NUTRITIONAL MANAGEMENT OF THORACIC AORTIC ANEURYSM WITH AORTOESOPHAGEAL FISTULA AND COVID-19

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ABSTRACT

Clinical studies have reported a rise in coagulation abnormalities with Coronavirus disease 2019 (Covid-19). Thoracic aortic aneurysms (TAA) are influenced by genetic, gender, cigarette smoking, hypertension, sporadic TAA and atherosclerosis. Preoperative malnutrition prerequisites adverse outcomes postoperatively in cardiac surgery patient. Aortoesophageal fistula (AEF) is as an abnormal anatomical communication between the digestive tract and aorta, the classical symptoms of which are defined by the Chiari triad. Though open surgical repair is the gold standard treatment, advancing age presents considerable operative risk hence endovascular aortic repair (EVAR) offers a least invasive approach for AEF management. Dual feeding maybe considered to delay postoperative malnutrition. This article addresses the Nutritional management of a 74 year old diabetic, covid 19 positive female patient with AEF and Thoracic EVAR (TEVAR). Peptide based, low osmolality, medium chain triglyceride and fiber supplemented formulas may improve GI complications in critically ill patients. Early enteral nutrition may improve clinical outcomes. Palliative care improves QOL in patient and family in life threatening illnesses. Mitigation strategies must focus on improving dietary habits and cessation of proinflammatory factors of AA, improved nutritional assessment in geriatric patients and incorporate a multimodal approach for the management of TEVAR thus integrating primary, secondary preventative measures and customized critical care.

Keywords: Thoracic Aortic Aneurysms, Aortoesophageal Fistula, Endovascular Aortic Repair, Palliative Care, Multimodal Approach.

I. INTRODUCTION

Coronavirus disease 2019 (COVID-19) encompasses a wide spectrum of clinical symptoms. While a majority of symptoms occur with acute respiratory syndrome coronavirus 2 (SARS-CoV-2), coagulation abnormalities have been found to a large extent despite prophylactic anticoagulant treatment.[1] Aortic Aneurysm (AA) are defined by the localized enlargement of the aorta due to weakening of the aortic wall. This asymptomatic disease may also present with aortic rupture resulting in high mortality rates.[2] Wang et al reported a 7.4/100,000 incidence of AA with a staggering 80% cases predominant in patients above 65 years. Among the elderly, 56.1/100,000 cases were recorded. The incidence of AA in men and women was recorded to be 11.09 and 3.65 per 100,000 population.[3] According to Stackelberg et al, abdominal adiposity may be associated with an increased risk of incidence of abdominal AA (AAA) (Men: 100cm and Women: 88cm).[4] Production of reactive oxygen species, inflammation and endoplasmic reticulum stress may contribute to degeneration of aortic media and apoptosis of smooth muscle cells, the principal feature of AAA and Thoracic AA (TAA). TAA is a multifactorial disease and may occur in ≤6-10 people per 100,000 population. It has been associated with a specific genetic variant. Cigarette smoking, hypertension, sporadic TAA, male sex and atherosclerosis have been implicated as strong risk factors of TAA. However, according to Quitana and Taylor, diabetes mellitus and female sex may be protective of TAA; the mechanisms of which remain elusive.

Risk factors in Elderly patients afflicted with cardiac disorders not only consist of malnutrition but also include cognitive decline and low physical performance. Low physical performance and malnutrition may be considered two sides of the same coin as they form a vicious cycle where malnutrition is affected by slow metabolism, reduced appetite, low intake and absorption of nutrients due to low physical performance and vice versa, low physical performance may be the product of muscle mass loss due to poor nutritional status. Assessment therefore allows us to derive possible patient outcomes keeping in mind pre-frailty and frailty burden.[5]
Cardiac surgery patients demonstrate an increased risk of adverse outcomes postoperatively in the presence of preoperative malnutritions. Other risk factors that may further aggravate cardiac surgery outcomes have been listed in figure 1 and figure 2.

Figure 1: Influence of Malnutrition on the outcome of Cardiac Surgery Patients[6]

The pathomechanisms of inflammation are further aggravated by nutritional deficiencies, depleted metabolic reserves and reduced defence mechanisms.[6] Postoperative gastrointestinal (GI) function is further influenced by anesthesiological and surgical procedures that interfere with nutritional interventions in intensive care stay.

Figure 2: Extrinsic Risk factors influencing nutrition support in cardiac surgery, PEEP: Positive end-expiratory pressure[6]

GI lesions such as ulcers and aortic aneurysms tend to influence each other and may result in hematemesis. Aortoesophageal fistula (AEF) is a rare cause of upper GI hemorrhage with an annual occurrence of 0.007 per million.[7] It is an abnormal anatomical communication between the digestive tract and the aorta and has been categorized into primary AEF and secondary AEF. The latter results from bacterial infection of artificial blood vessels post artificial revascularization surgery, trauma ingestion or iatrogenic causes while the former has been attributed to esophagitis, aneurysms, etc.[8] A higher incidence of PAEFs has been indicated in AA. The Chiari triad (classical symptoms of AEF) includes dysphagia, sentinel hemorrhage followed by exsanguinating hematemesis and chest pain.[9] A poor diagnosis rate of 25% after GI endoscopy is further compounded by the lack of awareness that AEFs can result in GI bleeding. Contrast enhanced computed tomography (CT) offers a better diagnostic rate (30-61%) and may be considered first when suspecting AEF.[10] The most common area of AEF formation has been indicated due to aortic rupture in the thoracic region.[9] Open surgical repair has been deemed the gold standard for the management of AEF. However, advancing age is correlated to increased operative risk after open repair. In such patients, endovascular stenting may be
beneficial in the presence of advanced pulmonary disease as chronic obstructive pulmonary disease which has been associated with TAA growth and rupture.[11] Thoracic endovascular aortic repair (TEVAR) has been accredited as a possible least invasive approach for the management of AEF in surgical literature. It is accompanied with a considerable risk of infection.[12] A study by Deery et al concluded deteriorative outcomes including high mortality during the perioperative phase and lower long term survival post TEVAR in female patients than in male patients even after adjusting age and comorbidities. This aspect may be further considered in determined optimal threshold and timing of intervention.[13] According to Cole, micronutrients must be provided post TEVAR due to the catabolic state in the first week of ICU care along with hypocaloric macronutrient administration.[14]

General recommendations by clinicians for Medical nutrition therapy during gastrointestinal bleeding (GIB) involved prolonged periods of fasting ranging from 48-72 hours as this is sought to stimulate improved intragastric pH control, reduce risk of rebleeding, reduce gastric secretion and inflammation and stabilize clots. There may be an increased risk of rebleeding in the initial 72 hours in patients with GIB. Although parenteral nutrition (PN) can be employed during the fasting periods, it is coupled with vascular catheter site infection, septicemia, thrombophlebitis, bacterial translocation, impaired intestinal integrity, impaired barrier function and defense.[15]

The European Society of Intensive Care Medicine (ESICM) and the European Society of Parenteral and Enteral Nutrition (ESPEN) Guidelines recommend the following:

- Early enteral nutrition (EEN) in critically ill adult patients than early PN.
- In the event that oral intake and EN are not possible then early and progressive PN should be employed within 3-7 days in case of severely malnourished patients. The composition of PN may contain lipid emulsions enriched with DHA+EPA (Fish oil 0.1-0.2g/kg/d).
- Delayed enteral nutrition (EN) in case of life-threatening hypercapnia, hypoxaemia or acidosis and further employing EEN in conditions of stable hypoxaemia and compensated or permissive hypercapnia and acidosis.
- EEE post abdominal aortic surgery
- Delayed EN in case of active upper GI bleeding and initiation of EN when the bleeding has stopped and no signs of rebleeding are apparent.[16], [17]

Blaser et al adds that prolonged postponement of EN is coupled with an increased risk of stress ulceration thus deemed unnecessary. Early EN has been associated with improved patient outcomes and shorter length of mechanical ventilation (<48 hours) in patients undergoing endovascular AAA repair. Postoperative EEN may further counteract intestinal ischemia and protect from stress ulceration.[18]

The use of combination therapy of EN and PN has been much debated. However, this may aid in delaying postoperative malnutrition and meet caloric and protein requirements during ICU care. PN associated complications such as refeeding syndrome, hyperglycemia, catheter-related bloodstream infection, TPN associated liver disease, central vein thrombosis, etc encourage the initiation of EEN when applicable in order to mitigate technical complications as well length of hospitalization (LOS) and intensive care. Glutamine supplemented in TPN may however improve innate immunity to resist bacterial mucosal invasion.[19]

II. OBJECTIVE

The case observes the nutritional management of a 74 year old female with AEF and TEVAR.

III. METHODOLOGY

74 year old female patient was admitted with chief complaints of back pain since 10 days which aggravated since 2 days, dysphagia since and generalized weakness since 2 days. She had a history of type 2 diabetes mellitus and was a non-vegetarian. Subjective global assessment and Nutrition risk score (NRS 2002) were calculated as of 13 and 7 respectively indicating moderate to severe malnutrition with need for nutritional intervention. A HRCT thorax revealed TAA with possible rupture and suspected AEF. Patient was RT PCR positive for COVID-19. CT Aortogram reports confirmed a ruptured thoracic aneurysm with extensive irregular acute and layered thrombus around the aneurysm in the left posterior hemithorax and extending to the
mediastinum. TEVAR was planned and simultaneous COVID-19 treatment was also initiated. She was anemic (Serum Hemoglobin: 7.9 g/dL) and transfused 2 pints of PRBC preoperatively. Post procedure, she continued to be NIV dependent and exhibited persistent dysphagia. In the presence of baseline malnutrition and existing dysphagia; soya, MCT, olive oil and fish oil containing TPN and Partial PN (PPN) (Aminoven 10%) was initiated on HOD#3. Endoscopic reports revealed mild esophageal narrowing secondary to extrinsic compression with probable ischemic ulcer. Patient exhibited dyselectrolytemia from HOD#0-3 and on HOD#9 (Serum Sodium 150 mmol/L) and was given conservative management. Catheter related infection was detected at the site of TPN administration. On HOD#8 laparoscopic assisted feeding jejunostomy was performed. TPN was ceased and jejunal feeds were initiated with semi-elemental based peptide formula (SEBP) on HOD#9. A calorie dense polymeric whey protein supplement was initiated on HOD#11. On HOD#11, the patient had 5 episodes of diarrhea. A soluble fiber supplement was initiated through the jejunal feeds along with SEBP following which a decreased frequency of diarrhea was observed. Harsh vesicular Bowel sounds were prominent and a probiotic capsule was administered on HOD#13. No episodes of loose stools were observed on HOD#14. On testing negative for COVID-19, the patient was removed from ICU isolation and transferred to intensive care. Potassium correction was done on HOD#14 (Serum Potassium: 3.44 mmol/L). On observing rise in total counts and serum procalcitonin levels (Serum Procalcitonin: 0.738 ng/mL) on HOD#13 a higher antibiotic course was initiated. On further evaluation, CT thorax report revealed aortic stent in situ with no endothelial leakage, bilateral pleural effusions (right>left) with possible internal septations/ loculations and small pneumothorax on the right side. These findings indicated a possible continued leak from the esophagus to the mediastinum which may be infected. Due to increased risk and poor outcomes surgical management was decided against after gastroenterologist and cardiothoracic and vascular surgery team reviews. In light of grave prognosis palliative care was advised. Nutritional counseling regarding the management and guidelines for home enteral nutrition (jejunal feeding) and continuation of SEBP+ polymeric formula was advised at the time of discharge on HOD#15.

Table 1. Nutritional Course during hospitalization

<table>
<thead>
<tr>
<th>HOD</th>
<th>DIETARY NOTES</th>
<th>ENERGY (Kcal)</th>
<th>Protein (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOD#0</td>
<td>NPO due to dysphagia</td>
<td>200</td>
<td>50</td>
</tr>
<tr>
<td>HOD#1</td>
<td>NPO for aortic angioplasty</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>HOD#2</td>
<td>Npo till further orders. Presence of Dysphagia</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>HOD#3</td>
<td>Initiated TPN @ 30ml/hr, Aminoven 10% @ 20 ml/hr (10 hrs)</td>
<td>530</td>
<td>53.5</td>
</tr>
<tr>
<td>HOD#4</td>
<td>TPN @ 40ml/hr, Aminoven 10% @ 20 ml/hr</td>
<td>1360</td>
<td>84</td>
</tr>
<tr>
<td>HOD#5</td>
<td>TPN @ 50ml/hr, Aminoven 10% @ 20 ml/hr</td>
<td>1520</td>
<td>104</td>
</tr>
<tr>
<td>HOD#6</td>
<td>TPN @ 50ml/hr, Aminoven 10% @ 20 ml/hr</td>
<td>1520</td>
<td>104</td>
</tr>
<tr>
<td>HOD#7</td>
<td>TPN @ 50ml/hr, Aminoven 10% @ 20 ml/hr</td>
<td>1520</td>
<td>104</td>
</tr>
<tr>
<td>HOD#8</td>
<td>NPO for Insertion of JT tube</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>HOD#9</td>
<td>on FJ feeds 50 ml/2nd hrly + Aminoven 10% 20ml/hr</td>
<td>920</td>
<td>77</td>
</tr>
</tbody>
</table>
HOD#10 Trophic feeds 40ml/hr Peptamen. Ischemic Ulceration of Esophagus, Tachepnoea (+) 1360 51

HOD#11 Trophic feeds 60ml/hr Peptamen + Pentasure 2.0 1970 99

HOD#12 Trophic feeds 60ml/hr Peptamen + Pentasure 2.0. Chest Physio, B/L crepts, Tachypnea 1970 99

HOD#13 Trophic feeds @ 50ml/hr Peptamen+ Pentafiber. 1 unit PRBC transfusion, diarrhea (added Cap Providac TID), B/L crepts. (No complaints of diarrhea after 4pm) 1064 42

HOD#14 Trophic feeds 60ml/hr Peptamen + Pentasure 2.0 1700 98.4

HOD#15 Trophic feeds 60ml/hr Peptamen + Pentasure 2.0 1700 98.4

NPO: Nil per os

**Figure 3:** Caloric Intake during Hospitalization

**Figure 4:** Protein Intake during Hospitalization

**IV. DISCUSSION**

Optimized EN delivery has been associated with improved clinical outcomes in patients with postoperative aneurysmal rupture/acute life-threatening dissection patients. In this scenario the presence of prolonged...
dysphagia called for the need for TPN within 3 days of admission and postoperatively. However, TPN was associated with infection at the site of TPN administration as a result of which jejunostomy was planned. EN has been associated with a decreased risk of infectious and noninfectious complications as compared to PN. It is safe, feasible, complies with physiology and helps maintain digestive tract morphology and function. ESPEN guidelines further indicate the use of postpyloric feeding (jejunal feeding) in the presence of gastric feeding intolerance.[17]

Diarrhea has been noted as a common complication of EN and has been implicated due to the absence of dietary fiber in EN. Elemental diets, TPN and various enteral feed types may instigate atrophy of the digestive tract mucosal epithelium. Findings of a study by Kato et al indicated an improved management of diarrhea in patients receiving EN after administration of soluble dietary fiber. Similar results were also derived from a systematic review by Reis et al indicating improved management of diarrhea in all hemodynamically stable and critically ill patients.[20] Soluble fiber supplementation may increase short-chain fatty acid production that promote proliferation of intestinal mucosal epithelial cells preventing mucosal epithelial atrophy. GI intolerance permits the use of peptide-based, fiber-containing or low-FODMAP formulas.[21] Peptide based EN may also show better tolerance with decreased risk of diarrhea compared to intact protein diets.[22] The use of peptide based, low-osmolality, MCT and fiber supplemented formulas in critically ill patients with GI complications predisposes these patients to fewer complications.[23]

Nutritional management of covid-19 focuses on the incorporation of adequate protein due to its effect on the immune system with keen influence on high biological value protein containing all amino-acids which exert anti-inflammatory effect. There may be a need for whey protein supplements to meet the increased protein requirement and its immunomodulating properties (1.3-1.5g/kg body weight). A combination of SEBP and polymeric whey protein formula was initiated on HOD#11. The polymeric formula was discontinued on account of diarrhea and restarted once diarrhea had subsided. Dual feeding i.e. combined EN and PN may improve caloric intake, glycemic control and insulin sensitivity. Weimann et al further adds that this form of combined nutrition may not be needed if PN is employed for <4 day.[24] Omega-3 fatty acids may suppress pro-inflammatory mechanisms reducing severity and/or improve recovery in COVID-19 patients. The type of carbohydrate consumed must be that of low glycemic index as consumption of high glycemic index food groups may cause mitochondrial overload and free radical synthesis which contribute to pro-inflammatory mechanisms. A supply of 2g/kg body weight /day not >150g/day may be considered. Adequate fiber intake (25-35g/day) has been associated with reduced gut and systemic inflammation. The immune system is further influenced by other bioactive compounds and micronutrients including vitamins A, B6, B12, C, D, E and folate, magnesium, zinc, copper, iron and selenium.[25] Preoperative frailty and the patient’s declining prognosis further increased her risk for the proposed surgical procedure. Although recent advances in clinical medicine have dictated safe operations in cardiac and non-cardiac geriatric patients, resource capabilities; quality of life (QOL) and variable outcomes hold priority over life-prolonging procedures. Most geriatric patients may prefer the environment of their homes to die.[26] Palliative care during life-threatening illnesses is beneficial as it diminishes anxiety, depressive feelings, stress and offers satisfaction and QOL to both patient and family alike.[27]

V. CONCLUSION

This article analyses the case of a 74 year female with Covid-19, TAA and AEF. There is a paucity in literature with respect to studies related to the prevalence, incidence and outcomes of AA and its subtypes in the general Asian population. The lack of awareness further complicates and hinders diagnosis. Zanten propagates that the multimodal approach may improve perioperative nutritional status, reduce GI dysfunction. Administration of immunoenhancing diets, absence of prolonged fasting, preoperative carbohydrate loading may further improve patient outcomes in the case of open abdominal aortic surgery. Zanten adds that in case of endovascular repair techniques, the multimodal approach incorporates early nasogastric tube removal, immediate postoperative mobilization, EEN or early oral diet within 24-48 hours postoperatively, application of prokinetic medications, acceptance of gastric residual volumes up to 500 ml, postoperative gum chewing and initiation of PN in case of severe malnourishment only at the end of the first week (Body mass index <18.5 kg/m²). Zanten concludes that this approach in AAA surgery may reduce the risk of GI dysfunction, medical complications, LOS, hospital costs.
and improve morbidity.[28] Improved clinical outcomes of surgery have been indicated with EEN in the peri and postoperative phases. However, contraindications to EN may hinder EN and hence symptom specific management must be employed to initiate EN/ PN as tolerated with routine nutritional assessment at the pre,peri and postoperative phases of surgery. Prolonged use of PN is coupled with considerable risk of catheter related infectious complications. Acosta et al indicated a reduced risk of AAA with increased intake of fruits and vegetables.[29] Diets rich in antioxidants and the cessation of pro-inflammatory factors such as alcohol abuse, cigarette smoking, occupational hazards, chemical exposure, sedentary lifestyle etc may contribute to improved cardiovascular health. Tonet et al highlights the need for assessment in geriatric patients and includes both physical performance evaluation and malnutrition to create customized intervention integrating aspects of secondary prevention, nutritional supplementation, diet and exercise programs supervised at home or by well-established facilities.[5] The high mortality rate of AEF calls for the need for early diagnosis and prompt surgical intervention to manage esophageal erosion and aneurysm. Future studies may focus on nutritional management of thoracic aortic aneurysms incorporating the multimodal approach and derive potential guidelines and recommendations for primary and secondary prevention and management of aortic aneurysm and its related complications.

VI. REFERENCES


