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FACULTY OF MEDICINE KHON KAEN UNIVERSITY

NUTRITION BOARD REVIEW

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Scope of Clinical nutrition

- **Nutrition care process**
  - Screening, assessment and diagnosis
  - Nutritional therapy
- **Common problem in nutritional therapy**：Feeding intolerance, nosocomial diarrhea, Refeeding syndrome, PN complication and monitoring
- **Micronutrient disorder**
- Nutrition in **special conditions**
- **Obesity and Metabolic bariatric surgery**

Section 1

Nutrition in **Special Conditions**

NUTRITION IN **SPECIAL CONDITIONS**

- Critically ill
- Kidney disease
- Liver disease
- Pancreatic disease
- Chyle leakage
- Cancer
- Perioperation
- Short bowel syndrome/ GI surgery

NUTRITION IN **SPECIAL CONDITIONS**

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Nutritional support

General concept : Energy requirement

General ward

BMI (kg/m²)	Energy requirement (kcal/kg/day)	Body weight
< 30	30-35	Actual BW
30-50	11-14	Actual BW
> 50	22-25	Ideal BW

Indirect calorimetry = gold standard of energy expenditure measurement

< 70% of *measured REE* in first 3 day

ICU

Full feeding in ICU (EN, PN) : after day 3-7

BMI (kg/m²)	Energy requirement (kcal/kg/day)	Body weight
< 30	↓**20-25**	Actual BW
30-50	11-14	Actual BW
> 50	22-25	Ideal BW

< 70% of *calculated* energy requirement first 7 day

or

2022 ASPEN 12-25 kcal/kg in 7-10 day

ESPEN ICU 2023
Warodomwichit D, et al. Thai JPEN. 2019

Respiratory failure

- **Overfeeding is the first consideration to avoid** : CO_2 production increases significantly with lipogenesis and may be tolerated poorly in the patient prone to CO_2 retention
- **Macronutrient modification** (↑fat, ↓CHO) is ***not recommended*** in acute respiratory failure
- **Rapid infusion of ILE** (especially SO based), regardless of the total amount, should be avoided in patients with severe pulmonary failure
- **Fluid restricted energy-dense EN formulations** (1.5–2 kcal/mL) be considered for patients with acute respiratory failure (especially if in a state of volume overload)

ILE; Intravenous lipid emulsion

Nutritional support

General concept : Protein requirement

Normal people : 0.8-1 g/kg/day

Hospitalized patient – depend on type and severity of illness

BMI (kg/m^2)	Protein requirement (g/kg/day)	Body weight
< 30	1.2-1.5	Actual BW
30-39.9	2	Ideal BW
> 40	2-2.5	Ideal BW

ICU patient

Guideline	Protein requirement (g/kg/day)	Body weight
2022 ASPEN	1.2-2	Actual BW
2023 ESPEN	≥ 1.3	Actual BW

or

24hr urinary nitrogen guided

Nitrogen balance = Nitrogen intake – Nitrogen excretion

PCR (g/day) = (24-hr UUN + 4) x 6.25

Protein prescription (g/day) = PCR + 10

Proteins contain **16% nitrogen;** Protein (g) = Nitrogen (g) **x 6.25**
PCR; Protein catabolic rate
UUN; Urine urea nitrogen

Warodomwichit D, et al. Thai JPEN. 2019

Cautions of 24-hr UUN calculation / Nitrogen balance

- **Low** 24hr UUN
  - Impaired renal function : eGFR < 50 mL/min/1.73 m^2
  - Liver disease (impaired urea cycle)
  - Long-term starvation
- **High** 24hr UUN
  - Inadequate caloric intake
  - Catabolic state: illness, steroid
- **Dietary protein** effects urine urea nitrogen*
- Increase **non-urinary** nitrogen loss
  - Diarrhea, fistula/stomal loss
  - Exudate fluid loss
  - Exfoliative dermatitis, burn

*More accurate with protein intake < 20 g/day

UUN; Urine urea nitrogen

Warodomwichit D, et al. Thai JPEN. 2019

Route of nutritional support

Adequacy = Gain >60% of total calorie requirement

Oral intake → (inadequate) → Oral nutritional supplement → (inadequate) → Enteral tube feeding → (inadequate) → Parenteral nutrition

GI tract feeding (EN) is always prioritized, Early in 24-48 hr

Early EN *should be* performed

- ECMO
- Prone position (reverse Trendelenburg position)
- Severe acute pancreatitis
- On neuromuscular blocking agent
- Post open abdomen/GI surgery

Low dose EN *should be* administered

- During TTM : increase EN dose after rewarming
- ↑IAP (no ACS)
- ALF (after control metabolic derangement,

severe hyperacute ALF with HE with highly elevated arterial NH_3 >150 µmol/L → defer protein 24-48hr until NH_3 is controlled + monitor NH_3 level when start protein

EN; Enteral nutrition
IAP; Intra-abdominal pressure
ACS; Abdominal compartment syndrome
ALF; Acute liver failure

ESPEN ICU 2023
Warodomwichit D, et al. Thai JPEN. 2019

Route of nutritional support

Oral intake → (inadequate) → Oral nutritional supplement → (inadequate) → Enteral tube feeding → (inadequate) → Parenteral nutrition

Time to start PN

TPN (PN alone)

- Malnourished : PN as soon as possible[1,2]
- Well nourished : PN after 7th day[1,2]

Supplemental PN (EN+PN)

- PN after day 3[2,3] to day 7[1,2,4]

(depend on nutritional status and current illness)

*Full feeding in ICU (EN, PN) : **after day 3-7**

TPN — **Contraindication to GI tract feeding**

Uncontrolled shock : MAP<50, vasopressive initiation/ escalation‡1
Life threatening hypoxemia, hypercapnia or acidosis
Mechanical bowel obstruction, perforated hollow viscous
Bowel rest needed/ bowel ischemia
Uncontrolled GI bleeding
High output intestinal fistula
Abdominal compartment syndrome
Gastric aspiration >500 mL/6hr, paralytic ileus
Contraindicated of enteral access device

‡Norepinephrine equivalent **< 0.1**: optimal for EN, **0.1 – 0.3**: may be acceptable, **> 0.5 µg/kg/min**: significant risk

1 McClave SA, et al. JPEN. 2016
2 Warodomwichit D, et al. Thai JPEN. 2019
3 Singer P, et al. Clin Nutr. 2019
4 Compher C, et al. JPEN. 2022
‡ Wischmeyer PE. Crit Care Med. 2020 Jan;48(1):122-5.

EN problem : Feeding intolerance

Clinical signs & symptoms :

- Abdominal distention
- Abdominal discomfort
- Nausea/vomiting
- Regurgitation/aspiration
- Diarrhea
- Reduced flatus/stool passage

GRV alone not predict FI, aspiration, pneumonia, MV day, ICU day, day in hospital, mortality

So NOT be used solely

Prokinetic

-Erythromycin 3-7MKD or 100-250mg tid (IV=1st line)

SE: cardiotoxicity, QT prolong, ATB resistance

-Metoclopramide 10mg qid

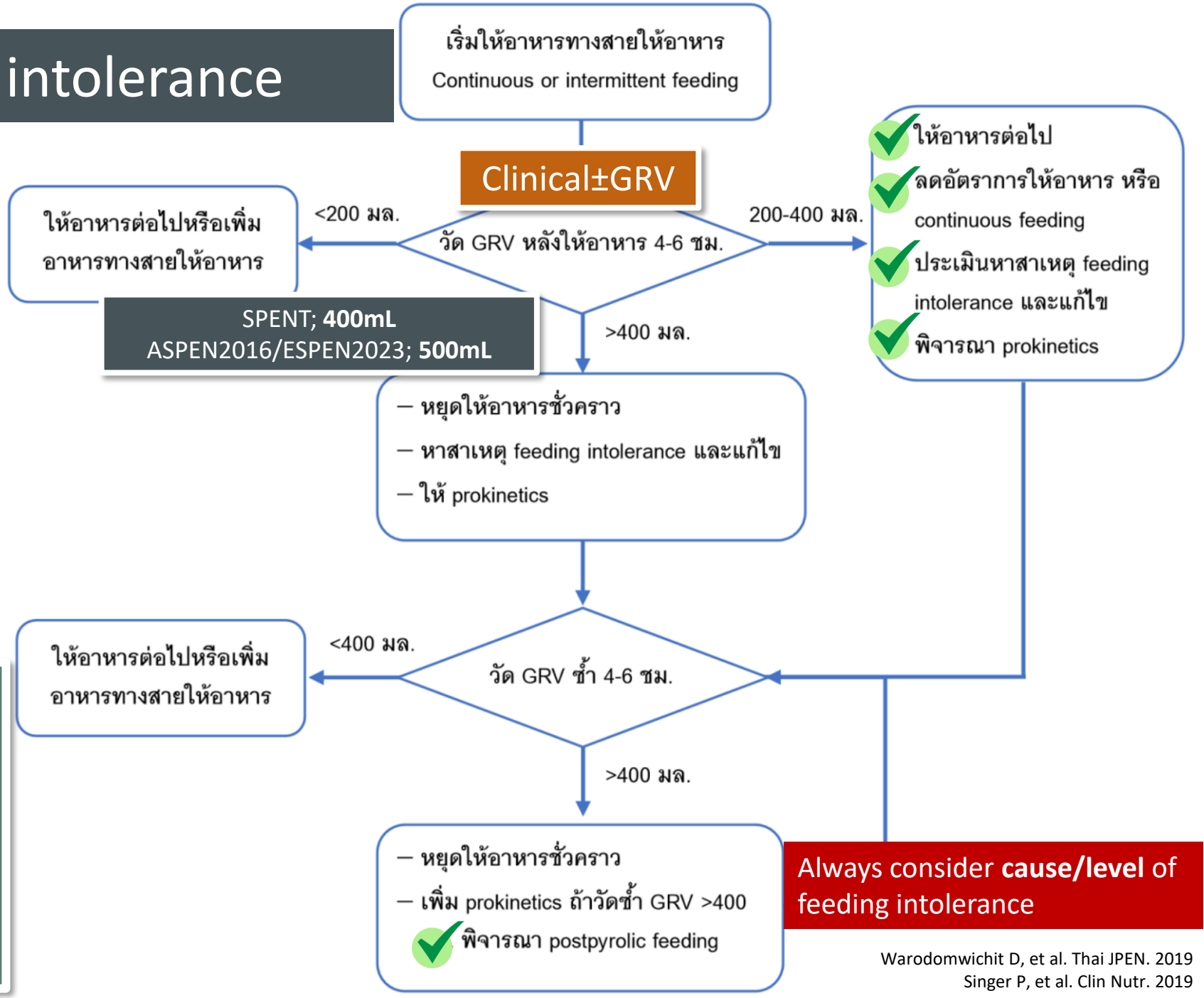
SE: QT prolong, tardive dyskinesia (elderly, renal impairment)

-IV or po can be used

-Combination→better

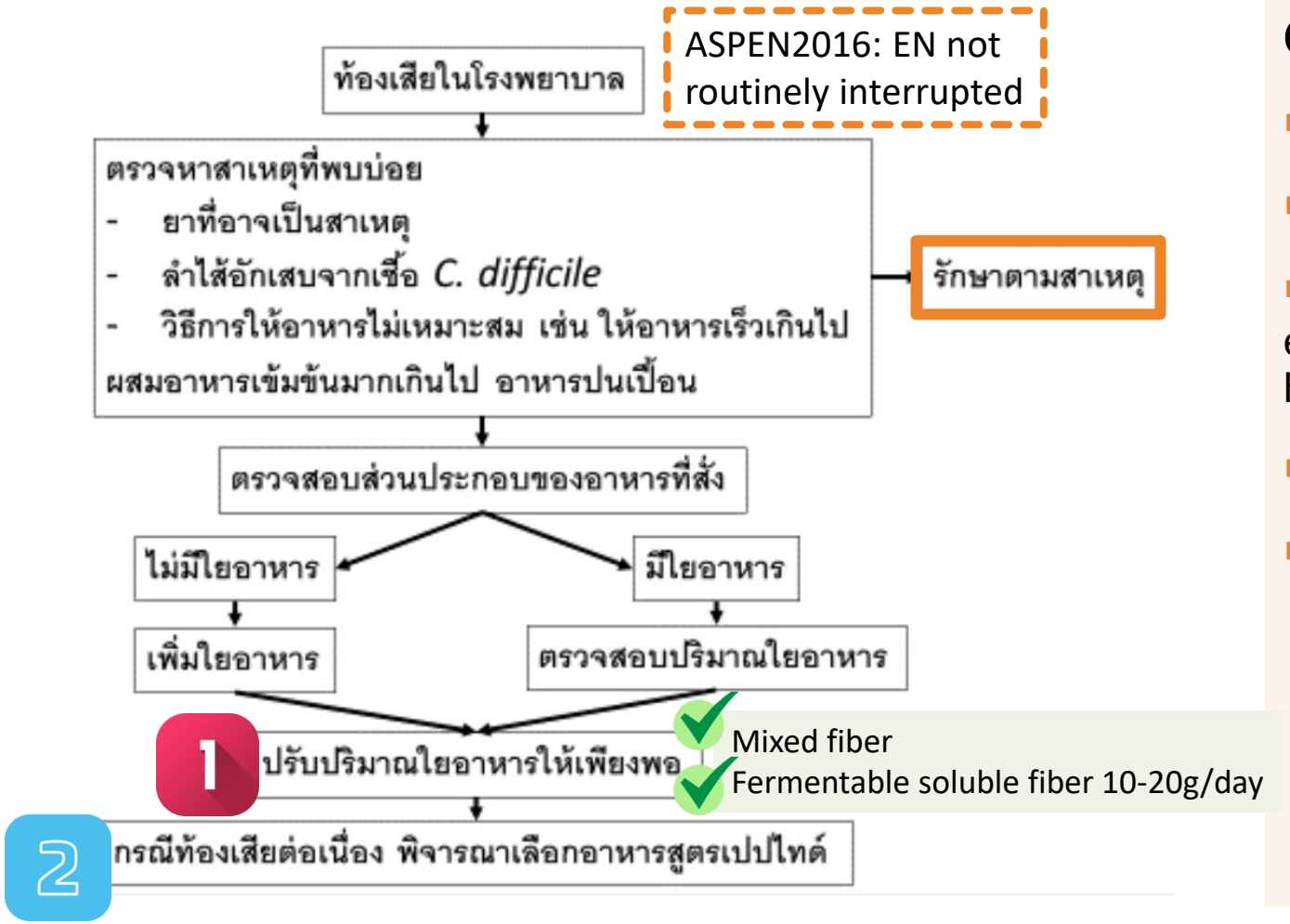
-Efficacy=1/3 at 3d and should be discontinue after 3d

-Naloxone infusion via EAD to reverse opioid narcotics at gut level → improve intestinal motility



Warodomwichit D, et al. Thai JPEN. 2019
Singer P, et al. Clin Nutr. 2019

EN problem : Nosocomial diarrhea



Causes of nosocomial diarrhea

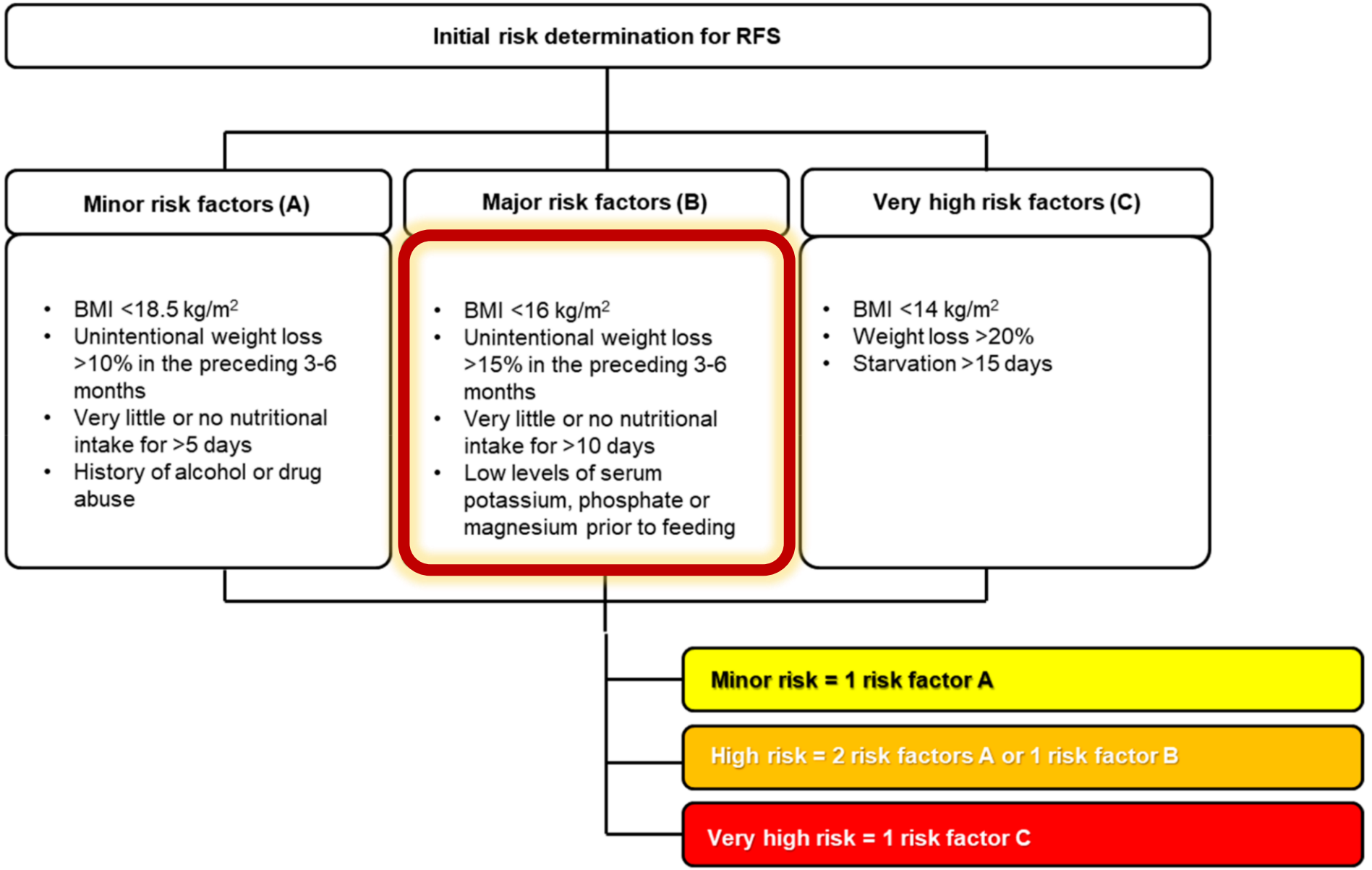
- Current illness: sepsis, systemic/viral infection
- Intraabdominal infection/inflammation
- Medication: PPI, H2blocker, colchicine, NSAID, electrolyte (K P Mg antacid), beta blocker, MFM, heavy metal, antibiotics
- *C.difficile* associated diarrhea
- EN related:
  - Contamination
  - Administration (rate, concentration)
  - Formula (osmolarity, sweetener, too much FODMAP, lack fiber)
  - Refeeding diarrhea

ASPEN ICU2016
Warodomwichit D, et al. Thai JPEN. 2019

Fiber: caution in stricture, CIPO, high risk of bowel ischemia/hemodynamic instability or severe dysmotility ,chronic pancreatitis on PERT

Semi-elemental: prefer in maldigestion/malabsorption, poor response to fiber

Risk of refeeding syndrome



J Clin Med. 2019 Dec 13;8(12):2202.

Nutritional Management according to risk of refeeding syndrome

Clinical and laboratory monitoring, management of complications

1 Low risk of RFS	2 High risk of RFS	3 Very high risk of RFS
Nutritional support: • Day 1-3: 15-25 kcal/kg/d • Day 4: 30 kcal/kg/d • From day 5: full requirements	Nutritional support: • Day 1-3: 10-15 kcal/kg/d • Day 4-5: 15-25 kcal/kg/d • Day 6: 25-30 kcal/kg/d • From day 7: full requirements	Nutritional support: • Day 1-3: 5-10 kcal/kg/d • Day 4-6: 10-20 kcal/kg/d • Day 7-9: 20-30 kcal/kg/d • From day 10: full requirements
Fluid management: • 30-35 ml/kg/d	Fluid management: • Day 1-3: 25-30 ml/kg/d • From day 4: 30-35 ml/kg/d	Fluid management: • Day 1-3: 20-25 ml/kg/d • Day 4-6: 25-30 ml/kg/d • From day 7: 30-35 ml/kg/d
No sodium restriction	Sodium restriction • Day 1-7: <1 mmol/kg/d	Sodium restriction • Day 1-10: <1 mmol/kg/d
Day 1-3: 200-300 mg thiamine	Day 1-3: 200-300 mg thiamine	Day 1-5: 200-300 mg thiamine
Day 1-10: Multivitamin	Day 1-10: Multivitamin	Day 1-10: Multivitamin

Monitoring
- Body weight or fluid balance
- Vital sign : BP, HR, RR, SpO2
- Clinical examination : hydration status, edema, cardiopulmonary status
- Lab : PO4, K, Mg, Na, Ca, glucose, Bun, Cr

J Clin Med. 2019 Dec 13;8(12):2202.

NUTRITION IN

SPECIAL CONDITIONS

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CKD : Nutritional requirement

In Thai guideline

Energy

<60 y : 35 kcal/kgIBW/day

≥60 y : 30-35 kcal/kgIBW/day

Protein

- CKD3b-5 ND : 0.6-0.8 g/kgIBW/day (>50% =high BV =complete EAA)
- CKD4-5 ND : <0.4 g/kgIBW/day+ Ketoanalogs
- HD : 1.1-1.4 g/kgIBW/day
- PD : 1.2-1.3 g/kgIBW/day

} ~1.2 g/kg/day

- Infected PD : 1.5-1.7 g/kgIBW/day
- Nephrotic range proteinuria[1]
  - GFR ≥60 : 0.8-1 g/kgIBW/day +1 g/g proteinuria (up to 5 g/day)
  - GFR <60 : 0.8 g/kgIBW/day

Do not use low protein diet in ***malnutrition, sarcopenia***

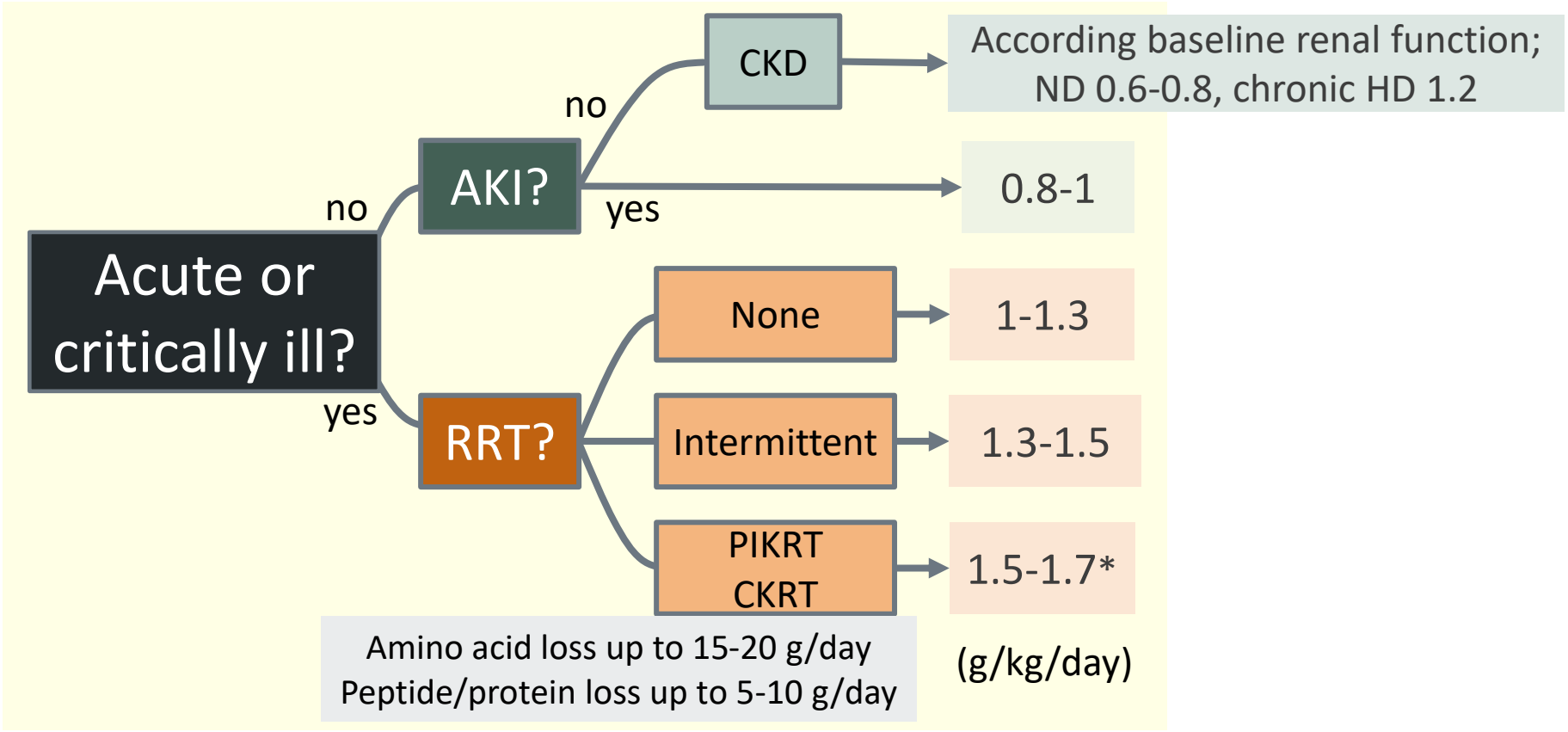
RRT : AA loss 10-15 g/session = need more 0.2 g/kg/day

ND; non dialysis
BV; biological value
EAA; essential amino acid
AA; amino acid

1 KDIGO glomerular disease 2021
SPENT 2018

Hospitalized AKI and CKD : protein requirement

- Protein requirement : **prefer guided by protein catabolic rate** (urinary nitrogen excretion)
- Protein should **not be restricted to avoid or delay** initiating dialysis therapy



*2016 ICU ASPEN guideline : up to 2.5 g/kg/day
PIKRT; prolonged intermittent kidney replacement therapy eg. SLED
CKRT; continuous kidney replacement therapy

Fiaccadori E, et al. Clin Nutr.2021:1644-68

CKD : Nutritional requirement

Dietary pattern	Healthy dietary pattern : Fish with high omega-3 (100 g x 2-3/wk) : Saturated fat <7%, Trans fat <1% *No omega-3 supplement for decrease CVD risk	In Thai guideline
Vitamin	Cholecalciferol/ergocalciferal, for 25(OH)D > 30 ng/ml Calcitriol in CKD 4-5ND with 2nd hyperPTH **Other supplement if indicated** *Caution : vitamin A (all), vitamin C (ND → hyperoxalosis) *Vitamin E 800 IU/day in HD with CVD	
RRT= risk of all water-soluble vitamin deficiency (esp **B1 C folate**), **Cu, Se, Zn[1], Fe, carnitine[2]**		
Na	<2g/day	
K	Keep normal K, 1.5-2 g/day in hyperK	
P	Keep normal P in GFR <45, 800-1000 mg/day in hyperP %Absorption: plant <50, animal 40-60, **inorganic >90**	
Fluid	500mL+urine output + dialysate net UF (HD/PD)	

ND; non dialysis

1 ESPEN hospitalized AKI/CKD 2021
2 ESPEN micronutrient 2022
SPENT 2018

NUTRITION IN

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Cirrhosis : Nutritional requirement

Compensated cirrhosis	**35 kcal/ABW, 1.2-1.5 g/ABW**
Encephalopathy Gr I-IV	35 kcal/ABW, 1.2-1.5 g/ABW (vegetable & dairy) ***No protein restriction*** EN in unable to eat
Critically ill cirrhosis	As Critically ill
Acute liver failure	As Critically ill **(defer protein 24-48 hr in severe hyperacute ALF with HE with arterial NH_3 >150µmol/l)**
Obesity with cirrhosis (compensated)	>5-10% weight loss (-500-800 kcal/day), >1.5 g/IBW **Weight reduction → ↓portal hypertension**
BCAA Dose 0.25g/kg/day	- **Advanced cirrhosis** to improve event free survival and QOL - **HE** : to improve symptom, reach protein intake - Protein intolerance (either BCAA or plant protein)
Corrected BW in ascites = Measured weight – 5/10/15% in mild/moderate/severe ascites – 5% in bilateral pedal edema	

-Avoid fasting : frequent meals 3-5/day
+late-evening snack (≥50g complex CHO)
NPO >12hr → IV glucose 2-3g/kg/day
NPO >3d → PN

-Na <2g/day in ≥ moderate ascites
-Water restriction in hypoNa <120-125
-Contraindication for PEG: severe ascites, INR >1.5, PTT >50, Plt <50000, GV

ABW; actual body weight
IBW; ideal body weight
ALF; acute liver failure
HE; hepatic encephalopathy
BCAA; branch chain amino acid
QoL; quality of life

EASL nutrition in chronic liver disease 2019
ESPEN liver disease 2020

MASLD

Liver disease :↑REE in ALF, cirrhosis, ASH not MASLD (normal REE)

- **Weight reduction** 7-10% improve steatohepatitis and liver biochemistry, >10% improve fibrosis (>5% steatosis, 7% steatohepatitis, 10% fibrosis)
- Overweight/obese: Intensive lifestyle intervention (ILI) for **weight loss** (diet control+↑physical activity =1st line)
- **Any strategies** for **same weight loss= equally effective**
    - Diet pattern: low calorie, low fat, low CHO, high protein ±↑Physical activity
    - Pharmacotherapy for weight loss: GLP-1 RA, dual GIP and GLP-1 RA
    - Bariatric surgery: Non-cirrhotic/compensated cirrhosis (× decompensated cirrhosis, portal hypertension)
- Without weight loss:
    - Exercise (moderate intensity>150min/wk, resistance)→ ↓liver fat
    - **Mediterranean diet** improve steatosis and insulin sensitivity
- Normal weight MASLD/MASH: ↑Physical activity to improve IR and steatosis, subtle (3%) weight loss
- Abstain from alcohol
- Avoid high fructose/fructose corn syrup

MASH pharmacotherapy

- **VitaminE** 800IU in nonDM* : ↓ steatohepatitis
- **Pioglitazone** 30-45mg in DM/nonDM* : ↓ steatohepatitis
- **Resmetirom** (thyroid hormone receptor ß-selective agonist) and **semaglutide*** : ↓ steatohepatitis and fibrosis (F2-3)

Other antioxidant: no proven benefit

*Biopsy-proven MASH

ESPEN liver 2020
EASL-EASD-EASO MASLD 2024

NUTRITION IN **SPECIAL CONDITIONS**

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- **Pancreatic disease**
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Acute pancreatitis : Mild

Mild pancreatitis

- Oral diet as soon as clinically tolerated, independent of serum lipase
- Low-fat (<30%) soft diet
- Can’t tolerate oral at 5-7 day → EN
- *If malnourished → early EN

Acute pancreatitis : Severe

- **Severe acute pancreatitis:** always at risk of malnutrition
- **"Nutrition as ICU patient"**
- Early EN (24-72h from admission) if intolerance to oral: EN ↓mortality
- Continuous drip NG 1st line (if intolerance → NJ)
- TC 25-30 kcal/kg/day, TP 1.2-1.5 g/kg/day, **standard formula (severe hyperTG: VLFD)**
- **Semi-elemental formula** in severe AP with **malabsorption**
- PN: <u>contraindication</u> of EN or inadequate EN (SPN)

<u>Contraindication of EN</u>
prolonged ileus, intestinal obstruction, GOO, ACS, complex pancreatic fistula,…

Uncontrolled shock
Life threatening hypoxemia, hypercapnia or acidosis
Perforated hollow viscous, uncontrolled GI bleeding
Bowel rest needed/ bowel ischemia
Gastric aspiration >500 mL/6h, paralytic ileus

- Exclusive PN (no EN) → add IV L-glutamine 0.2 g/kg/day (not in multiple organ failure)

No role of probiotics, other IMN, PERT* (except *proven or obvious exocrine insufficiency and malabsorption with steatorrhea*)

- **Minimally invasive necrosectomy**: oral diet in 1st 24h (if intolerance → NJ →PN)
- **↑Intraabdominal pressure**:
  - 12-15 mmHg → early EN via NJ (prefer) or NG
  - 15-20 mmHg → EN via NJ 20 mL/h (↓ or off feed if ↑IAP)
  - >20 mmHg or ACS → off EN, start PN
- **Open abdomen**: EN if tolerate ±SPN

VLFD; very-low fat diet
SPN; supplemental parenteral nutrition
GOO; gastric outlet obstruction
ACS; abdominal compartment syndrome
IMN; immunonutrient
PERT; pancreatic enzyme replacement therapy

Acute pancreatitis : Severe hypertriglyceridemia pancreatitis

- Initial NPO: ↓ Exogenous chylomicron
- Restart nutritional support as severity of pancreatitis
- Oral/EN: **VLFD (<15-20 g/day, <10-15% of total calorie)**
- PN: No ILE****
- Insulin: Only in hyperglycemia/DM
- Heparin: Controversy
- Plasmapheresis: Not 1st line/ routine, fail conservative or pregnancy, ↓TG60%
- Med: Fibrate, n-3 fatty acid, niacin, statin, combination

VLFD; very-low fat diet
ILE; intravenous lipid emulsion

Chronic pancreatitis

Chronic pancreatitis = high risk of malnutrition: at least *yearly* screening of malnutrition and micronutrient deficiency

Cause of malnutrition:

- Pancreatic insufficiency: Pancreatic exocrine insufficiency (PEI) when function <10%, pancreatic DM (later than PEI)
- Abdominal pain
- Lower food intake
- Alcohol use, smoking
- Hypercatabolism: ↑REE up to 50%
- Gastroparesis (>40%)
- SIBO (up to 40%)

PEI: 30-90% in chronic pancreatitis

- S&S: steatorrhea, abdominal pain, weight loss, malnutrition
- Screen in all new Dx and *yearly*
- **Pancreatic function test** → Dx PEI before S&S present

  Fecal elastase-1 = 1st line test

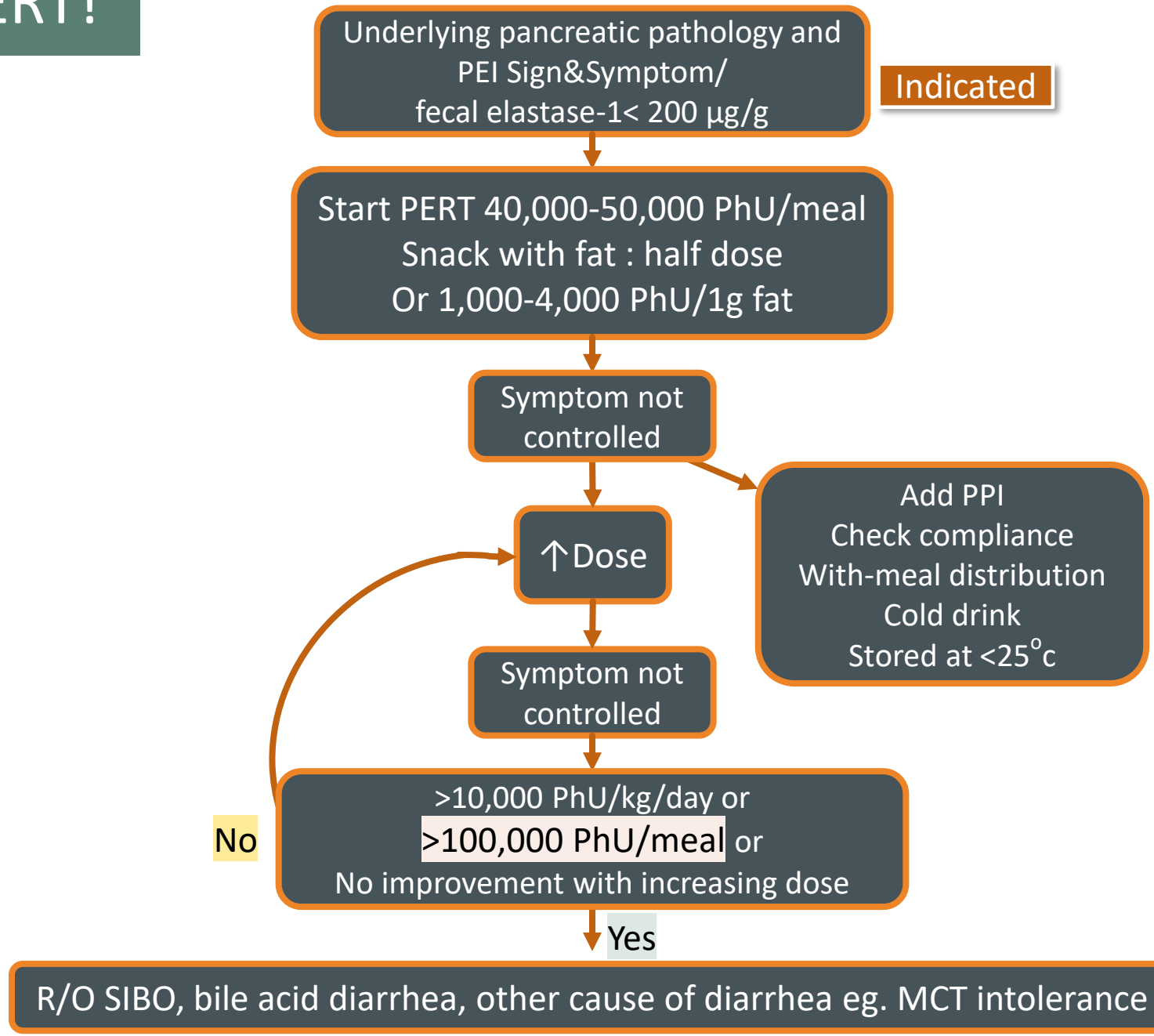
  < 200 µg/g stool → moderate PEI

  < 100 µg/g stool → severe PEI

Pancreatic enzyme replacement therapy (PERT); acid resistant, active at pH>5.5 (best pH7-8), **with meal** administration

- Initiate if PEI presents (S&S and/or lab test of malabsorption)
- All meal/snack, ONS, EN
- Starting dose *20,000-50,000* PhU/main meal, *half with snack* (requirement **not more than 100,000 PhU/regular meal**)
- Efficacy: GI symptom, nutrition parameters → pancreatic function test (fecal elastase-1, ^{13}C-MTG-breath test) in non-responder

PRACTICAL PERT!



Adapted from BMJ Open Gastroenterol. 2021 Jun;8(1):e000643.

Chronic pancreatitis : Nutritional support

- Normal nutritional status: well-balanced diet
- Malnutrition: oral → ONS → EN → PN
- Oral: **high energy** (30-35 kcal/kg), **high protein** (1-1.5 g/kg), 5-6 small meals
  - Fat 20-30% total calorie, complex CHO/avoid simple sugar in pancreatic DM
  - **Avoid fat restriction*** (except *uncontrolled steatorrhea during adequate PERT and exclude SIBO*)
  - Avoid very high fiber (>25 g/day) → inhibit PERT→↑fat malabsorption
- ONS: 1st line = **standard formula (+PERT) → MCT-based semi-elemental ONS (±PERT)** in *uncontrolled steatorrhea during adequate PERT and exclude SIBO*
- EN:
  - NJ if pain, delayed gastric emptying, persistent N/V, GOO
  - **Standard formula (+PERT) → MCT-based semi-elemental if intolerance**
- PN: indicated in GOO, complex fistula, EN intolerance
- Micronutrient at risk: vit A, D, E, K, B12, folate, B1, Mg, Fe, Se, Zn → *yearly* monitor → supplement if positive clinical sign or low micronutrient level
- Regular BMD

MCT (C6-C12) : lipase-independent absorption → alternative source of energy in fat malabsorption
Max dose 50g/day, GI side effects: cramp, nausea, diarrhea, no essential fatty acid

NUTRITION IN

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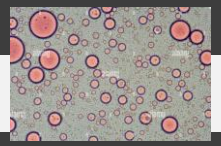
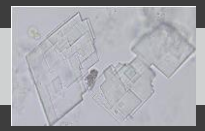
Chyle leak

Diagnosis	Chyle = lymphatic fluid Postsurgical/trauma, obstruction, infiltration, malformation, ↑lymphatic pressure: portal HT, Rt-sided HF	Cholesterol effusion RA,TB, Chronic exudative/pneumothorax/ hemothorax (pseudochylothorax)	Empyema
Centrifugation			Clear supernatant
Sudan III stain, fat globule	+ 		
Cholesterol crystal		+ 	
Ethyl ether 1-2mL	Clear		
Lipoprotein analysis	Chylomicron * Gold standard for Diagnosis		
Fluid TG	**Pleural effusion: > 110 mg/dl , fluid > serum** **Ascites: > 200 mg/dl** Pericardium effusion: > 500 mg/dl , TG > cholesterol	Pleural effusion <50mg/dl	
Fluid cholesterol	**< 200 mg/dl , fluid<serum**	> 200 mg/dl	
Fluid profile	High protein (2-6 g/dL), ↓LDH, lymphocyte predom 200 kcal/L, Electrolyte same as plasma Pleural: **exudate**(↑prot), Ascites: **false high SAAG** CBC: lymphopenia (lymphocyte loss) (Profile can be varied due to underlying cause)		Exudative, PMN predominate

Respir Med. 2010 Jan;104(1):1-8.
Breathe (Sheff). 2022 Aug 9;18(2):210163.

Chyle leak : Treatment

Definite: Treat primary cause

Conservative:

Nutrition: Aim↓chyle flow, adequate nutrition

- Absent or very low LCT diet (LCT < 5-10%, 10g)

- Caution: **Essential fatty acid deficiency (EFAD),** malnutrition, fat-soluble vitamin deficiency

- ILE: 100 g/week of soy-based ILE for essential fatty acid (EFA)
- MCT oil: ↑**Calorie** 8.3 kcal/g, Caution: **no EFA**, GI side effects (bloating, cramping, diarrhea, vomiting)
- Fluid/energy/protein/electrolyte/fat-soluble vitamin replacement according loss
- Response: Significant↓ in 1week, cease in 2 week
- NPO in high Flow (>500-1000mL/day), trauma, highly symptomatic site, failure of VLFD

Symptomatic drainage

Drug: Octreotide *(off-label use)*

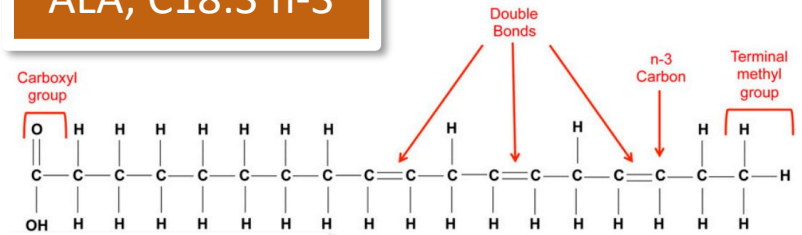
- Response: Significant↓ in 1week

Fail conservative: (> 1.5L/day, 0.5-1L/day x5day, persistent leakage > 2week, rapidly decline in nutritional status) →*identify leak site (lymphangiography)* →*surgical/interventional (thoracic duct ligation/embolization)*

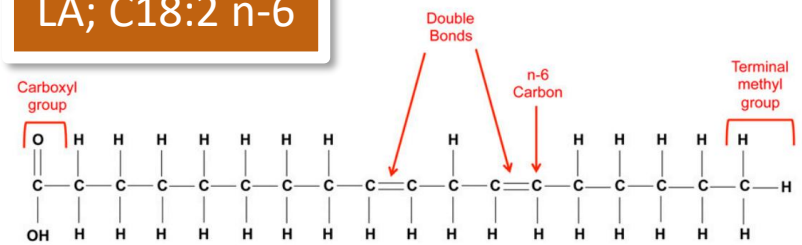
Respir Med. 2010 Jan;104(1):1-8.
Breathe (Sheff). 2022 Aug 9;18(2):210163.

Essential fatty acid deficiency (EFAD)

ALA; C18:3 n-3



LA; C18:2 n-6



EFA requirement

0.5-1% of total calorie

(1-3 g/2000 kcal, ICU 1-3 g/day)

1-3 % of total calorie

(2-7g /2000 kcal, ICU 9-12 g/day)

Clinical manifestation of EFAD (LA deficiency)

- Dry scaly skin, skin eczema
- Alopecia, hair depigmentation
- Anemia, thrombocytopenia

(**ALA deficiency** : numbness, paresthesia, blurred vision)

Diagnosis Holman index (C20:3 n-9/ C20:4 n-6) > 0.2 (>0.4; clinical/severe)
(=Plasma Mead acid to arachidonic acid ratio; triene to tetraene ratio)

Type of ILEs Commercial 3-in-1 PN	20% Intralipid Kabiven	20% lipofundin Nutriflex	20% clinoleic Oliclinomel	20% lipidem -	20% SMOF lipid SMOF kabiven
Fat composition, g/100mL LA (C18:2 ω-6)	53	27	18.5	25.7	18.7
Kcal from LA (kcal/mL)	1.06	0.55	0.318	No data	0.4
Volume for LA 80kcal (mL)	75.5	144.6	210.5	No data	200

Calculate minimal required dose to prevent essential fatty acid deficiency

Treatment/ Prevention of EFAD

- 20% intralipid (1st gen) 250mL x2/week
- 20% lipofundin (2nd gen) 250mL x4/week
- 3rd to 4th generation ILEs 250mL/day

Warodomwichit D, et al. Thai JPEN. 2019
ASPEN core curriculum 3rd ed

NUTRITION IN **SPECIAL CONDITIONS**

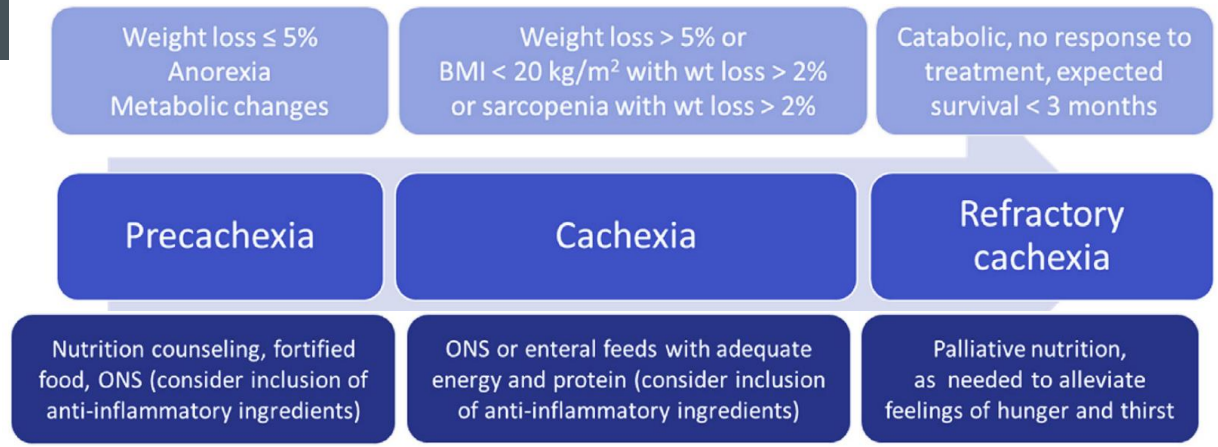
- Critically ill
- Kidney disease
- Liver disease
- Pancreatic disease
- Chyle leakage
- **Cancer**
- Perioperation
- Short bowel syndrome/ GI surgery

Cancer

Nutritional support in oncology

TC: 25-30 kcal/kg/day in **weight stable**, ↑**TC in weight loss***
TP: 1-1.5 g/kg/day
Micronutrients: RDA, supplement in deficiency
Exercise: Moderate intensity aerobic (50-75% maxHR)
10-60min 3/wk + resistance exercise

Cancer cachexia: definition



Palliative setting

- Consider prognosis of cancer, life expectancy (LE), QOL, burden of nutrition care:
- Benefit of nutrition if **LE > few weeks**,
- Benefit of PN if **LE > 2month**
- Dying=comfort care (no PN/IV fluid), **short and limited hydration** only to R/O **dehydration** as precipitating cause of **acute confusional state**

Appetite stimulant and pharmacological agents

Med/product	Benefit	Condition	Duration	Side effect
Steroid	↑Appetite	Advanced cancer (short LE)	1-3wk	Muscle wasting, IR, infection
Progestin: megestrol, MPA	↑Appetite, BW (fat mass)	Advanced cancer	8-12wk	Thromboembolism, impotence, vaginal spotting
Long chain n-3 FA or fish oil	↑Appetite, food intake, BW, LBM, QOL, prevent CMT toxicity eg. peripheral neuropathy	Advanced cancer +CMT/RT +risk of weight loss/ malnourish	Long-term	Mild GI SE, epistaxis (combine use with ibrutinib)
Olanzapine 2.5mg od	↑Appetite, BW	Advanced cancer	12wk	Minimal

*No evidence of BCAA/AA/metabolite, NSAID, cannabinoid, androgenic steroid

ESPEN cancer 2021
ASCO cancer cachexia 2023

NUTRITION IN **SPECIAL CONDITIONS**

- Critically ill
- Kidney disease
- Liver disease
- Pancreatic disease
- Chyle leakage
- Cancer
- **Perioperation**
- Short bowel syndrome/ GI surgery

Perioperative nutrition

Preoperation

- Preoperative nutritional support, indication same as non surgical patient, start at OPD, Route prefer EN>PN
- **Severe malnutrition or high metabolic risk**: *Postpone operation 10-14 days* for nutritional support
    - Weight loss **> 10–15 %** within 6 months
    - BMI **< 18.5** kg/m^2
    - NRS **≥ 5** or SGA **C**
    - Serum albumin **< 30 g/L** (without evidence of hepatic or renal dysfunction)

} ≥1/4

- Timing of NPO before GA: Clear liquids up to **2 hr**, solid food up to **6 hr** (patients without aspiration risk)
- Carbohydrate loading before major elective abdominal surgery: Evening before and **up to 2 hr** pre-anesthesia

Postoperation

- Route prefer EN>PN, enteral feeding as early as possible (within first few hours)

Immunonutrition (arginine + omega-3 fatty acids + nucleotides)

Major tumor surgery: Immunonutrition pre- or perioperatively
GI cancer: oral/enteral immunonutrition for 5–7 days preoperatively

ERAS nutrition component: Prehabilitation, nutrition optimization (nutritional support), CHO loading, avoid prolonged fasting, early postoperative EN, no routine NG tube, optimize fluid, glycemic control)

NUTRITION IN **SPECIAL CONDITIONS**

- Critically ill
- Kidney disease
- Liver disease
- Pancreatic disease
- Chyle leakage
- Cancer
- Perioperation
- **Short bowel syndrome/ GI surgery**

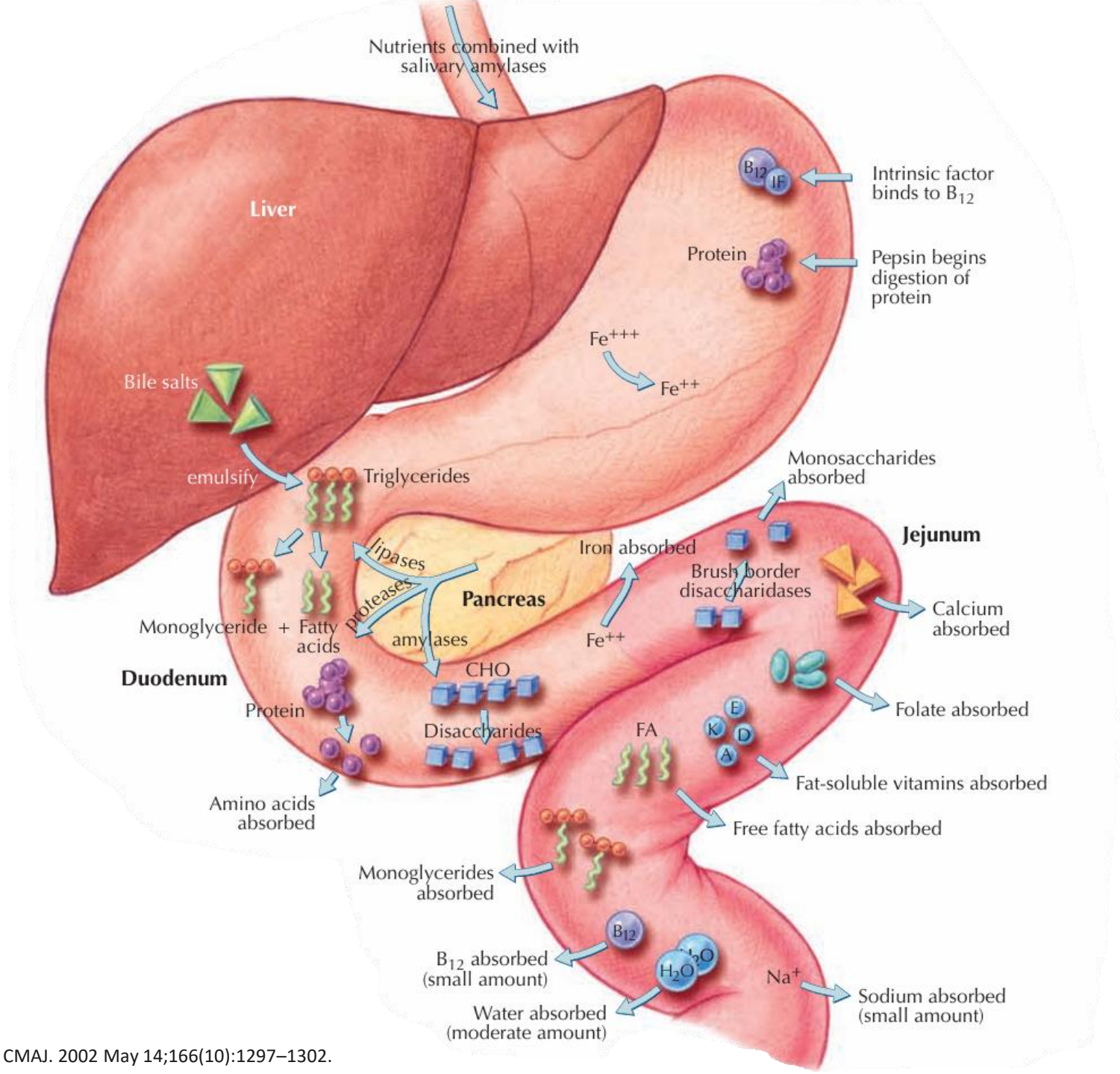
Nutrition management of adult short bowel syndrome

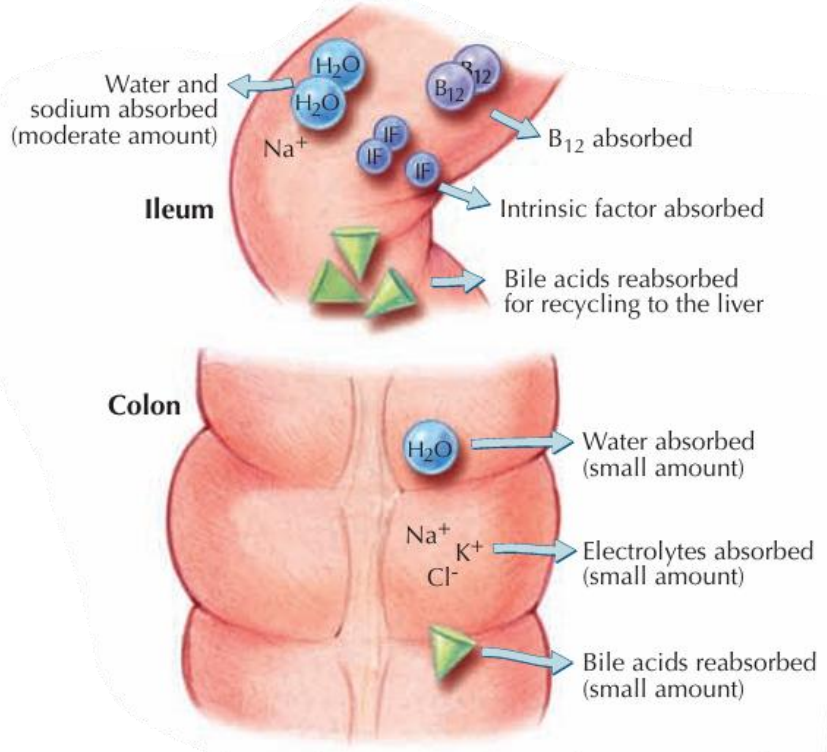
Nutrient	Colon in continuity	End jejunostomy	Additional considerations
Nutritional issue	**Enteric hyperoxaluria, BAM, SIBO, d-lactic acidosis**	**Fluid and electrolyte losses, poor bowel adaptation**	• **PN-dependent - with colon: SB< 50 cm** **- without colon: SB < 100cm**
Energy	35-45 kcal/kg/day Up to 60 kcal/kg/day	35-45 kcal/kg/day Up to 60 kcal/kg/day	• Reactive hyperphagia for compensate malabsorption • Prefer **whole food>semi-elemental** for ↑bowel adaptation • Frequent meal (5-6 meals/day)
Carbohydrate	50-60% of energy	50-60% of energy	• Simple CHO may worsen diarrhea • Prefer complex CHO
Protein	1.5-2 g/kg/day 20-30% of energy	1.5-2 g/kg/day 20-30% of energy	• Choose high biological value protein
Fat	**20-30% of energy**	Up to 40-60% of energy	• Use fecal fat test (72-hr collection) to guide management • Essential fatty acids critical • May use MCT oil for malabsorption
Fiber	10-15 g/day	10-15 g/day	• Use soluble fiber 5-10 g/day if stool volume >3L/day
Oxalate	**Avoid high-oxalate foods**	No limitation	• Restrict oxalate especially if steatorrhea present • Increase Ca intake with meal
Fluids	Isotonic/hypotonic Avoid hyperosmolar	**Isotonic high-sodium** Avoid hyperosmolar	• Separate solid food and fluid, at least 30 min • Sip ORS/water throughout the day • Avoid simple sugar, sugar-sweetened beverage, juice • Hypotonic fluid: coffee, tea, water, carbonated drink
Sodium	No limitation	No limitation	• Increase Na loss in SBS
Lactose	As tolerated	As tolerated	• Dairy product as source of protein, Ca, vitaminD

BAM; bile acid malabsorption

The ASPEN Adult Nutrition Support Core Curriculum 3rd ed.

Physiologic of nutrient absorption along GI tract





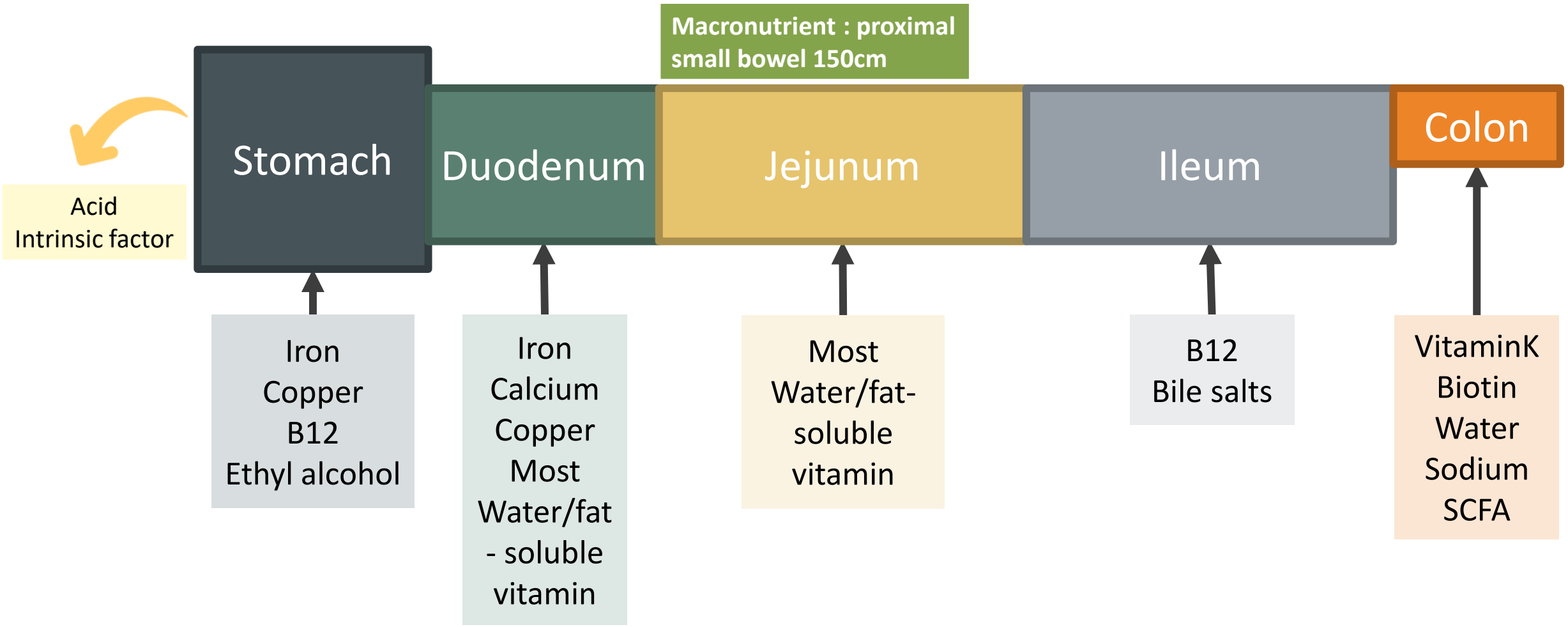
Complications of SBS/ Intestinal failure

- Diarrhea : Malabsorption, other mechanism
- Malnutrition, dehydration, electrolyte imbalance, <u>micronutrient deficiency</u>
- PN and CVC-related problem
- <u>Non-malnutrition complication</u>

CMAJ. 2002 May 14;166(10):1297–1302.

CVC; central venous catheter

Micronutrient absorption along GI tract



Adapted from Patel JJ, et al. Nutr Clin Pract. 2017

Causes of vitamin B12 deficiency

Vegetarian diet

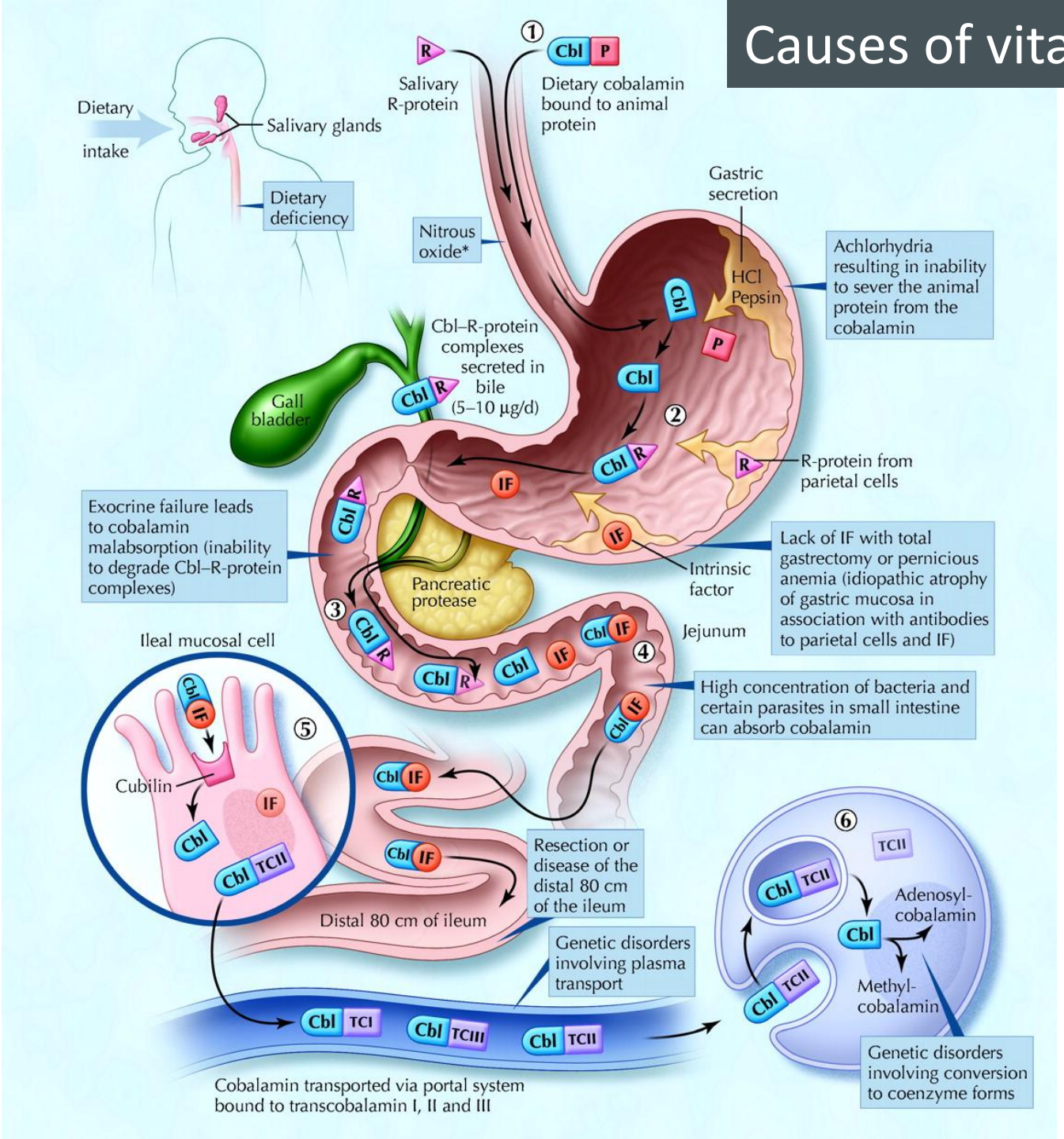
PEI
Pancreatectomy

SIBO
Intestinal parasite

Ileal resection
Ileal disease

B12 transport

B12 metabolism
- Genetic disease
- Nitrous oxide



Achlorhydria

Gastrectomy

Pernicious anemia

Associated autoimmune features
- Vitiligo
- Autoimmune thyroiditis
- Type 1 DM
- Autoimmune polyglandular syndromes

https://flipper.diff.org/app/pathways/info/260

GI disease/surgery : Micronutrient at risk

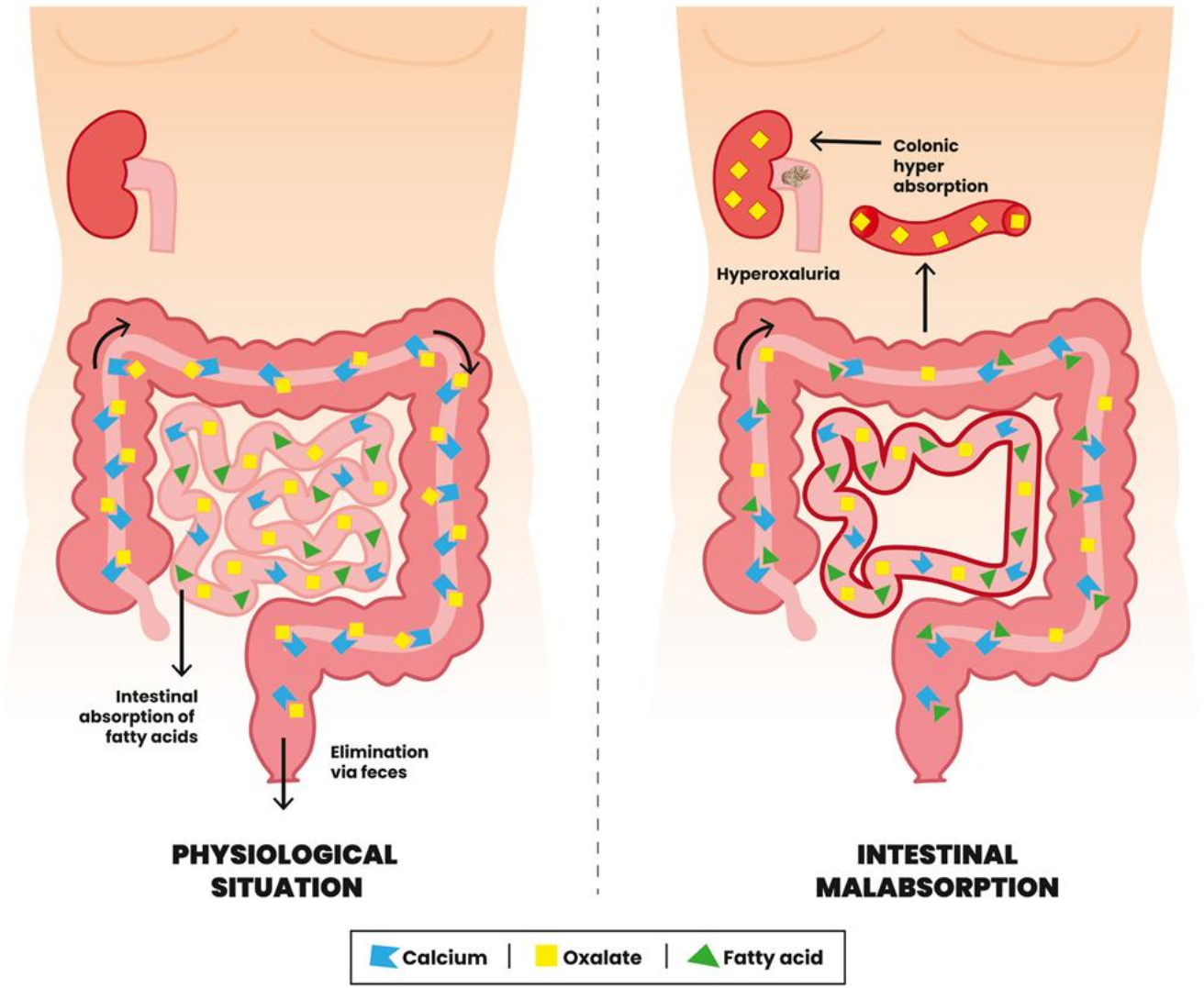
- **Gastrectomy**:
  - Achlorhydria: Fe (non-heme), Ca, Cu, vitamin B12
  - Intrinsic factor: Vitamin B12
- **Ileal resection:**
  - **> 20 cm** resected in Crohn's disease: Vitamin B12
  - **> 60-120 cm** resected in other disease: Vitamin B12
  - **60-100 cm** resected: *Bile acid diarrhea**
  - **>100 cm** resected: *Bile acid deficiency with steatorrhea*: Fat-soluble vitamin, divalent cations
  - Absence of ileocecal valve: (SIBO) Vitamin B12, 1, 6 (may ↑folate)
- **Bypass surgery and pancreatic surgery:**
  - Bypassed proximal small bowel: Fe (non-heme), Ca, Zn, Cu, folate
  - PEI: Fat-soluble vitamin, vitamin B12
  - Pancreaticocibal asynchrony/ inactivation of pancreatic enzyme: Fat-soluble vitamin
- **Chronic cholestasis/ biliary obstruction:** Fat-soluble vitamin
- **Short bowel syndrome**:
  - Multiple vitamin and mineral deficiencies (esp. Zn, Mg, K in diarrhea/ostomy)
- **Fat malabsorption** (any diseases): Fat-soluble vitamin, divalent cations (Fe, Ca, Zn, Mg), EFA, ↑*oxalate**

* Only in intact colon

Short bowel syndrome : Non-malnutrition complication

Disease: clinical	Patient condition/risk	Treatment /prevention
Bile acid malabsorption: **Voluminous** diarrhea	-Ileal resect **60-100cm**/ileal disease**+Intact colon**	-**Bile acid sequestrant**
Bile acid deficiency: **Fat malabsorption, steatorrhea**, fat soluble vitamin deficiency, essential fatty acid deficiency	-**Ileal resection >100cm, ileal disease** -Long term **bile acid sequestrant** use	-Bile acid supplement (not available in Thailand) -Vitamin supplement -MCT
D-lactic acidosis: **Alteration of conscious, ataxia, slurred speech,** **Wide AGAP metabolic acidosis, normal L-lactate/ketone, ↑D-lactate**	-**High CHO diet**+Lactobacillus overgrowth -Intact colon -↑Risk in SIBO -Acidosis, ↑oxalate (inh D-lactate elimination) **Ddx thiamine def/WE with L-lactic acidosis**	-Oral ATB: metronidazole, neomycin, vancomycin -**Withhold oral CHO (IV=ok but beware of B1def)** -Supportive **hydration, acid-base (bicarb, HD)** -Long term:**↓CHO/simple sugar, ↓oxalate**, ↓Fermented food, ±rotating ATB
SIBO: **Bloat**,abd pain, nausea, vomiting, diarrhea (watery/ malabsorption), ↓B1,**B12**,B3,B6 (bacterial use), fat soluble vitamin (bile acid deficiency), ↑folate	-Altered anatomy (anastomosis ,blinded loop, no IC valve) -Altered motility -↑pH: PPI use -Malabsorption	-Antibiotics -↓Fermentable product
Oxalate stone: Enteric hyperoxaluria	-**Intact colon+fat malabsorption**	-**Low oxalate diet, low fat, ↑oral calcium**
KUB stone (in general)	-Diarrhea→dehydration, chronic acidosis→ ↑Uca ↓Ucitrate -HypoK, hypoMg	-Correct diarrhea, electrolyte, K citrate
Osteoporosis/ bone demineralization	-Chronic acidosis→activate osteoclast, ↑UCa -↓VitD renal activation -↓VitD/Ca absorption	-Correct diarrhea -Ca/vitD supplement

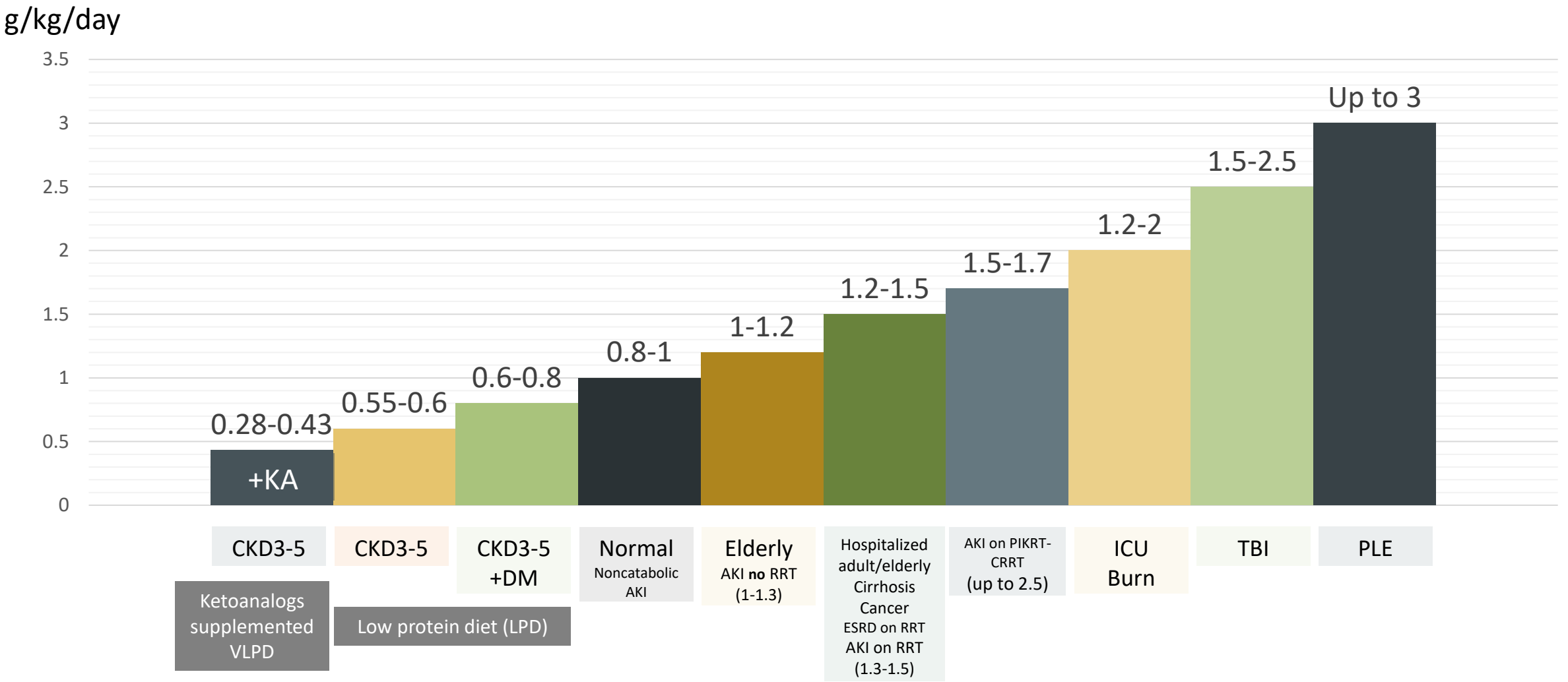
Enteric hyperoxaluria: From fat malabsorption to nephrolithiasis



- Unabsorbed fatty acids bind **calcium** in the gut lumen → ↑**free oxalate**
- Increased colonic permeability due to bile acids & fatty acids
- Upregulation of oxalate transporters
- Reduced oxalate degradation due to ↓ ***Oxalobacter formigenes*** colonization
- Dehydration & low urine volume → **supersaturation of calcium oxalate** → **nephrolithiasis / nephropathy**

Clin J Am Soc Nephrol. 2020 Sep 8;16(3):487–495.

Protein requirement in specific disease



KA; ketoanalogs
VLPD; very-low protein diet
TBI; traumatic brain injury
PLE; protein losing enteropathy

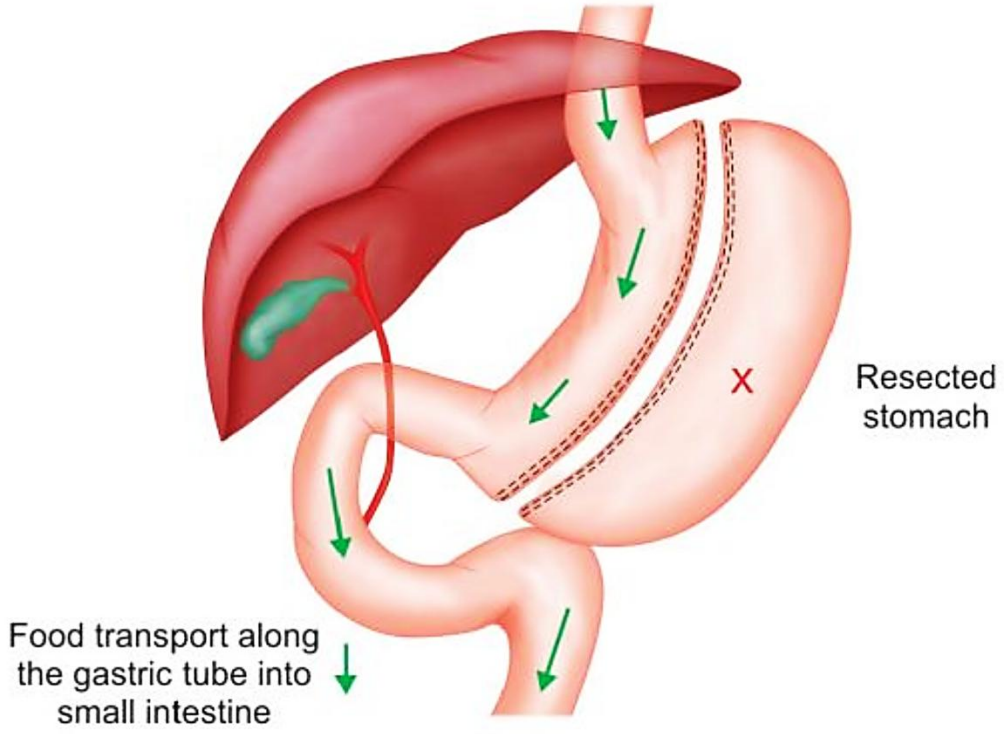
Section 2

Obesity and Metabolic Bariatric surgery

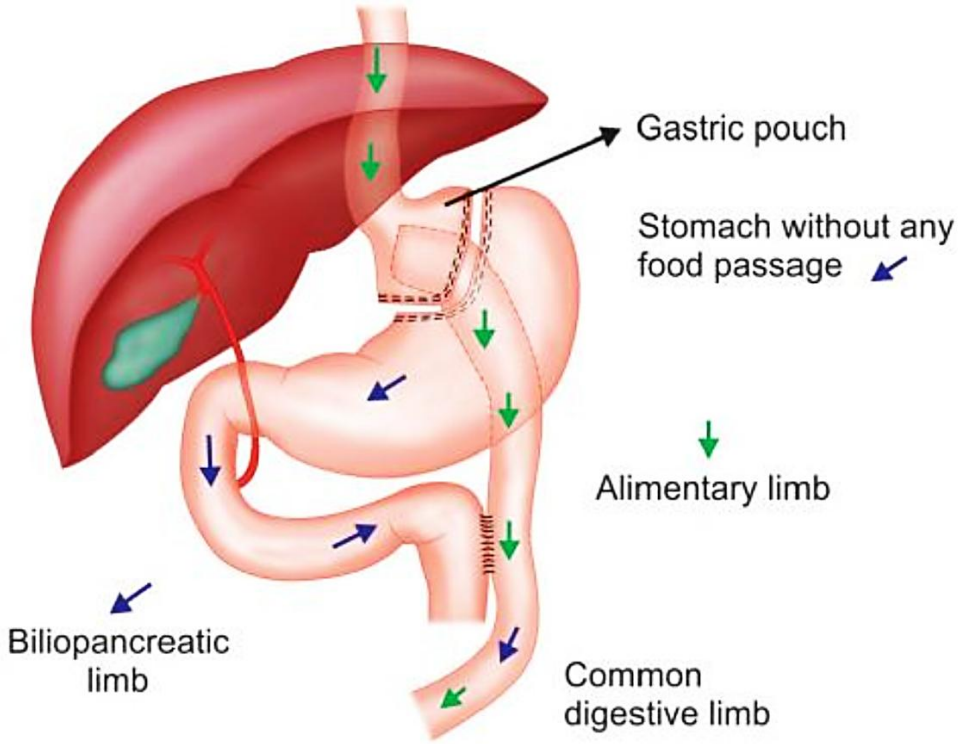
Bariatric surgery

(Asian) Indication of bariatric surgery
BMI ≥ 37.5 kg/m^2
BMI ≥ 32.5 kg/m^2 with comorbidity

Sleeve gastrectomy



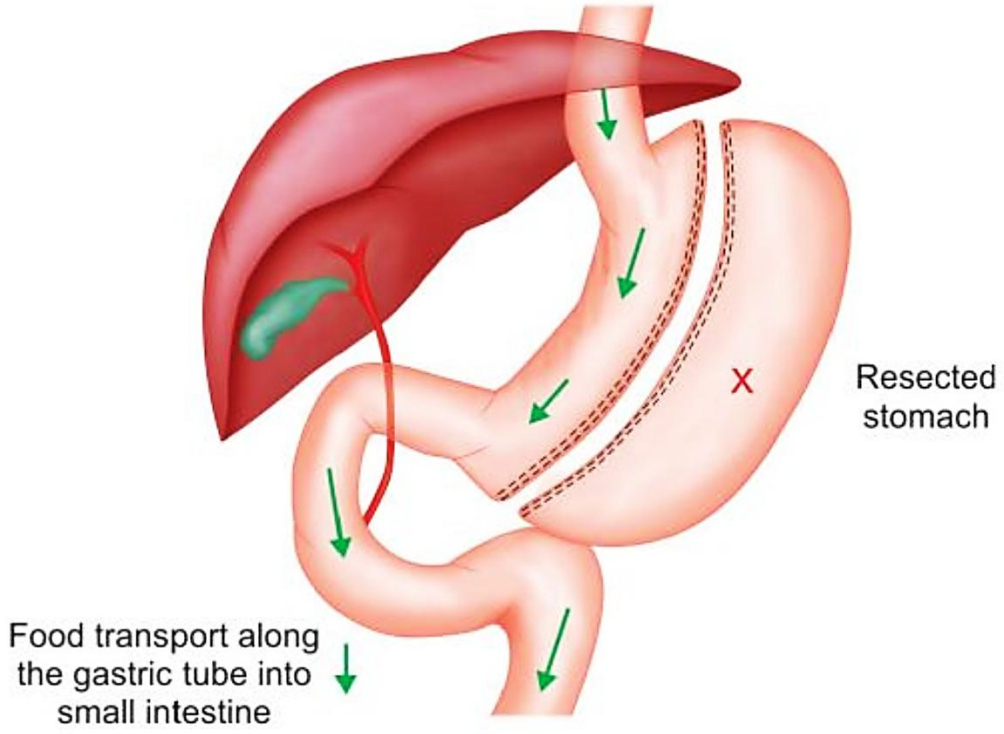
Roux-en-Y gastric bypass



Nandakumar G. Evidence Based Practices in Gastrointestinal & Hepatobiliary Surgery. 2017.

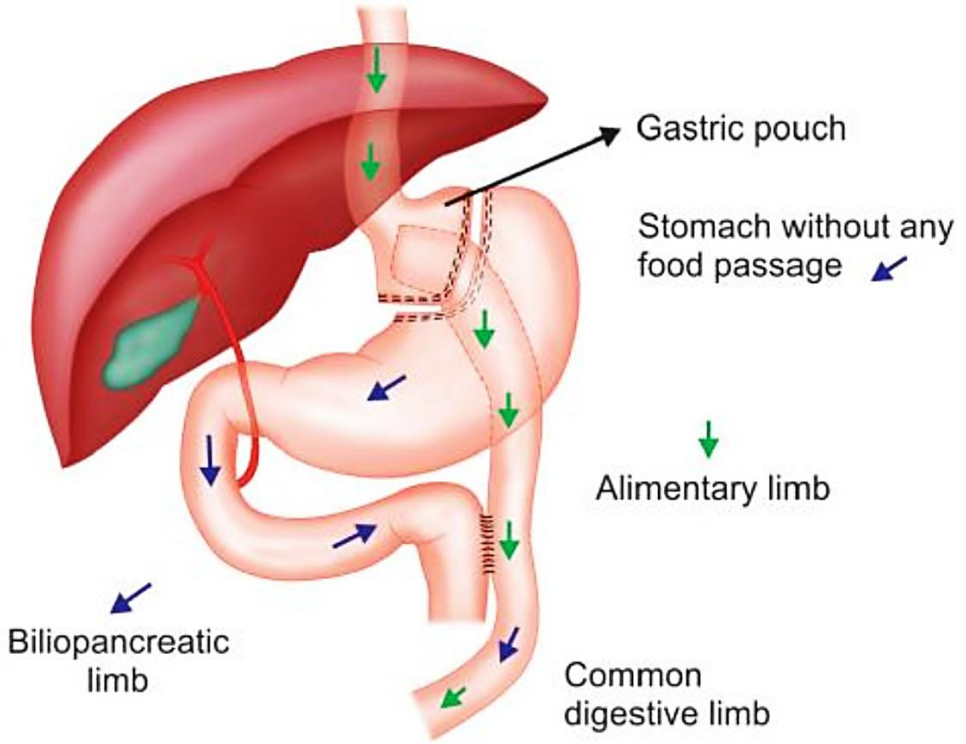
Bariatric surgery : Micronutrient deficiency

Sleeve gastrectomy



Risk : B1, B12, folate, Fe

Roux-en-Y gastric bypass



Risk : B1, B12, folate, Fe, Zn, Cu
Fat malabsorption : A D E K deficiency

Nandakumar G. Evidence Based Practices in Gastrointestinal & Hepatobiliary Surgery. 2017.

Post bariatric surgery complications

- **Micronutrient deficiency**: key = Postop onset + risk
  - B1 : **Vomiting**, **early onset** deficiency in 2-3week
  - B12 : **Late** onset (years)
  - Anemia : Iron, folate, B12, copper deficiency
  - Copper : Mimic B12
    - → Bone marrow: Cytoplasmic vacuolization in myeloid and erythroid precursor in Cu deficiency
    - → Skin: Hypopigment in Cu VS. hyperpigment in B12 deficiency
  - Fat malabsorption: A D E K deficiency
- **Undernutrition/sarcopenia**
- **Gallstone-related disease (due to rapid weight loss)**: manage as standard gallstone disease, prophylactic UDCA
- **KUB stone**: Uric acid stone, calcium oxalate stone (enteric hyperoxaluria in fat malabsorption+colon)
- **Bone loss and osteoporosis**:
  - Preop: Optimize vitamin D, Ca, BMD baseline
  - Postop: VitaminD 3000 IU/day (keep 25(OH)D >30 ng/mL) +elemental Ca 1200-2400 mg/day, protein 60-75g, weight-bearing exercise, DXA at 1-2yr postop
  - **Treatment osteoporosis**→ parenteral antiresorptive(ZOL,DMAB) but beware of hypocalcemia
- **Dumping syndrome**

Post bariatric surgery complications : Dumping syndrome

*Also occur in other stomach, pylorus surgery, esophagus surgery, vagotomy, jejunal feeding

Early dumping (30-60min after meal)	Late dumping (1-3hr after meal)
Pathophysiology: impaired gastric volume capacity or gastroenterostomy, rapid release of nutrients to jejunum	
• **Hyperosmolar contents in the jejunum** • Release of vasoactive agents (neurotensin, VIP) • Release of incretins (GIP, GLP-1) • Release of glucose-modulating hormones (insulin) → Fluid shift, ↓plasma volume, small bowel distention → ↑GI Motility, secretion	• **Rapid absorption of glucose** • ↑↑↑↑↑↑ Increased incretin release (GLP-1) • Exaggerated insulin release → **Post-gastric bypass hypoglycemia; PBH**
Symptoms: First few months after surgery	Typically1-3 yr after surgery
Vasomotor symptoms - Palpitation, tachycardia - Flushing - Hypotension - Perspiration - Syncope - Fatigue, need to lie down **GI symptoms** - Abdominal pain - Diarrhea - Borborygmi - Bloating - Nausea	**Autonomic/adrenergic** - Palpitation - Tremor - Perspiration - Aggression **Neuroglycopenia** - Fatigue - Weakness - Confusion - Hunger - Syncope
DDx surgical complication (stenosis, fistula, adhesion, internal hernia, ischemia, marginal ulcer), SIBO, gallstone	DDx hyperinsulinemic hypoglycemia

Beek AP, et al. Obes Rev. 2017

Dumping syndrome

Diagnosis

-Clinical, Sigstad's score(>7 suggest early dumping), Art's questionnaire (early vs late)

-Provocative test

OGTT (Endocrine Society *do not suggest* for dx postprandial hypoglycemia)

(Early½-1hr) : ↑Hct >3%,↑HR >10/min*

(Late1-3hr) : Hypoglycemia

Mixed meal test: more physiologic,↑specificity

-Gastric emptying study : rapid gastric emptying

Treatment

- Diet modification (all) = ***1st line***
  - Frequent, small meal (CHO: <30g/meal, 15g/snack), avoid rapidly absorbed CHO/high GI, ↑protein, ↑fiber
  - Eat slowly, chew well, avoid fluid in 30 min after meal
  - If not effective →lie down 30min after meal

- Medications

(late) : α-glycosidase inhibitor (slow CHO digestion), diazoxide (↓hyperinsulinemia, 2nd line, ↓evidence)

(all) : Somatostatin analog (↓motility/gut hormone, postprandial vasodilatation)

-(late) Reversal surgery, pancreatectomy (not recommend)

-(all) Continuous tube feeding via remnant stomach tube

Beek AP, et al. Obes Rev. 2017

Sigstad scoring system

Patients circle the symptoms they experience and the assigned scores are totaled to make a diagnosis. A total score > 7 suggests dumping syndrome; a score < 4 suggests a different diagnosis and the need for additional assessment.

Shock	+5
Fainting, syncope, unconsciousness	+4
Desire to lie or sit down	+4
Breathlessness, dyspnea	+3
Weakness, exhaustion	+3
Sleepiness, drowsiness, apathy, falling asleep	+3
Palpitations	+3
Restlessness	+2
Dizziness	+2
Headaches	+1
Feeling of warmth, sweating, pallor, clammy skin	+1
Nausea	+1
Abdominal fullness, meteorism	+1
Borborygmus	+1
Eructation	-1
Vomiting	-4

Adapted from Tack and Deloose 2014.

Further reading !

- **Nutrition care process**
  - Screening, assessment and diagnosis
  - Nutritional therapy
- **Common problem in nutritional therapy** : Feeding intolerance, nosocomial diarrhea, Refeeding syndrome, PN complication and monitoring
- **Micronutrient disorder**
- Nutrition in **special conditions**
- **Obesity** and bariatric surgery


GOOD
LUCK

Obesity

1. Diagnosis

Nutritional status classification	WHO criteria	Asian criteria
Underweight	<18.5	<18.5
Normal	18.5-24.9	18.5-22.9
Overweight	25-29.9	23-24.9
Obesity class I	30-34.9	25-29.9
Obesity class II	35-39.9	≥30
Morbid obesity	≥40	≥40

Metabolic syndrome (criteria ≥ 3/5)

Waist circumference	: F ≥ 80, M ≥ 90	cm
SBP or DBP	: ≥130 or DBP ≥ 85	mmHg
Fasting blood sugar	: ≥100	mg/dL
Triglyceride	: ≥150	mg/dL
HDL	: F < 50, M < 40	mg/dL

2. Causes

- **Primary Causes**
  - Genetic causes
    - Monogenic disorders
      - Melanocortin-4 receptor mutation
      - Leptin deficiency — **Rx** recombinant leptin
      - POMC deficiency — **Rx** setmelanotide (melanocortin-4 receptor agonist)
    - Syndromes
      - Prader-Willi
      - Bardet-Biedl
      - Cohen
      - Alström
      - Froehlich

PWS: Short stature, mental retard, hypog hypog, hypotonia, small hand and feet, almond eyes, triangular mouth, compulsive behavior

BBS: Polydactyly, retinal dystrophy, renal and cardiac abnormal, hypog, mental retard มือตาไตใจไข่โง่

Alstrom: คล้าย BBS เด่น dilated cardiomyopathy, SNHL, normal cognitive function

- **Secondary Causes**
  - Neurological
    - Brain injury
    - Brain tumor
    - Consequences of cranial irradiation
    - Hypothalamic obesity
  - Endocrine
    - Hypothyroidism[a]
    - Cushing syndrome
    - GH deficiency
    - Pseudohypoparathyroidism
  - Psychological
    - Depression[b]
    - Eating disorders
  - Drug-Induced
    - Tricyclic antidepressants Amitriptyline, nortriptyline, some SSRI
    - Oral contraceptives (Less weight gain than injectable progestin)
    - Antipsychotics : Clozapine, olanzapine, quetiapine, risperidone
    - Anticonvulsants Gabapentin, pregabalin, valproate, vigabatrin
    - Glucocorticoids
    - Sulfonylureas
    - Glitazones, insulin
    - β blockers: Metoprolol (>carvedilol, nebivolol)
    - ARV: PI
    - Antihistamine: sedative>non-sedative

Endocrine society 2015
ADA 2025

Causes of Secondary obesity: Drug induced weight gain

	Weight gain
Antidiabetic medications	
- Insulin	↑↑
- Thiazolidinediones	↑↑
- Sulfonylureas	↑ to ↑↑
Antidepressants	
- TCA: nortriptyline, amitriptyline, doxepine	↑↑ to ↑↑↑
- SSRI: paroxetine, escitalopram, citalopram	↑↑ to ↑↑↑
- SNRI: mirtazapine	↑↑
Antipsychotics	
- Olanzapine	↑↑
- Clozapine	↑↑
- Quetiapine	↑↑
- Risperidone	↑
Mood stabilizer: Lithium	↑↑

	Weight gain
Anticonvulsants:	
- Carbamazepine	↑↑↑
- Gabapentin	↑↑↑
- Valproic acid	↑↑↑
Other medications	
Oral contraceptives, hormone replacement	↑ to ↑↑
Systemic corticosteroids	↑↑↑
Inhaled corticosteroids	↑
β blockers: propranolol, metoprolol, atenolol	↑ to ↑↑
Antihypertensives: clonidine	↑
Antihistamines: diphenhydramine	↑

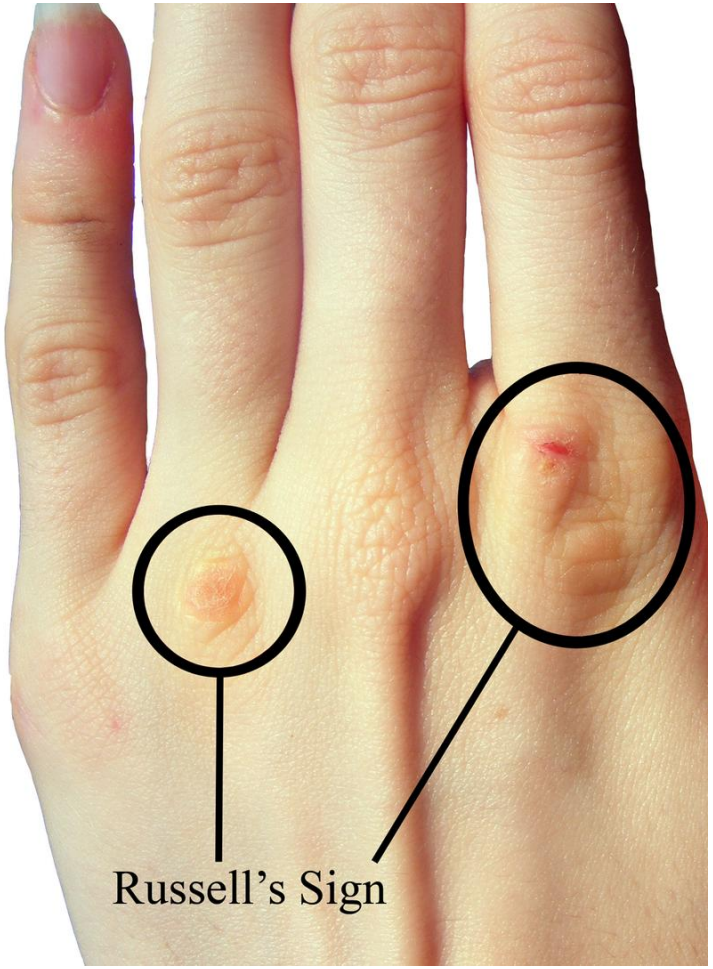
↑ up to 5 kg weight gain; ↑↑ 5 to 10 kg weight gain; ↑↑↑ >10 kg weight gain

TCA, tricyclic antidepressant; SNRI, serotonin-norepinephrine reuptake inhibitor; SSRI, selective serotonin reuptake inhibitor;

Obesity Canada Guidelines: Assessment of Obesity (Rueda-Clausen et al., 2020).

Clin Pract. 2007;4(5):641-50.

Eating disorder : Russell's sign



Self-induced vomiting over long periods of time (purging)

Found in eating disorder
- Bulimia nervosa
- Purging disorder
- Anorexia nervosa

https://en.wikipedia.org/

3. Obesity-related complication

Metabolic	Mechanical	Mental
Metabolic syndrome (WC,TG,HDL,BP,BS)	OSA, OHS	Depression, mood disorder
ASCVD, AF, VTE	Pulmonary hypertension	Anxiety disorder
MASLD	OA, back pain, Plantar fasciitis	Eating disorder
Gout	GERD	Sleep disorder
PCOS, infertility, hypogonadism	Stress incontinence	self-image, attention
Gall stone	Pseudotumor cerebri	Internalized weight bias

↑risk of cancer
- GI tract
- Hormone: breast, cervix, endometrium, ovarian, prostate
- Other: kidney, meningioma, thyroid

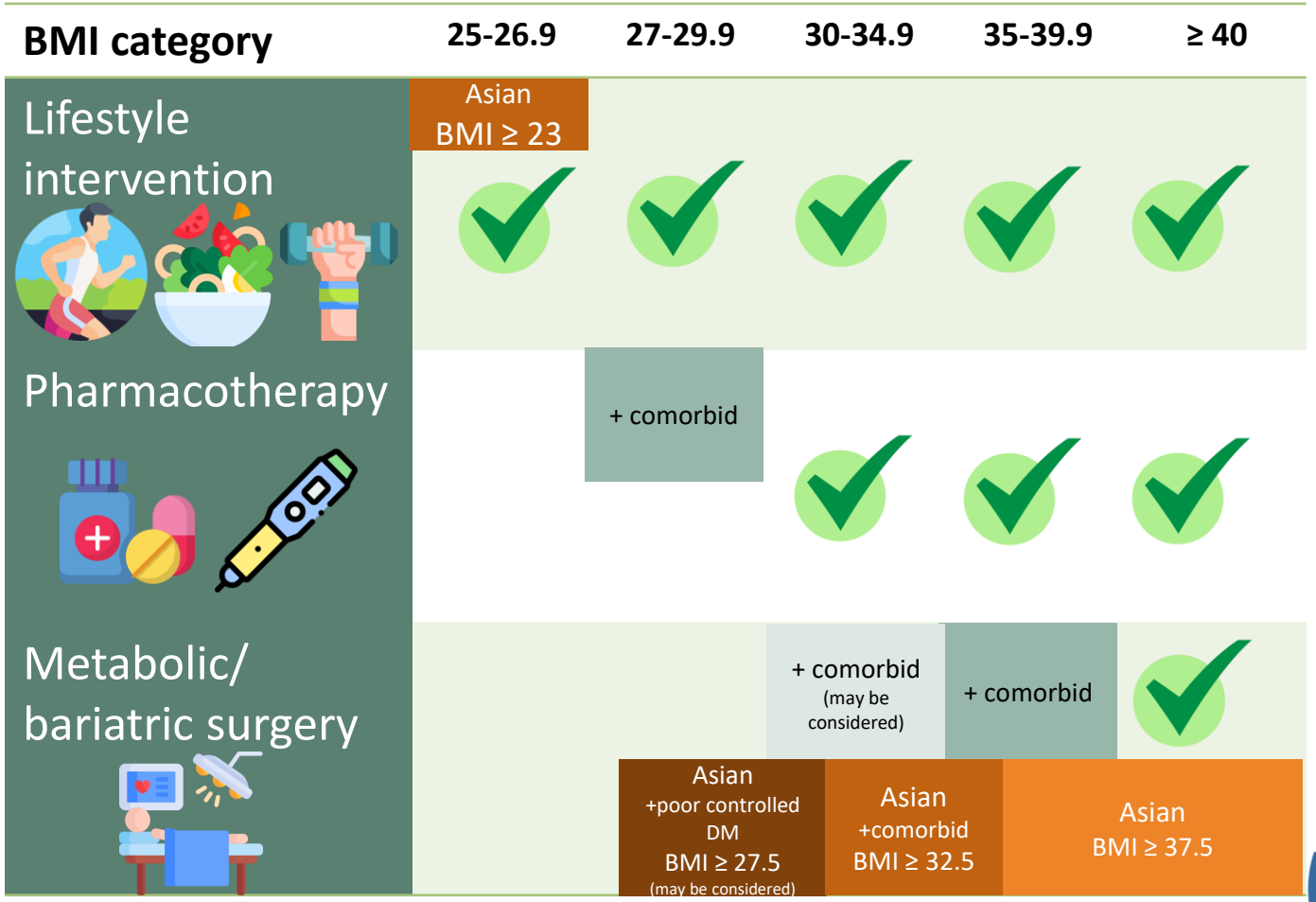
Benefit of weight loss on obesity-related complication

>5% : ***Most* metabolic** improvement
>10% : ***Most* mechanical** improvement
T2D : > 7% T2D prevention, >10-15% T2D remission
MASH : > 10%
ASCVD : > 10% ↓CVD and AF, >15% ↓CVD mortality
OSA : > 7-10%
OHS : > 25-30% (hypoventilation resolution)

4. Treatment

Weight loss effectiveness	
5-7%	Intensive lifestyle intervention
10-15%	VLCD or meal replacement
3-20^{+}%	Weight loss medication
10-20%	Endoscopic procedures
20-35^{+}%	Bariatric surgery

Step approach to obesity treatment



Intensive lifestyle intervention

Goal: Weight reduction 5-10% in 3-6 month
Diet: 500-750 kcal energy deficit
LCD F:1200–1500, M:1500–1800 kcal/day
Varied eating pattern, IF, meal replacement
VLCD: <800-1000 kcal/day for short-term (<3mo) for rapid weight loss (before bariatric surgery, greater glycemic control, CPAP)
Side effect: ketosis, gallstone (weight loss>1.5 kg/wk), dehydration, electrolyte abnormality, hyperuricemia
Exercise: mod intensity >150min/wk (high intensity >75min/wk) +resistance 2-3/wk

Pharmacotherapy

-*Adjunctive* to diet, physical activity, and behavioral counseling for ↓weight, maintain weight loss
-Successful= >5%weight reduction at 1st3mo→ continue long term use

(Asian) Indication of bariatric surgery

BMI ≥37.5 kg/m^2
BMI ≥32.5 kg/m^2 with comorbidity

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Pharmacotherapy for weight reduction

Withdrawn medications
- Lorcaserin: cancer
- Sibutramine: CV disease, stroke
- Fenfluramine: VHD, pulmonary hypertension
- Rimonabant: psychiatric disorder

Medication	%weight loss	Side effects	Safety concern/consideration
Short term use ≤12week			
Sympathomimetic (↑NE±dopamine) Phentermine 15-37.5mg OD	-6.6 to -7.4	Palpitations, ↑BP and HR, dry mouth, insomnia, dizziness, irritability	✕ Combine use with MAOI/uncontrolled HT/CVD /seizure/anxiety disorder/hyperthyroid/ glaucoma
Long term use >12week			
Pancreatic lipase inhibitor (↓fat absorption 30%) Orlistat 120mg TID	-10.2	Abdominal pain, flatulence, steatorrhea, incontinence	-Fat soluble vitamin/cyclosporin/LT4/anticonvulsant malabsorption -Severe liver injury -Cholestasis -Gallstone -Renal oxalate stone
Sympathomimetic/anticonvulsant Phentermine/topiramate ER 15mg/92mg OD	-7.8 to -9.3	↑BP and HR, dry mouth, insomnia, depression, suicidal ideation, birth defects, nasopharyngitis, paresthesia, constipation	✕ Combine use with MAOI/hyperthyroid/glaucoma -Birth defects -Cognitive impairment -Acute angle-closure glaucoma
Opioid antagonist/dopamine and norE reuptake inhibitor (dopa>norE) Naltrexone/bupropion ER 32mg/360mg BID	-5 to -6.1	Palpitations, ↑BP and HR, nausea, headache, constipation, dry mouth, insomnia, dizziness	✕ Uncontrolled HT/seizure/chronic opioid use/AN/BN/MAOI/drug or alcohol withdrawal -Acute angle-closure glaucoma -Risk of suicidal in young patient with depression
GLP1-RA Liraglutide 3mg OD Semaglutide 2.4mg weekly	-8.0 -14.9	Nausea/vomiting, diarrhea, GERD constipation, pancreatitis, gallstones, ↑HR, injection site reaction	✕ Medullary thyroid cancer/MEN2 (PH or FH) -pancreatitis→consider not start/discontinue -AKI in CKD patient
GIP/GLP1 coagonists Tirzepatide 15/10/5mg weekly	-20.9/-19.5/-15		

All med: ✕ pregnancy or potential pregnancy or breastfeeding
*All reproductive female must use reliable contraceptive method

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Q&A

THANK YOU