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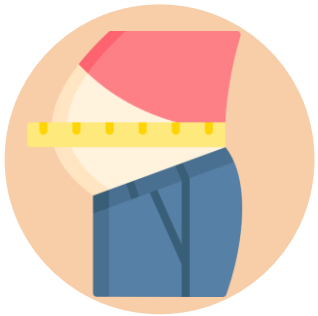
FACULTY OF MEDICINE KHON KAEN UNIVERSITY

NUTRITION BOARD REVIEW

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TOPIC

- **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**

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NUTRITION IN

SPECIAL CONDITIONS

NUTRITION IN **SPECIAL CONDITIONS**

- Critically ill
- Kidney disease
- Liver disease
- Pancreatic disease
- Chyle leakage
- Cancer
- Elderly-sarcopenia
- Intestinal failure/ Short bowel syndrome

NUTRITION IN **SPECIAL CONDITIONS**

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GENERAL CONCEPT : ENERGY REQUIREMENT

General ward

BMI (kg/m^2)	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/m^2)	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

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

24h-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

PCR; Protein catabolic rate

Warodomwichit D, et al. Thai JPEN. 2019

CAUTIONS of 24-hr UUN calculation / NITROGEN BALANCE

- Low 24-hr UUN
  - Impaired renal function : eGFR < 50 mL/min/1.73 m^2
  - Liver disease (impaired urea cycle)
- High 24-hr UUN
  - Starvation or inadequate caloric intake
  - Catabolic state: Illness, steroid
- Dietary protein effect 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

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

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Time to start PN

TPN

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

Supplemental 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

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

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

EN PROBLEM : FEEDING INTOLERANCE

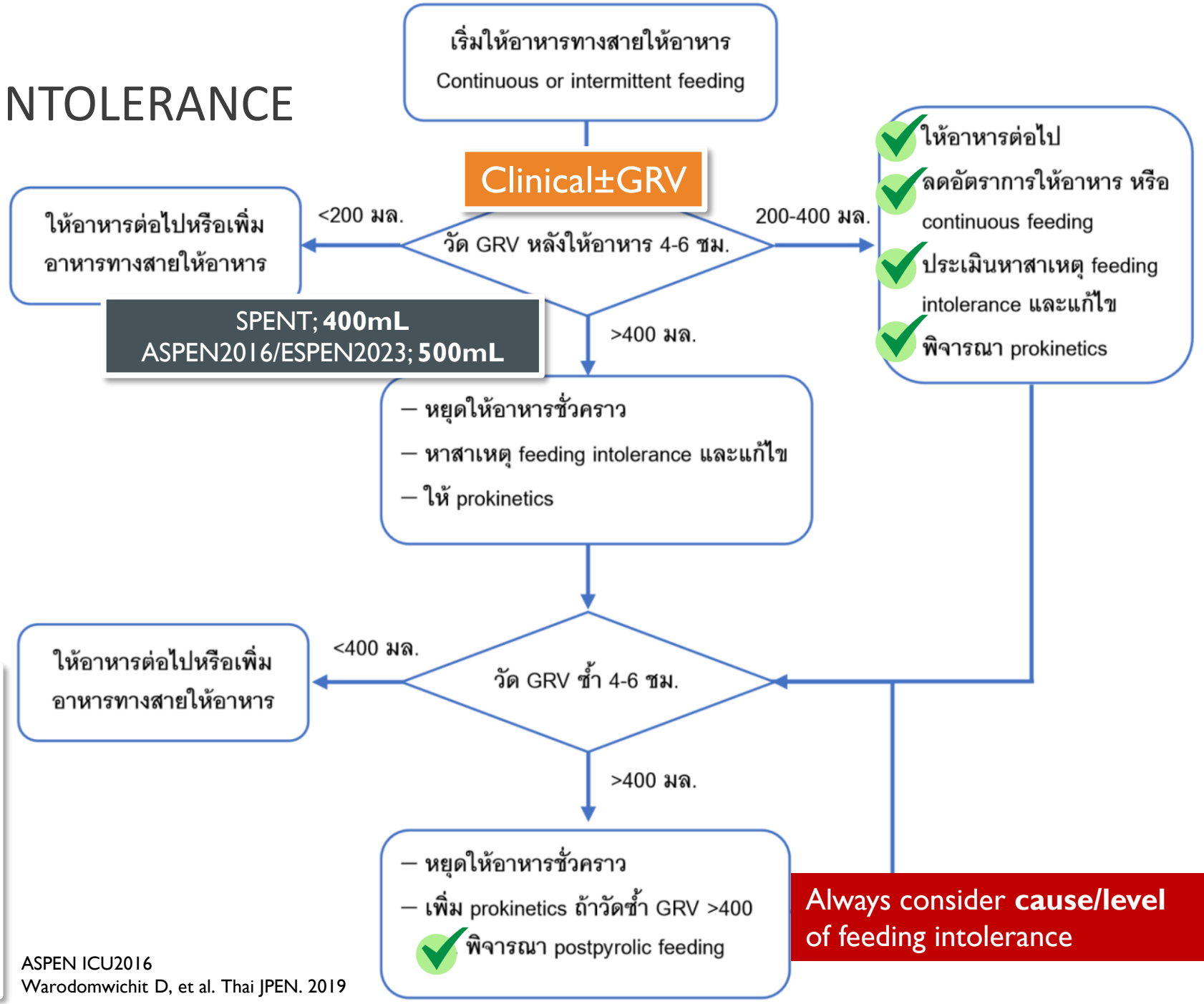
Clinical :

- 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

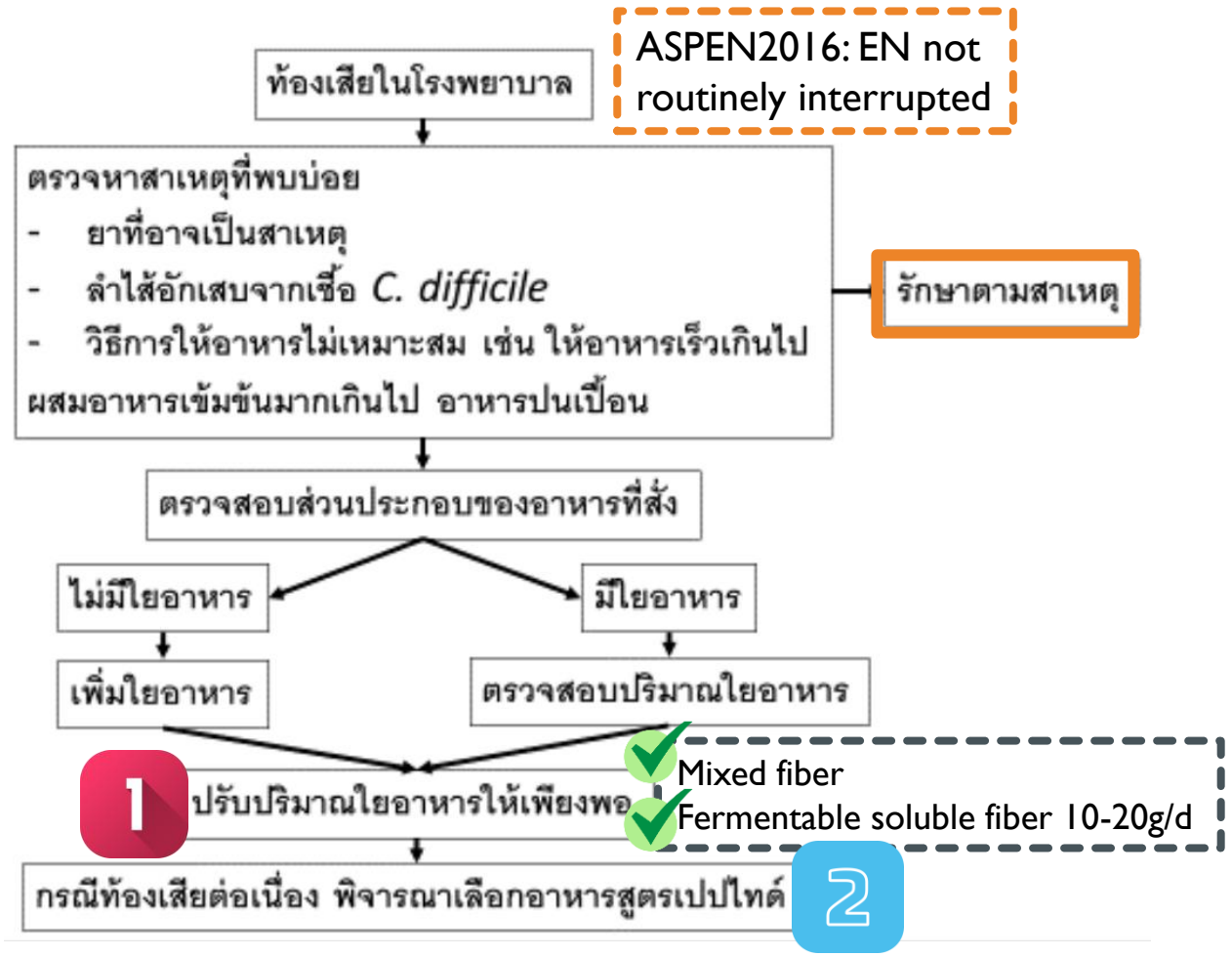
-Erythromycin 3-7MKD or 100-250mg tid (IV=1stline)
SE: cardiotoxicity, QT prolong, ATB resistance
-Metoclopramide 10mg qid
SE: QT prolong, tardive dyskinesia (elderly, renal impairment)
-IV or po can be used
-Combination→better
-Efficacy=1/3 at 3d and should be discontinue after 3d
-Naloxone infusion via EAD to reverse opioid narcotics at gut level → improve intestinal motility



Always consider **cause/level** of feeding intolerance

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

EN PROBLEM : NOSOCOMIAL DIARRHEA



Cause 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, conc)
  - 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

RESPIRATORY FAILURE

- **Macronutrient modification** (↑fat, ↓CHO) is **not recommended** in acute 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
- 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

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CKD : NUTRITIONAL REQUIREMENT

In Thai guideline

Energy

<60 y	: 35 kcal/kgIBW/d
≥60 y	: 30-35 kcal/kgIBW/d

Protein

- CKD3b-5 ND : 0.6-0.8 g/kgIBW/d (>50% =high BV =complete EAA)
- CKD4-5 ND : <0.4 + Ketoanalogs g/kgIBW/d
- HD : 1.1-1.4 g/kgIBW/d
- PD : 1.2-1.3 g/kgIBW/d
- Infected PD : 1.5-1.7 g/kgIBW/d
- Nephrotic range proteinuria[1]
  - GFR ≥60 : 0.8-1 g/kgIBW/d +1 g/g proteinuria (up to 5 g/d)
  - GFR <60 : 0.8 g/kgIBW/d

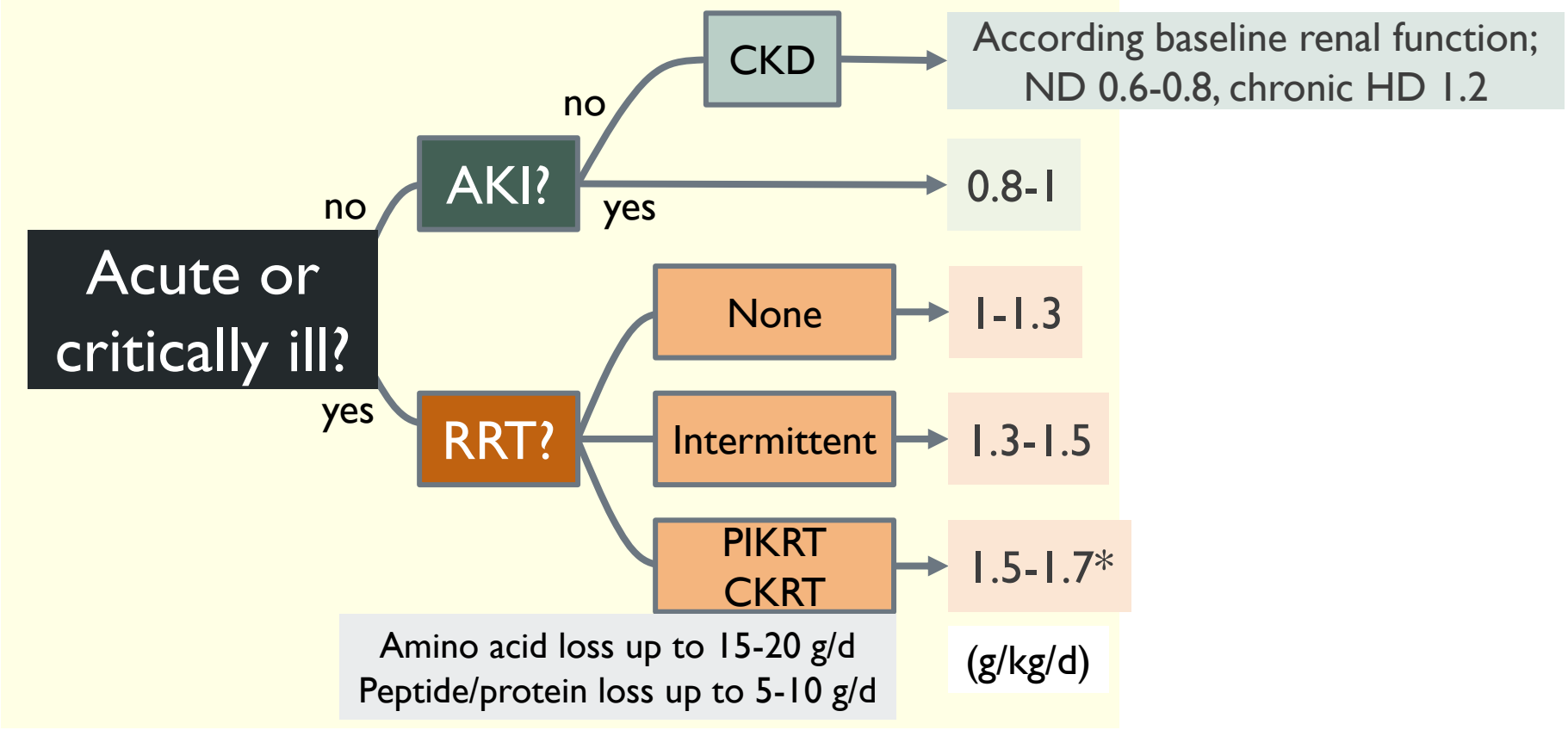
RRT : AA loss 10-15g/session = need more 0.2g/kg/d

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

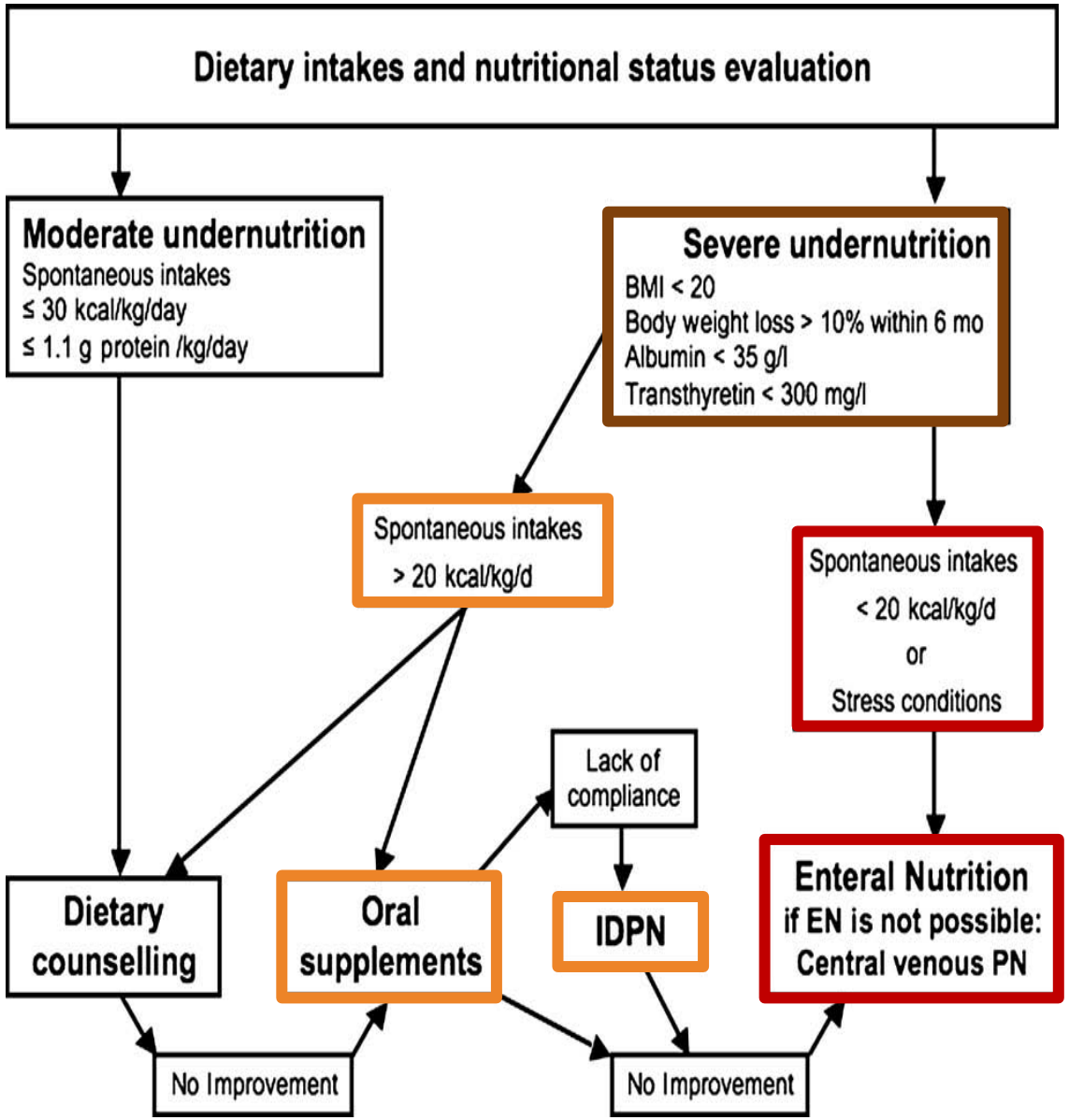
- Protein requirement : **prefer guided by protein catabolic rate** (urinary nitrogen excretion)
- Protein should **not be restricted to avoid or delay** initiating dialysis therapy



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

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

KIDNEY DISEASE: ROUTE OF NUTRITIONAL SUPPORT



IDPN; Intradialytic parenteral nutrition

CKD : NUTRITIONAL REQUIREMENT

In Thai guideline

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
Vitamin	Cholecalciferol/ergocalciferal, for 25(OH)D > 30 ng/ml Calcitriol in CKD 4-5ND with 2nd hyperPTH **Other supplement as indication** *Caution : vitaminA(all), vitaminC (ND → hyperoxalosis) *VitaminE 800 IU/d in HD with CVD
RRT= risk of all water-soluble vitamin (esp **B1 B9 C**), **Cu, Se, Zn[1], Fe, carnitine[2]**	
Na	<2g/d
K	Keep normal K, 1.5-2 g/d in hyperK
P	Keep normal P in GFR <45, 800-1000 mg/d 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

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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)**
Obese cirrhosis (compensated)	>5-10% weight loss (-500-800 kcal/day), >1.5 g/IBW **Weight reduction → ↓portal hypertension**
BCAA Dose 0.25g/kg/d	- **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/d
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

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
- Bariatric surgery: Non-cirrhotic/compensated MASH

- 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

Other medications *No other proved antioxidant

-**VitaminE** 800IU in nonDM* : resolution of steatohepatitis

-**Pioglitazone** 30-45mg in DM/nonDM* : resolution of steatohepatitis

-**Resmetirom** (thyroid hormone receptor ß-selective agonist)* :1st and only medication for steatohepatitis and fibrosis (F2-3)

*Biopsy-proven MASH

ESPEN liver 2020
EASL-EASD-EASO MASLD 2024

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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
- *If malnourished → early EN
- Can't tolerate oral at 5-7 day → EN

ACUTE PANCREATITIS : SEVERE

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

Severe acute pancreatitis: always at risk of malnutrition

"Nutrition as ICU patient"

- Early EN (24-72h from admission) if intolerance to oral: ↓mortality
- Continuous drip NG 1st line (if intolerance → NJ)
- TC 25-30 kcal/kg/d, TP 1.2-1.5 g/kg/d, **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/d (not in multiple organ failure)

- **MIS Necrosectomy**: oral diet in 1st 24h (if intolerate → NJ →PN)
- ↑**IAP**:
  - 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
MIS; minimally invasive surgery
IAP; intraabdominal pressure
IMN; immunonutrient
PERT; pancreatic enzyme replacement therapy

ACUTE PANCREATITIS : SEVERE HYPERTRIGLYCERIDEMIA PANCREATITIS

- Initial NPO
- Restart nutrition support as severity of pancreatitis
- Oral/EN: VLFD(<15-20 g/d, <10-15%TC)
- 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

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 CP

-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

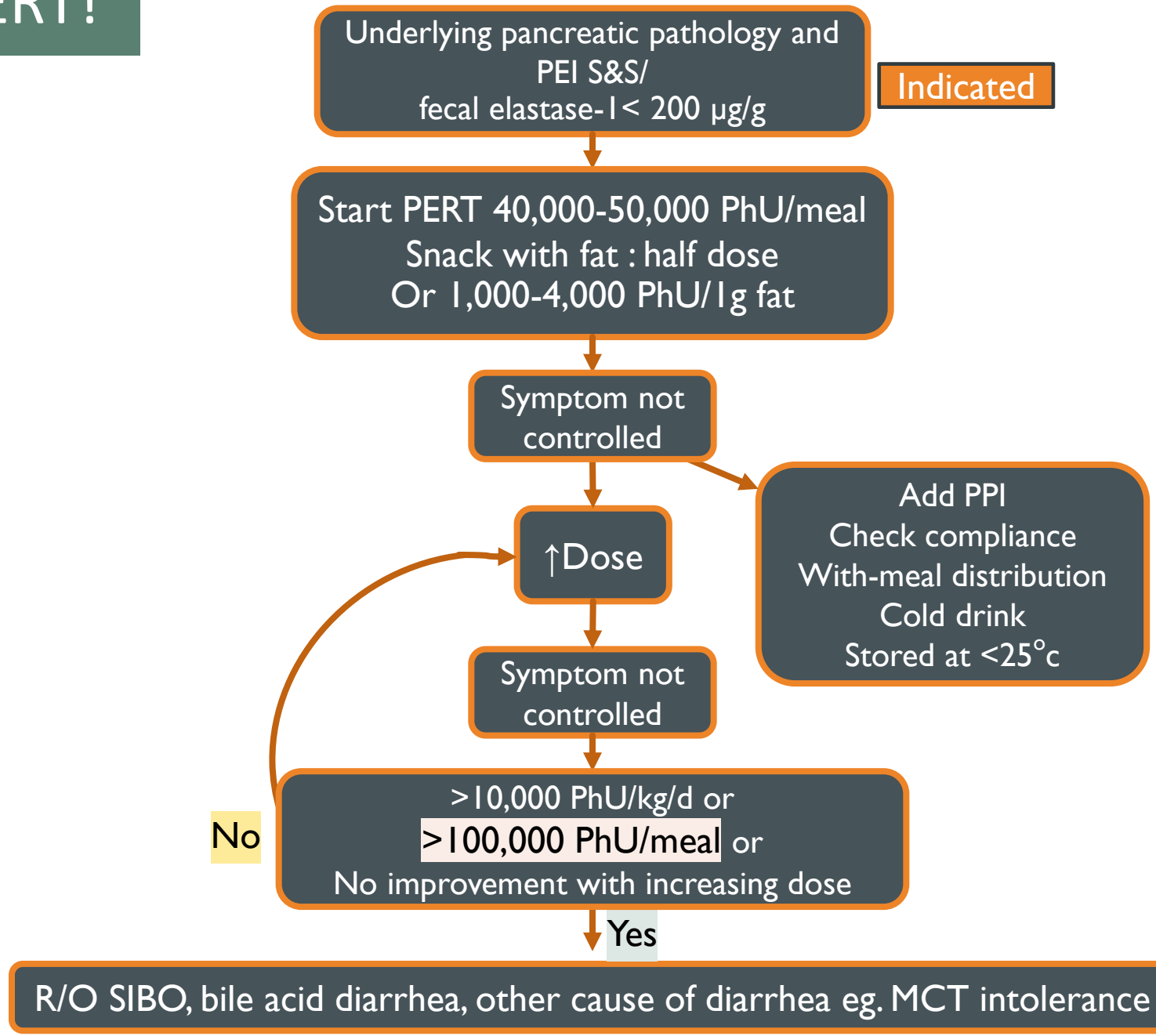
-Initiate if PEI presents (S&S and/or lab test of malabsorption)

-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 : NUTRITION 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/d) → 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, B9, 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

ESPEN pancreatitis 2024

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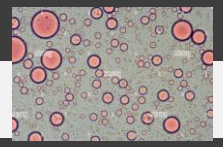
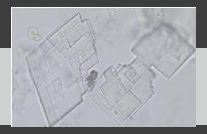
CHYLE LEAK

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 Dx		
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 predom

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: ↑**Calorie** 8.3 kcal/g, Caution: **no EFA**, GI SE
- Fluid/energy/protein/electrolyte/fat-soluble vitamin replace according loss
- Response: Significant↓ in 1week, cease in 2 week
- NPO in high Flow (>500-1000mL/d), trauma, highly symptomatic site, failure of VLFD

Symptomatic drainage

Drug: Octreotide *(off-label use)*

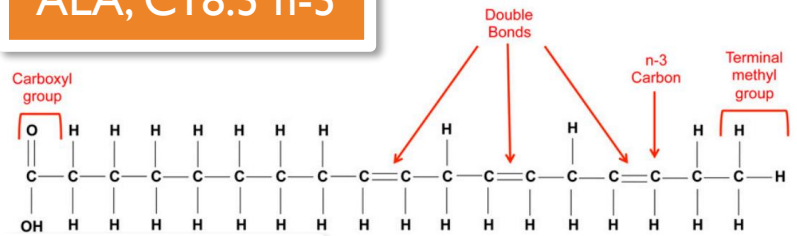
- Response: Significant↓ in 1week

Fail conservative: >1.5L/day, 0.5-1L/day x5day, persistent leakage >2week, rapidly decline in nutritional status

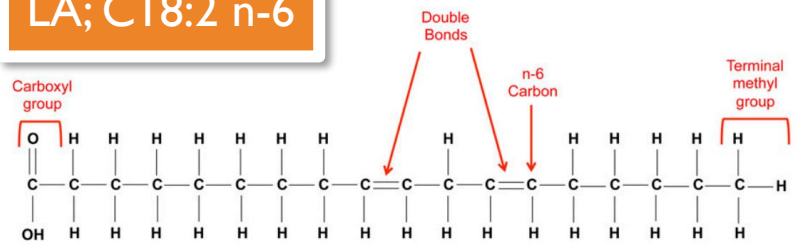
→*identify leak site (lymphangiography)* → *surgical/interventional (thoracic duct ligation/embolization)*

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
(=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 (1stgen) 250mL x2/week
- 20% lipofundin (2ndgen) 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**

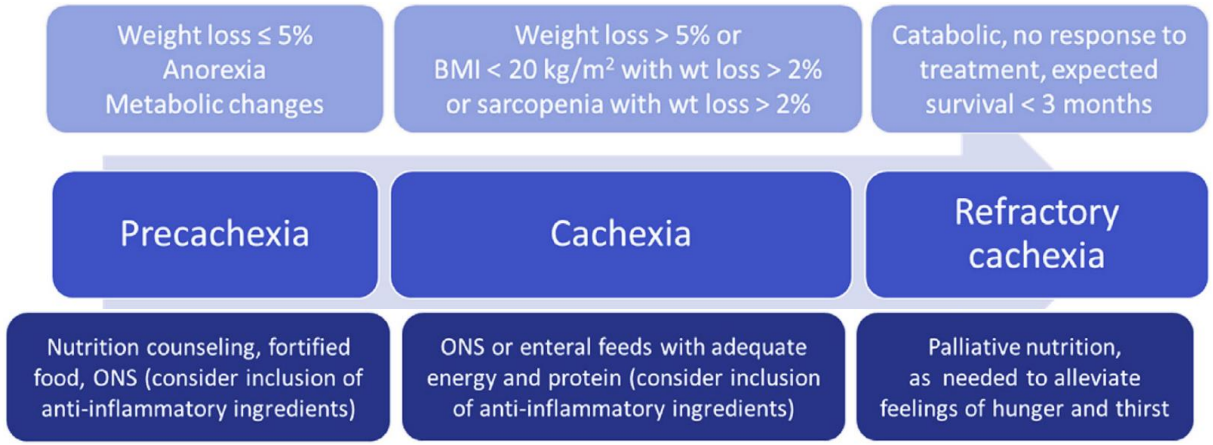
- Critically ill
- Kidney disease
- Liver disease
- Pancreatic disease
- Chyle leakage
- **Cancer**
- Elderly-sarcopenia
- Intestinal failure/ Short bowel syndrome

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



Pharmaconutrient 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

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ELDERLY-SARCOPENIA

Nutritional requirement in geriatrics

TC: 30 kcal/kg/day

Severe/advanced dementia→ do not start EN/PN (prefer comfort feeding)

TP: >1g/kg/day, 1.2-1.5 g/kg/day in acute or chronic illness,
Up to 2.0 g/kg/day in severe illness, injury or malnutrition
Fluid: > 1.6 L/day in older women, > 2.0 L/day in older men
Micronutrients: RDA for elderly
Fiber: 25g/day
ONS=benefit in OPD, IPD, post discharge setting:
*ONS 400kcal/day, protein 30g, continue>1mo
Exercise: ↑physical activity and exercise (aerobic+resistance) to maintain or improve muscle mass and function

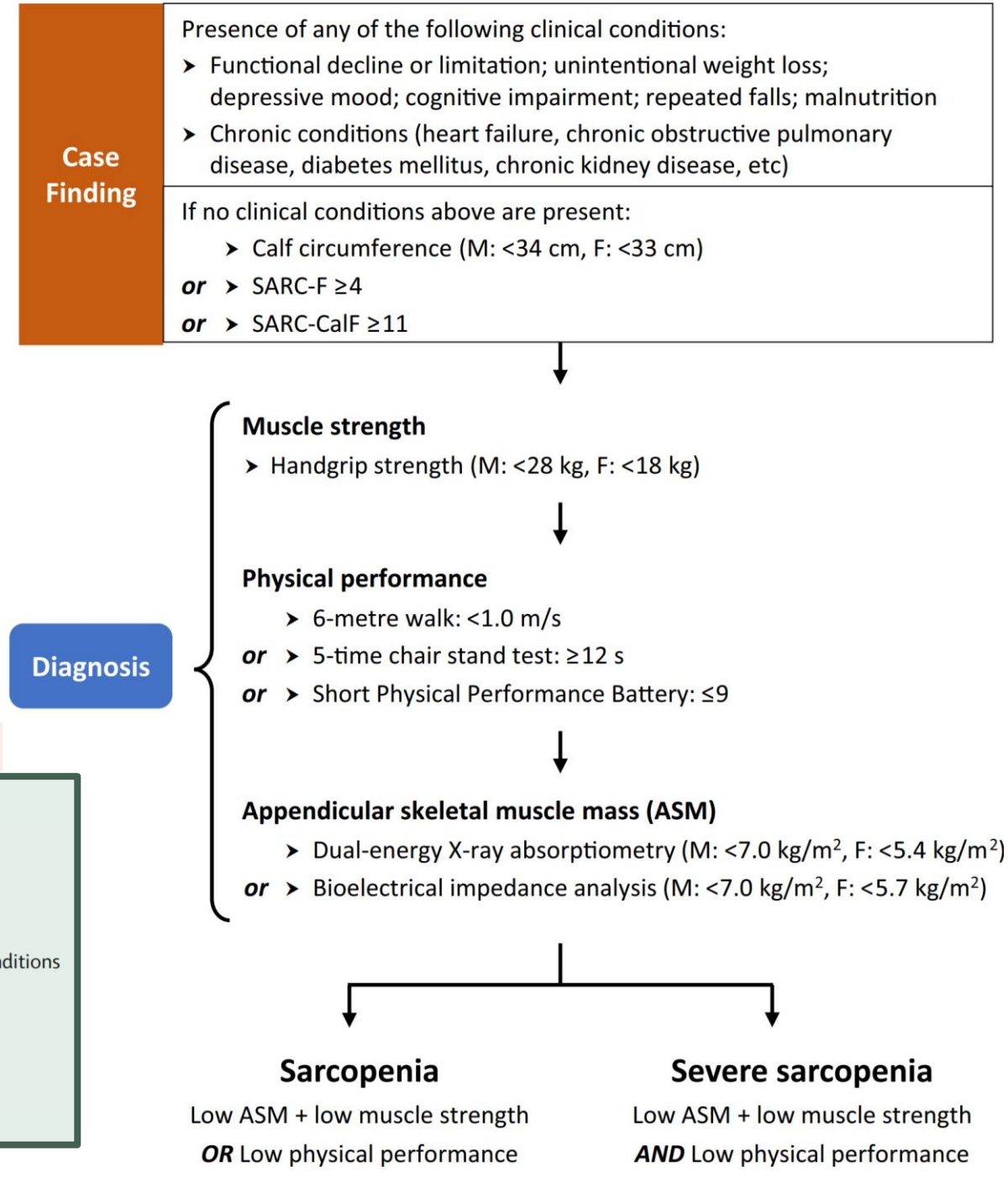
2° sarcopenia

Disease
- Bone and joint diseases
- Cardiorespiratory disorders including chronic heart failure and chronic obstructive pulmonary disease
- Metabolic disorders (particularly diabetes)
- Endocrine diseases (particularly androgen deprivation)
- Neurological disorders
- Cancer
- Liver and kidney disorders

Iatrogenic
- Hospital admission
- Drug-related

Nutritional
- Low protein intake
- Low energy intake
- Micronutrient deficiency
- Malabsorption and other gastrointestinal conditions
- Anorexia (ageing, oral problems)

Associated with inactivity
- Bed rest, immobility, deconditioning
- Low activity, sedentary lifestyle



AWGS 2019
ESPEN geriatrics 2022
Deutz NE, et al. Clinical Nutrition 33 (2014) 929-936

NUTRITION IN **SPECIAL CONDITIONS**

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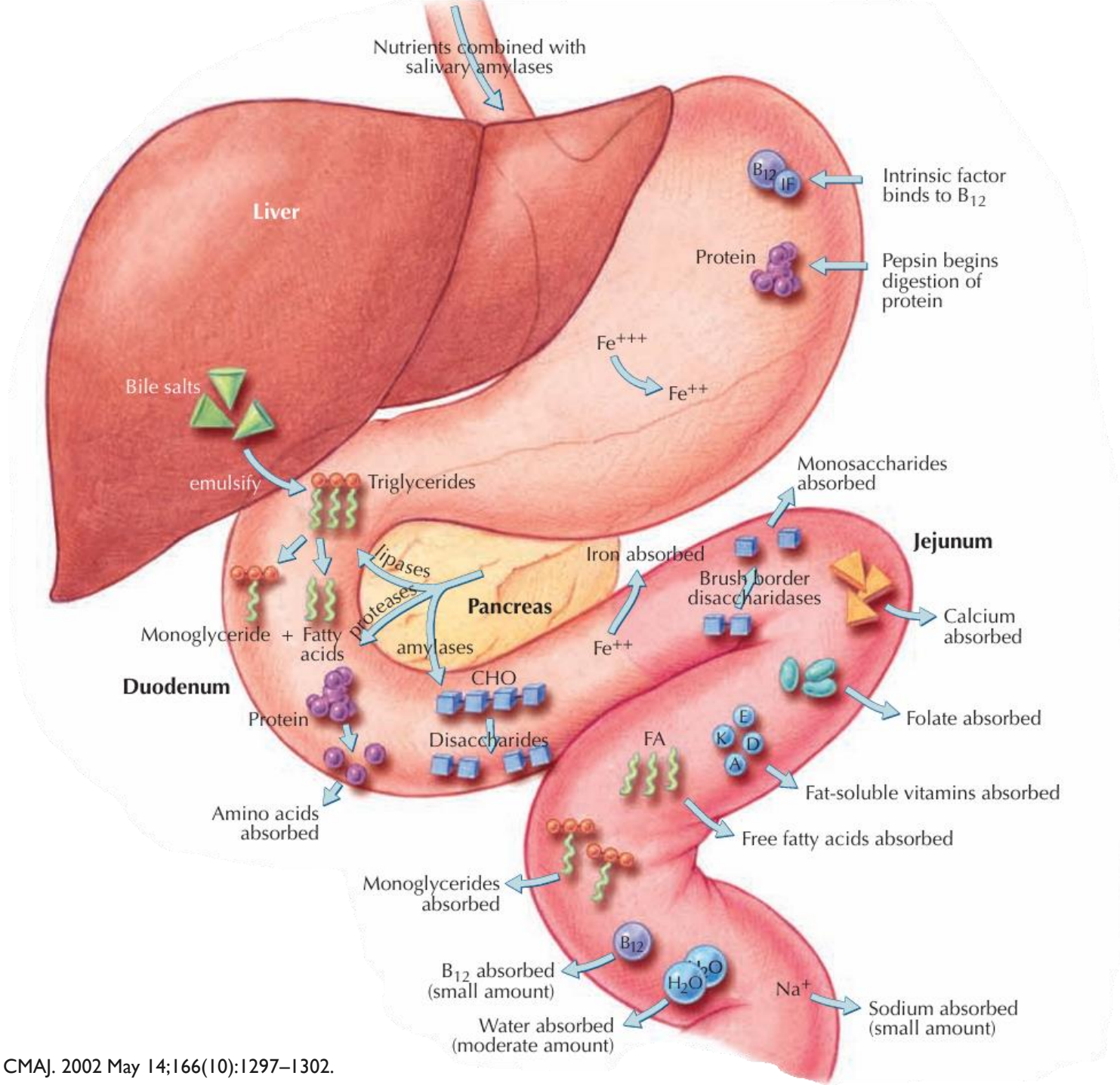
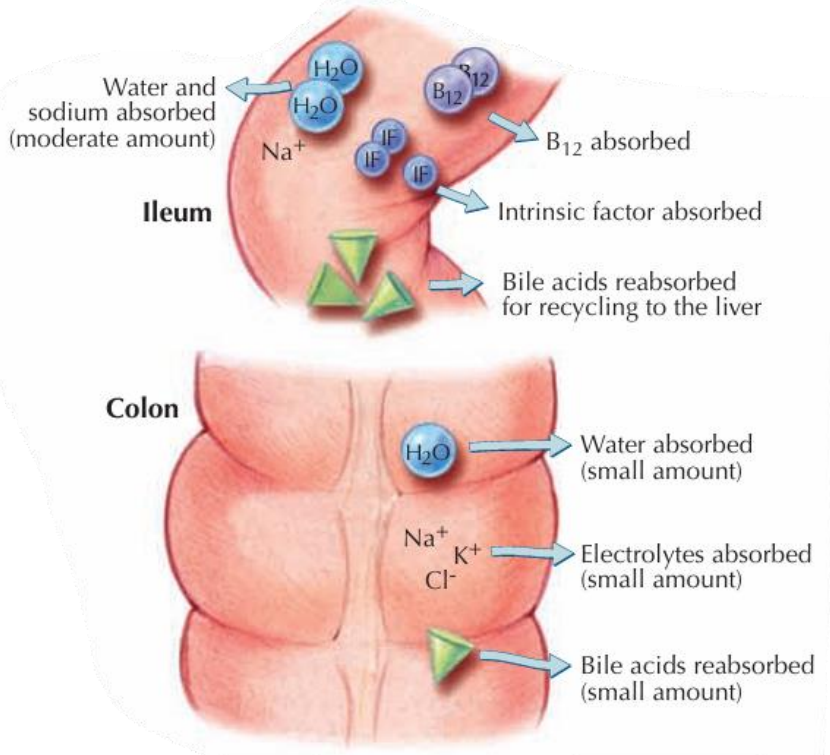


CMAJ. 2002 May 14;166(10):1297–1302.

Physiologic of nutrient absorption along GI tract



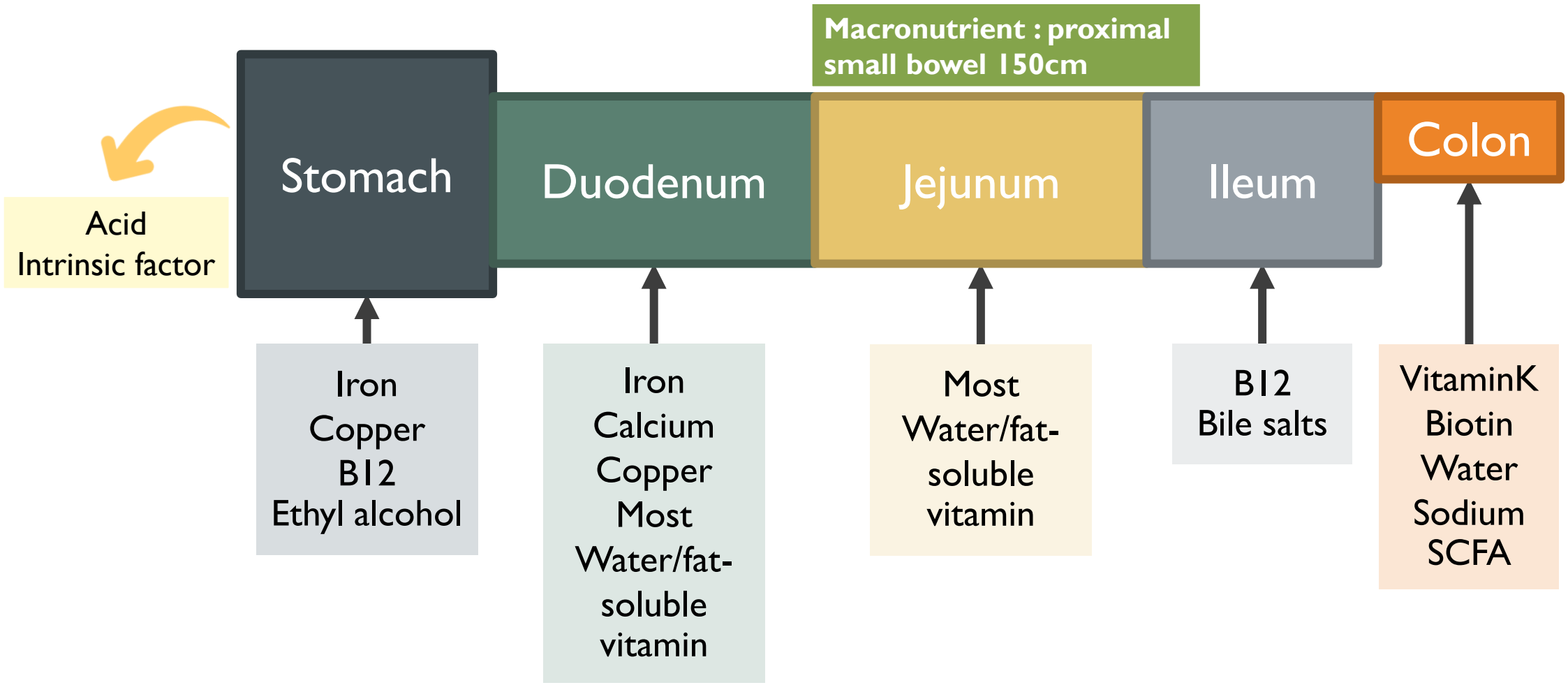
SHORT BOWEL SYNDROME

Complication of SBS/ intestinal failure

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

CVC; central venous catheter

MICRONUTRIENT ABSORPTION



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

GI DISEASE/PROCEDURES : MICRONUTRIENT AT RISK

Gastrectomy :

- Acid-required micronutrient absorption : Iron, Calcium
- Vitamin B12
- Copper

Bypass surgery and pancreatic surgery :

Pancreaticocibal asynchrony/ inactivation of pancreatic enzyme : Fat soluble vitamin

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* *with intact colon
- **>100 cm** resected : *Bile acid deficiency* with steatorrhea with risk of fat-soluble vitamin deficiency
- Absence of ileocecal valve/ anastomosis : SIBO (vitamin B12, 1, 6)

Short bowel syndrome : Multiple micronutrient deficiencies

VITAMIN B12 DEFICIENCY

Vegetarian diet

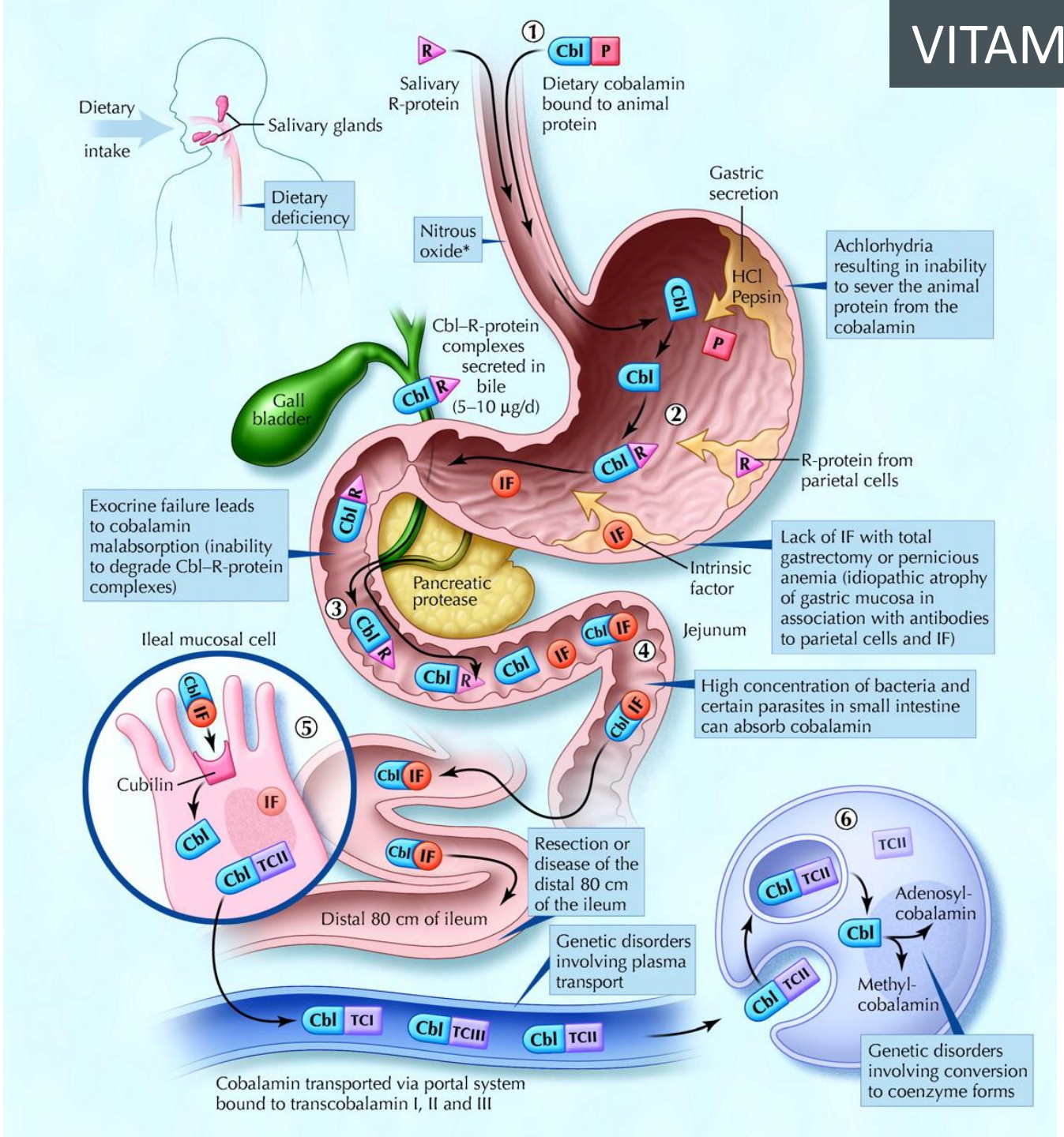
PEI
Pancreatectomy

SIBO
Intestinal parasite

Ileal resection
Ileal disease

B12 transport

B12 metabolism
- Genetic disease
- Nitrous oxide



Achlorhydria

Gastrectomy

Pernicious anemia

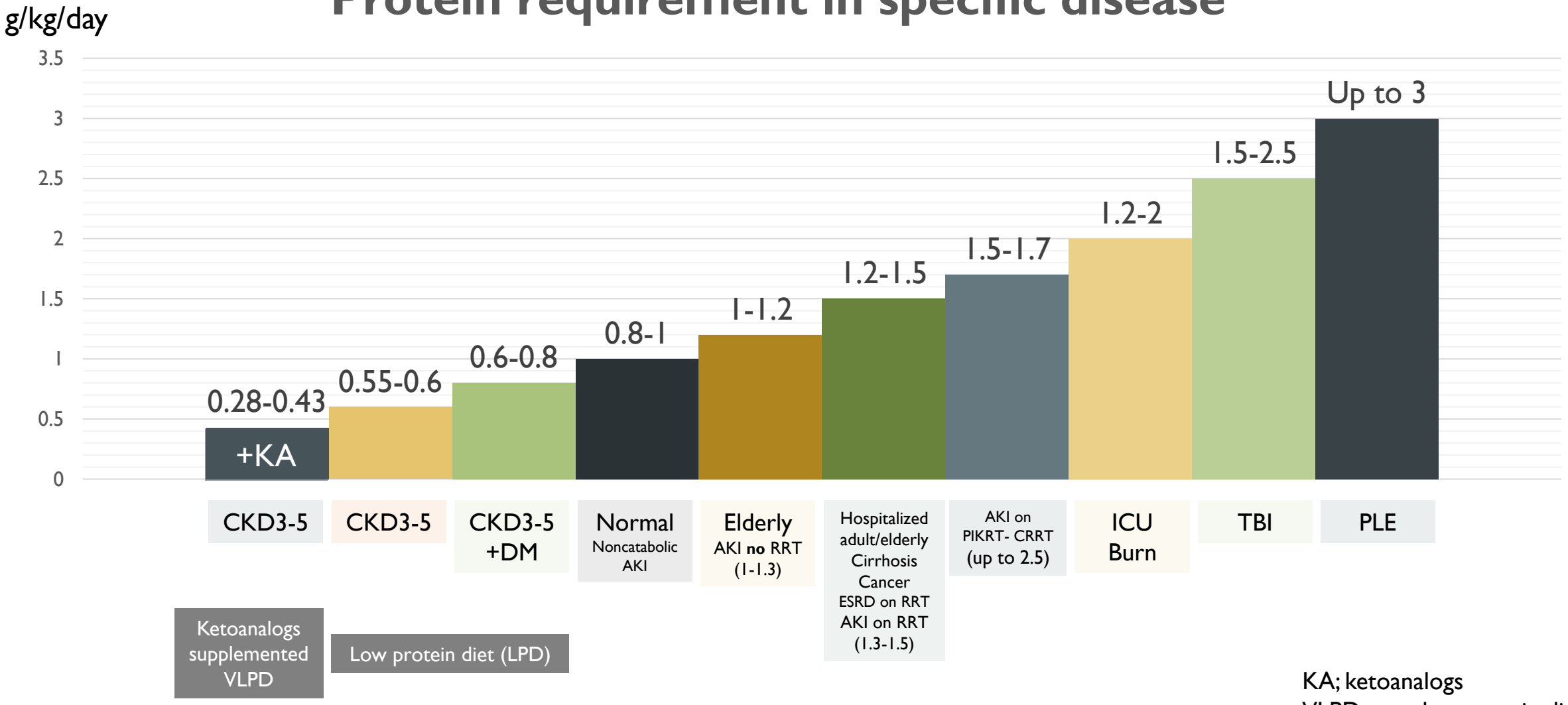
Associated autoimmune features
- Vitiligo
- Autoimmune thyroiditis
- Type 1 DM
- Autoimmune polyglandular syndromes

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

SHORT BOWEL SYNDROME : *NON-MALNUTRITION* COMPLICATION

Disease: clinical	Patient condition/risk	Treatment /prevention
Bile acid diarrhea: **voluminous** diarrhea	-**Intact colon+**ileal resect **60-100cm**/ileal disease	-**Bile acid sequestrant**
Bile acid deficiency: **steatorrhea**, fat soluble vitamin 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: **AOC, ataxia, slurred speech, WAMA, 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 B1def)** -Supportive **hydration, acid-base (bicarb, HD)** -Long term:↓**CHO/simple sugar, ↓oxalate**, ↓fermented food, ±cyclic ATB
SIBO: **bloat**,abd pain,N/V, diarrhea (watery/ malabsorption), ↓B1,**B12**,B3,B6 (bacterial use), fat soluble vitamin (bile acid def)	-Altered anatomy (anastomosis ,blinded loop, no IC valve) -Altered motility -↑pH: PPI use -Malabsortion	-ATB -↓Fermentable product
Oxalate stone: Enteric hyperoxalaturia	-**Intact colon +fat malabsorption**	-**Low oxalate diet, low fat, ↑oral calcium**
KUB stone (in general)	-Diarrhea→dehydration, chronic met acidosis→ ↑Uca ↓Ucitrate -hypoK, hypoMg	-Correct diarrhea, electrolyte
Osteoporosis/ bone demineralization	-Chronic acidosis→activate osteoclast, ↑UCa -↓vitD renal activation -↓vitD/Ca absorption	-Correct diarrhea -Ca/vitD supplement

Protein requirement in specific disease



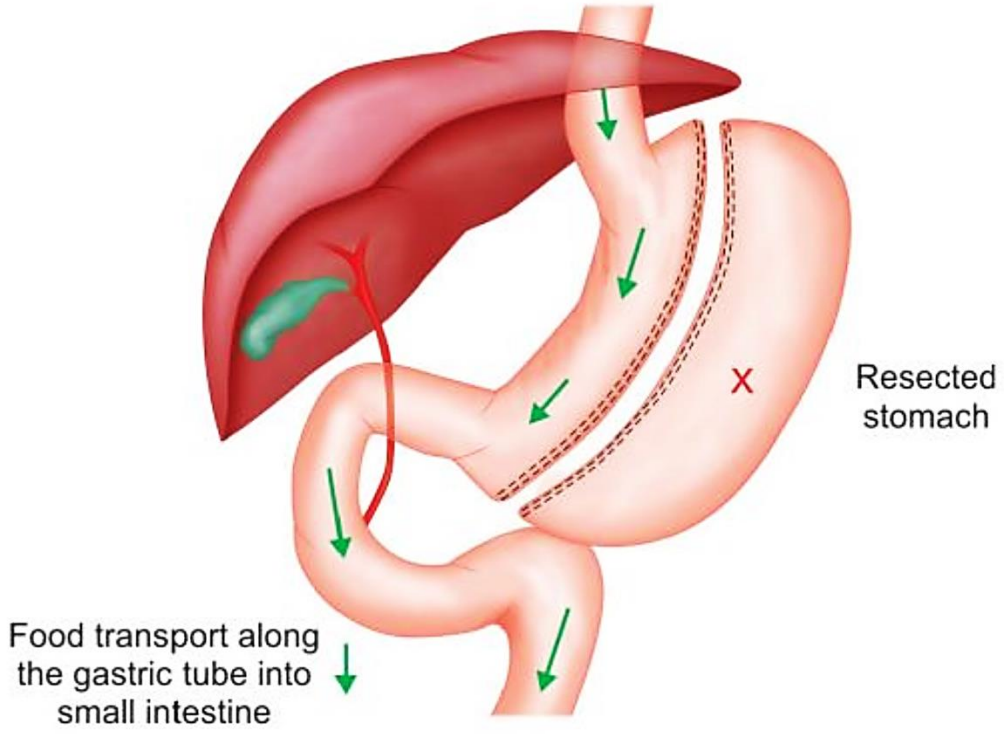
KA; ketoanalogs
VLPD; very-low protein diet
TBI; traumatic brain injury
PLE; protein losing enteropathy

OBESITY AND BARIATRIC SURGERY

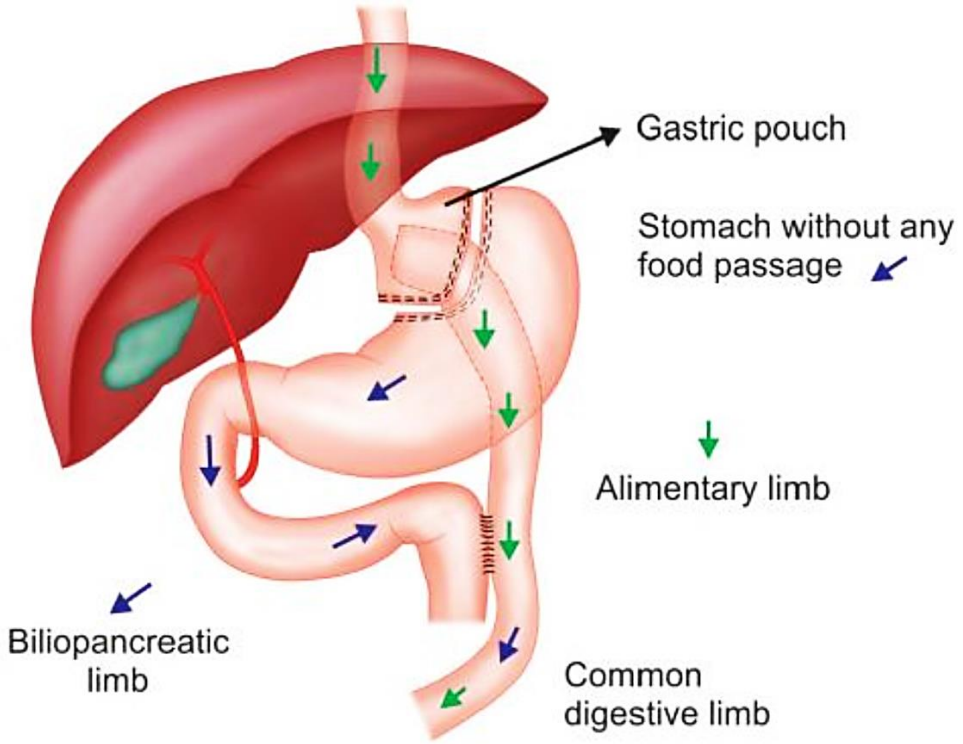
BARIATRIC SURGERY

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

Sleeve gastrectomy



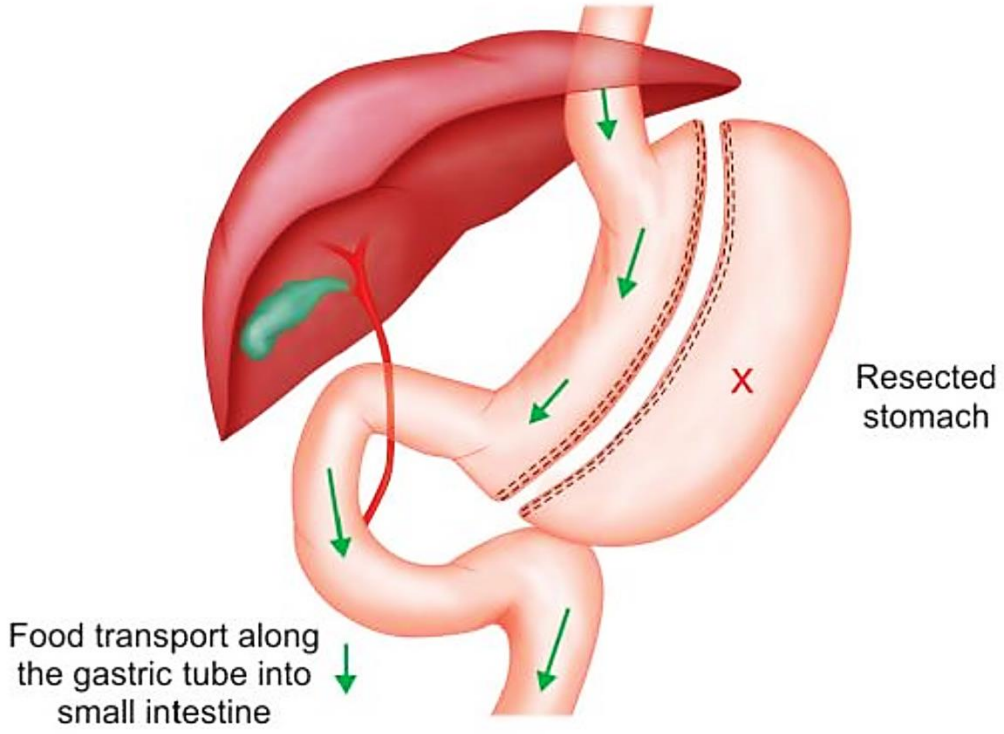
Roux-en-Y gastric bypass



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

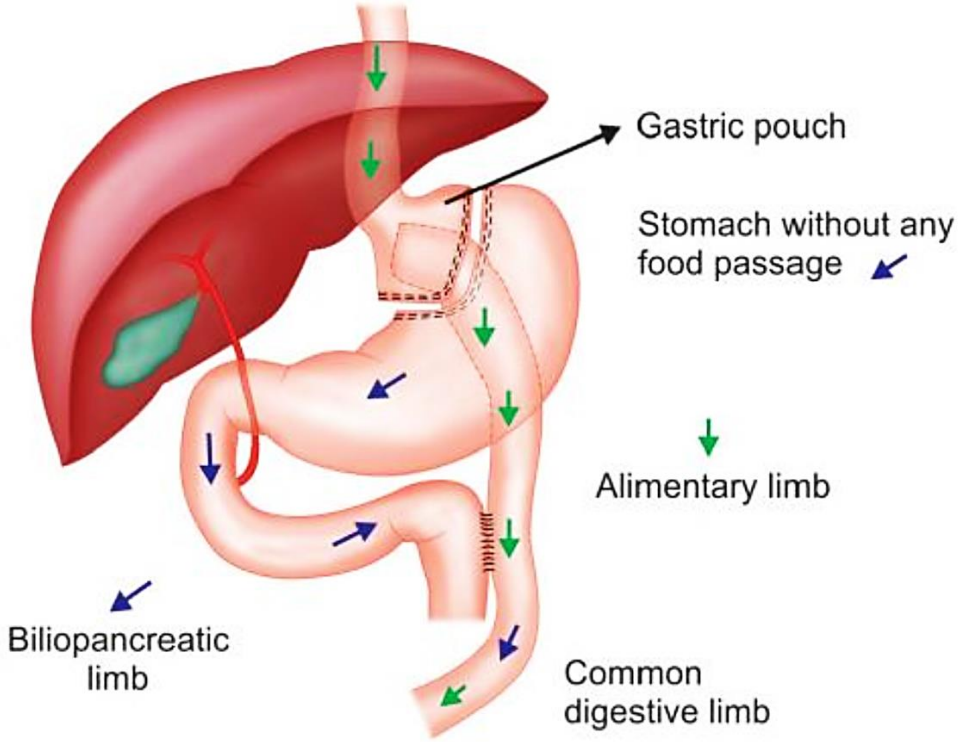
BARIATRIC SURGERY : MICRONUTRIENT DEFICIENCY

Sleeve gastrectomy



Risk : B1, B12, iron deficiency

Roux-en-Y gastric bypass



Risk : B1, B12, iron deficiency, folate
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**
- **Gallstone-related disease**: Treat as normal gallstone disease (rapid weight loss)
- **KUB stone**: Uric acid stone, enteric hyperoxalaturia in fat malabsorption
- **Bone loss and osteoporosis**:
  - Preop: optimize
  - Postop: VitaminD 3000IU/d (keep 25(OH)D>30 ng/mL) +elemental Ca 1200-2400 mg/d, protein 60-75g, exercise, DXA 1-2yr postop
  - **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	Typically 1-3 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 - Agression **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 in 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

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 (≥3/5)

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

DRUG-INDUCED OBESITY

Antidepressant	Weight gain	Weight neutral	Weight loss
TCA	Amitriptyline +++ Nortriptyline ++	Imipramine	
SSRI	Paroxetine +++	Citalopram Escitalopram	Fluoxetine Sertraline
SNRI	Mirtazapine +++ Venlafaxine + Duloxetine +		
Dopamine and norE reuptake inhibitor			Buproprion***
Antipsychotic *Atypical antipsychotic: ↑weight, TG, LDL, sugar	Olanzapine +++ Clozapine Quetiapine Risperidone Perphenazine Ziprasidone +	aripiprazole	
Mood stabilizer	Lithium		
Anti-convulsant	Gabapentin Pregabalin Valproic acid Vigabatrin Carbamazepine		Felbamate Topiramate Zonisamide

1-3 month use: weight loss
>4 month use: weight maintenance

Endocrine society 2015

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	Depression
ASCVD	Pulmonary hypertension	Bipolar disorder
MASLD	OA, back pain	Psychosis
Gout	GERD	Anxiety disorder
PCOS, infertility	Stress incontinence	Eating disorder
Gall stone		

↑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, >15% T2D remission
CVD : >10% ↓CVD and AF, >15% ↓CVD mortality
OSA :>10kg
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
20-35+%	Bariatric surgery

STEP APPROACH TO OBESITY TREATMENT

BMI category	25-26.9	27-29.9	30-34.9	35-39.9	≥ 40
Lifestyle intervention 	Asian BMI≥23 ✓	✓	✓	✓	✓
Pharmacotherapy 		+ comorbid	✓	✓	✓
Metabolic/ bariatric surgery 		Asian +comorbid BMI≥27.5 (may be considered)	+ comorbid (may be considered) / Asian +comorbid BMI≥32.5	+ comorbid	✓ / Asian BMI≥37.5

Intensive lifestyle intervention

Goal: Weight reduction 5-10% in 6-12 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

ADA2025

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

ADA2025