

Enteral Nutrition

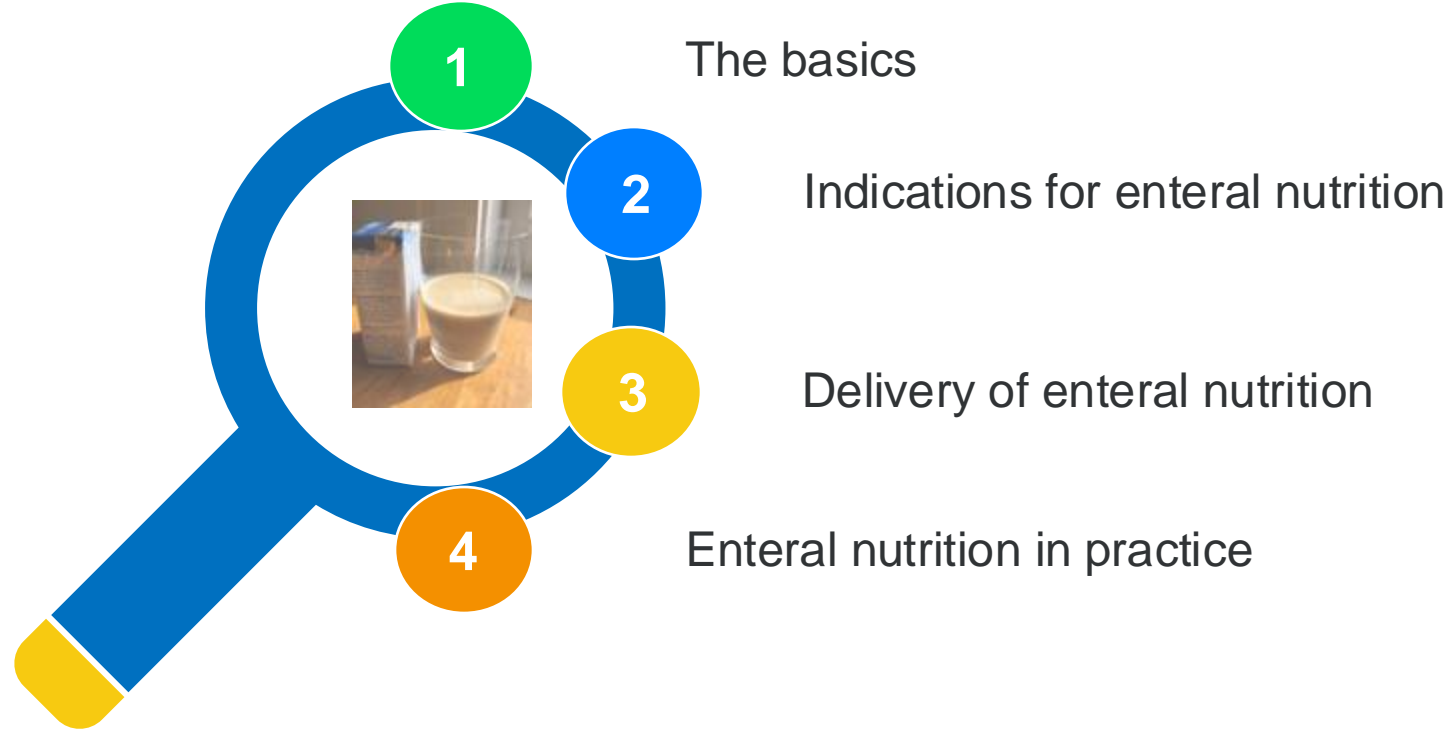
Shameer Mehta
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7th October 2024



Conflicts of Interest Declaration

No conflicts of interest to declare

Outline



The basics

Types of artificial nutritional support

- Food fortification

- Oral nutritional supplements

- Tube feeds

 - Gastric

 - Small bowel

- Parenteral nutrition

Types of artificial nutritional support

Food fortification

Oral nutritional supplements

Tube feeds

Gastric

Small bowel

Parenteral nutrition

Enteral nutrition



Types of oral nutritional supplements

Elemental
(amino-acid)

E028

Emsogen

Semi-elemental
(oligo-peptide)

Vital 1.5

Peptamen 1.5

Polymeric
(whole protein)

Ensure Plus
Modulen IBD
Fresubin Energy
Fortisip



Indications

Principal indications

Supportive therapy to correct undernutrition

EEN as a primary therapy in Crohn's disease

EN as supportive therapy

Undernutrition is common in a range of conditions

Table 1. Summary of Studies Estimating Prevalence of Malnutrition in Patients With IBD.

Study	Country	Patient population	Definition of malnutrition	Prevalence of malnutrition, % (n/N)
Ciorcîrlan et al ⁷	Romania	Patients diagnosed with IBD within 6 months of registration date	Weight loss of >5% of initial weight in 3 months prior to registration	36.3% (131/361)
Mijač et al ³	Serbia	Patients with active IBD	BMI < 18.5 kg/m ² SSF < 15th percentile MAC < 15th percentile TSF < 15th percentile	31.6% (24/76) 39.4% (30/76) 69.7% (53/76) 26.3% (20/76)
Casanova et al ⁸	Spain	Outpatients diagnosed with IBD	MAMC < 15th percentile SGA grade B or C OR BMI < 18.5 kg/m ² OR FFMI < 10th percentile	50.0% (38/76) 16% (53/333)
Valentini et al ⁹	Germany Austria Italy	Patients with IBD in clinical remission	SGA grade B or C OR BMI < 18.5 kg/m ² OR serum albumin level < 40 g/L	26.4% (38/144)
Nguyen et al ¹⁰	United States	Hospitalized patients with IBD	ICD-9 code for malnutrition	CD: 6.1% UC: 7.2%

EN as supportive therapy

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31-36%

EN as supportive therapy

Extra-intestinal manifestations in IBD

TABLE 1. Characteristics of Patient Affected by One or More EIMs

	CD	UC	IC	IBD Total
No. patients	248	105	13	366
No. females (%)	151 (60.9)	52 (49.5)	9 (69.2)	212 (57.9)
Median age at enrollment (in yr)	41	41	38	41
Interquartile range	29–50	32–50	29–49	30–50
Range	16–77	17–82	20–71	16–82
Median disease duration (in yr)	9	9	4	8
Interquartile range	3–16	4–15	1–7	3–16
Range	0–52	0–49	0–10	0–52
Disease location, n (%)	L1: 66 (26.6) L2: 91 (36.7) L3: 81 (32.7) L4: 2 (0.8) Missing: 8 (3.2)	E1: 13 (12.4) E2: 40 (38.1) E3: 47 (44.8) Missing: 5 (4.7)		
Medication (ever treated), n (%)				
5-ASA	152 (61.3)	98 (93.3)	12 (92.3)	262 (71.6)
Steroids systemic	184 (74.2)	85 (81.0)	12 (92.3)	281 (76.8)
Budesonide	77 (31.0)	11 (10.5)	0 (0.0)	88 (24.0)
Azathioprine/6-MP	195 (78.6)	64 (61.0)	8 (61.5)	267 (73.0)
Methotrexate	72 (29.0)	13 (12.4)	2 (15.4)	87 (23.8)
TNF-antagonists	129 (52.0)	22 (21.0)	5 (38.5)	156 (42.6)
Cyclosporine/tacrolimus	5 (2.0)	10 (9.5)	1 (7.8)	16 (4.4)

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366/1249 patients
= 29.3%

EN as supportive therapy

Undernutrition affects clinical outcomes

1.

Table 2 Multivariate analysis of predictors for infection-related hospitalizations in patients with inflammatory bowel disease.

Characteristic	Odds ratio	95% Confidence interval
Age category		
19–35 years	Reference	
36–50 years	1.00	0.94–1.07
51–65 years	1.08	1.01–1.16
66 years and older	1.20	1.11–1.30
Gender		
Male	Reference	
Female	1.07	1.01–1.12
Race		
White	Reference	
Non-white	0.99	0.94–1.04
Eisenhauer co-morbidity score		
0	Reference	
1	1.27	1.18–1.36
2	1.68	1.56–1.80
≥ 3	2.31	2.14–2.50
Bowel surgery		
No	Reference	
Yes	1.78	1.67–1.90
Chronic steroid use		
No	Reference	
Yes	0.97	0.87–1.09
Smoking		
No	Reference	
Yes	0.81	0.77–0.86
IBD type		
Ulcerative colitis	Reference	
Crohn's disease	0.96	0.91–1.00
Emergent admission		
No	Reference	
Yes	1.41	1.34–1.49
Nutritional status		
None	Reference	
Malnutrition	1.83	1.65–2.03
Parenteral nutrition	2.27	2.02–2.56

2.

Multivariate model for predicting VTEs following colorectal surgery for IBD

	OR	95%CI	p
Preoperative steroid use	2.17	1.7–2.8	<0.001
Bleeding disorder	2.74	1.8–4.3	<0.001
Malnourished	1.41	1.1–1.9	0.02
Partially dependent functional status	1.98	1.2–3.2	0.006
Hematocrit <37	1.50	1.1–2.0	0.007
Emergency case	1.83	1.2–2.8	0.004
Anesthesia time >231 min	1.96	1.5–2.6	<0.001
Postoperative wound infection	1.89	1.3–2.7	<0.001

Receiver operator area under the curve: 0.73. Goodness-of-fit: $p = 0.16$.

3.

Table 3. Multivariate analysis of predictors of severe hospital course in patients with Crohn's disease

Characteristic	Odds ratio	95% Confidence interval
<i>Hematological</i>		
No anemia or transfusion	Reference	
Anemia (without transfusion)	1.49	1.37–1.61
Transfusion	2.68	2.24–3.20
<i>Nutritional status</i>		
No malnutrition/total parenteral nutrition (TPN)	Reference	
Malnutrition (without TPN)	3.67	3.20–4.22
TPN	8.65	6.49–11.52
<i>Volume depletion</i>		
No	Reference	
Yes	1.25	1.16–1.34
<i>Transfer from outside hospital</i>		
No	Reference	
Yes	2.34	1.99–2.74
<i>Admission to teaching hospital</i>		
No	Reference	
Yes	1.19	1.12–1.27
<i>Clostridium difficile infection</i>		
No	Reference	
Yes	2.46	1.95–3.11
<i>Disease behavior</i>		
Inflammatory	Reference	
Obstructing	2.61	2.42–2.81
Fistulizing	9.13	8.09–10.30

EN as supportive therapy

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Elizhauser co-morbidity score		
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EN as supportive therapy

Undernutrition is modifiable: IBD

Table 3. Univariate and Multivariate Analyses of Risk Factors Associated With Major Complications After Bowel Resection for Crohn's Disease.

Variable	Univariate Analyses		Multivariate Analyses	
	OR (95% CI)	P Value	OR (95% CI)	P Value
Sarcopenia	8.02 (1.02–64.46)	.050	9.24 (1.10–77.50)	.04
Decreased SMI, cm ² /m ²	1.14 (1.04–1.26)	.005	1.11 (1.02–1.22)	.023
MFI	1.21 (0.65–2.27)	.548		
BMI >18.5 kg/m ²	0.87 (0.20–3.76)	.847		
Preoperative EN	0.14 (0.04–0.55)	.005	0.13 (0.03–0.51)	.004
Preoperative serum albumin (>35 g/L)	0.14 (0.04–0.52)	.003	0.19 (0.05–0.74)	.017
Stoma creation	0.13 (0.03–0.64)	.012	0.39 (0.06–2.38)	.306

Retrospective Chinese study of 114 patients undergoing elective abdominal surgery for Crohn's disease

EN as supportive therapy

Undernutrition is modifiable: IBD

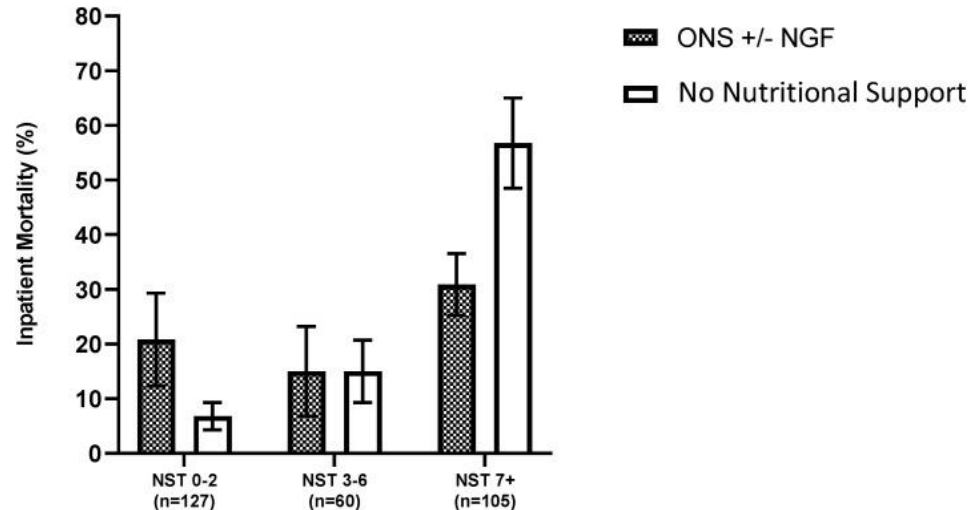
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Retrospective Chinese study of 114 patients undergoing elective abdominal surgery for Crohn's disease

EN as supportive therapy

Undernutrition is modifiable: COVID-19



EN as supportive therapy

Undernutrition is common, negatively affects clinical outcomes and is modifiable in a range of conditions

EN is an effective, cheap and safe treatment of undernutrition in a range of conditions

Have a low threshold for using supplemental EN (with dietetic input where possible and monitoring for refeeding syndrome)

EN as primary therapy in Crohn's disease

Exclusive enteral nutrition (EEN)

First used as pre-operative nutritional support

Serendipitous finding that patients on an elemental diet improved prior to surgery (n=13)

Voitk et al, Arch Surg, 1973

Subsequent controlled trial demonstrated that elemental EEN was comparable to steroids in patients with ileitis (n=27)

O'Morain et al, Br Med J, 1980



EEN: paediatric data

AP[®]T Alimentary Pharmacology & Therapeutics

WILEY

Meta-analysis: efficacy of exclusive enteral nutrition as induction therapy on disease activity index, inflammation and growth factors in paediatric Crohn's disease

Mohammad Hassan Sohoul^{1,2}  | Somaye Fatahi³ | Fatemeh Farahmand¹ |
Hosein Alimadadi¹ | Shaikh Sanjid Seraj⁴ | Pejman Rohani¹ 

World Journal of Pediatrics (2019) 15:26–36
<https://doi.org/10.1007/s12519-018-0204-0>

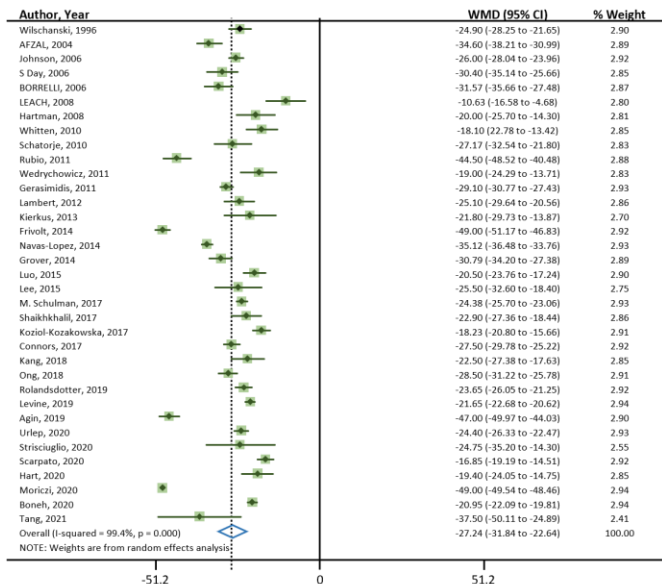
META-ANALYSIS

Exclusive enteral nutrition versus corticosteroids for treatment of pediatric Crohn's disease: a meta-analysis

Yu Yu¹ · Kang-Chen Chen² · Jie Chen¹ 

EEN: paediatric data

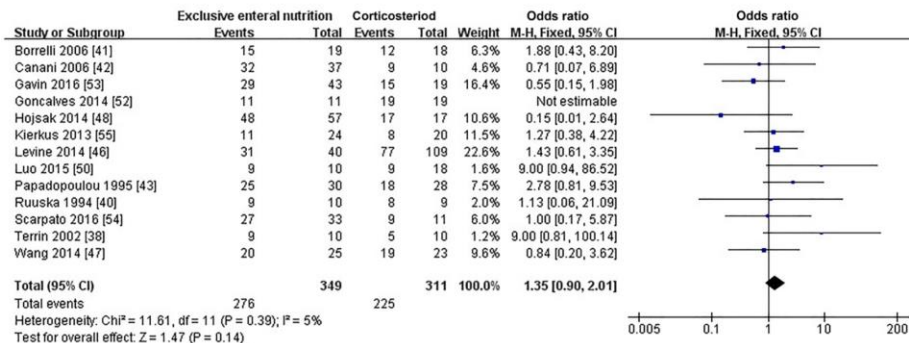
Induction of remission:



Sohouli et al. Aliment Phar Ther 2022

35 studies; ages 10-16
Largely polymeric feeds

EEN v corticosteroids for induction of remission:

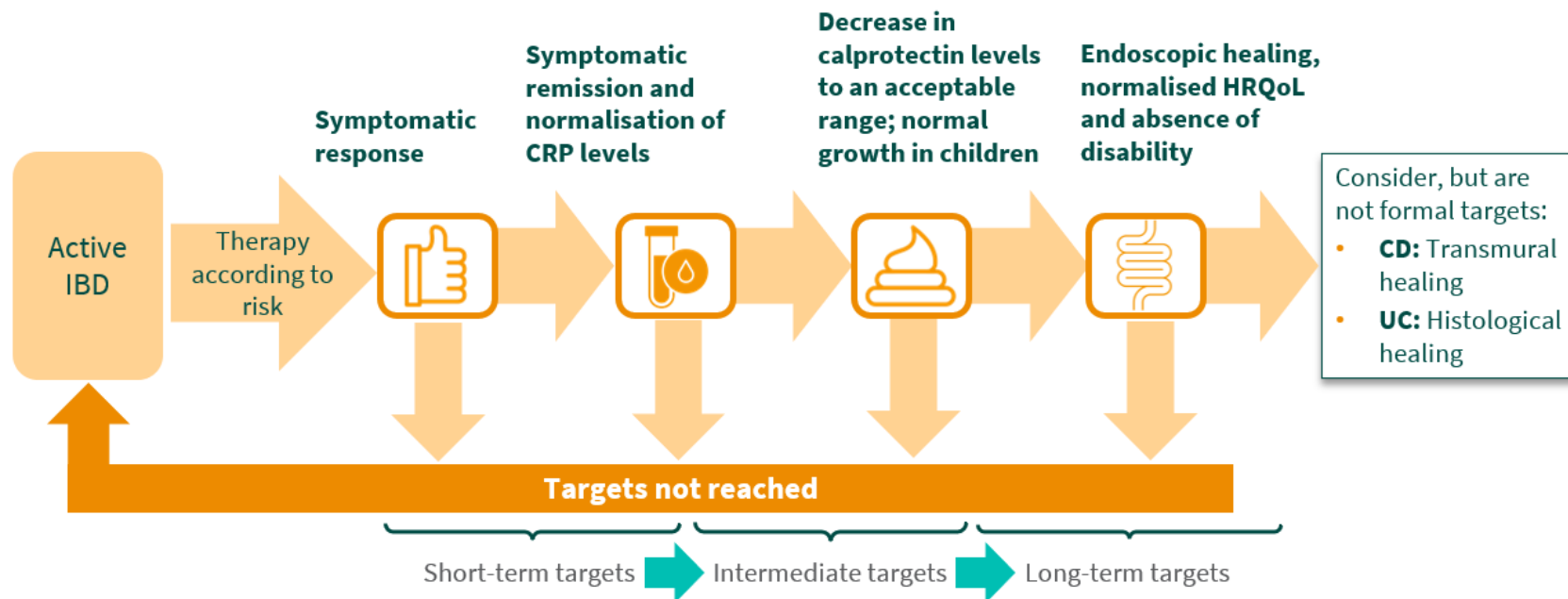


Yu et al. World J Peds 2019

349 EEN patients; 311 corticosteroid patients
Largely polymeric feeds

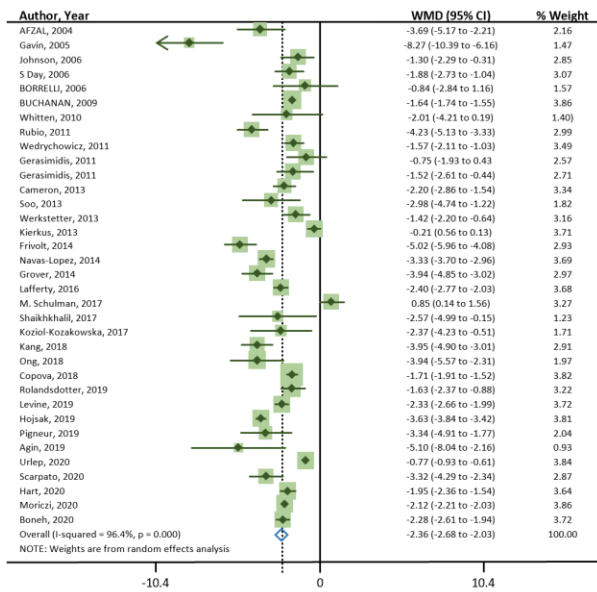
EEN: paediatric data

But can EEN achieve the endpoints we now target in Crohn's disease?



EEN: paediatric data

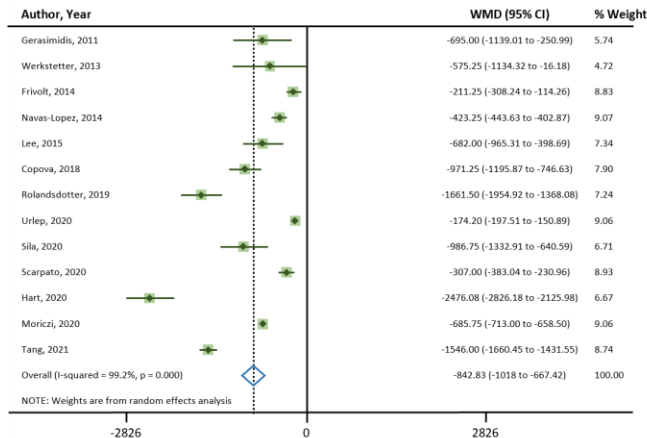
Reduction in CRP:



35 studies

Sohouli et al., APT 2022; 56(3):384-395

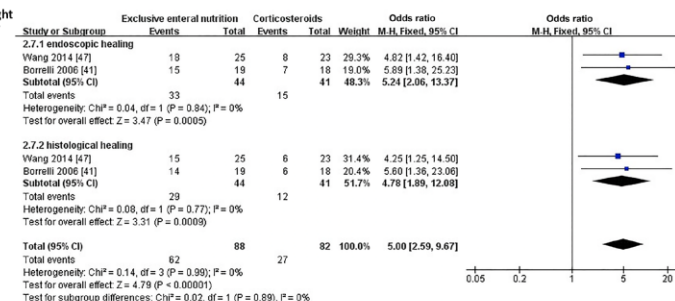
Reduction in FCP:



13 studies

Sohouli et al., APT 2022; 56(3):384-395

Effect on mucosal healing:



2 studies

Yu et al., World J Paed 2019;15:26-36

EEN: adult data

Narrative review of 7 studies

EEN as effective as corticosteroids when tolerated:

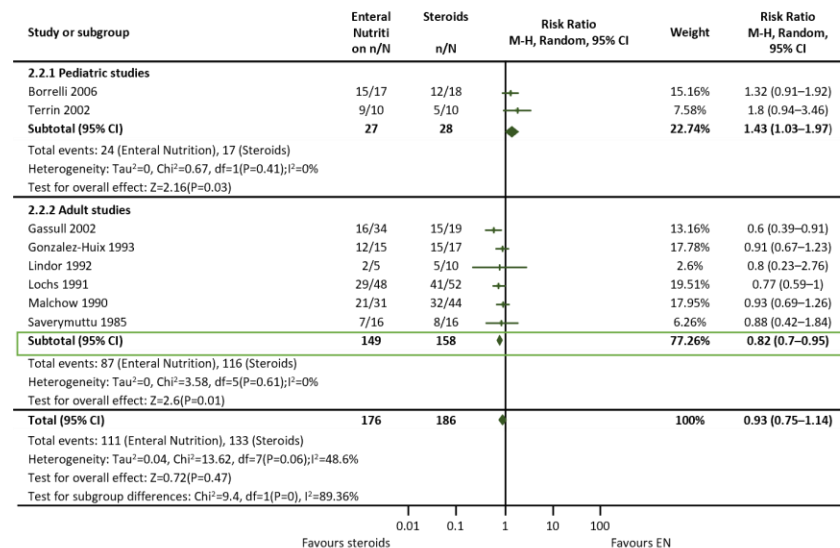
Remission rate*

23–100% EEN group vs 30–100% steroid group

Wall et al, World J Gastro 2013;19:7652-60

Cochrane review 2018:

Analysis 2.2. Comparison 2 Enteral nutrition versus corticosteroids, Outcome 2 Remission rate – Per-protocol



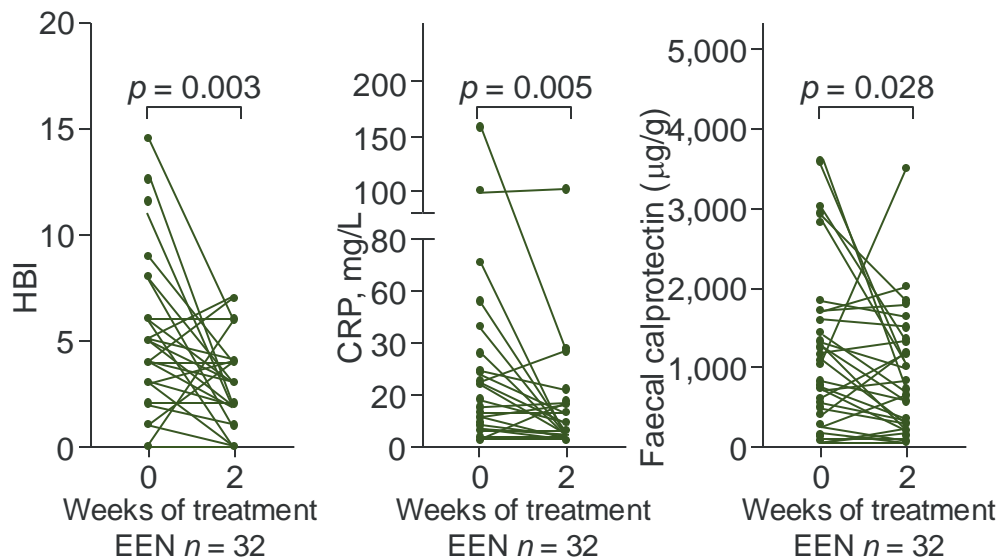
*Of those patients who completed the course of EEN therapy.

EEN: adult data

Prospective trial of 38 adults with active Crohn's disease:

2 weeks EEN (32/38 patients completed)

Followed by 6 weeks EEN or PEN with usual diet



EEN: adult data

EEN can be very useful in the acute setting:

First presentation, no histological diagnosis

Known Crohn's disease, A&E admission with worsening symptoms, infection not yet excluded

Known Crohn's disease, A&E admission with obstruction due to stricture with active inflammation

EEN: Pre-surgical optimisation

Aims of EEN in the pre-surgical setting:

1

Treat active inflammation, 'downstage disease', reduce steroid exposure, reduce post-operative risk

2

Improve nutritional status, enhance post-operative recovery, reduce post-operative risk

EEN: Pre-surgical optimisation

Does EEN modify risk factors for post-operative complications?



Active inflammation



Steroid dependency



Sepsis



Undernutrition

EEN: Pre-surgical optimisation

Does EEN modify risk factors for post-operative complications?



Steroid dependency

Prospective, non-randomised trial of 56 patients undergoing elective ileocolonic resection

Median 3.5 weeks EEN feasible in 34/35 'high risk' patients
(obstructive symptoms, steroid treatment, weight loss >10%, penetrating disease)

Discontinuation of steroids pre-operatively was achieved in 10/16 patients (62.5%)

EEN: Pre-surgical optimisation

Does EEN modify risk factors for post-operative complications?



Sepsis

Chinese prospective, observational study of 44 patients with CD complications (abscess, fistula, stricture)

12 Weeks EEN tolerated in 41/44 patients
25 patients with an intra-abdominal abscess
Antibiotics +/- drainage as required (rates not reported)

Resolution in 19/25 (76%) patients
75% improvement in 4/25 (16%) patients

EEN: Pre-surgical optimisation

Does EEN modify risk factors for post-operative complications?



Undernutrition

Recent systematic review of the effects of EEN in the pre-operative phase in Crohn's disease

5 cohort studies; 2 case-control studies

EEN for 2-4 weeks (one study at 12 weeks)

1 study: significant increase in BMI ($p \leq 0.01$)

3 studies: non-significant increase in BMI

(BMI not reported in 12-week study)

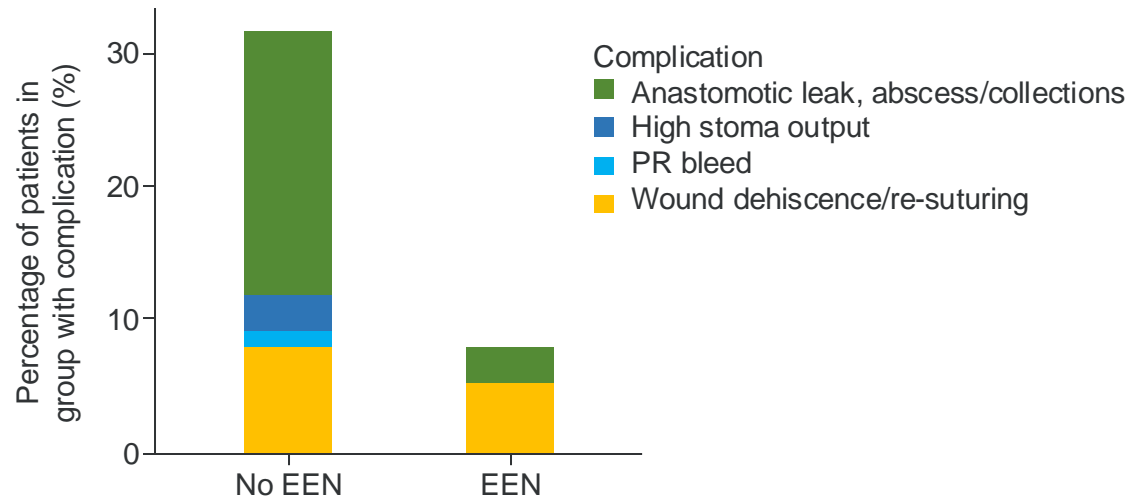
Longer EEN duration for correction of undernutrition?

Markers of body composition...?

EEN: Pre-surgical optimisation

Effects of EEN on post-operative outcomes

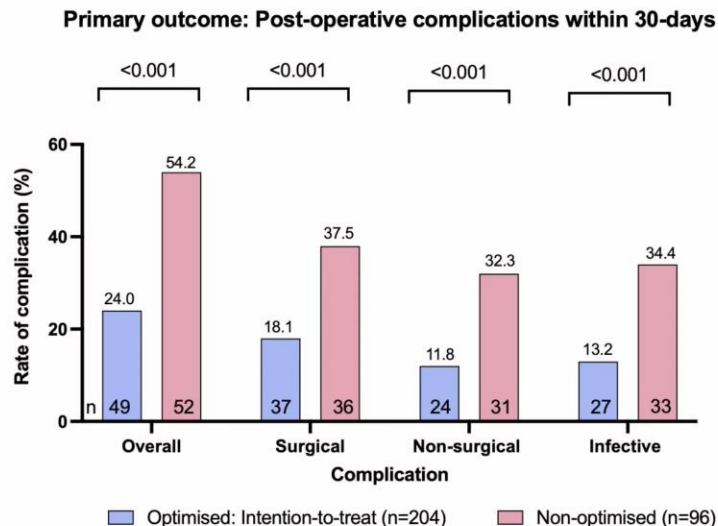
38 patients undergoing elective surgery for CD with 76 matched controls



EEN: Pre-surgical optimisation

Effects of EEN on post-operative outcomes

Retrospective study of 125 EEN v 96 'non-optimised' patients undergoing surgery for CD



EEN: Pre-surgical optimisation

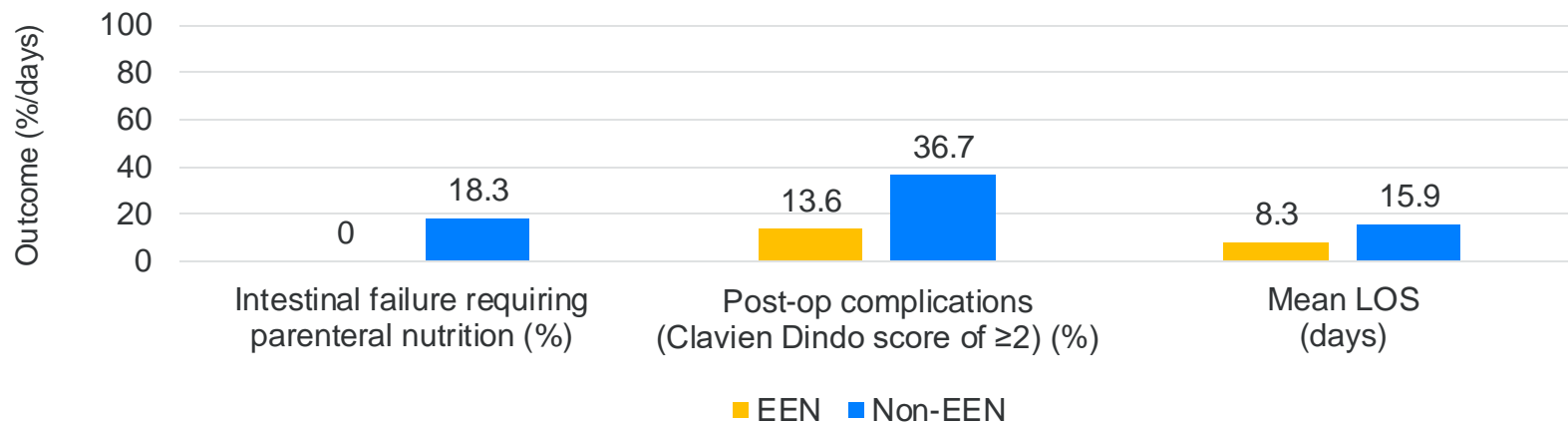
Effects of EEN on post-operative outcomes

Our data from a single centre, retrospective cohort study

Patients with CD undergoing surgery for stricturing, penetrating or medically-refractory disease

22 EEN v 120 non-EEN; matched for BMI, phenotype, smoking status and elective/emergent surgery

EEN: Pre-surgical optimisation



EEN v non-EEN:

Unplanned admissions at 3 months: OR = 0.44, p=0.3

Disease recurrence at 6 months: OR=0.45, p=0.3

EEN: Pre-surgical optimisation

A randomised controlled trial is required....

**Optimisation before Crohn's surgery
using Exclusive Enteral Nutrition**



Special situations: short bowel syndrome

Exclude/treat reversible causes

- Infection (e.g. *Clostridium difficile*)
- Obstruction
- Recurrent disease (e.g. Crohn's disease)
- Medications



**St. Mark's
solution**

Medical management

- Restrict hypotonic fluids to $\leq 1,000$ ml/day
- Hypertonic fluids (1,000 ml/day)
 - St Mark's solution
 - Double-strength Dioralyte™ [Sanofi]
- Acid suppression
 - Omeprazole 40mg twice a day
- Motility reduction
 - Loperamide up to 32 mg four times a day
 - Codeine 60mg four times a day
- High calorie, low residue diet

Special situations: short bowel syndrome

| Enteral feeding

- Important for gut barrier integrity, immune function and hepato-protection, even if supplemental
- Advice for food intake \Rightarrow little and often, higher fat intake, calorie dense foods
- Advice for enteral feeds \Rightarrow avoid elemental preparations (can drive output)
- Careful monitoring to assess effect of feeds on gastrointestinal losses is important

Special situations: ECFs

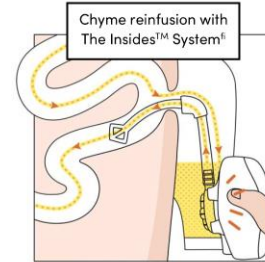
Similar principles apply...

Consider distal limb feeding / enteroclysis

Chyme re-infusion

The Insides System:

The Insides™
System^{fi}



Special situations: DGBI

Disorders of gut-brain interaction

Challenging group; complex; increasing in number

Unclear long term benefit of nutritional support

POSITION PAPER

Neurogastroenterology & Motility  WILEY

Avoiding the use of long-term parenteral support in patients without intestinal failure: A position paper from the European Society of Clinical Nutrition & Metabolism, the European Society of Neurogastroenterology and Motility and the Rome Foundation for Disorders of Gut-Brain Interaction

High rate of EN-related complications:

87% (76/86) of patients with hEDS and enteral feeding tubes reported complications

Delivery

Routes of delivery: tips

ONS

You can prescribe (cf enteral feeds)

Start with polymeric feeds

Use your dietitian...

Do not forget about refeeding syndrome

NG feeding

Misplaced tubes remain a Never Event

Most are caused by mis-reading and mis-documentation of CXRs

4 statements required:

1. Does the tube path follow the oesophagus/avoid the contours of the bronchi?
2. Does the tube clearly bisect the carina or the bronchi?
3. Does it cross the diaphragm in the midline?
4. Is the tip clearly visible below the left hemi-diaphragm?

Routes of delivery: tips

PEG / RIG feeding

High morbidity: patient-related factors

Patient *selection, selection, selection*

Beware disc slippage within the first 24 hours

NJ feeding

Hard indications: GOO

Other indications:
Idiopathic gastroparesis
- slow gastric feeding
is worth attempting

Single-handed scope withdrawal
to allow 1-to-1 exchange

PEGJ feeding

Two meta-analyses:

↓ risk of aspiration

No difference in:

ITU admission
Mortality

Simple troubleshooting

Availability

Use whatever you have!

Palatability

Use cold ONS

Minimise flavour fatigue by using a variety

Ask patients to use a straw to bypass the tongue

Tolerability

Diarrhoea:
Consider fibre content
(all ONS are gluten-free)

Satiety:
Prescribe ONS in between meal times
Consider overnight feeds

Use your dietitian!

Enteral nutrition in practice

EEN: MDT working

Dietetic support to support patients with EEN is vital:

01



Monitoring of adherence

02



Nutritional assessment

03



Managing feed intolerances

04



Identification of avoidant/restrictive food intake disorders

05



Discussion of post-EEN strategies

Tips for EEN

Use a polymeric feed

Do allow water

Headaches due to lack of caffeine is common – do consider adding black coffee / tea to improve adherence

Set clear aims and duration of therapy where possible:

Induction of remission: 6–8 weeks

Pre-operative EEN: minimum of 4 weeks

Bridge to medical therapy: 8–12 weeks

Management of intra-abdominal sepsis: 6–12 weeks alongside antibiotics / drainage

Start at target rate from day 1 (no need for gradual uptitration unless using an elemental feed)

Consider early cessation if no response after 2–4 weeks if using to induce remission

Transitioning to a normal diet can be done quickly: over 4 days with a full meal added per day

Consider early re-introduction of EEN in the event of a further flare upon food re-introduction

EEN care pathway

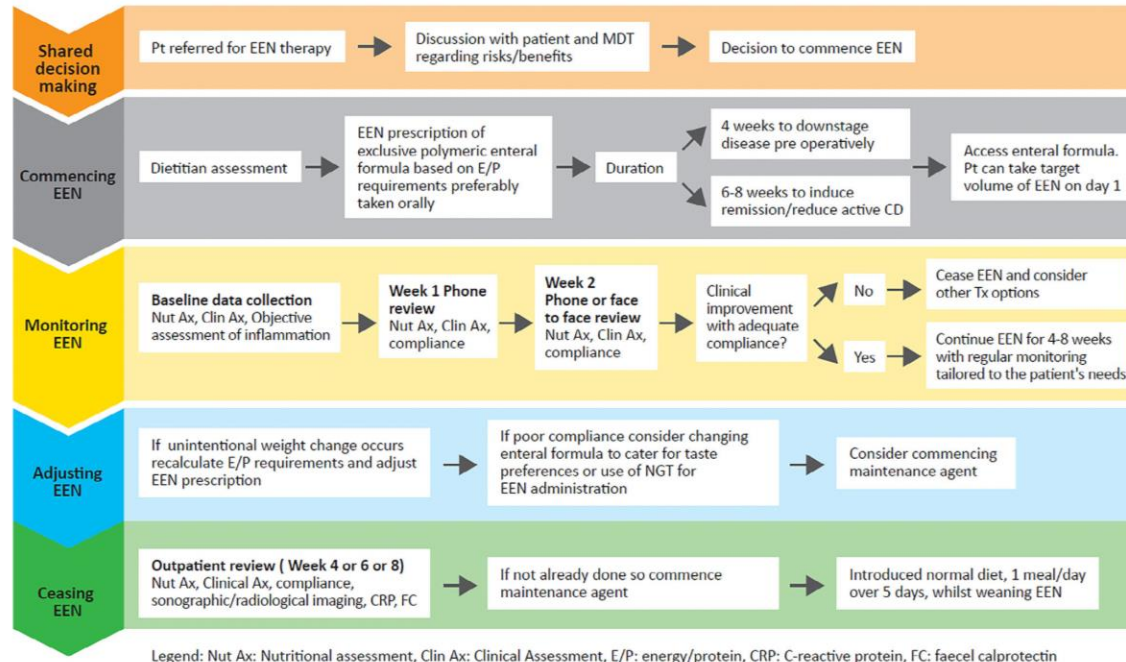


Figure 1 Optimal care pathway for using exclusive enteral nutrition in adults with active CD. CD, Crohn's disease; Clin Ax, clinical assessment; CRP, C-reactive protein; E/P, energy/protein; EEN, exclusive enteral nutrition; FC, faecal calprotectin; MDT, multidisciplinary team; NGT, nasogastric tube; Nut Ax, nutritional assessment.

MDT working...

MDT working...



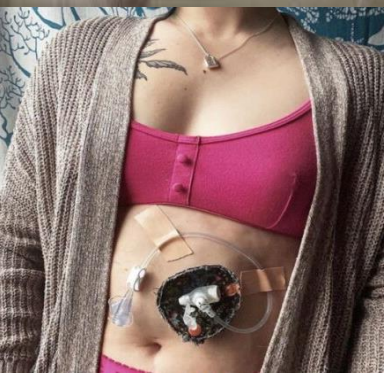
Summary

Enteral nutrition is an effective, cheap and safe intervention to treat undernutrition and improve clinical outcomes in a range of conditions

Exclusive enteral nutrition is effective in induction of remission and pre-surgical optimisation in IBD

Careful patient selection and setting goals of therapy are important considerations before starting enteral nutrition

Multidisciplinary working is vital in achieving optimal outcomes



Thank you
Questions?

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