**Case Report**

# Successful triple valve surgery in a malnourished patient: what to prepare?

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**ABSTRACT**

Valvular heart disease accounts for 10% to 20% of all cardiac surgical procedures in the United States. The decision to intervene, as well as the type of intervention for a patient with severe valvular heart disease, should be based on an individual risk-benefit analysis. Once a patient is considered a candidate for cardiac surgery, a comprehensive patient evaluation of medical conditions and comorbidities helps improve operative outcomes and minimize the mortality rate. Patients with severe valvular heart disease with chronic heart failure at times, progressing to malnutrition. Patients undergoing cardiac surgery experience a systemic inflammatory response, which contributes to acute organ injury leading to a higher incidence of comorbidities and worse malnutrition. Therefore, preoperative risk assessment and nutritional assessment are critical to performing safe cardiac surgical procedures. We report a case of a malnourished 17-year-old man with multiple valvular heart disease with optimum preoperative preparation, including nutritional status leading to the good outcome of complex cardiac surgery even in high-risk patients.

## INTRODUCTION

Valvular heart disease has a high prevalence, especially in developing countries, although Indonesia's data is very limited. In recent decades, the epidemiology of valvular heart disease has changed dramatically as socio-economic development and population composition change with older mean ages. However, rheumatic heart disease is still the main etiology of valvular heart disease in the developing country (Soesanto, 2012). The definitive management of valvular heart disease (VHD) includes percutaneous intervention and surgery. In Indonesia, surgery remains the main option for VHD due to valve abnormalities; for example, valve morphology due to rheumatic heart disease. When surgery is decided, a thorough assessment of the patient's condition and comorbid factors is mandatory, including nutritional status (Brinkley & Gelfand, 2013; Moore, Chen, Mallow, & Rizzo, 2016).

Malnutrition and heart disease have been shown to have a strong association, and malnutrition is a predictor of surgery outcome, morbidity, mortality, length of patient care, and cost of hospitalization. Unfortunately, nutritional status is still a factor that is often neglected in the perioperative phase of patients undergoing heart valve surgery (Chermesh et al., 2014; Okoshi, Capalbo, Romeiro, & Okoshi, 2016).

In this case, we present how optimal preoperative preparation involving good nutritional preparation can provide good operative outcomes even with complex surgical procedures in high-risk patients.

## CASE REPORT

Male, 17 years old, came to the hospital with shortness of breath for a month, and the symptom was getting worse a week before admission. Dyspnea is felt continuously even at rest, and the stomach is enlarged in the last one month with swelling in both legs. The patient slept in a sitting position. There was no cough or fever. The patient had known he had heart disease for ten years and is often hospitalized for acute heart failure. The patient was last hospitalized six months ago, and after that, the patient was lost to follow up because of his financial problem.

Physical examination showed acute heart failure signs with a general condition of weakness with hypotension (blood pressure 70/50 mmHg) and respiratory rate 28x/minute. On examination of the head and neck, there was icterus, dyspnea, and increased jugular venous pressure (JVP). Chest examination revealed retraction, a diastolic murmur at the apex grade III/IV, and a diastolic murmur of the ICS II right parasternal line. On pulmonary examination, there were bilateral rales. The abdomen showed ascites and hepatomegaly with the liver palpable up to 12 cm below the arcus ribs. There was edema in both legs with cold roots.

The echocardiography examination showed valves with severe MS (planimetric MVA 0.8 $cm^2$, MVA by mean PHT 0.7 $cm^2$, MVA by VTI 0.9 $cm^2$; MV by mean PG 29.35 mmHg, MV by mean PHT 278ms with Wilkins score (2-3-2-2), mitral annular dilatation (4.1 cm) with moderate MR (MR ERO A 0.4 $cm^2$), MR reg vol 36 ml, Carpentier type I, valve metoaptation RCC and NCC with moderate AR (AR Sdec 3,3 m/s2, AR PHT 387 ms), severe TR (TR ROA/RAA 35%; hepatic reverse flow (+), moderate PR (PR Sdec 2,7 m/s2). Dilated LA (LA major 7.1 cm, LA minor 5.8vm), normal LV (LVIDd 5.0 cm), dilated RA (RA major 6.5 cm, RA minor 5.0 cm) with estimated RAP 15 mmHg, dilated RV (RVDB 3.6 cm) with severe pulmonary hypertension (est. PASP 116.10 mmHg). There was no thrombus/ intracardiac vegetation, and spontaneous echo contrast was obtained in the left atrium. Normal LV systolic function (EF by Teich 71%, by biplane 72%, decreased RV systolic function (TAPSE 1.5 cm0, segmental

analysis), normokinetic LV there is LVH (LVMI 77.14 g / m2, RWT 0.411).

The ECG examination showed that sinus rhythm tachycardia was 120 bpm with the right frontal axis deviation, normal horizontal axis. The laboratory examination showed anemia (Hb 10.8 gr/dL), hypoalbuminemia (2.63 g/dL), increased direct bilirubin (3.01 mg/dL), and total bilirubin (4.59 mg/dL). Cardiomegaly, with a cardiothoracic ratio of 65%, was obtained from the chest radiograph. From catheterization of the right heart, the pressure in the pulmonary artery was 82/35, RV gradient 15.01, RVA 0.73cm. From LVED pre 16 mmHg left heart catheterization. Ventriculography: Post LVED 19 mmHg, MR grade III CO 3.56 CI 3.14, Aortography: AR grade II, Stroke Volume 37.06, SVI 32.72.

Patients with severe malnutrition, body weight 20 kg, height 140 cm, BMI 10.2 kg/m$^2$ (underweight). Subjective Global Assessment (SGA) score in this patient was 29 and classified into severely malnourished, and from MUST scoring patient was included a high-risk category. The preoperative risk was also assessed using EuroSCORE I and EuroSCORE II, which included this patient as a high-risk category (7.53% and 33.12%, respectively).

A multidiscipline discussion was held and decided that the operation would be carried out after the patient was relieved from acute heart failure and if the nutritional condition was good because the patient was in severe malnutrition. During hospitalization, because the patient was malnourished and hypo albumin, the patient was also consulted to the Nutrition Team, and it was planned to provide an appropriate high calorie and high protein diet and supplementation with albumin so that the patient's weight could increase and the condition during surgery was more optimal. During hospitalization, the patient developed cardiogenic shock and episodes of atrial fibrillation with sinus recurrence with digoxin. After treatment for approximately one month in the hospital, acute heart failure has been resolved, and the patient's weight has gained 8 kilograms. BMI has gained from 10 kg/m$^2$ to 14,29 kg/m$^2$, so the team decided to undergo Double Valve Replacement (DVR) and Tricuspid Valve Repair surgery.

The patient was admitted to the ICU for seven days with a stable condition then continued with the regular treatment room with the results of an echocardiographic evaluation, namely:

**Postoperative Trans Thoracal Echocardiography**

Valves:

1. Prosthetic mitral valve, good location, and function (peak velocity 1.9 m/s, mean gradient 3.03 MR-PR MV / VTI-LVOT 0.82)

    Effective Orificium Area 2, cm$^2$
    Pressure Half Time 98 ms

2. Prosthetic aortic valve is well located and functioned (peak velocity 2.51 m/s. Mean gradient 18.46 mmHg, doppler velocity index 0.64, AVA VTI 1.3cm$^2$

3. TR light (TR max PG 49.42 mmHg)

4. Medium PR (PR Sdec 4.3 m / s2) Cardiac Chamber Dimensions: LA / LV / RA / RV dilated. No thrombus or vegetation was found.

Normal LV systolic function (EF by Teich 62%)

LV E / A fusion diastolic function

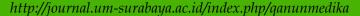RV systolic function decreased (TAPSE 1.0 cm)

Normokinetic LV segmental analysis,

LVH concentric remodeling

After surgery, the patient was discharged with the anticoagulant warfarin and had a significant weight gain.

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## DISCUSSION

Significant stenosis or regurgitation can be found in one or multiple valve diseases, especially in rheumatic and degenerative heart disease etiologies. Until now, there is still very limited data regarding valvular heart disease affecting more than one valve (Falk et al., 2017). The prevalence of valvular heart disease in the United States is 2.5% with an increased prevalence proportional to age, 2% in the age group before 65 years, to 8.5% in the age group between 65-75 years and 13.2% above 75 years with the most affected valves are mitral and aortic valves (Brinkley & Gelfand, 2013; Maganti, Rigolin, Sarano, & Bonow, 2010; Manjunath, Srinivas, Ravindranath, & Dhanalakshmi, 2014; Moore et al., 2016). A study in China recruited 3948 adult subjects with valvular heart disease; it is mentioned that 1.04% had multiple valve heart disease (Shu et al., 2016). In line with these data, a study in India with 13,289 subjects having valvular heart disease had a prevalence of 21.4% of subjects had a combination of mitral stenosis and aortic regurgitation (Manjunath et al., 2014).

There are several basic principles for the management of patients with multiple valve heart disease (Falk et al., 2017):

1. If there are stenosis and regurgitation in one valve, treatment or correction is prioritized for the dominant abnormality or valve with a more severe degree, but if stenosis and regurgitation are found in the same degree, the management and intervention are according to the severity index of stenosis and regurgitation.

2. If more than one valve is affected, the management follows the algorithm for each valve lesion.

3. The decision to perform surgery must consider additional risks because the procedure is more complex.

In this patient, the echocardiography examination showed severe MS, severe MR, and moderate AR were accompanied by severe secondary TR due to severe MS. According to the 2017 ESC Guidelines regarding Valvular Heart Disease, Mitral Valve Replacement (MVR), Aortic Valve Replacement (AVR), and Tricuspid Valve repair (TVr) with LA reduction will be carried out.
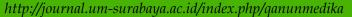
### Preoperative Assessment of Valvular Heart Disease

The principle of VHD surgery preparation is almost the same as preoperative heart disease. Complete medical history and physical examination of the patient along with complete cardiac and extracardiac supporting examinations are mandatory to achieve a standardized surgery preparation so the surgical outcome can be optimized with minimal complication (Bojar, 2011).

Several scoring systems have been developed to help to determine the perioperative risk stratification of cardiac surgery, including the EuroSCORE and Society of Thoracic Surgery Risk score (STS score). The evaluation of each patient's demographic factors, heart disease, and noncardiac comorbidities is needed to assess postoperative morbidity and mortality. Cardiac surgeons are using EuroSCORE I, which is now being deprecated, and started using EuroSCORE II, which is more accurate in distinguishing between low and high risk in patients with valvular heart disease and can better assess postoperative outcome. Classification of risk groups according to the EuroSCORE II scoring system is divided into three risk groups, namely low risk (0-2%), medium risk (3-5%), high risk (>6%)(Bojar, 2011).

**Figure 1.** Preoperative Risk assessment using the European System for Cardiac Operative Risk Evaluation I (EuroSCORE I) (Source: Bojar, 2011)



**Figure 2.** Preoperative Risk assessment using the European System for Cardiac Operative Risk Evaluation I (EuroSCORE II) (Source: Bojar, 2011)

The patient, in this case, was included high-risk patients on both EuroSCORE I and EuroSCORE II with significantly different risk percentages (7.53% vs. 33.12%), while the STS score could not be taken into account because the patient underwent three valve corrections whereas the STS score only listed one valve with or without CABG.

### Malnutrition in Valvular Heart Disease

Malnutrition is common in patients with both structural and congenital heart disease. Structural abnormalities result in insufficient nutrients to meet the needs of biological metabolism; reduced body mass also reduces myocardial function and ventilation, prolongs the healing period, and decreases the immune system with an increased risk of infection.

Therefore, patients with structural and congenital heart disease are classified as a high-risk group for malnutrition (Monteiro et al., 2012). Malnutrition is an independent prognostic factor for mortality in patients who have fallen into heart failure, which is then termed "cachexia cardiac". The impaired heart will induce a systemic response characterized by neurohormonal and inflammatory activation. Initially, both processes have cytoprotective benefits, but over time they will maladapt. The cytokines that play a role mainly TNF-α, originally called cachexia, regulate more than 150 genes (Rahman et al., 2014).

Heart failure is believed to be a multi-systemic disease on the basis of chronic inflammatory pathophysiology. TNF-α can interfere with the gastrointestinal system causing changes in the intestinal barrier and transport protein dysfunction along with the increasing gastrointestinal permeability and then causing bacterial translocation. This process plays a role in reducing nutrient absorption in patients, which then leads to malnutrition. TNF - α will directly cause a direct depressive effect on the myocardium; besides that, it will also activate various cellular effects through the nuclear factor-κB (NF-κB) pathway, which causes ischemia, increased insulin resistance, decreased exercise capacity, and decreased appetite so that it will worsen cachexia (Pompéia et al., 2012; Rahman et al., 2014).

## Inflammation on Cardiac Surgery

Patients undergoing cardiac surgery will suffer from a complex systemic inflammatory syndrome, which manifests as pyrexia, tachycardia, leucocytosis, hypotension, edema, and organ failure. Some stimuli will cause an inflammatory reaction during and after surgery. Trauma due to surgery will activate neutrophils, endothelial cells, platelets, and trigger the release of pro-inflammatory mediators such as TNF-α and various kinds of interleukins (IL). Contact between foreign surfaces during activation of the Cardiopulmonary Bypass (CPB) machine will activate leukocytes, platelets, and several cellular components such as the complement system as well as the calicrein cascade, which induces inflammatory mediators such as TNFα, IL-1, IL-6, and IL-8. After a period of ischemia during aortic cross-clamping, the tissue reoxygenation process will also trigger an ischemic response, namely ischemia and reperfusion injury (I / R injury). Enteral hypoperfusion at the time of surgery also increases mucosal permeabilities of the gastrointestinal tract, thereby facilitating bacterial translocation. This inflammatory process also underlies the complications of various organs' dysfunction after cardiac surgery (Hill et al., 2018; Rahman et al., 2014).
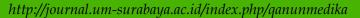
## Role of Nutrition and Nutrition Status Scoring in Patient undergoing Cardiac Surgery

Malnutrition is a sub-acute or chronic nutritional disorder, either excessive or nutritional deficiency accompanied by inflammatory activity that causes changes in body composition and reduced body function. Cardiac surgery patients who are malnourished have been shown in various studies to experience worse surgical outcomes, including higher morbidity and mortality.

To minimize these problems, examining good nutritional status predictors will help the clinician determine further management and whether a surgical correction is needed. Detecting patients at a high risk of malnutrition is essential for adequate management. Nutritional assessment scores have recently been updated but have not been validated for the cardiac patient population and are rarely used in cardiac surgery. Currently, there are several scoring modalities that can be used to assess nutritional status, including the Short Nutritional Assessment Questionnaire

(SNAQ), the Malnutrition Universal Screening Tool (MUST), the Malnutrition Screening Tool (MST), Nutrition Risk Screening 2002 (NRS-2002), Mini Nutritional Assessment. Short-Form (MNA-SF) and Subjective Global Assessment (SGA). Lomivorotov et al. reported a reasonably high malnutrition rate in patients undergoing cardiac surgery, namely 4.6–19.1%. Investigators suggest that most of the screening tools available are insensitive to assess postoperative risk.

In clinical practice, malnutrition is usually diagnosed formally or informally through history taking and anthropometric measurements. Body Mass Index (BMI) links body weight and height. In the general population, BMI <20 kg / m2 may indicate severe malnutrition in the elderly or malignant population but not in the patient population with cardiovascular disease because of edema, which can be a confounding factor in calculating lean body mass. The acute and chronic disease usually affects lean body mass or lean mass more because the decrease in muscle mass may not be reflected by a decrease in BMI. However, BMI is still very popularly used to assess a patient's nutritional status quickly.

Subjective global assessment (SGA) combines elements of history and physical examination and has been validated as a tool for assessing malnutrition in a variety of conditions. When SGA is applied to cardiac patients, most of them will be assessed for malnutrition than the standard anthropometric measurement combined with albumin and leukocyte values (Gonçalves, Jesus, Gonçalves, Deiró, & Dias, 2016; Rahman et al., 2014; Stoppe et al., 2017).

The Malnutrition Universal Screening Tool (MUST) is a relatively new nutritional assessment score. This score combines BMI, unintentional weight loss, and acute illness to predict nutritional risk. This score is easy to apply because it is designed for a variety of populations without specific measurements. The MUST score aims to stratify patients into groups requiring only observation or intervention. The MUST score has been studied to predict mortality in cardiovascular patients, but no studies have used this score in a population that has already fallen into the cardiac cachexic phase (Gonçalves et al., 2016; Stoppe et al., 2017).

Malnutrition should be treated as a dynamic condition. It can be diagnosed early when abnormalities in laboratory tests are combined with a history of weight loss and a physical examination of decreased muscle mass. Laboratory tests that are usually associated with malnutrition are anemia, hypo albumin, and prealbumin, low total cholesterol, and lymphopenia. Malnutrition is often not diagnosed if we only use BMI because of the overload condition, which is a confounding factor for BMI. Drastic changes in body weight are usually caused by overload conditions and response to diuretic therapy, but slower changes in body weight usually indicate changes in nutritional status, especially when accompanied by a stable patient's condition and build-up of muscle mass (Lomivorotov et al., 2013; Ringaitienė et al., 2016; Stoppe et al., 2017).

In this case, we found a patient with chronic malnutrition that was quite severe supported by anamnesis, physical examination of muscle mass loss, and laboratory results that showed anemia, hypoalbumin, thus requiring the Nutrition team intervention to optimize preoperative conditions. And according to the available literature, with the intervention of The nutrition team and the interventions for heart failure therapy, the patient gained 5 kilograms in 1 month. The patient underwent surgery and got good results. Post-surgery with valve replacement correction and improved cardiac function, the patient experienced a significant improvement in nutritional status after surgery.

## CONCLUSION

Valvular heart disease has a fairly high prevalence, especially in developing countries, although there is no data yet for prevalence in Indonesia. Patients with an indication for surgery are expected to achieve an excellent postoperative outcome with a better quality of life. Therefore, preoperative evaluation is very important because it is related to the safety and success of cardiac surgery procedures, especially in valvular heart disease. Several data that need to be prepared before surgery are the patient's medical history, physical examination, both cardiac and extracardiac, stratification of the risk of surgery using the STS and EuroSCORE scoring system, and several supporting examinations in order to minimize postoperative morbidity and mortality. The supporting tests used to complement the preoperative process are laboratory tests, non-invasive examinations (echocardiography, exercise tests, MRI, and CT scan), to semi-invasive cardiac catheterization. Malnutrition and heart disease have also been shown to have a strong association, and malnutrition is a predictor of surgical outcome, morbidity, mortality, length of patient care, and hospitalization costs. Unfortunately, nutritional status is still a factor that is often neglected in the perioperative phase of patients undergoing heart valve surgery. Optimal preparation and complementary investigations can reduce the mortality and morbidity of postoperative patients with a higher survival rate.

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