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Optimization of Enteral Feeding for Acute Decompensated Congestive Cardiac Failure with Fluid Restriction: A Case Study

Muhammad Hakim Abdul Jalil[1], Mohd Ramadan Ab Hamid[1,3*], Norhafizah Hamdan[2], Siti Farhanah Mohd Rusli[1]

[1]Centre for Dietetics Studies, Faculty of Health Sciences, Universiti Teknologi MARA, 42300 Puncak Alam, Selangor, Malaysia
[2]Jabatan Dietetik dan Sajian, Hospital Ampang, 68000 Ampang, Selangor Darul Ehsan, Malaysia
[3]Integrated Nutrition Science and Therapy Research Group (INSPiRE), Faculty of Health Sciences, Universiti Teknologi MARA, 42300 Puncak Alam, Selangor, Malaysia

ABSTRACT

The aim of this case study is to explore dietitian's clinical decision-making in providing nutritional care. Ms. C, an 84-year-old Chinese woman with underlying atrial fibrillation, hypertension and diabetes mellitus was admitted into ward due to worsening progression of heart failure complicated with Upper Gastrointestinal Bleeding (UGIB), Community Acquired Pneumonia (CAP) and hypervolemic hyponatremia. Ms. C's Body Mass Index (BMI) was normal for elderly (27 kg/m^2) with estimated weight and height of 70 kg and 160 cm respectively. Patient was hyperglycemic, hypertensive, and breathing under ventilatory support. Prior to admission, she complained of lethargy, difficulty of breathing and stomach pain. Patient was on fluid restriction of 500 mL/day in view of body fluid retention. Patient was on enteral feeding 3 hourly 6 times per day tolerating 100 mL of diabetic formula providing energy of 456 kcal/day and protein of 20 g/day. Inadequate enteral infusion related to physiological changes (fluid retention) requiring restricted fluid intake as evidenced by estimated energy intake of 456 kcal/day and protein intake of 20 g/day less than energy requirement of 1,400 kcal/day and protein requirement of 84 g/day. The goal was to provide adequate energy and protein concomitantly adhering to the fluid restriction and achieving good glycemic control. Modular protein was added to the diabetic formula. Ms. C was able to tolerate 100 mL enteral feeding throughout hospital stay. Managing patient with multiple organ complications prove to be challenging. High-density formula is often used for fluid restriction patient however inappropriate for diabetic patient. Product unavailability in the hospital also limiting patient care. Clinical reasoning and clinical judgment were necessary to ensure prioritization of patient care.

Keywords: decompensated congestive cardiac failure, enteral feeding, fluid restriction

INTRODUCTION

A chronic and progressive clinical disease, heart or cardiac failure is brought on by anatomical or functional problems in the heart. Cardiac dysfunction results in elevated cardiac filling pressures during rest and stress (Arrigo *et al.* 2021). The subacute or acute dysfunction in decompensated cardiac failure overwhelms compensatory mechanisms, resulting in signs and symptoms of elevated filling pressures in the left or right ventricles (and frequently both), including dyspnea, presyncope, and lethargy. Left ventricular failure causes pulmonary vascular congestion, which raises right ventricular pressures and devastatingly affects multiorgan function (Njoroge & Teerlink 2021). Sequentially, multiorgan failure manifests, causing pulmonary oedema, gastrointestinal oedema, and cardiorenal syndrome.

The most prevalent symptoms and signs of Decompensated Congestive Cardiac Failure (DCCF) are directly linked to intravascular congestion, which a gradual fluid build-up can bring on through interdependent mechanisms such as sodium retention due to renal dysfunction, dietary indiscretion, or noncompliance with medical advice (Njoroge & Teerlink 2021). This condition of fluid congestion often requires fluid restriction as part of treatment approaches. The objective of this paper is to describe the Medical Nutrition Therapy (MNT) for the decompensated congestive cardiac failure with fluid restriction.

*Corresponding Author: email: ramadan7230@uitm.edu.my
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PATHOPHYSIOLOGY

Atrial Fibrillation (AF), Hypertension (HTN), and Diabetes Mellitus (DM) significantly contribute to DCCF through interconnected mechanisms. HTN elevates afterload, resulting in left ventricular hypertrophy and diastolic dysfunction. Chronic pressure overload further promotes myocardial fibrosis and leads to systolic failure. AF diminishes cardiac output by impairing the atrial kick and causing tachycardia-induced cardiomyopathy, thereby placing additional strain on an already compromised heart. Meanwhile, DM triggers diabetic cardiomyopathy through metabolic dysfunction, microvascular damage, and autonomic neuropathy, while also accelerating atherosclerosis and ischemic heart disease. Collectively, these conditions worsen volume overload, neurohormonal activation (e.g., RAAS), and myocardial remodelling, ultimately resulting in acute decompensation, which manifests as pulmonary edema, arrhythmias, and end-organ hypoperfusion. This situation demands aggressive management of blood pressure, rhythm control, and metabolic optimization to restore stability.

Hyponatremia, characterized by blood sodium concentration less than 135 mEq/L is the most prevalent electrolyte abnormalities in hospitalized patients. Hypervolemic hyponatremia in heart failure patients is multifactorial and mostly results from the continuous secretion of Arginine Vasopressin (AVP) due to inefficient renal perfusion stemming from reduced cardiac output, cardiorenal syndrome or diuretics medication (Rodriguez *et al.* 2019). The presence of acute kidney injury in heart failure patients indicates cardiorenal syndrome could have occurred.

Right leg cellulitis is a form of skin infection commonly associated with patients with diabetes. The capability of uncontrolled diabetic patients to fight an infection is reduced as compared to healthy person. Similar to most skin and soft tissue infections, they first present as Staphylococccal or Streptococcal infections; but, as the infection's depth and severity escalate, they rapidly evolve into polymicrobial infections involving gram-negative and anaerobic organisms (Raspovic & Wukich 2014).

Upper Gastrointestinal Bleeding (UGIB) is commonly caused by Peptic Ulcer Disease (PUD). Helicobacter pylori infection and Nonsteroidal Anti-Inflammatorydrugs (NSAID) use are the two most frequent causes of PUD. Mucosal inflammation brought on by Helicobacter pylori results in damage and degradation of epithelial cells. By inhibiting the Cyclooxygenase-1 (COX-1) pathway, which results in a reduction in prostaglandin synthesis, NSAIDs damage mucosal tissue (Antunes *et al.* 2023).

Community-Acquired Pneumonia (CAP) is caused by pathogens including bacteria, viruses and fungi. The pharynx is where pathogens first colonize, and then they enter the lower respiratory tract by micro-aspiration. The infection then triggers the host's pulmonary defense. Pneumonia will occur if the host's defenses are compromised or if the pathogen's virulence or high inoculum overcomes them. CAP caused by Carbapenem-resistant Enterobacteriaceae (CRE) makes the infection more difficult to treat with common antibiotics, potentially increasing the severity and duration of illness (Regunath & Oba 2024).

The Nutrition Care Process (NCP) is part of medical nutrition therapy procedures practised by dietitians. It includes nutrition assessment, diagnosis, intervention, monitoring, and evaluation. Nutrition assessment involves several domains: client history, anthropometry measurement, biochemical data, medical tests, and procedure domain, nutrition-focused physical findings, food/nutrition-related history, and comparative standards. An NCP was applied to this patient to optimise her enteral feeding. Elderly is among the population at increased risk of malnutrition. Malnutrition is thought to be a major contributing factor in the complex etiology of sarcopenia and frailty. It is linked to poor outcomes, such as higher rates of infections, length of hospital stay, duration of convalescence following acute illness, as well as mortality risk (Morley 2017). A proper management of enteral feeding through MNT providing adequate nutrients is beneficial for the recovery process.

PATIENT'S PROFILE

Ms. C is an 84-year-old Chinese elderly female living with her family, with a middle socioeconomic status. She is semi-dependent, and able to walk using a walking stick at home. She has underlying hypertension on antihypertensives, atrial fibrillation on anticoagulants, and diabetes mellitus on oral antidiabetic agent medication. Before admission, Ms C had complained of sharp, epigastric pain radiating to the back of her body. She was also reported to have melena stool, shortness of breath, and generalised lethargy. Blood and stool investigation, echocardiogram, and endoscopy showed that Ms C was having acute decompensated congestive cardiac failure, hyperosmolar hypervolemic hyponatremia, right leg cellulitis, upper gastrointestinal bleeding and multiple ulcers with Forrest III grade, acute kidney injury, uncontrolled diabetes mellitus not in diabetic ketoacidosis, and community-acquired pneumonia with Carbapenem-Resistant Enterobacteriaceae (CRE). The Forrest Classification is a method to describe gastrointestinal ulcer. Forrest III indicates that there is evidence of clean-based ulcer without active bleeding (Chan 2024; Gralnek *et al.* 2021).

NUTRITION ASSESSMENT

Table 1 summarises the nutrition assessment at the time of the dietitian's visit, two weeks after the patient's admission.

Anthropometry data. For the anthropometry assessment, Ms C's weight was estimated to be 70 kg using mid-upper arm circumference (MUAC), with a height of 160 cm. Her Body Mass Index (BMI) was 27.3 kg/m^2, which was normal for older female aged 65 and above (Winter *et al.* 2014). Elderly people with BMI below 25 and above 35 kg/m^2 are more likely to experience malnutrition, reduced muscle strength, mobilization problem, diminished functional capacity, and difficulty in walking and balancing (Kiskac *et al.* 2022). Her dosing weight was taken at 70 kg since it is in the recommended range.

Biochemical data, medical tests and procedures. For the blood workup, Ms C's blood glucose showed uncontrolled diabetes ranging from 7.6 to 13.5 mmol/L under treatment of insulin sliding scale. In addition, biochemical data implied that Ms. C was experiencing electrolyte imbalances from hypernatremia and hypokalemia, hypoalbuminemia, and anaemia. Before the dietitian's visit, she reported hyponatremia, with blood sodium ranging from 122 mmol/L to 133 mmol/L. An endoscopy called Esophagogastroduodenoscopy (OGDS) was ordered to investigate gastrointestinal bleeding and melena stool. Multiple ulcers were found at the antrum and prepyloric area of the stomach, indicating Forrest III-grade gastric ulcers. A rectal swab of melena stool was sent for culture and sensitivity test, finding that Ms C was a carrier of Carbapenem-resistant Enterobacter Ales (CRE).

Nutrition-focused physical findings. A Nutrition-Focused Physical Examination (NFPE) was carried out. Her appearance looks lethargic with depressed interosseous muscle and dark circles on the orbital fat, indicating moderately malnourished. The NFPE is physical examination from head-to-toe to evaluate muscle mass, fat stores, fluid retention and functional capacity (Mordarski 2016; Tyler 2020). Malnutrition status could be identified through NFPE because body composition is closely related to underfeeding and inflammation (Hummell & Cummings 2022). Ms C was hypertensive, breathing with an oxygen support machine, and afebrile. There was no bowel passing or melena stool reported. Ms C was under strict fluid restriction of 500 mL per day.

Food nutrition-related history. There was minimal oral food intake before ward admission, and during the time hospital stay, thus, enteral feeding was initiated. At the time of the dietitian's visit, she was on nasogastric tube feeding with 50 mL diabetic complete and balanced formula, bolus, three hourly six times per day, providing energy of 547 kcal/day and protein of 24 g/day.

NUTRITION DIAGNOSIS

A nutrition diagnosis was made in the form of a PES statement (problem, aetiology, and sign and symptom); inadequate enteral nutrition infusion related to physiological changes (hypervolemic hyponatremia) requiring low fluid intake as evidenced by energy intake of 547 kcal/day and protein intake of 24 g/day less than the requirement of 1,400 kcal/day and protein of 84 g/day and fluid restriction of 500 mL per day.

NUTRITION INTERVENTION

Energy and protein are very crucial for assisting in the recovery process (Volkert *et al.* 2022). Achieving total energy and protein requirements for this patient proved difficult due to fluid restriction of 500 mL daily. At the time of the dietitian's visit (Day-1), there was also a

Table 1. Summary of the nutrition assessment

Nutrition assessment	Criteria	Normal range	First visit (Day-1)	Interpretation
Anthropometry	BMI for elderly	23–30 kg/m^2	27.3 kg/m^2	Normal for elderly (Winter *et al.* 2014)
	Ideal body weight	Weight at BMI 27	70 kg	Used as a dosing weight
Biochemical data, medical tests, and procedure	Blood glucose	4.0–7.8mmol/L	7.6–13.5 mmol/L	Uncontrolled diabetes
	Urea	2.9–7.9 mmol/L	7.3 mmol/L	Normal
	Creatinine	48–98 µmol/L	96 µmol/L	Normal
	Sodium	135–145 mmol/L	149 mmol/L	Hypernatremia
	Potassium	3.5–5.0 mmol/L	3.1 mmol/L	Hypokalemia
	Calcium	2.2–2.7 mmol/L	2.6 mmol/L	Normal
	Magnesium	0.65–1.05 mmol/L	0.84 mmol/L	Normal
	Alanine transferase	4–36 U/L	8 U/L	Normal
	Total Protein	60–83 g/L	66 g/L	Normal
	Albumin	35–50 g/L	31.6 g/L	Hypoalbuminemia
	Haemoglobin	12–16 g/dL	9.6 g/dL	Anaemic due to UGIB
	Endoscopy			Multiple ulcers at the antrum and prepyloric area indicating grade Forrest III gastric ulcers
	Rectal swab culture & sensitivity			Carrier of Carbapenem-resistant enterobacterales
Nutrition-focused physical findings	Physical appearance		Lethargic	
	Interosseous muscle		Depressed skin	Moderately malnourished
	Orbital fat		Dark circles	Moderately malnourished
	Blood pressure		150/76	Hypertensive
	GCS		E3V1M5	Moderate brain injury
	SpO2		97% under BiPAP	Breathing with oxygen support
	Fluid balance		640/2,200=-1,560 mL	Negative balance under fluid restriction of 500 mL
	Stool		No stool passing	
	Temperature		36.9°C	Afebrile
	On enteral feeding with 50 mL diabetic complete and balanced formula six times per day			
	Energy		547 kcal per day	42% of the energy requirement
	Protein		24 g per day	29% of the protein requirement
	Energy requirement		20 kcal/kg body weight/day	1,400 kcal per day
	Protein requirement		1.2 g/kg body weight/day	84 g per day

BMI: Body Mass Index; UGIB: Upper Gastrointestinal Bleeding; GCS: Glasgow Coma Scale; SpO2: Oxygen Saturation; BiPAP: Bilevel Positive Airway Pressure; E3V1M5: Indicates a patient's level of consciousness based on three categories: Eye-opening (E), Verbal response (V), and Motor response (M) where E3V1M5 means the patient E3: Opens their eyes in response to verbal stimuli (but not spontaneously or to pain); V1: Makes no verbal response; M5: Withdraws to pain.

limited choice of enteral products in the hospital. The usual dietitian's practice for fluid restriction patients was using high energy density ready-to-drink formula, which was usually highly concentrated with energy and protein but with less fluid content. Thus, with these limitations, the diet therapy was to step up enteral feeding to 100 mL six times per day with the same diabetic formula mixed with a protein modular formula consisting of whey protein concentrate, providing around 726 kcal energy per day and 55 g protein per day. The feeding regime had a concentrated dilution of 1.4 kcal/mL, which was not the usual dilution for the diabetic formula. The total feeding frequency was set at six times per day.

NUTRITION MONITORING & EVALUATION

A follow-up was made on the next day (Day-2 of dietitian's visit) to monitor and evaluate Ms C's tolerance towards the feeding regime. Ms. C tolerated the feeding plan, as there was no vomiting, diarrhoea, or high gastric residual volume. However, the patient was issued death-in-line due to a poor prognosis from multiorgan failure. She was also planned for feeding omission. The dietitian's plan was for nurses to follow the previous feeding regime when the patient had been allowed feeding. As it was the weekend, a second follow-up was made the following week (Day-6), showing that the patient had been tolerating the feeding plan by the dietitian achieving around 56% of the energy requirement and 0.8 g protein per kg body weight. The nutrition diagnosis persists, which was inadequate enteral nutrition infusion related to physiological changes (hypervolemic hyponatremia) requiring low fluid intake as evidenced by energy intake of 726 kcal/day (56% of requirement) and protein intake of 55 g/day (0.8 g/kg body weight) less than requirement of 1,400 kcal/day and protein of 84 g/day and fluid restriction of 500 mL per day. A further increase in energy and protein intake was required at this point. As no caregivers were around, dietitians could not discuss the possibility of caregivers procuring the high energy density ready-to-drink formula at the pharmacies, which could meet patients' needs. Thus, because of fluid restriction, the dilution of diabetic formula and modular protein could only be increased minimally to 1.6 kcal/mL, achieving around 966 kcal/day and 59 g of protein per day. Despite this, the feeding plan could not be carried out because the patient passed away on Day-7 which was after 30 days of hospitalization.

DISCUSSION

This case study explores dietitians' clinical decision-making in optimising enteral feeding in an elderly patient with decompensated congestive cardiac failure with multiorgan failure and fluid restriction. To survive the acute illness, the body undergoes an adaptive metabolic response to extreme physical stress, such as acute illness or hospitalisation. Patients experience several changes, including increased energy expenditure, hyperglycemia, loss of muscle mass and function, and eventually, behavioral, and psychiatric issues (Deer & Volpi 2018). These changes will promote a state of catabolism which will further hinder the recovery process of patients. To replace the amino acids lost during fasting and catabolic stress such as hospitalisation or serious sickness, consuming the amount of protein required to promote muscle protein synthesis in older persons adequately is crucial (Deer & Volpi 2018). Recommendation guidelines for protein requirement of elderly hospitalised patients should be determined by the individual clinical situation (Zhu *et al.* 2020). Usual protein intake should be around 1.0 to 1.5 g/kg body weight, while for energy, a simple weight-based equation of 20–30 kcal/kg/d can be used for most elderly patients (Zhu *et al.* 2020). The patient was planned for 20 kcal/kg body weight and 1.2 g of protein/kg body weight; however, it proved to be challenging to achieve due to various limitations.

Patients with decompensated congestive cardiac failure and hypervolemic hyponatremia usually will have fluid restriction as part of medical treatment. This limitation of 500 mL/day restriction would affect nutrient intake because most enteral feeding would require around 1,500 to 2,000 mL fluid per day to achieve energy and protein requirements. Enteral product availability in the hospital is one of the main factors contributing to the decision-making of a dietitian. Patients with fluid restriction require high-density energy and concentrated ready-to-drink formula. Due to the formula was not available at the time, approaches could be taken by modifying the powdered formula into a concentrated formula by adjusting the standard dilution. The patient had diabetes with blood sugar ranging from 7.3 to 13 mmol/L; thus, the appropriate formula should be used. A diabetic powdered formula mixed with modular protein was utilised. The dilution of 1.4 kcal/ml was not the usual and may cause intolerance for the patient. The patient relied on the help of an oxygen machine and Bilevel-Positive Airway Pressure (BiPAP) to breathe, which may disrupt the patient's tolerance to feeding. The priority was to ensure the patient could tolerate the feeding plan. The feeding regime will be increased gradually as patient's tolerance. Other factors considered in decision-making include the biochemical data and current medical condition. The patient was having multiorgan failure with known affecting systems, including renal, endocrine, circulatory, and respiratory. At the time of the dietitian's visit (Day-1), blood creatinine and urea had improved, but serum albumin and haemoglobin were below the expected value. Serum albumin concentrations and mortality in elderly are clearly correlated. Low serum albumin levels were primarily caused by inflammatory conditions (Cabrerizo *et al.* 2015). Ms C was having multiple organ failure leading to inflammatory states in her body. Elderly individuals with low albumin levels have been shown to have a significant decrease of muscle mass (Keller 2019). Through nutrition-focused physical examination of the muscle and fat status, there were signs of moderately malnourished, which could result from chronic nutrition inadequacy often found in sick, elderly patients. Hence, adequate energy and protein provision was the main priority in managing the case to reduce further consequences of malnutrition.

To reflect on the case, suggestions for improvement include better communication between healthcare professionals. A nutrition support team of physicians, dietitians, nurses, and pharmacists would help determine the best patient care (Barrocas *et al.* 2022). An informed, understanding, and collective decision through discussion among healthcare professionals would minimise any misinformation or lack of care. Given the considerable control medical practitioners have within decision-making hierarchies in hospital settings, the power relationships between dietitians and medical practitioners are particularly significant (Vo *et al.* 2020). As the patient could not meet energy and protein requirements from enteral feeding alone, discussing Parenteral Nutrition (PN) with healthcare professionals would aid in patient care. Frequent interruptions due to gastrointestinal difficulties can make enteral feeding challenging, which can compromise the delivery of adequate protein and calories (Blaser *et al.* 2020). Some of these circumstances are linked to a higher risk of malnutrition and might be a sign that full or supplemental PN should be started (Berger & Pichard 2022). Aside from this, communication between dietitians and caregivers is also essential to resolve the issue of product unavailability. To enhance patients' health outcomes, dietitians need to possess strong communication skills and humanistic trait building positive relationship with patients or caregiver (Sladdin *et al.* 2017). Patients with fluid restriction require special high-density energy and concentrated formula. High-density energy formula with strength of 2 kcal/mL provides only 70% of water make it appropriate for patients with fluid restriction (Zadak & Kent-Smith 2009). These products usually are obtainable at the local pharmacies.

CONCLUSION

Elderly hospitalised patients for acute illness were among those often prone to malnutrition. Enteral-feeding patients with fluid restriction also have a high risk of malnutrition because the patient has no oral food intake and relies solely on enteral tube feeding. Optimisation of enteral feeding patients with fluid restriction requires wise clinical decision-making by dietitians. An informed, understanding, and collective decision through discussion among healthcare professionals would benefit patients in the hope of reducing malnutrition risk and promoting recovery.

CONSENT

Verbal consent has been obtained from the patient.

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DECLARATION OF CONFLICT OF INTERESTS

There are no conflicts of interest.

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