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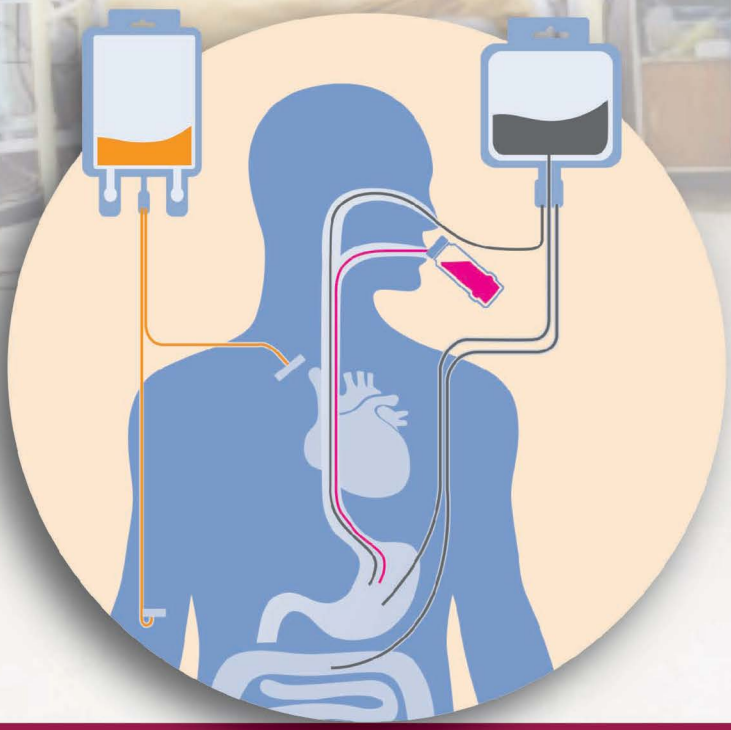

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JAYPEE

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Pathophysiology of Malnutrition, Starvation, Metabolic Derangements in Diseased
(Simple Starvation, Stress Starvation Malnutrition and the Response to Injury)

CHAPTER 2

Mirey Karavetian

Malnutrition has different definitions applicable across a spectrum of several nutrition-related disorders. According to the European Society for Enteral and Parenteral Nutrition (ESPEN), malnutrition may refer to both over nutrition, undernutrition or imbalance due to disproportionate intakes, which in turn causes measurable adverse effects on health. The term malnutrition in this text is used to refer to undernutrition particularly disease-related malnutrition.[1]

Malnutrition in the hospital setting has been the attention of research worldwide. The adverse effects of malnutrition have high impact on the patient's health outcomes and the cost of health care. Malnourished patients tend to have increased risks of medical complications, infections, impaired wound healing, intensive care unit (ICU) admissions, lower immunity, decreased muscle mass resistance to therapy, higher needs of medication and aggressive therapy, longer hospital stay, and mortality.[2]

Main causes of malnutrition detailed in table 1 include physiological and/or psychological reasons in addition to socioeconomic barriers to food intake. Physiological ones are related to disease related obstructions, disturbed malabsorption, altered nutrient uptake, increased needs, decreased gastrointestinal kinetics. Psychological causes are related to disturbed consciousness to control food intake or disturbed understanding of uses of food to health and thus refusal of food. Finally, socioeconomic reasons are there to prevent people from having access to safe (hygienic or nontoxic) and nutritious foods.[3]

RELATIONSHIP BETWEEN MALNUTRITION AND INFLAMMATION (TABLE 1)

When a patient has a disease whether acute or chronic, it is taken for granted that inflammation follows. The severity of the disease will determine the level of inflammation. The stronger the inflammation the more dominant are its side effects on the body. These include: release of cytokines which work as appetite inhibitors; release of cortisol which creates insulin resistance leading to hyperinsulinemia and preventing glucose uptake by tissues. Once glucose uptake is inhibited, this leads to gluconeogenesis from amino acids, ketones, and lactate. Muscle is, broken down to produce glucose, fat is broken down to produce glycerol for gluconeogenesis and ketones to fuel the body; and glucose either from gluconeogenesis or previously consumed meal is broken down to pyruvate by glycolysis. Due to insulin resistance, the pyruvate uptake

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Table 1: Causes of malnutrition.

Reasons of malnutrition	*Subcategories*	*Examples*
Physiological	Obstructive	Cystic fibrosis, gastrointestinal (GI) obstruction
	Disturbed absorption of nutrients	Malabsorptive diseases or surgeries effecting pancreas/liver/small intestine/stomach casing diarrhea, vomiting
	Disturbed uptake of nutrients	In case of inflammation insulin resistance blocks glucose entry to tissue, in case of liver cirrhosis protein is not metabolized
	Increased energy/nutrient needs	Cancer, chronic obstructive pulmonary disease, burns strong inflammatory conditions, where high catabolism is coupled with high appetite suppressing hormones
	Decreased kinetics in GI	Dysphagia, delayed gastric emptying
Psychological	Refusal of food	Anorexia nervosa or bulimia
	Disturbed level of consciousness	Comatose or somnolent patients with Alzheimer disease and other patients that do not allow the patient to voluntarily control food intake
Socioeconomic	Food insecurity	Lack of available food due to poverty or no access
	Low food safety	Lack of access to clean and safe food due to poverty or no access

to further metabolism is halted and the latter is changed to lactic acid; which in turn is recycled to glucose by gluconeogenesis. In chronic inflammation, the hyperglycemia, coupled with hyperinsulinemia and continuous tissue breakdown (protein and fat) will lead to protein energy wasting and malnutrition. Flowchart 1 details physiological response of the body to inflammation leading to malnutrition. On the other hand, chronic malnutrition exacerbates inflammation, since protein pools are depleted and plasma proteins become deficient (immunoglobulins, transferrin, albumin, etc. Once the patient enters the inflammation and malnutrition cycle, it is very difficult to reverse the damages done to the body.[5]

EFFECT OF STARVATION ON METABOLIC AND NUTRITIONAL STATUS (TABLE 2)

As for starvation, ketosis is inhibited as long as there is 100 g of glucose intake daily; the latter is usually supplied through IV dextrose solution for almost all hospitalized patients. In some cases, this cannot be administered. At complete absence of food for 2–3 days, glycogen stores liver and muscle drop, the body starts thriving on ketone bodies and preserving the small reserves of glucose (using it sparingly). Ketone bodies are also used to prevent exaggerated levels of gluconeogenesis from protein and thus preserve muscle mass as much as possible. As lipolysis increases glycerol becomes the main source of gluconeogenesis and equally the free fatty acids transform to ketone bodies. In a normal fed state, ketone bodies account to a maximum of 2% of the energy sources for the body and traces of it are found in the blood; yet in

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Flowchart 1: Effect of inflammation on nutritional status.

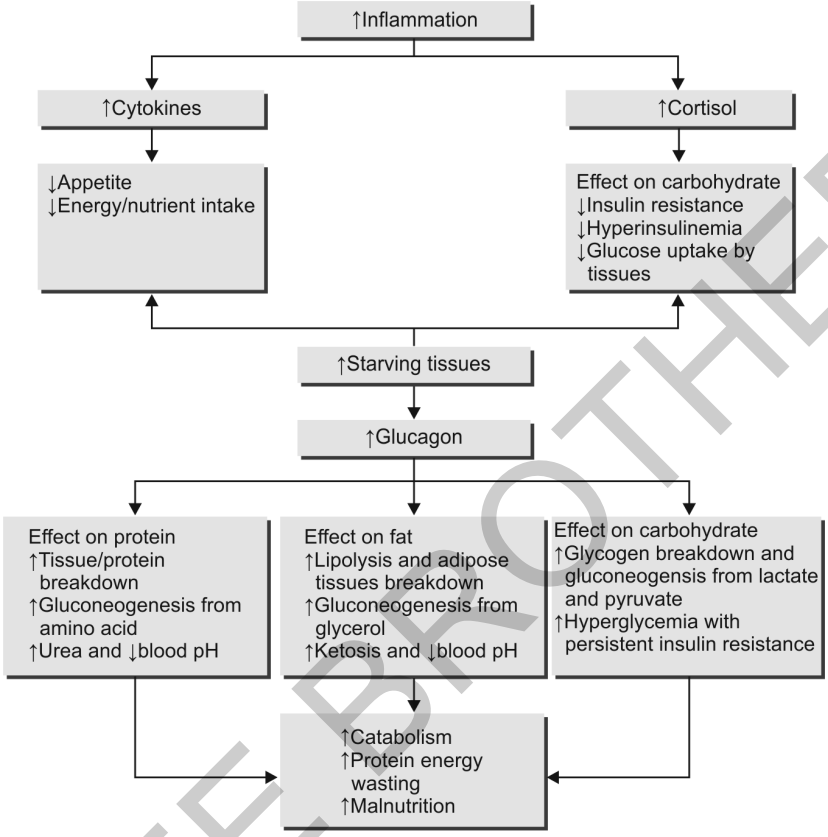

Table 2: Effect of starvation on hormones and nutritional status.[6]

Hormones	*Levels in blood*	*Effect on body*
Leptin	Low	It is released by adipocytes ↓ appetite suppression ↓ TSH secretion from pituitary
Thyroid	Low	Hypometabolic state ↓ resting energy expenditure (20–25 kcal/kg)
Cortisol	High	↑ insulin resistance to assure that glucose is used by brain and vital organs ↑ lipolysis → ketones become the main source of energy and glycerol the main source of gluconeogenesis thus preserving existing glycogen and amino acid pools
Insulin	Low	In nondiabetic starved patients, glucose is maintained at normal level thus insulin stays low. This allows glucagon to be released
Glucagon	High	↑ hepatic glycogenolysis and gluconeogenesis
Ghrelin	High	↑ appetite
RQ	Low	0.7

(TSH, thyroid stimulating hormone; RQ, respiratory quotient).

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a fasting state, the blood acetoacetate concentration rises to 1.0 mmol/L and β-hydroxybutyrate to 2–3 mmol/L, after a 2 or 3 day fast (the latter 2 are ketone bodies). If starvation continues to day 7, ketone bodies start contributing to 40–70% of the total energy of the body; and thus, the remaining energy would come from newly formed glucose. To prevent the further deterioration of the body from starvation, leptin levels are decreased which tries to increase the appetite, also triggers the decrease of thyroid hormone release from the pituitary and thus thermogenesis drops significantly; the body starts to thrive on much less daily energy (around 20–25 kcal/kg instead of 30–35 kcal/kg). Cortisol and glucagon in a starved state are elevated due to hypoglycemia and are the starting points of gluconeogenesis. Cortisol, in turn, as mentioned earlier causes insulin resistance; but this is done to channel glucose to vital organs rather than the skeletal muscles. Vital organs do not need insulin receptors (GLUT4) for glucose uptake, unlike the adipose tissue and the skeletal muscles. In nondiabetic patients during starvation, glucose stays in normal levels and thus insulin stays low allowing glucagon release and ketones to become the main source of energy for the body. The latter is evidenced with the drop of respiratory quotient (RQ) from 0.85 (indicating mixed diet) to 0.7 (indicating metabolism fully depending on fat). In prolonged starvation, the body reaches to a level where most of its energy comes from ketones and around 10–20% from amino-acid based gluconeogenesis. The length of survival of such patients depends on the amount of fat initially found in the body.[4]

Extended fast is characterized by a low glycemic levels, physiologic hypoinsulinemia, and moderate ketosis. The latter is not dangerous and is only a physiologic manifestation of appropriate metabolic regulation. It should not be mixed with diabetic ketoacidosis which can be potentially harmful. In some rare cases where the patient may experience metabolic stress and extreme dehydration, then the ketosis of starvation can become harmful and dangerous. Otherwise, the hormonal reaction to starvation is one of the many ways the body protects itself for survival in difficult times.

REFEEDING SYNDROME

Refeeding syndrome is seen in patients with depleted nutrient stores, without any food intake (NPO) for 7–10 days, or with chronic alcoholism coupled with significant involuntary weight loss among others. When feeding is introduced after a prolonged absence of nutrients, specifically carbohydrate, detrimental rearrangement of serum minerals, specifically potassium and phosphorus can occur. This can be explained by the fact that glucose uptake by tissues is an active transport and needs potassium and phosphorus. A depleted patient from nutrients is not expected to have sufficient stores of these minerals in the plasma ready for such action, thus the big change leaves the body in a dangerous hypokalemia, hypophosphatemia, and hypomagnesemia. This situation can lead to cardiac arrhythmias, heart failure, and acute respiratory failure. A good way to prevent such a negative outcome is by replenishing the patient with electrolyte solution before starting the feeding.

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CONCLUSION

This chapter has provided a brief review on the pathophysiology of starvation and its effect on nutrient uptake, hormones and energy balance. Moreover, a detailed description of the causes of malnutrition has been explained. Early detection of malnutrition and providing nutritional management accordingly can help prevent health complications and improve patient clinical outcomes.

REFERENCES

1. Chen CC, Schilling LS, Lyder CH. A concept analysis of malnutrition in the elderly. J Adv Nurs 2001; 36(1):131-42.
2. Somanchi M, Tao X, Mullin GM. The Facilitated Early Enteral and Dietary Management Effectiveness Trial in Hospitalized Patients with Malnutrition. JPEN J Parenter Enteral Nutr 2011; 35(2):209-16.
3. Lochs H, Allison S, Meier R, et al. Introductory to ESPEN Guidelines on Enteral Nutrition: Terminology, Definitions and General Topics. Clin Nutr. 2006; 25:180-6.
4. Keith N. Frayn Metabolic Regulation: A Human Perspective, 3rd edn. Wiley-Blackwell, 2010.
5. Douyon L, Schteingart DE. Effect of obesity and starvation on thyroid hormone, growth hormone, and cortisol secretion. Endocrinol Metab Clin North Am 2002; 31:173-89.
6. Ross AC, Caballero B, Cousins RJ, Tucker KT, Ziegler TR. Modern nutrition and health disease, 11th edn. Lippincott Williams & Wilkins, a Wolters Kluwer business; 2014.

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