

# LA CHIRURGIA RIABILITATIVA

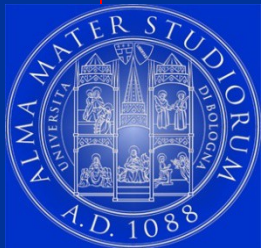
## **SINDROME DA INTESTINO CORTO: GLI ASPETTI ETICI, L'APPROCCIO MEDICO E LE ESIGENZE IN CAMPO NORMATIVO**

*VII CONGRESSO NAZIONALE ASSOCIAZIONE A.N.A.D.P.*

*"UN FILO PER LA VITA" ONLUS*

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# Intestinal Failure - Definition

originally defined by Fleming and Remington as ‘a reduction in the functioning gut mass below the minimal amount necessary for adequate digestion and absorption of food’

*Fleming CR, Remington M. Intestinal failure. In: Hill GL, ed. Nutrition and the Surgical Patient. Edinburgh: Churchill Livingstone, 1981*

- acute or chronic
- secondary to a variety of causes
- inability to maintain protein energy, fluid, electrolyte or micronutrient balance



## **TYPE 1**

- self-limiting IF
- following abdominal surgery
- Managed in non-specialist units

## **TYPE 2**

- IF in severely ill pts
- major resections
- septic, metabolic and nutritional complications
- multidisciplinary intervention

## **TYPE 3**

- chronic IF
- long term TPN
- managed in specialist unit



# Intestinal Failure – Causes

- **Short Bowel Syndrome**
  - *Children*: gastroschisis, mid-gut volvulus, atresia, necrotizing enterocolitis
  - *Adults*: Resection (iatrogenic, ischemic, inflammatory, tumors, obstruction)
- **Functional**
  - Pseudo-obstruction
  - enterocyte abnormalities



# complications related to intestinal failure (1)

## Related to SBS

- **Diarrhea**
- **Dehydration, Electrolyte imbalance**
- **Hypocalcemia, Hypomagnesemia**
- **Trace element and vitamin deficiencies**
- **D-lactic acidosis**
- **Calcium oxalate stones**
- **Metabolic bone disease**

**Gastric acid hypersecretion**

## Related to TPN

- **Hyperglycemia**
- **Hypoglycemia**
- **Line sepsis**
- **Thrombosis/ Loss of venous access**
- **Air embolus**
- **Catheter breakage**
- **Hepatobiliary dysfunction**



# complications related to intestinal failure (2)

**Sepsis was identified as the principal cause of death in patients with intestinal failure over 25 years ago and, despite advances in therapy, the same is true today**

*Soeters PB, Ebeid AM, Fischer JE. Review of 404 patients with gastrointestinal fistulas. Impact of parenteral nutrition. Ann Surg 1979*

**Resolution of sepsis is of primary importance before intestinal function and nutritional status can be restored**



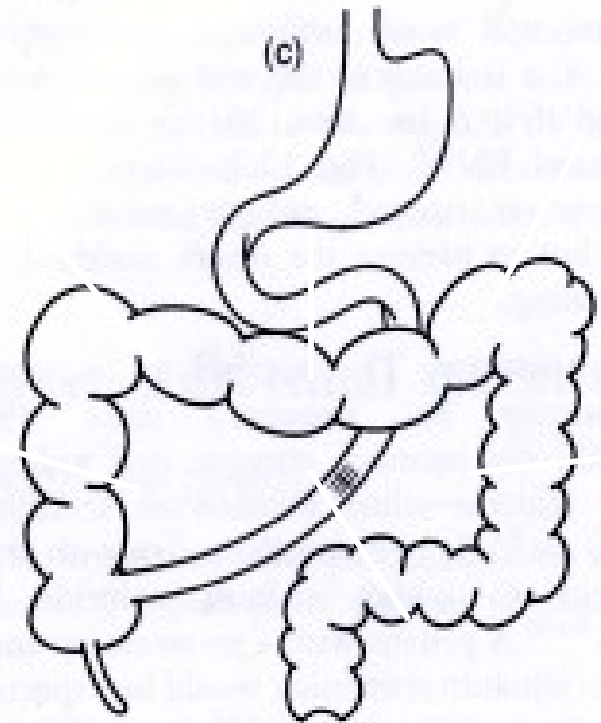
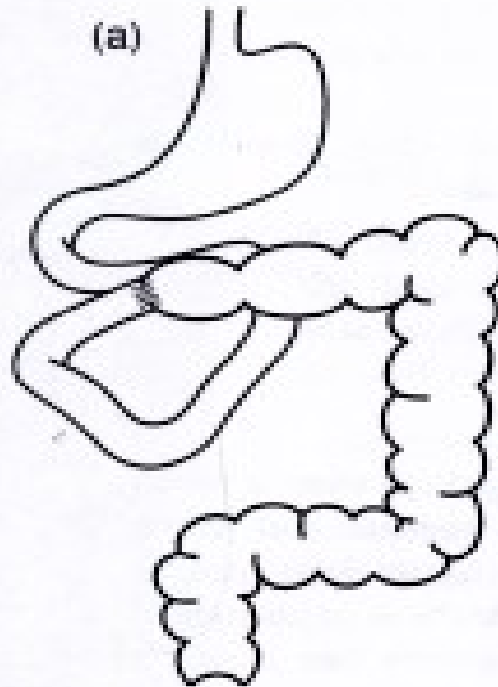
# Main types of SBS responsible for Severe IF

*Remnant post duodenal small bowel length :*

Type I  
Enterostomy  
**≤ 100 to 150 cm**

Type II  
Jejuno-colonic  
**≤ 50 to 75 cm**

Type III  
Jejuno-ileal  
**≤ 35 to 50 cm**



# Intestinal Failure – outcome

- length of remnant intestine
- Age at starting TPN
- enteral independence rate
- underlying disease

influence  
survival

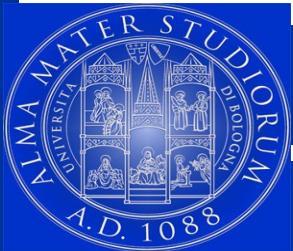
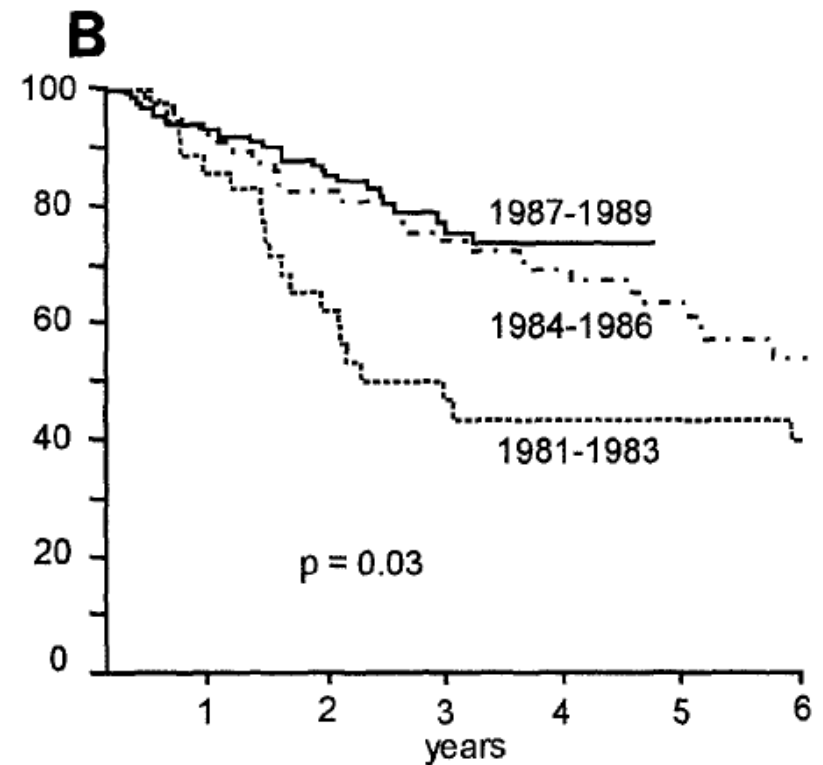
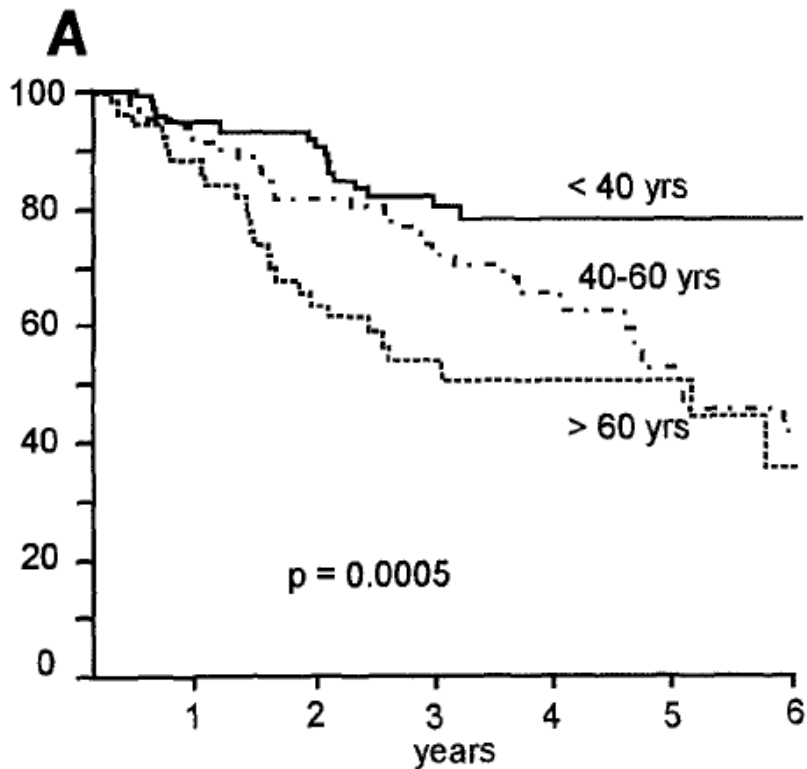


*I. Vantini et al. / Digestive and Liver Disease 36 (2004)*



# Prognosis of Patients With Nonmalignant Chronic Intestinal Failure Receiving Long-term Home Parenteral Nutrition

BERNARD MESSING,\* MARC LÉMANN,\* PAUL LANDAIS,† MARIE-CLAUDE GOUTTEBEL,<sup>§</sup> MICHÈLE GÉRARD-BONCOMPAIN,<sup>||</sup> FRANCOIS SAUDIN,<sup>||</sup> ANDRÉ VANGOSSUM,<sup>¶</sup> PHILIPPE BEAU,<sup>#</sup> CLAIRE GUÉDON,\*\* DIDIER BARNOUD,†† MARTINE BELIAH,\* HENRI JOYEUX,<sup>§</sup> PAUL BOULETREAU,<sup>||</sup> DOMINIQUE ROBERT,<sup>||</sup> CLAUDE MATUCHANSKY,<sup>#</sup> XAVIER LEVERVE,†† ERIC LEREBOURS,\*\* YVON CARPENTIER,<sup>¶</sup> and JEAN-CLAUDE RAMBAUD\*



# Is TPN permanent?

## Factors Affecting Adaptation:

- Extent of resection ( $> 80\%$ )
  - Adults ( $< 100$  cm remnant)
  - Pediatric ( $< 40$  cm remnant)
- Site of resection (jejunum vs. ileum)
- Mucosal disease or enterocyte disease
- Anatomy (presence of ICV, full colon)
- Age (Infant vs. adult or elderly)



over the last half century  
in the field of INTESTINAL FAILURE surgeons  
have witnessed 3 major therapeutic options:



**TPN**



**BOWEL RESCUE**



**INTESTINAL TRANSPLANT**

• common aim: ACHIEVING ENTERAL AUTONOMY

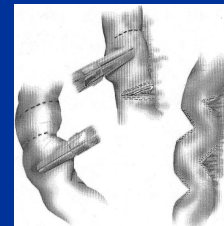
- increase nutrient and water absorption
- slowing gastrointestinal transit AND/OR
- increasing absorptive surface
- eliminating/reducing/prevent need for  
long term TPN dependancy

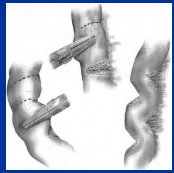
PRIMARY  
GOAL



# Potential Therapies in the Patient with Intestinal Failure

- Medical therapy (PN, enteral feedings – drip, bolus, supplement, motility agents, GH, Glutamine, GLP-2, Lipid formulations/Omegaven)
- Non-transplant surgical therapy
  - Tapering enteroplasty
  - Reversed segment
  - Intestinal Lengthening
- Intestinal transplant

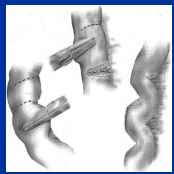




# Autologous intestinal reconstruction surgery for intestinal failure management

*Brian A. Jones, Melissa A. Hull and Heung Bae Kim*

Techniques of autologous reconstruction are varied, but have the common goal of using surgical manipulation of existing bowel in an attempt to **improve intestinal absorption** and **facilitate enteral autonomy**. Procedures such as **intestinal segment reversal**, **colonic interposition**, and **recirculating loops** were described in the 1950s and 1960s, but are rarely used today. **Tapering enteroplasty** and **plication** are occasionally used to correct the size discrepancy that is initially encountered with a dilated proximal loop in intestinal atresia. The primary autologous intestinal procedure used today are longitudinal intestinal lengthening and tailoring (LILT, also known as **Bianchi**) and serial transverse enteroplasty (**STEP**). A third procedure, the Iowa (Kimura) procedure, has been reported but is rarely used.



- **SURGICAL APPROACH** depends on:

REMNANT LENGTH, TYPE and CALIBER  
INTESTINAL FUNCTION

INTESTINAL COMPLICATIONS

NUTRITIONAL SUPPORT

- **SURGICAL APPROACH** consists on:

RELIEF of OBSTRUCTION

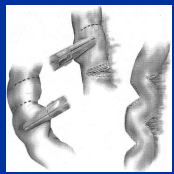
REPAIR of FISTULAE

LYSIS of ADHESIONS

RECONNECTION and REMOVAL of STOMA

BOWEL LENGTHENING





# Surgical approach

1. Tapering enteroplasty or plication
2. Reversed intestinal segments
3. Colonic interposition
4. Intussusception valve
5. Lengthening
  - Bianchi tapering and lengthening
  - STEP
  - Kimura



# 1) *Tapering Enteroplasty*

**Goal :**

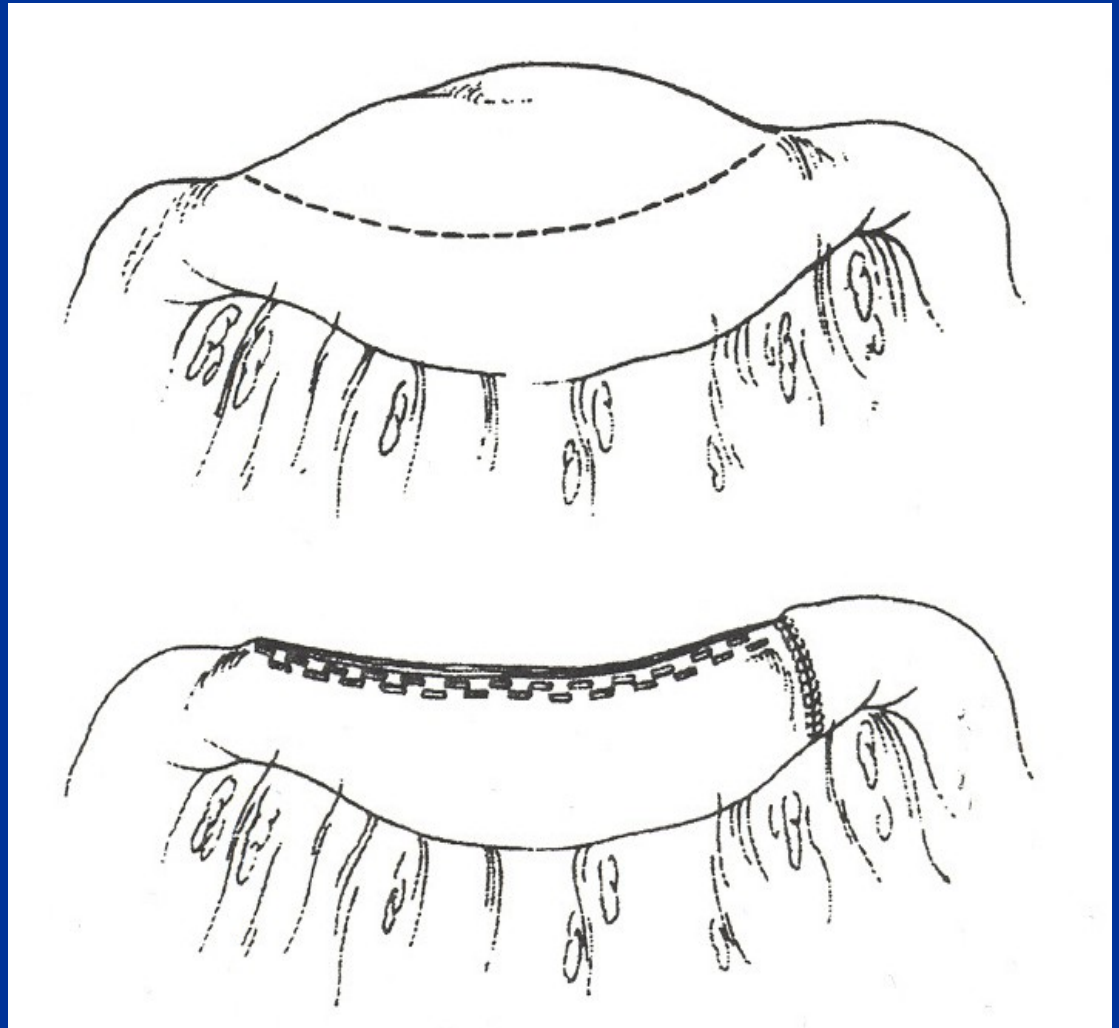
**IMPROVE MOTILITY**

+

**DECREASE STASIS**

and **BACTERIAL**

**OVERGROWTH**





## 2) *Reversed Segment*

- **Goal** : SLOW MOTILITY to allow longer contact time for absorption of nutrients
- **Technical aspects** : Reversed segment usually placed close to colon in distal small bowel
  - *Adults* : length of reversed segment: 10 – 12 cm
  - *Children*: length of reversed segment: 3 - 5 cm

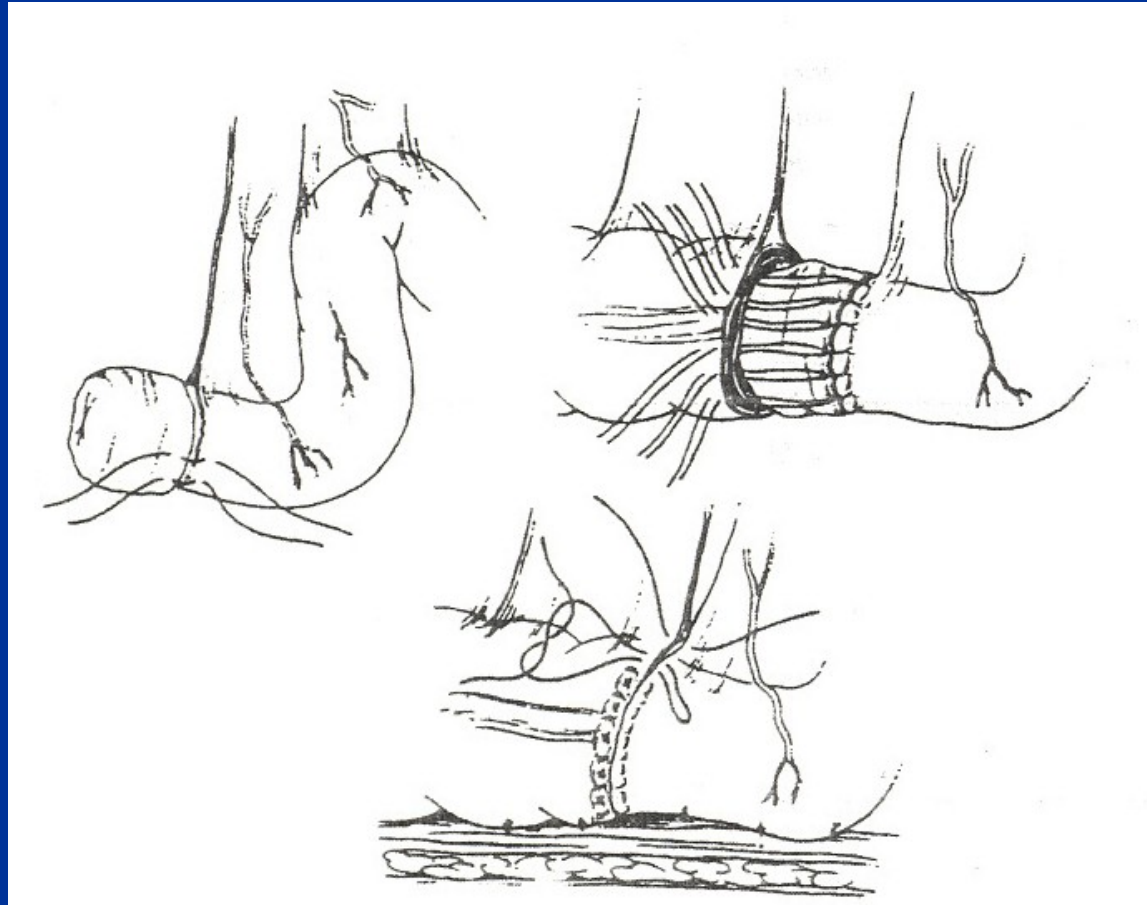


### 3) *Colonic Interposition*

- **Goal** : SLOW MOTILITY to allow longer contact time for absorption of nutrients by the mucosa (*as reversed segment*)
- **Technical aspects**
  - Placed between jejunum and ileum to delay delivery of nutrients to distal small bowel
  - Variation in length from 8 cm to 24 cm
- Not dependent on obstruction for prolongation of transit time (isoperistaltic)



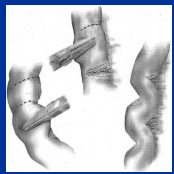
## 4) *Interposition Valve (1)*



# *Interposition Valve (2)*

- **Goals :**
  - SLOW MOTILITY so INCREASE CONTACT OF NUTRIENTS TO MUCOSA
  - DECREASE BACTERIAL REFLUX FROM COLON so DECREASE INCIDENCE OF BACTERIAL OVERGROWTH
- **Technical aspects:**
  - 4 cm valve (constructed from distal 8 cm of small bowel) interposed between small intestine and remnant colon
- **Complications**
  - Nephrolithiasis
  - Cholelithiasis requiring cholecystectomy
  - Perforation, enterocutaneous fistula, bowel obstruction
  - Obstruction, progression of liver disease





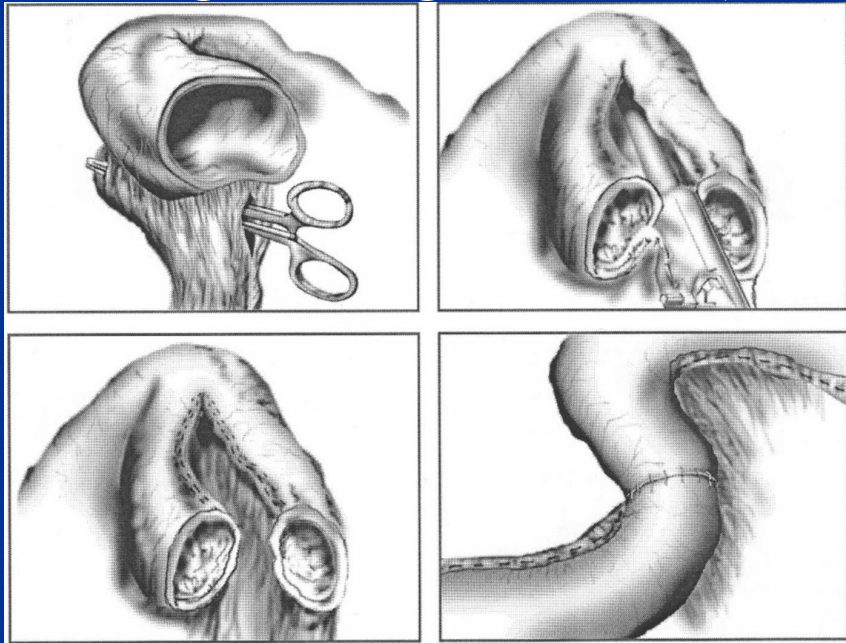
## 5) *Intestinal Lengthening*

- Bianchi – Longitudinal Intestinal Lengthening
- STEP – Serial Transverse Enteroplasty

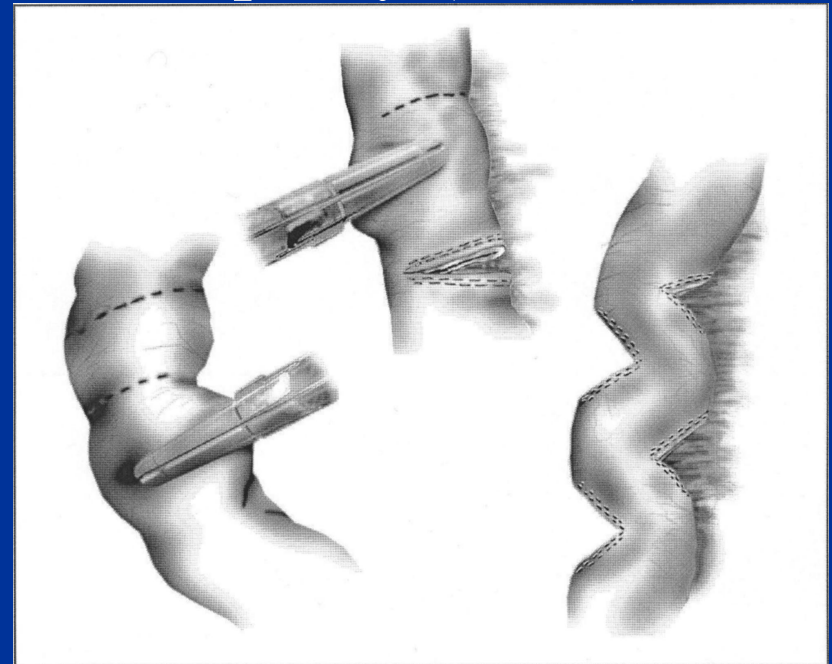


# *Bianchi vs STEP*

- Longitudinal intestinal lengthening (Bianchi)

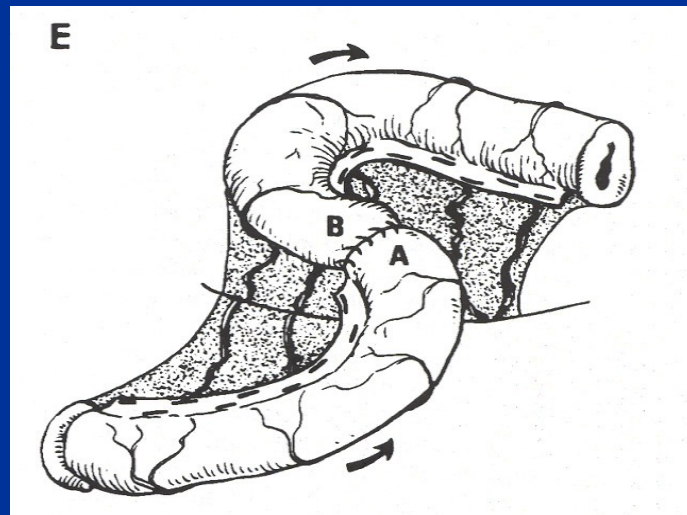
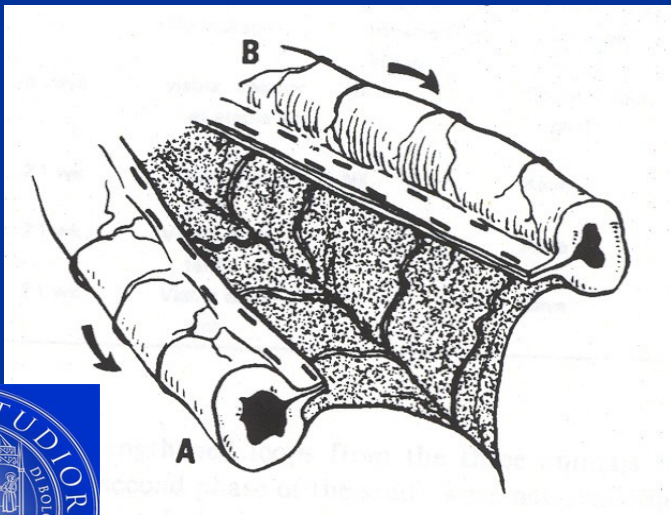
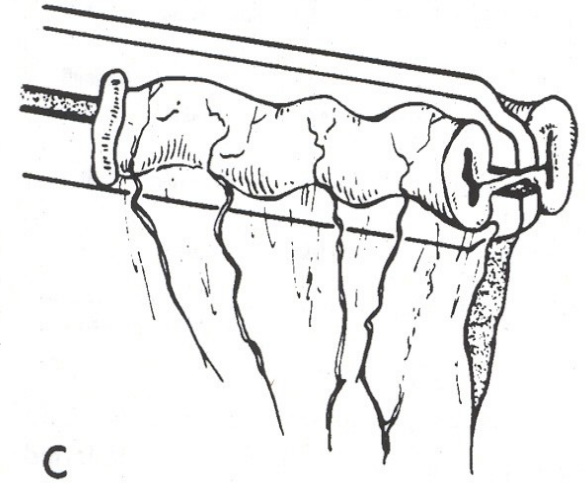
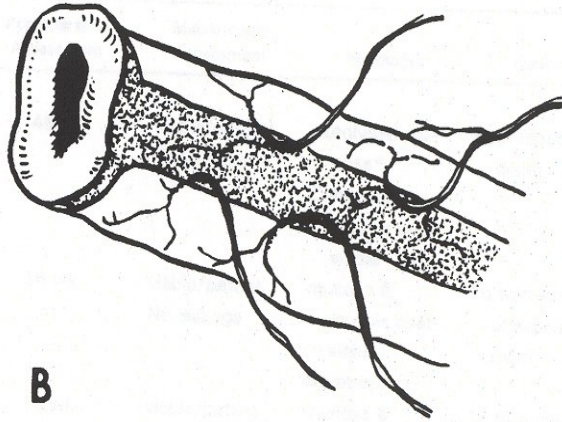
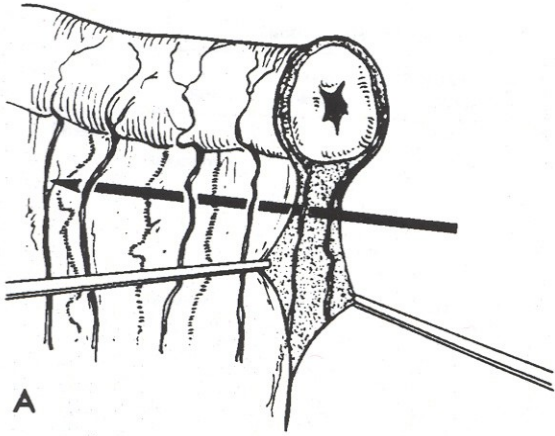


- Serial transverse enteroplasty (STEP)



# Bianchi Procedure

INTESTINAL LOOP LENGTHENING



# A Multidisciplinary Approach to the Treatment of Intestinal Failure

*Debra Sudan, M.D., John DiBaise, M.D., Clarivet Torres, M.D., Jon Thompson, M.D., Stephen Raynor, M.D., Richard Gilroy, M.D., Simon Horslen, M.D., Wendy Grant, M.D., Jean Botha, M.D., Alan Langnas, D.O.*

- 90 IF patients 2000-2004
  - 40 medical weaning only
  - 50 surgical intervention
    - 30 children
    - 20 adults
  - 94% fully TPN dependent
- Surgical indications
  - TPN, with life-threatening complications
  - Fistula, obstruction or excluded segment
  - Dilation/dysmotility
- **Surgeries performed**
  - **Bianchi lengthening (n = 20)**
  - **STEP or re-STEP (n = 8)**
  - **Closure of fistula or ostomy ( n = 10)**
  - **Strictureplasty (n = 1)**
  - **Bowel resection (n =7)**
  - **Ileostomy/colostomy (n = 2)**
  - **Reversed segment ( n = 1)**
- **Patient survival 86% (mean follow-up 2-y)**
- **65% weaned from PN, 25% partial weaning, 10% no improvement in enteral function**
- **Transplant - 7 referred/ 4 transplanted; isol sb (1), LSB (3)**





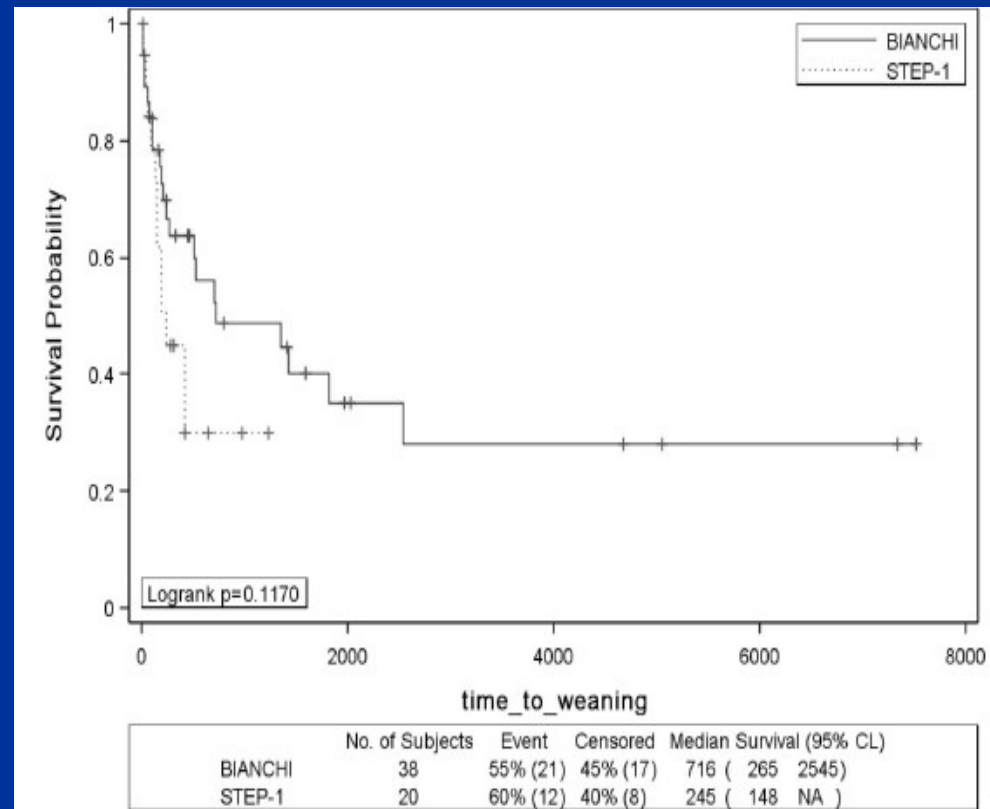
# Comparison of Intestinal Lengthening Procedures for Patients With Short Bowel Syndrome

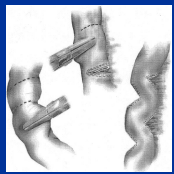
Debra Sudan, MD, Jon Thompson, MD, Jean Botha, MB, Bch, FCS(SA), Wendy Grant, MD, Dean Antonson, MD, Steve Raynor, MD, and Alan Langnas, DO

## Weaning of TPN

TABLE 1. Bianchi Versus STEP

Risk Factor	Overall (n = 64)	Bianchi (n = 43)	STEP (n = 21)	P
Age				
Adult	38 (18-66)	32 (18-50)	40 (18-66)	0.06
Pediatric	1.3 (0.1-14)	1.25 (0.2-12)	2.2 (0.1-14)	0.14
Gestational age at birth	34 (27-40)	34 (27-40)	34 (29-40)	0.46
Gender				
Male	32	25	7	0.06
Female	32	18	14	
Patient follow-up, yr	3.8 (0.4-24)	5.9 (0.4-24)	1.7 (0.4-1.6)	0.003



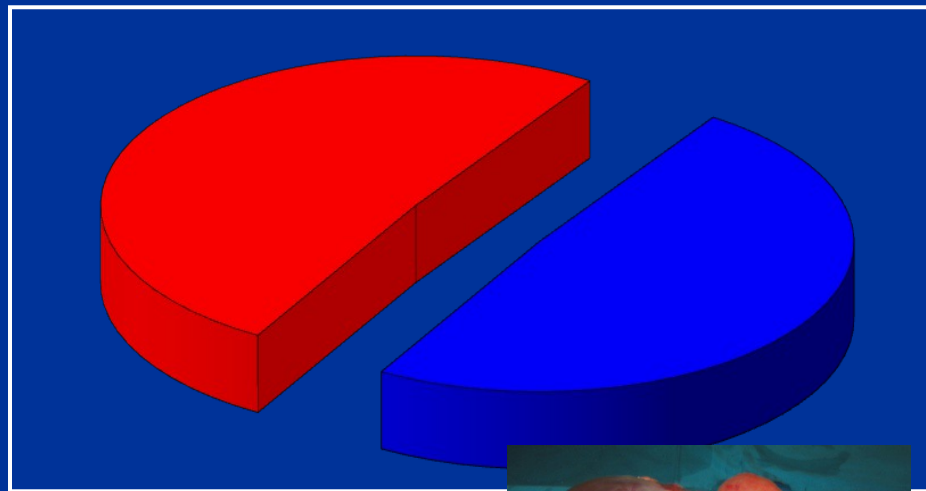


**Modena-Bologna: > 13 years experience**

**118 ADULT patients with INTESTINAL FAILURE  
referred for SURGICAL APPROACH**

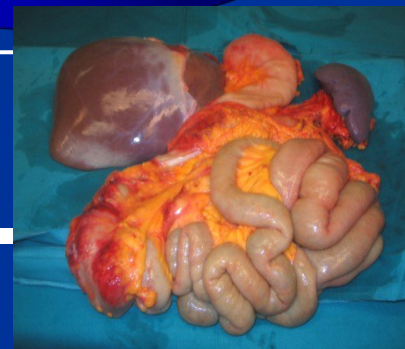
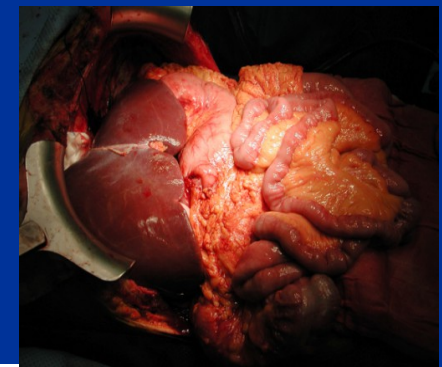
**RESCUE**

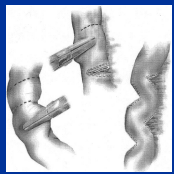
**70 patients**



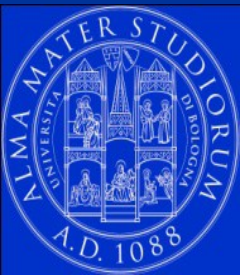
**INTESTINAL  
TRANSPLANT**

**49 cases  
in 48 pts**

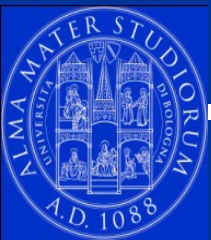




- Retrospective review of **53** consecutive adult patients undergoing **NON TRANSPLANT** treatment for **BENIGN CHRONIC INTESTINAL FAILURE** between December 2000 and September 2013
- All patients underwent previous surgery in other centers
- All were on **TPN** at various degree
- Medical management included TPN as necessary, optimizing enteral intake, treatment of diarrhea, steatorrhea and bacterial overgrowth

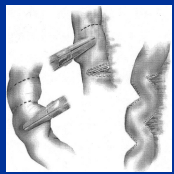


- Patients were considered for surgery if
  - MALABSORBITIVE SYMPTOMS** (sbs, stoma output..)
  - INTESTINAL COMPLICATIONS** (obstructions, stenosis, fistulas..)
  - NO LIVER DISEASE**
- Surgical treatment included all **NON TRANSPLANT PROCEDURES** performed to
  - IMPROVE INTESTINAL FUNCTION**
  - EXPAND INTESTINAL SURFACE AREA**
  - TREAT INTESTINAL COMPLICATIONS**
- **CLINICAL IMPROVEMENT** was defined as **REDUCING** (> 25%) **OR DISCONTINUING TPN** while maintaining body weight, resolving a specific anatomical problem (obstruction, fistula..) or ameliorating symptoms of malabsorption



# Small bowel rescue – University of Bologna experience

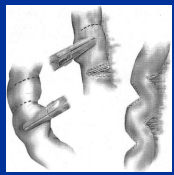
## *PATIENTS CHARACTERISTICS*



Age at surgery (mean $\pm$ SD, yr)	46 $\pm$ 14
Male, n (%)	35 (50)
Weight (kg), mean $\pm$ SD	65 $\pm$ 17
Total serum bilirubin level (mg/dL), mean $\pm$ SD	0.9 $\pm$ 0.6
Prior abdominal surgery, mean $\pm$ SD	3.6 $\pm$ 3.2
Residual intestinal length in SBS (cm), mean $\pm$ SD	77 $\pm$ 28
Time TPN	7days/week

# Small bowel rescue – University of Bologna experience

## *CAUSES OF INTESTINAL FAILURE*



	N (%)
SBS (intestinal infarction)	16 (23)
Intestinal Fistulas	23 (33)
Obstructions/Adhesions	22 (31)
Crohn	3
Cocoon Syndrome	6
Other	13
Dismotility	9 (13)

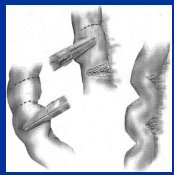
70

Adult

PTS

# Small bowel rescue – University of Bologna experience

## ***SURGICAL PROCEDURES***



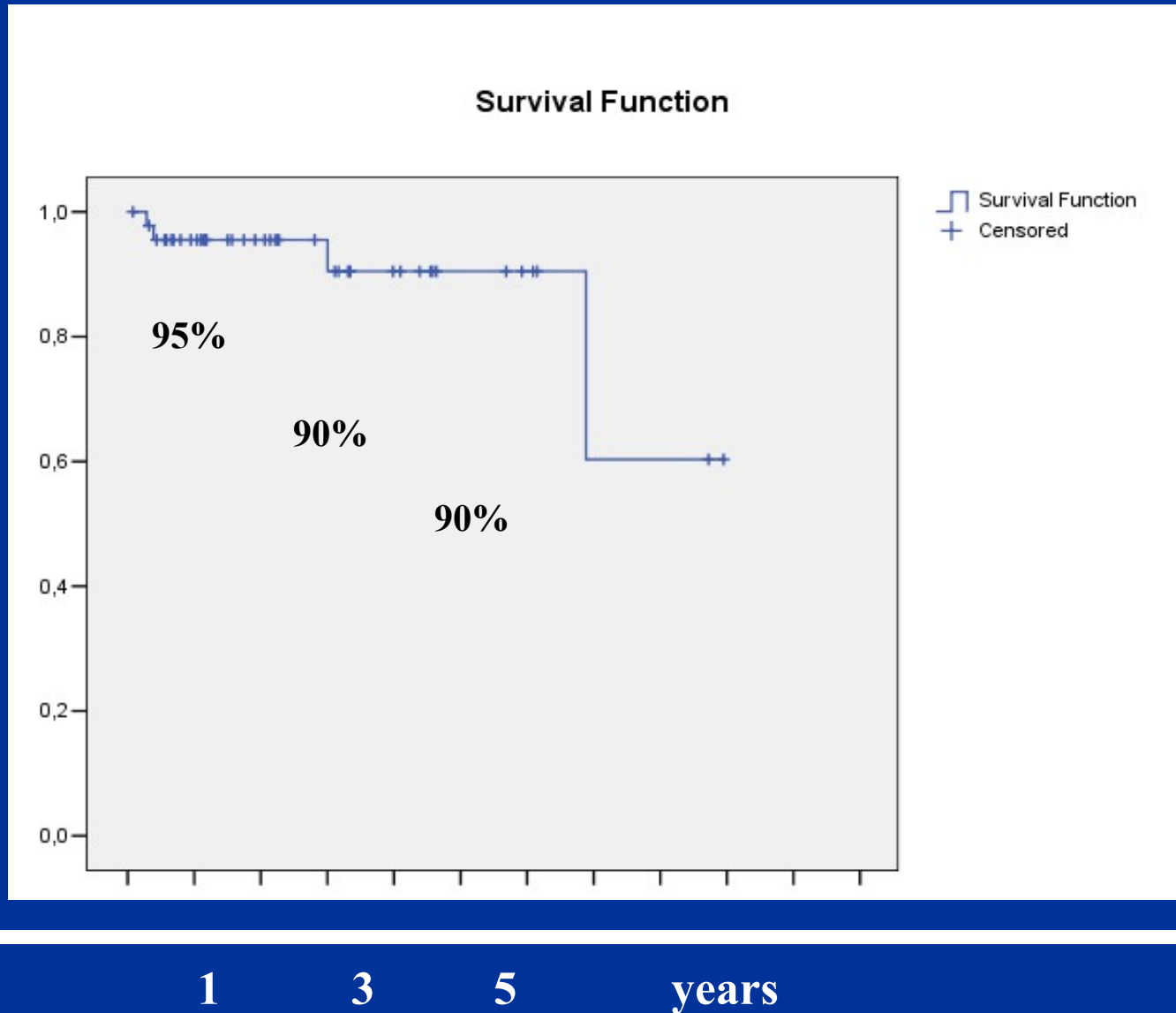
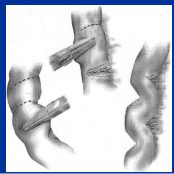
TO IMPROVE INTESTINAL FUNCTION	
improve motility (gastro-enteric anastomosis)	6
resection diseased segments/adhesiolysis	12
TO EXPAND SURFACE AREA/SLOW MOTILITY	
restore intestinal continuity	28
intestinal lengthening (STEP)	6
TO TREAT INTESTINAL COMPLICATIONS	
repair fistulas/relieve obstructions	18

**MEAN FOLLOW UP:**

**23 months**

# Small bowel rescue – University of Bologna experience

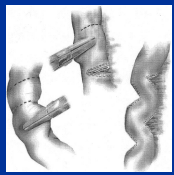
## *SURVIVAL*





# Small bowel rescue – University of Bologna experience

## RESULTS



70 pts – 5 pts (LOST)

61 PTS ALIVE

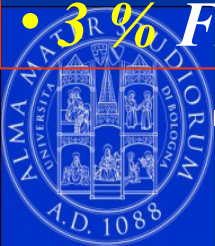
Deaths = 4 pts

mean follow-up:  
23 months

**SEPSIS**  
(3 cases)

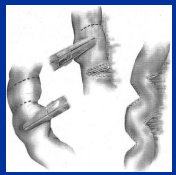
**CARDIAC  
CAUSE**  
(1 case)

- SURVIVAL: 90 %
- 73 % OFF TPN
- 17% ON REDUCED TPN + ORAL FEEDING
- 7% SAME AMOUNT OF TPN
- 3% FAILED RESCUE (waiting tx – 2 pts)



# Small bowel rescue – University of Bologna experience

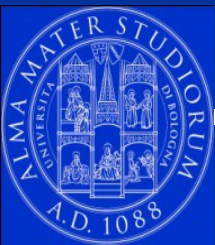
## ***RESULTS: POST OPERATIVE COMPLICATIONS***



**MEAN FOLLOW UP:**

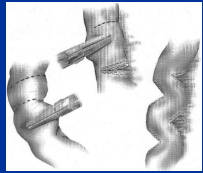
**23 MONTHS**

- **1 re-operation: INTESTINAL OCCLUSION**
- **1 re-operation. BLEEDING**
- **1 re-operation. ACUTE CHOLECYSTITIS**
- **1 fistula: CONSERVATIVE TREATMENT**



# Small bowel rescue – University of Bologna experience

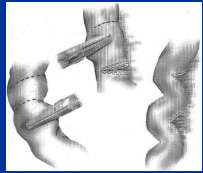
## ***RESULTS: STEP (6 patients)***



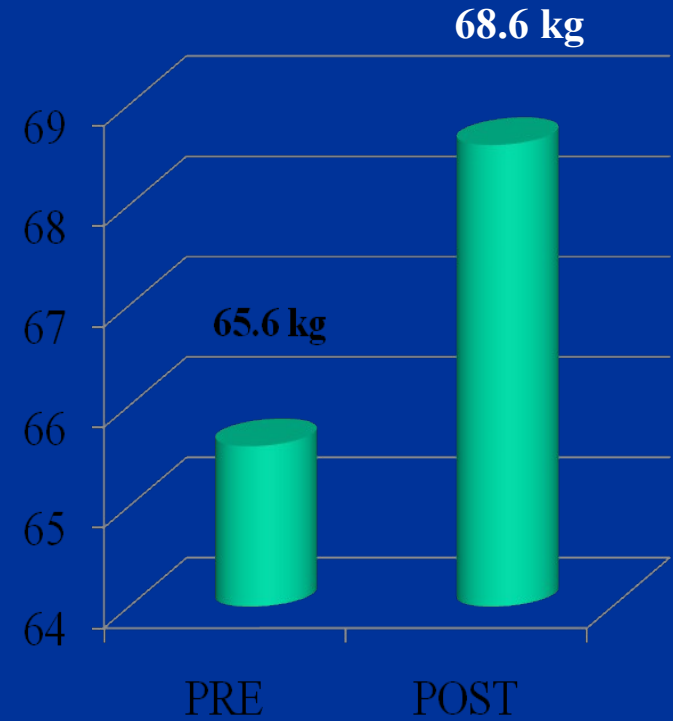
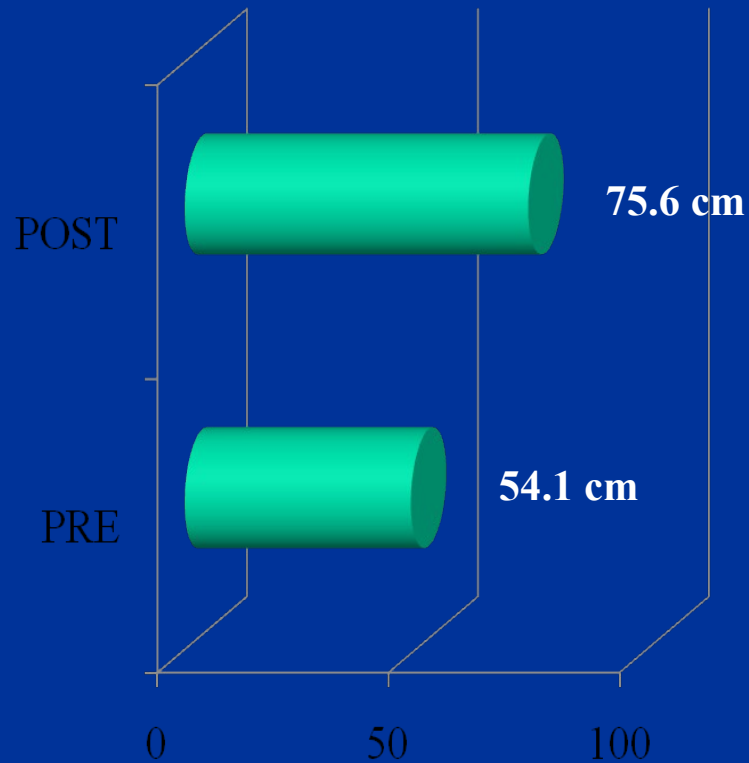
	Sex	Age	Disease	Length pre (cm)	Length post (cm)	Enteral autonomy	TPN rate	outcome	Cause death
1	F	47	infarction	55	75	No	1/2	died	cardiac
2	M	63	infarction	60	100	Yes	-	Alive	-
3	M	55	infarction	55	67	No	1/2	Alive	-
4	F	55	Infarction	30	55	Yes	-	Alive	-
5	F	47	infarction	70	82	No	Same	Waiting tx	-
6	M	61	Infarction	55	75	No	1/2	Alive	-

# Small bowel rescue – University of Bologna experience

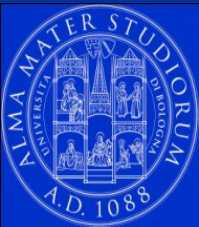
***RESULTS: STEP (6 patients)***



## INTESTINAL LENGTH



## BMI





**from December 2000 to December 2013**

**49 transplants in 48 adult patients**

**36** isolated INTESTINAL TRANSPLANTS

**13** MULTIVISCERAL TRANSPLANTS

(7 WITH LIVER)

**4** ABDOMINAL WALL TRANSPLANTS

(COMBINED WITH INTESTINAL TRANSPLANTS)

# Small bowel transplantation – University of Bologna experience

## *CAUSES OF INTESTINAL FAILURE*

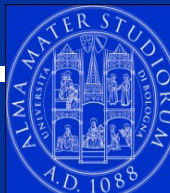


	N (%)
SBS (intestinal infarction)	20 (42)
Congenital	1 (2)
Gardner syndrome	10 (21)
Trauma	2 (4)
Microvillous disease	1 (2)
Massive intestinal angiomatosis	1 (2)
Radiation enteritis	1 (2)
Motility Disorders (CIPO)	11 (23)
Crohn's disease	1 (2)

48

Adult

PTS



# Small bowel transplantation – University of Bologna experience

## *INDICATIONS FOR TRANSPLANT*



ALL PATIENTS UNDERWENT IT<sub>x</sub> AS LIFE SAVING PROCEDURE  
AFTER FAILURE of TPN

	N (%)
Loss of venous access	15 (31)
Recurrent sepsis	13 (27)
Electrolyte/fluid imbalance	10 (20)
Liver dysfunction	8 (16)
Quality of life	3 (6)

**49 TX**

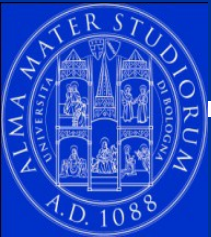
# Small bowel transplantation – University of Bologna experience

## *CLINICAL FEATURES OF ALL PATIENTS*



48 pts

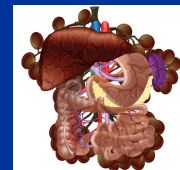
Age at transplant (mean $\pm$ SD, yr)	34.3 $\pm$ 9.8
Male, n (%)	26 (54)
Total Parenteral Nutrition (months), mean $\pm$ SD	12 $\pm$ 61
Weight (kg), mean $\pm$ SD	57 $\pm$ 11.9
Total serum bilirubin level (mg/dL), mean $\pm$ SD	1.45 $\pm$ 2.5
Serum creatinine (mg/dL), mean $\pm$ SD	1 $\pm$ 0.2
Prior abdominal surgery, mean $\pm$ SD	2 $\pm$ 2.3
Cardiovascular disorders/diabetes, n (%)	6 (12.5)





# Small bowel transplantation – University of Bologna experience

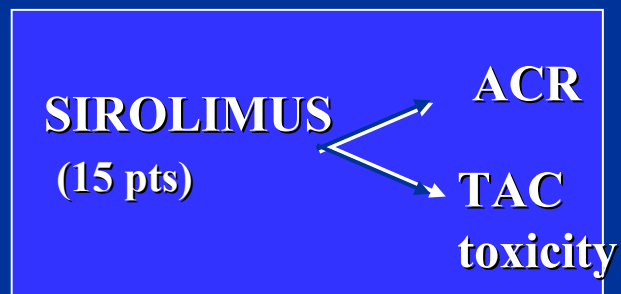
## GRAFT TYPE, DONOR CHARACTERISTICS,



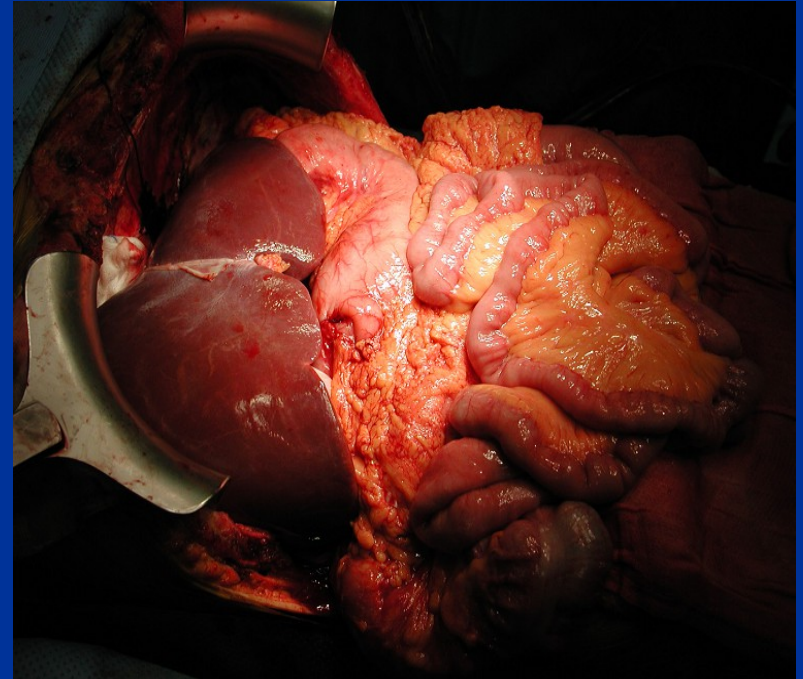
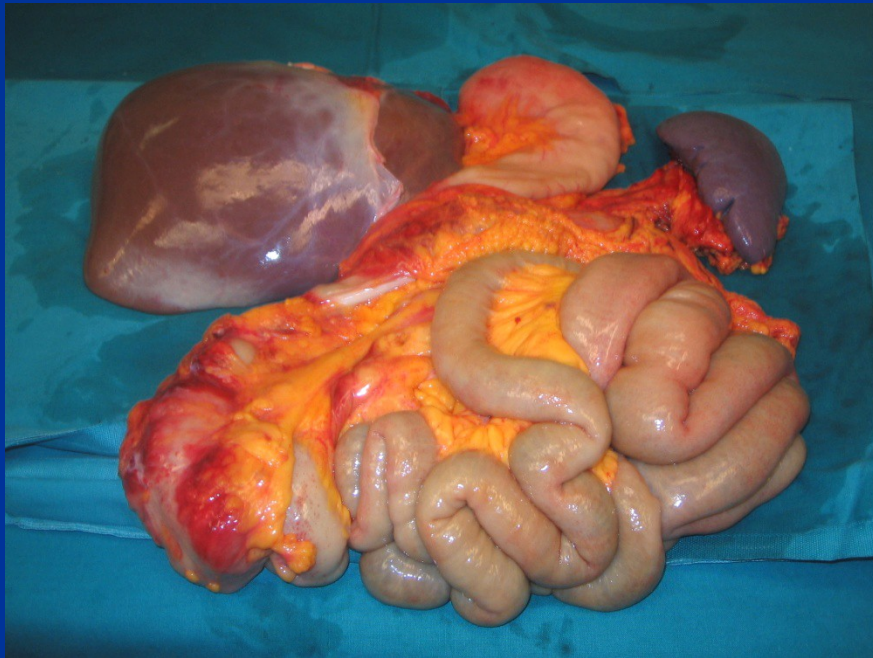
### IMMUNOSUPPRESSIVE REGIMENS

Type of graft:	
LIVER FREE	42
LIVER CONTAINED	7
ABDOMINAL WALL	4
Tx	
Donor age (yr), mean $\pm$ SD	26 $\pm$ 13
Donor weight (kg), mean $\pm$ SD	60 $\pm$ 13
Cold Ischemia time (min), mean $\pm$ SD	354 $\pm$ 110
Immunosuppressive regimens (n° of tx)	
DACLIZUMAB INDUCTION+TAC+steroids	12
THYMOGLOBULINE+TAC+steroids	2
ALEMTUZUMAB+TAC-NO steroids	35

85.7% grafts without protective liver effect



# Small bowel transplantation



# Small bowel transplantation – University of Bologna experience

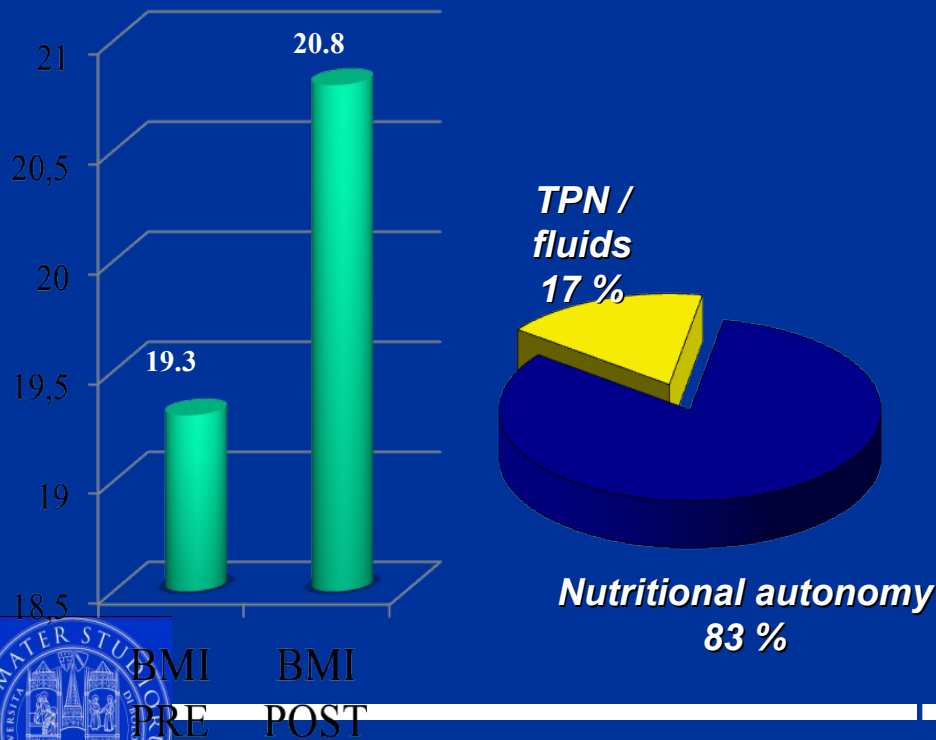
## RESULTS



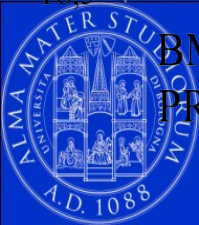
**Alive = 23 pts  
(1 pt retransplanted)  
48 %**

**21  
isolated  
graft  
2 MV  
with liver**

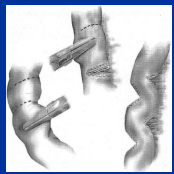
**Deaths = 25 pts  
52 %**



CAUSES OF DEATH	n (%)
Rejection (acute or chronic)	2 (8)
<b>Sepsis</b>	<b>14 (56)</b>
PTLD	2 (8)
De novo malignancy	1 ((4)
Renal failure	1 (4)
Liver failure	1 (4)
Other (suicide/cerebrovascular accident)	2 (8)
Intraoperative	2 (8)

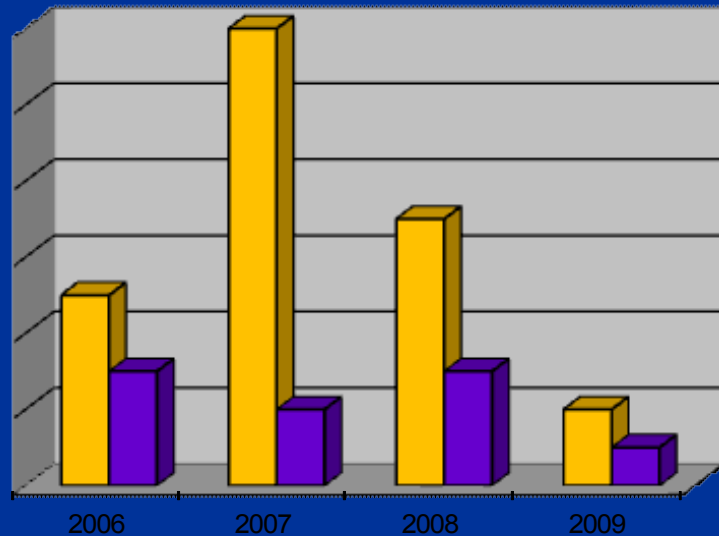


# Small bowel rescue – University of Bologna experience

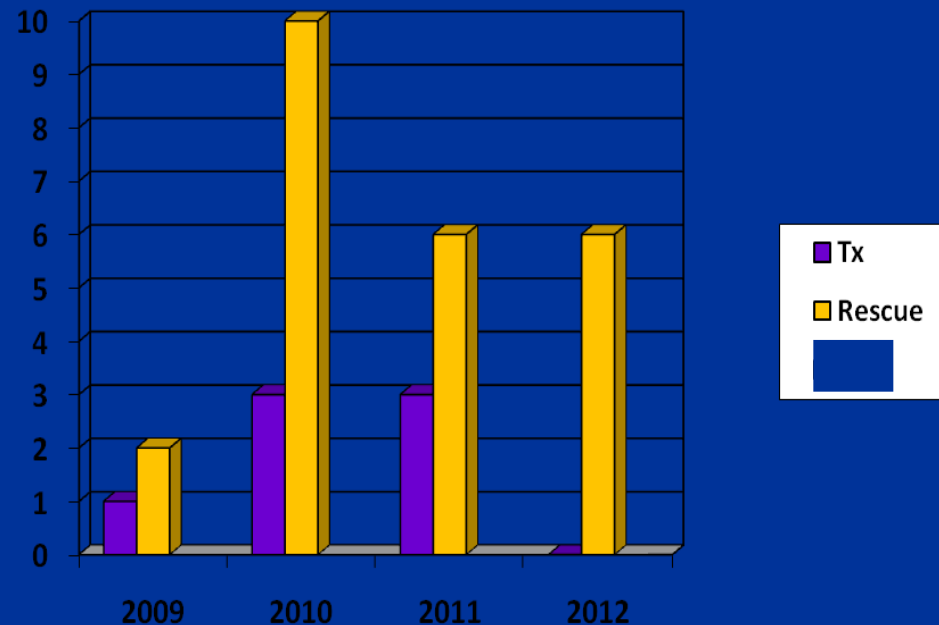


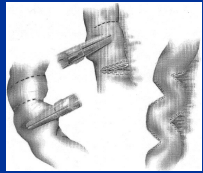
## ***RESULTS: COMPARISON BETWEEN TRANSPLANT AND RESCUE***

Bologna  
SURGERY for INTESTINAL FAILURE (2006-2009)



Bologna  
SURGERY for INTESTINAL FAILURE (2009-2012)





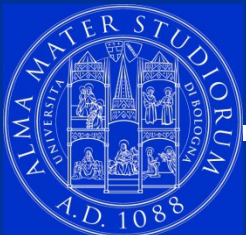
**5 years patient survival**

**55% Transplantation**

**90% Rescue**

**Surgical Approach to Complicated Intestinal Failure for Benign Disease in Adult Patients: Transplantation or Surgical Rehabilitation?**

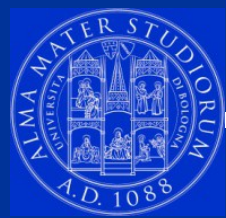
*A. Lauro, C. Zanfi, A. Dazzi, L. Golfieri, A. Amaduzzi, G. Ercolani, M. Cescon, A. Siniscalchi, G.L. Grazi, M. Vivarelli, G. Varotti, M. Ravaioli, M. Del Gaudio, F. Di Benedetto, A. Cucchetti, G. La Barba, G. Vetrone, M. Zanello, L. Pironi, S. Faenza, and A.D. Pinna*



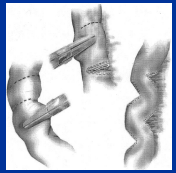
# ***IN OUR EXPERIENCE***

Surgical Approach to Complicated Intestinal Failure for Benign Disease in Adult Patients: **Transplantation or Surgical Rehabilitation?**

- UltraSBS , Gardner's , CIPO → Transplantation Candidacy
- SBS , fistulas, stenosis → Rescue Candidacy



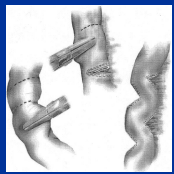
# Summary



- Non-transplant surgical therapy
  - **Tapering enteroplasty** : rare use (lengthening preferred, to preserve absorptive mucosa)
  - **Reversed segment** : rare use
  - **Colonic interposition and interposition valve**
  - **Kimura** : not indicated (safer alternative lengthening options available)
  - **Bianchi vs. STEP** : both similarly effective and similar safety profile, but STEP technically easier and does not preclude repeat lengthening
  - Durability of STEP not yet confirmed



# Conclusions



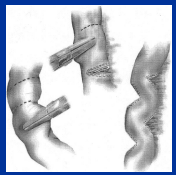
- In our series **MOST COMMON OPERATIONS** were
  - **RESTOTATION OF INTESTINAL CONTINUITY**
  - **PROCEDURES to RELIEVE OBSTRUCTION**
  - **REPAIRING ENTEROCUTANEOUS FISTULAS**
- **PATIENT SURVIVAL RATE > TRANSPLANT SURVIVAL**
- **NO LONG TERM IMMUNOSUPPRESSION COMPLICATIONS**

**SURGICAL RESCUE SAFER THAN**  
**TRANSPLANTATION**



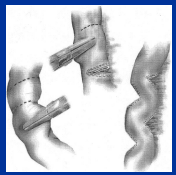


# Conclusions



- Adequate therapy depends on the degree of small bowel losses and on resulting functional disturbances
- **DIFFICULT TO DEFINE the right SURGICAL TREATMENT and the right TIME**
- **FAILURE IN RESCUE → INTESTINAL TRANSPLANT**

# Conclusions



WHEN SUCCESSFUL, THE NEED  
FOR INTESTINAL  
TRANSPLANTATION AND  
ASSOCIATED LONG TERM  
IMMUNOSUPPRESSION  
COMPLICATIONS  
MUST BE AVOIDED





