2002	USA	1997-2000	61	49 TPN adult pts	***few pts > 100 cm***	12 pts enterostomy	16 pts off	1 year
Van Gossum[47] 2001	Multicentre	NR	228	222 TPN adult pts	***50 pts > 100 cm***	41% pts enterostomy	not specified	2 years
Jeppesen[30] 2001	Denmark	NR	8	4 TPN adult pts	***1 pt > 100 cm***	all pts enterostomy	not specified	< 1 year
Jeppesen[29] 2000	Denmark	1995-1997	49	45 TPN adult pts	***few pts > 100 cm***	27 pts enterostomy	not specified	< 1 year
Wasa[49] 1999	Japan	1969-1998	30	18 TPN pts (few paed pts)	***few pts > 100 cm***	not specified	4 pts off	8 years
Jeppesen[16] 1998	Denmark	NR	9	19 TPN adult pts	***most pts > 100 cm***	9 pts enterostomy	not specified	< 1 year
Carbonell[14] 1996	France	1972-1995	135	135 TPN adult pts	***few pts > 100 cm***	13 pts enterostomy	Retrosp= 79 pts off; Prosp= 27 pts off	Retrosp= 5.7 years ; Prosp= 1.3 year
Messing[41] 1995	France	1980-1989	217	Most adults but few paed pts	***few pts > 100 cm***	50 pts enterostomy	88 pts off	mean 6 years
Nordgaard[13] 1994	Denmark	NR	14	14 adult pts (most no TPN)	***7 pts > 100 cm***	6 pts enterostomy	not specified	< 1 year
Nguyen[3] 1989	USA	1980-1987	32	few paed pts, no-TPN pts	***most pts > 100 cm***	21 pts enterostomy	not specified	2.4 years

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TABLE 2 - EXCLUDED STUDIES: DATA ABOUT PATIENTS WITH JEJUNO-COLIC ANASTOMOSIS OR JEJUNO-ILEOCOLIC ANASTOMOSIS ARE MIXED WITH ENTEROSTOMY.

Author, Year of publication	**Country**	**Years of study**	**n. patients enrolled**	**Adult patients (pts) with TPN at surgery**	**SBS <100cm at surgery**	***Reconnection surgery with colonic continuity***	**TPN off after surgery**	**Minimum 1 year follow-up after surgery**
Atalay[19] 2003	Turkey	1995-2003	42	42 TPN adult pts	42 pts <100 cm	***10 pts enterostomy***	10 pts off	4.5 years
Evaluation about the effects of growth hormone or nutrients on absorption of the remnant small bowel after massive intestinal resection								
Byrne[22] 2005	USA	NR	41	40 TPN adult pts	few pts >100 cm	5 pts enterostomy	none off	< 1 year
Byrne[20] 1995	USA	NR	47	47 TPN adult pts	5 pts >100 cm	4 pts enterostomy	19 pts off	1 year
Segmental reversal for the reconstructive surgery of the remnant small bowel								
Panis[11] 1997	France	1985-1991	8	8 TPN adult pts	all	8 pts colonic continuity	4 pts off	2.11 years
Data about the end of total parenteral nutrition are missing and/or presence of paediatric patients								
Guo[27] 2013	China	NR	10	10 TPN adult pts	10 pts < 100cm	10 pts col. continuity	***not specified***	<2 years
Guo-Hao[28] 2003	China	NR	38	38 TPN adult pts (4 paed pts)	all	38 pts colonic continuity	22 pts off	5.9 years

in 13 adults with minimum 1 year follow-up (ended up on December 31st, 2014) affected by short bowel syndrome after massive small bowel resection with residual small bowel length < 100 cm. Mean age was 54.1 years (61.5% males), 53.8% classified as ASA III: their initial disease was bowel occlusion in 53.5% of cases and they were operated few times (mean number of previous surgery: 2.9, 53.8% represented by ostomy takedown) before coming to our tertiary care centre from surrounding hospitals (61.5% of patients coming from our region) (Table 8). Their stomal output was high (> 500 cc/day) in 69.2% of cases and TPN dependence was 100%. After a period of recovery in our department (at time of surgery mean albumin level and mean creatinine level were normal – 3.9 g/dl and 1.2 mg/dL respectively), we performed a jejuno-colonic anastomosis (SBS type II) in 53.8% of our patients, in 46.1% of the cases without ileo-cecal valve reconnecting the residual small bowel to left colon only, and leaving a mean residual small bowel length of 75.7 cm (minimum 45 cm, maximum 100 cm). Mean operative time was 5 hours (in 84.6% of patients without blood transfusions), and we were able to perform a primary closure of their damaged abdominal wall in 76.9% of cases (single layer without mesh) (Table 9). In-hospital mortality was 0%: mean length of hospital stay

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TABLE 3 - EXCLUDED STUDIES: DATA ABOUT PATIENTS WITH THE LENGTH OF RESIDUAL SMALL BOWEL LOWER THAN 100 CM ARE REPORTED BUT THEY ARE NOT CORRELATED WITH THE DIFFERENT TYPE OF THE RECONSTRUCTIVE SURGERY OF THE REMNANT SMALL BOWEL (JEJUNO-COLIC ANASTOMOSIS, JEJUNO-ILEOCOLIC ANASTOMOSIS OR ENTEROSTOMY).

Author, Year of publication	Country	Years of study	n. patients enrolled	Adult patients (pts) with TPN at surgery	SBS < 100cm at surgery	Reconnection surgery with colonic continuity	TPN off after surgery	Minimum 1 year follow-up after surgery
Amiot[18] 2013	France	1980-2009	107	107 TPN adult pts	57 pts >100 cm	7 pts enterostomy	51.5% off	5.9 years
Vantini[48] 2004	Italy	1990-2001	68	few paed pts, no-TPN pts	31 pts >100 cm	4 pts enterostomy	32 pts off	3 years
Messing[1] 1999	France	1980-1989	217	124 TPN adult pts	42 pts >100 cm	18 pts enterostomy	64 pts off	min 4 years
Thompson[5] 1995	USA	1980-1994	160	few paed pts, no-TPN pts	most pts > 100 cm	none	29% pts off	4.3 years

was 23.3 days, most of the patients (76.9%) did not require a second look operation, their wound became infected in 61.5% but later did not require V.A.C. (vacuum assisted closure) or skin grafting for definitive closure (92.3% of cases). At discharge, 76.9% were on loperamide or cholestyramine to slow intestinal motility. After a minimum period of 1 year of intestinal rehabilitation, all of them (100%) went back to oral intake and 69.2% were off TPN (9 patients): 1 patient died on TPN few months after the surgical procedure for cancer recurrence, 1 was still on TPN as before our reconnection surgery while the remaining 2 on TPN reduced their iv support from 24h/day to 16 and 12/h day respectively. No patient was later listed for transplantation (Table 10).

Discussion

Intestinal rehabilitation has again gained popularity in recent years due to the questionable long term results of intestinal transplantation (56): since the '70 with the spreading of TPN, reports on surgical techniques of intestinal rescue after massive bowel resection have been published in the international literature. These procedures have been later ('90) partially abandoned with the upcoming beginning of the intestinal/multivisceral transplantation era, supported by new and powerful immunosuppressive drugs like FK 506. But recently, due to the questionable long term results achieved in more than 20 years of transplant activity, intestinal transplantation has been confined to a very well selected patient population, leaving again room to intestinal surgical rehabilitation. Moreover, the use of these techniques has been constantly increased in adult population, while in the beginning bowel rehabilitation was specially devoted to paediatric patients: especially STEP (serial transverse enteroplasty) has been increasingly performed (57) in the last 10 years as a lengthening procedure in case of short bowel syndrome, while only recently segmental reversal procedures have again become popular between bowel surgeons. The role of colon as a digestive organ in patients with short bowel syndrome has been widely demonstrated since the '90 (58-61): there is international agreement on the fact that the remaining small bowel after massive intestinal resection is taking advantage by the presence of the colon, through restoration of colonic continuity, in order to complete the process of digestion. In our series autologous gastrointestinal reconstruction techniques like STEP or segmental reversal procedure could not be used: the remaining small bowel in our 13 patients was not dilated enough for STEP nor its vascular supply was adequate to support a segmental rever-

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TABLE 4 - EXCLUDED STUDIES: DATA NOT REPORTED ABOUT THE TYPE OF THE RECONSTRUCTIVE SURGERY OF THE REMNANT SMALL BOWEL AND/OR PRESENCE OF PATIENTS WITH ENTEROSTOMY.

Author, Year of publication	Country	Years of study	n. patients enrolled	Adult patients (pts) with TPN at surgery	SBS <100cm at surgery	*Reconnection surgery with colonic continuity*	TPN off after surgery	Minimum 1 year follow-up after surgery
Weiming[50] 2004	China	1997-2002	37	37 TPN adult pts	37 pts < 100 cm	***not specified***	21 pts off	2 years
Seguy[45] 2003	France	1990-1994	12	12 TPN adult pts	1 pt > 100 cm	***3 pts enterostomy***	not specified	< 1 year
Zhu[52] 2002	China	1997-2000	27	27 TPN adult pts (few paed pts)	27 pts < 100 cm	***not specified***	10 pts off	1 year
Ellegard[25] 1997	Sweden	NR	10	10 TPN adult pts	6 pts > 100 cm	***6 pts enterostomy***	few pts off	< 1 year
Nordgaard [42] 1996	Denmark	NR	66	Few paed pts	Most pts > 100 cm	***66 pts enterostomy***	not specified	< 1 year
Pakarinen [44] 1995	Finland	1987-1992	24	12 TPN adult pts	6 pts > 100 cm	***2 pts enterostomy***	8 pts off	8.8 years
Nightingale [12] 1992	UK	1980-1990	84	84 adult pts (few no TPN)	Few pts > 100 cm	***43 pts enterostomy***	19 pts off	5 years

sal procedure. In all our adult cases we were forced intra-operatively to reconnect the remaining small bowel, always < 100 cm, to the colon (whole or part of it): we mainly performed an handsewn anastomosis, and we were able to close the damaged abdominal wall (damaged due to a number of previous surgical procedures) by single layer technique, without mesh, V.A.C. or skin grafting in most of the cases as reported. All patients were on TPN before the operation and their clinical condition was improved substantially before taking them into the operating room, recovering the nutritional status (mean albumin level at surgery: 3.9 g/dL) and the fluid requirement (mean creatinine level at surgery: 1.2 mg/dL). Intra-operatively and post-operatively, no mortality was reported: most of our patients required loperamide/cholestyramine due to a number of post-operative bowel movements but all recovered an adequate oral intake supported by TPN at the beginning and, after a minimum period of 1 year of bowel rehabilitation, near 70% were off total parenteral nutrition apart from 4 of them as reported. Our outcome was supported by the systematic review of the literature , showing an extremely rarity of such cases reported on papers: after deep selection, the 3 analysed manuscripts confirmed weaning from TPN on a long term follow-up (40%, 50% and 90% respectively) after reconnection surgery without autologous gastrointestinal reconstruction, especially after type III re-

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TABLE 5 - CHARACTERISTICS OF STUDIES AND PATIENTS OF "INCLUSION CRITERIA" PAPERS.

First author, year of publication	Hospital, city, nation	Type of study	Number of patients enrolled	Age Means ±SD or range	Sex (M/F)	Time of enrolling patients
ChaerBorges[23] 2011	University of Sao Paulo, Brazil	Retrospective observational study Monocentric	10	47 ± 12	6/4	1986-2004
Gong[26] 2009	Jinling Hospital, Nanjing, China	Retrospective observational study Monocentric	61	37.56 ± 14.30	46/15	1997-2008
Wilmore[51] 1997	Harvad Medical School, Boston,USA	Prospective study Monocentric	45	43 (19-71)	22/23	1988-1995

TABLE 6 - CHARACTERISTICS OF THE SMALL AND LARGE BOWEL AFTER RESECTION OF "INCLUSION CRITERIA" PAPERS.

First author, year of publication	Reconstructive surgery of the remnant small bowel	Remnant Small Bowel Length, after resection (Means±SD)	Remnant Colon	Delay Since Continuity Restablishment, (yr) (Means±SD)
ChaerBorges[23] 2011	Duodenocolic anastomosis: 1 pt Jejunocolic anastomosis: 7 pts Jejunoileocolic anastomosis: 2 pts	28.9±19 cm	Only 5 right colectomy, the whole colon was present in 5 pts	NR
Gong[26] 2009	Jejunocolic anastomosis: 30 pts Jejunoileocolic anastomosis: 31 pts	Jejunocolic anastomosis < 60 cm: 19 pts 60-100 cm: 11 pts Jejunoileocolic anastomosis < 35 cm: 12 pts 35-100 cm: 19 pts	NR	NR
Wilmore[51] 1997	Jejunoileocolic anastomosis: 45 pts	average 23 cm	Colonic length 60%	NR

TABLE 7 - EVALUATION OF METHODOLOGICAL QUALITY OF THE INCLUDED STUDIES.

Items/author*	ChaerBorges[23] 2011	Gong[26] 2009	Wilmore[51] 1997
Case series collected in more than one centre, i.e. multi-centre study	1	1	1
Is the hypothesis/aim/objective of the study clearly described?	1	1	1
Are the inclusion and exclusion criteria (case definition) clearly reported?	1	1	1
Is there a clear definition of the outcomes reported?	1	1	1
Were data collected prospectively?	0	0	1
Is there an explicit statement that patients were recruited consecutively?	0	0	0
Are the main findings of the study clearly described?	1	1	1
Are outcomes stratified? (e.g., by disease stage, abnormal test results, patient characteristics)	1	1	1
Total Score	**6**	**6**	**7**

** listed by references*

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TABLE 8 - PRE-OPERATIVE DATA "S. ORSOLA" UNIVERSITY HOSPITAL, BOLOGNA, ITALY.

Patient ID, gender, age and primary disease	Transferred from outside hospital (region of Italy)	Year and type of abdominal operation (year and number of prior abdominal operations)	Albumin before surgery	Creatinine before surgery	Stomal/ Fistula output	Pre TPN at admission
1. V. E. male, 57 years-occlusion	EMILIA ROMAGNA	2003 RESECTION for ENTEROCUTANEOUS FISTULA (2003 -3 previous surgeries)	3.7 g/dl	0.8 mg/dL	Fistula <500cc/day	YES
2. G.A. male, 67 years-diverticulitis	ABRUZZO	2003 RESECTION for ENTEROCUTANEOUS FISTULA (2002-3 previous surgeries)	4.4 g/dl	1.9 mg/dL	Fistula >500cc/day	YES
3. C.T. male, 34 years-occlusion	CAMPANIA	2006 OSTOMY TAKEDOWN and RECONNECTION SURGERY (2004- 1 previous surgery)	4.7 g/ dl	1.5 mg/dL	Stoma 3000 cc/day	YES
4. R. D. male, 41 years- trauma	LIGURIA	2006 RESECTION for ENTEROCUTANEOUS FISTULA (2005- 3 previous surgeries)	3.1 g/ dl	0.9 mg/dL	Fistula <500cc/day	YES
5. V.E. female, 44 years-trauma	EMILIA ROMAGNA	2009 OSTOMY TAKEDOWN and RECONNECTION SURGERY (2008- 2 previous surgeries)	4.3 g/dl	1.2 mg/dL	Stoma 1500 cc/day	YES
6. N.L. male, 45 years–bowel infarction	EMILIA ROMAGNA	2010 OSTOMY TAKEDOWN and RECONNECTION SURGERY (2009- 6 previous surgeries)	3.9 g/ dl	0.7 mg/dL	Stoma 3000 cc/day	YES
7. S. G. male, 55 years-diverticulitis	EMILIA ROMAGNA	2010 RESECTION for ENTEROCUTANEOUS FISTULA (2009- 3 previous surgeries)	3.8 g/ dl	0.8 mg/dL	Fistula <500cc/day	YES
8. V. L. female, 69 years-occlusion	MARCHE	2010 OSTOMY TAKEDOWN and RECONNECTION SURGERY (2009- 3 previous surgeries)	3.2 g / dl	1.0 mg/dL	Stoma 3500 cc/day	YES
9. M.F. female, 60 years- colonic cancer	EMILIA ROMAGNA	2012 OSTOMY TAKEDOWN and RECONNECTION SURGERY (2011- 3 previous surgeries)	3.8 g/dl	1.1 mg/dL	Stoma 4000 cc/day	YES
10. C. AM. female, 48 years-occlusion	EMILIA ROMAGNA	2012 OSTOMY TAKEDOWN and RECONNECTION SURGERY (2011- 2 previous surgeries)	4.4 g/dl	2.0 mg/dL	Stoma 1500 cc/day	YES
11. M. M. female, 65 years -occlusion	EMILIA ROMAGNA	2013 ENTERO-CUTANEOUS FISTULA and RECONNECTION SURGERY (2012- 4 previous surgeries)	3.4 g/dl	2.6 mg/dL	Fistula <500cc/day	YES
12. T.V. male, 82 years- occlusion	EMILIA ROMAGNA	2013 OSTOMY TAKEDOWN and RECONNECTION SURGERY (2012- 3 previous surgeries)	4.3 g/ dl	1.1 mg/dL	Stoma 2000 cc/day	YES
13.T.R. male, 37 years- occlusion	TOSCANA	2013 ENTERO-CUTANEOUS FISTULA and RECONNECTION SURGERY (2013-2 previous surgeries)	4.3 g/ dl	0.7 mg/dL	Fistula 1250 cc/day	YES
-mean 54.1 years **-61.5% males** **-53.5% occlusion**	**61.5 % from EmiliaRomagna**	**mean 2.9 previous surgeries = 53.8% OSTOMY TAKEDOWN**	**3.9 g/ dl**	**1.2 mg/dL**	**69.2 % = > 500cc/day**	**YES 100%**

construction and an adequate period of medical rehabilitation.

Conclusions

In conclusion, after a minimum period of 1 year of intestinal rehabilitation and in near 70% of adult patients, in our series restoration of colonic continuity after small bowel massive resection looked able to produce a TPN independence without autologous gastrointestinal reconstruction in front of a residual small bowel length with a mean cut-off of 75 cm. These data seem to be confirmed by a systematic review, showing a parenteral nutrition independence ranging from 40% to 90 % in 116 adult patients with SBS < 100 cm reconnected to the colon without autologous gastrointestinal reconstruction on a long term follow up (minimum > 1 year).

Conflict of interest
None.

Financial support and sponsorship
None.

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TABLE 9 - INTRA-OPERATIVE DATA "S. ORSOLA" UNIVERSITY HOSPITAL, BOLOGNA, ITALY.

Patient ID and ASA score	Operative time and blood transfusions	First operator	Residual small bowel	Residual colon	Type and number of Anastomosis (A.)	Closure of the abdomen
1. V.E. II	9 h/ YES	ADP	80 cm JEJUNUM/ILEUM	WHOLE COLON	JEJUNAL-ILEAL A. and ILEAL-ILEAL A. (SBS Type 3)	SINGLE LAYER
2. G.A. II	6 h/ NO	ADP	70 cm JEJUNUM/ILEUM	RIGHT COLON colostomy	2 ILEAL-ILEAL A. (SBS Type 3)	SINGLE LAYER
3. C. T. II	4 h / NO	ADP	100 cm JEJUNUM	LEFT COLON	JEJUNAL-COLIC A. (SBS Type 2)	SINGLE LAYER
4. R. D. III	4 h 30 min / NO	AL	95 cm JEJUNUM/ILEUM	WHOLE COLON	ILEAL-COLIC A. (SBS Type 3)	SINGLE LAYER
5. V.E. II	4 h / NO	LA	80 cm JEJUNUM/ILEUM	WHOLE COLON	ILEAL-COLIC and COLO-COLIC A. (SBS Type 3)	MESH
6. N. L . III	4 h / NO	AL	50 cm JEJUNUM/ILEUM	WHOLE COLON	JEJUNAL-ILEAL A (SBS Type 3)	SINGLE LAYER
7 .S. G. III	4 h / NO	ADP	70 cm JEJUNUM	WHOLE COLON	JEJUNAL-COLIC A. (SBS Type 2)	SINGLE LAYER
8. V. L. III	3 h / NO	ADP	80 cm JEJUNUM/ILEUM	LEFT COLON	ILEAL-COLIC A. (SBS Type 3)	SINGLE LAYER
9. M. F. III	3 h / NO	AL	65 cm JEJUNUM	LEFT COLON	JEJUNAL-COLIC A. (SBS Type 2)	SINGLE LAYER
10. C.AM. II	5 h 30 min / NO	AL	80 cm JEJUNUM	LEFT COLON	JEJUNAL-COLIC A. (SBS Type 2)	SINGLE LAYER
11. M. M. III	6 h / NO	AL	80 cm JEJUNUM	LEFT COLON	JEJUNAL-COLIC A. (SBS Type 2)	MESH
12. T.V. III	5 h / NO	AL	90 cm JEJUNUM	WHOLE COLON	JEJUNAL-COLIC A. (SBS Type 2)	SINGLE LAYER
13.T. R. II	7 h / YES	ADP/ AL	45 cm JEJUNUM	LEFT COLON	JEJUNAL-COLIC A. and COLO-COLIC A. (SBS Type 2)	MESH
53.8 % ASA III	**-5 h operative time** **- 84.6% NO blood transfusion**	**-7 AL** **-6 ADP**	**-mean 75.7 cm (max 100cm-min 45 cm)**	**46.1% without ileocecal valve**	**53.8% SBS Type 2**	**76.9% SINGLE LAYER WITHOUT MESH**

ADP and AL = main surgeons

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TABLE 10 - POST-OPERATIVE DATA "ST. ORSOLA" UNIVERSITY HOSPITAL, BOLOGNA, ITALY.

Patient ID and second abdominal operation	Wound complications	Post operative VAC therapy and/or skin graft	Oral intake	Length of hospital stay	Loperamide / Cholestyramine at discharge	Post TPN (minimum 1 year follow-up)	In-hospital mortality
1. V.E. NO	INFECTION	NO	YES	22 days	YES	NO at discharge	NO
2. G.A. NO	INFECTION	NO	YES	11 days	NO	NO at discharge	NO
3. C.T. NO	NO	NO	YES	8 days	NO	NO (stop 2 years after operation)	NO
4. R. D. NO	NO	NO	YES	18 days	YES	NO at discharge	NO
5. V.E. YES= WOUND INFECTION	INFECTION	NO	YES	23 days	YES	NO at discharge	NO
6. N. L. YES=ABDOMINAL BLEEDING/ CHOLECYSTITIS	INFECTION	NO	YES	48 days	YES	NO at discharge	NO
7. S. G. NO	NO	NO	YES	22 days	YES	NO (stop 3 years after operation)	NO
8. V. L. NO	NO	NO	YES	10 days	YES	**YES** (TPN as before the operation)	NO
9. M. F. NO	NO	NO	YES	16 days	YES	**YES** (death few months later for early cancer recurrence)	NO
10. C.AM. NO	INFECTION	NO	YES	14 days	YES	NO at discharge	NO
11. M.M. NO	INFECTION	VAC	YES	55 days	YES	**YES** (12h/die)	NO
12. T.V. YES= OCCLUSION	INFECTION	NO	YES	33 days	NO	NO (within 6 months)	NO
13.T.R. NO	INFECTION	NO	YES	23 days	YES	**YES** (16 h/die)	NO
76.9 % NO	**61.5 % WOUND INFECTION RATE**	**92.3 % NO**	**100% YES**	**mean 23.3 days**	**76.9% YES**	**69.2 % off TPN**	**100% NO**

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