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MALNUTRITION AS PREDICTOR FOR MORTALITY IN TETRALOGY OF FALLOT TOTAL CORRECTION

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Abstract— Malnutrition is a common cause of morbidity and mortality in children with Tetralogy of Fallot (TOF), especially in developing country like Indonesia. However there are still limited studies that focus on the correlation between malnutrition and mortality in children with TOF undergoing total corrective surgery. The purpose of this study is to determined the correlation between malnutrition on mortality in TOF patients undergoing total correction. This is a retrospective cross-sectional study using medical records from 2016 to 2019. In this study, majority of mortality was found in male patients (39.3%) while the female's rate was lower (36.8%). The overall mortality in malnourished patients was 38.3%. Out of 72.34% patients with malnutrition, 73.5% of them were severely malnourished. Around 87.5% children under 5 years old were stunted, 46% of them were underweight, and 39% waswasted. Meanwhile in children above 5 years old, 69.5% was stunted and 12.5% was wasted. Our study shows that malnutrition is significantly correlated to mortality in TOF post corrective surgery (p=0.001; OR :2.12). As one of the significant and potentially treatable pre-operative comorbidity, prevention of malnutrition by early diagnosis is important to reduce the mortality in TOF repair.

Keywords— Tetralogy of Fallot, Malnutrition, Total Correction, Mortality

1. Introduction

Malnutrition is common in children with congenital heart disease (CHD) especially in developing countries, including Indonesia [1]. Tetralogy of Fallot contributes for around 7-10% of all CHD. It involves ventricular septal defect (VSD), obstruction of the right ventricular outflow tract (RVOT), overriding of the ventricular septum by the aortic root, and also right ventricular hypertrophy [2]. Presence of these abnormalities could disrupt patient's hemodynamics and nutritional intake, eventually results in growth impairment.

A study in Indonesia reported a high percentage of malnutrition (59%) in patients with CHD [3]. Another study also showed a high percentage of malnourishment in children with TOF. Around 39.02% of the children were undernutrition, 70.73% were stunted, and 52% were underweight [4].

Factors such as genetic, hypoxia and hemodynamic imbalance, inadequate nutritional intake, swallowing dysfunction, hypermetabolic state, congestive heart failure, immaturity of the gastrointestinal tract [5,6,7], and also psychosocial and hormonal might contribute to the growth impairment and malnutrition in children with CHD [8,9].

Total correction has been widely used as preferable treatment for children with TOF in early ages, as the long term outcome and quality of live has been considered excellent with only 3% mortality rate and more than 90% survival rate in 5 years [10]. In developing countries like Indonesia, less than 50% of the population has access to health care facilities and the likelihood of receiving earlier corrective surgery is extremely low [11]. The delay of seeking health services results in a high prevalence of preoperative malnutrition in patients with CHD.

However, to the authors' knowledge, only limited studies have been conducted in developing countries discussing on the link between malnutrition and mortality in children undergoing TOF total correction surgery. Therefore, the aim of this study is to analyze the correlation of malnutrition as risk factor that affect the mortality of TOF repair.

2. Methods

2.1 Study design, Sampling, and Participants

This retrospective cross-sectional study was conducted in Soetomo General Hospital, Surabaya, Indonesia. Total sampling was done from all medical records of TOF patients performed total correction from 2016 to 2019. Patients with history of minimally invasive pre-operative actions and incomplete medical record data were excluded. This study has been approved by Soetomo General Hospital Surabaya Ethical Committee in Health Research (Approval Number 1280/KEPK/VII/2019). Privacy and confidentiality of the information were guaranteed, as data did not include patient personal identities.

2.2 Data Collection

Diagnosis of TOF is defined by ICD 10 diagnosis code 21.3 where only patients performed total correction were taken. Patients' data include : age, weight, heigh, and gender. Nutritional status was determined using World Health Organization (WHO) standardized age- and sex-specific growth reference to calculate Height for Age Z-scores (HAZ), weight for age Z-scores (WAZ), weight for height Z-scores (WHZ) for children below 5 years old. Whereas, for children 5 years and above, Height for Age Z-scores and Body Mass Index for Age Z-scores (BMIZ) were used.

Stunting and underweight based on HAZ and WAZ can be classified into normal (Z-score > -2 SD), stunted and underweight (Z-score -2 to -3 SD), and severely stunted and severely underweight (Z-score < -3 SD). Wasting and thinness was measured by WHZ and BMI and classified as normal (Z-Score +1 to -1 SD), Wasted/thinness (Z-score -2SD to -3SD), severely wasted/thinness (Z-score >-3SD), possible risk of overweight (Z-score +1 to +2SD), Overweight (Z-score +2 to +3SD), and Obese (Z-score >+3SD) [12].

Data were then classified into two groups of patients with malnutrition and without malnutrition. Malnutrition refers to deficiencies, excesses, or imbalances in a person's intake of energy and/or nutrients.

2.3 Statistical Analysis

Statistical analyses were performed using SPSS Statistics 25.0 computer program for windows. A descriptive statistical analyses was performed in the form of mean±SD and median. To assess correlation between malnutrition and mortality, Chi-Square or Fisher's exact test were used. Odds ratios with 95% confidence intervals and P values were computed for the statistically significant variables by using standard formulae. A p-value of <0.05 was considered statistically significant.

3. Result

3.1 Characteristics of Subjects

From 2016 until 2019, there were 47 medical records that met the inclusion criteria. Patients age vary from 12 months to 306 months with an average of 84.12 (±65.69) months old. The mortality is higher in male (61.1%) than female (58.6%). The mean for weight and height in deceased patients were 14.21 kg and 89 ± 29.5 cm (Table 1).

Table 1 Characteristics of Tetralogy of Fallot Patients Performed Total Correction

Characteristics	Dead (n = 18)	Alive (n = 29)
Sex		
Male (%)	11 (61.1)	17 (58.6)
Female (%)	7 (38.9)	12 (41.4)
Age (months)		
< 60	13 (72.2)	11(37.9)
> 60	5 (27.8)	18 (62.1)

Weight (mean)	14.21	21.55
Height (mean)	89 ± 29.5	112.93 21.72

3.2 Patterns of Malnutrition

Height For Age 0 to 5 Years Old

Out of 24 patients, 14 of them were stunted (58%) and 7 were severely stunted (29%). The overall percentage of patients with stunting (stunting and severely stunting) was really high (87.5%)/ The number of of stunted patients was higher in male than female (Fig. 1).

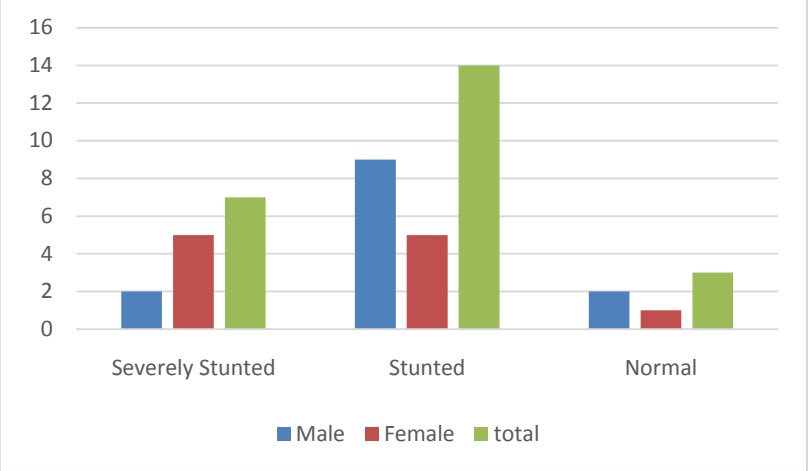

Fig.1 : Height For Age Z-score in 0-5 years Old TOF Children Performed Total Correction

Weight For Age 0 to 5 Years Old

The total of underweight patients (underweight and severely underweight) was 11 out of 24 cases (46%). Only 1 patient was overweight and 12 patients had normal WAZ score (Fig.2).

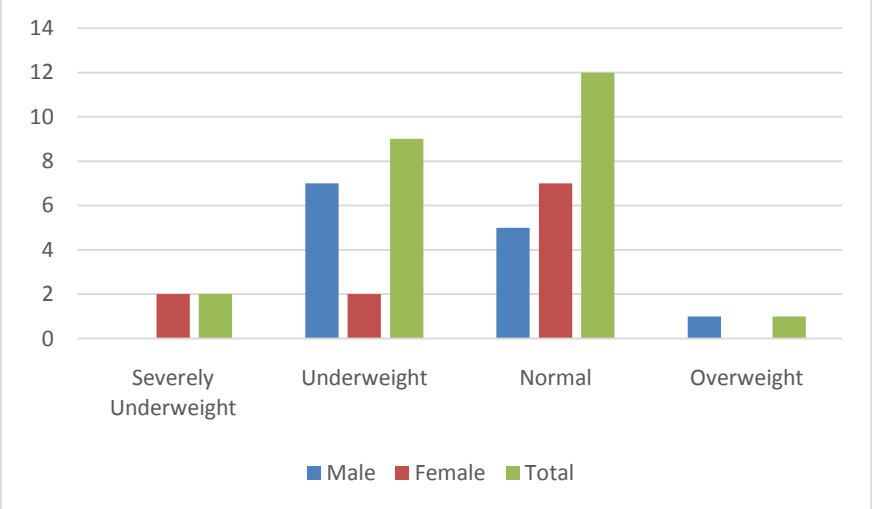

Fig.2 : Weight For Age Z-score in 0-5 years Old TOF Children Performed Total Correction

Weight For Height 0 to 5 Years Old

The percentage of wasting children (wasted and severely wasted) was quite small, only 12.5%. On the other hand, patients with overweight and obesity were 7 out of 24 (29%) (Fig.3)

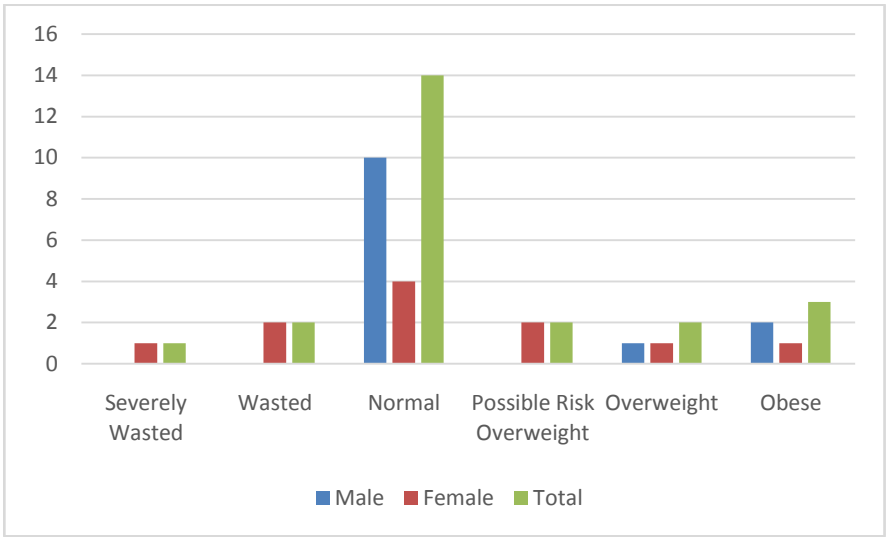

Fig.3 : Weight for Height Z-score in 0-5 years Old TOF Children Performed Total Correction

Height For Age 5 to 19 Years Old

Percentage of patients above 5 years old with stunting (stunted and severely stunted) was as high as 69.5% (16 out of 23 cases). Similar to patients below 5 years old, the prevalence of stunting was higher in male compare to the female (Fig.4).

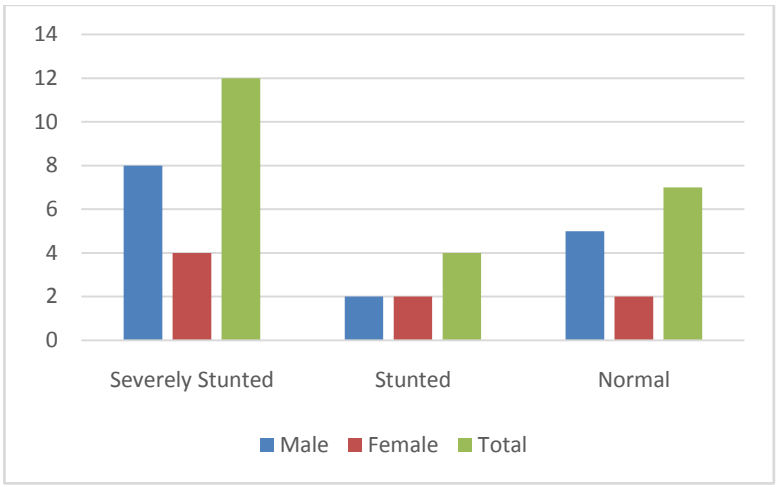

Fig.4 : Height for Age Z-score in 5-19 years old TOF Patients Performed Total Correction

BMI For Age 5 to 19 Years Old

The percentage of patients above 5 years old with thinness (thinness and severe thinness) was 39% (9 out of 23 cases). Only 1 patient was overweight and 2 patients were obese (Fig.5).

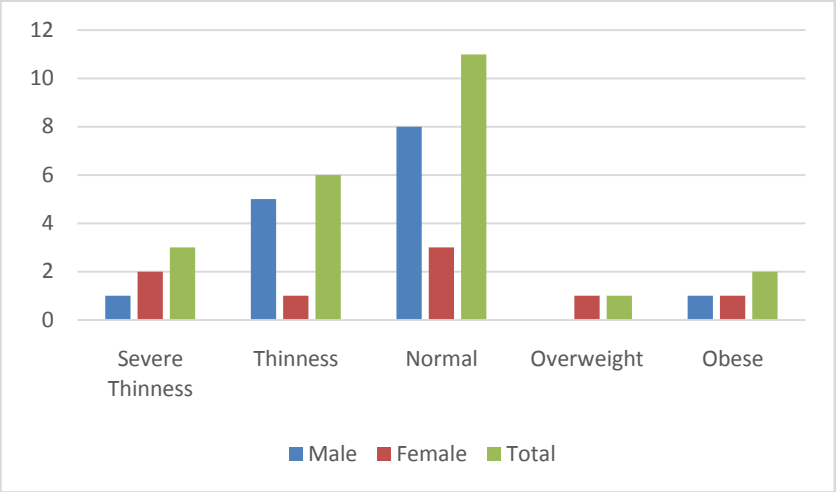

Fig.5: BMI for Age Z-Score in 5-19 years old TOF Patients performed Total Correction

3.3 Correlation Between Malnutrition & Mortality

The overall percentage of malnourished patients in our study was 72.34% (34 out of 47 cases). From 34 of the malnourished patients, 25 of them were severely malnourished (73.5%). The overall malnourished patients that had mortality after being perfomed total correction was 38.3%. Using Chi-Square method, it is shown that pre-operative malnutrition is significanty correlated to mortality in TOF patients after being performed total correction (p = 0.001). Patients with malnutrition also had increased risk for mortality as high as 2.12 times higher than patients without malnutrition (Table 2).

Table 2 Correlation between Malnutrition and Mortality

	Dead (n)	Alive (n)	Total	p-value	O.R
Nutritional Status					
Malnutrition	18	16	34	0.001	2.12
Normal	0	13	13		

Analyzed using Chi-Square Test

4. Discussion

In this study, the prevalence of TOF that was performed total correction was higher in male (59.6%) than female (40.4%). The overall mortality in our study is 38.3%. Additionally, the mortality was also higher in male rather than female patients with 39.3% and 36.8% respectively. Previous studies also showed that TOF prevalence and mortality was higher in male than female [13,14].

The optimum age of performing total correction is between ages 3 to 11 months [15]. However, in low-income country, most patients were performed surgery after 12 months of life. Contrary to the practice in developed countries, patients in developing countries tend to not receive timely repair intervention [11]. Poor access to health facilities leads to late presentation of TOF and contributes to malnutrition.

The high prevalence of malnutrition (72.34%) in our study, demonstrated the importance of assessing nutritional status in TOF patients. Additionally, 25 out of 47 patients (53%) of the patients were severely malnourished. Another studies in Indonesia also presented high number of TOF patients with malnutrition [4,17].

In this study, 38.3% patients with malnutrition suffered mortality after being performed total correction surgery. It was clearly showed that malnutrition was statistically significant to mortality when performed total correction surgery. Being malnourished at the time of operation increases the mortality rate of patients

as high as 2.12 times. A study in the same institution also show a high mortality rate in malnourished CHD patients [16]. Similar studies also show significant correlation of poor nutritional status and the outcomes of CHD patients undergoing surgery [18,19,20]. In contrast, in centers in europe, there are reports that malnutrition is not a risk factor for death when patients are operated [21].

The percentage of stunting was 87.5% in children 0-5 years old and 69.5% in children 5 years and above. The percentage of underweight was 46%, while thinness was 39% and wasted was only 12.5%. This was higher compare to the other study by Okoromah et al., that reported percentages of stunted, underweight, and wasting were 28.8, 20.5, and 41.1% respectively [22].

The percentage of nutritional status in this study showed variabilty, as this was explained by Okoroigwe et al., that children whose nutritional intakes are met with needs will have normal nutritional status [23]. On the other hand, children whose nutritional intakes do not met with needs are stunted, underweight and undernutrition. Some children with normal weight for height, low weight for age, and low height for age will have underweight as a result of short stature (stunted). In contrary, children who have low weight for height, low weight for age and normal height for age, will be underweight and undernutrition, even though they are not stunted [24].

To our knowledge, this is the first study that analyze malnutrition as risk factor for mortality in TOF children performed total correction in Indonesia. However, this study may yet to be generalized since it only involves single-center as the source of data. This is also a retrospective study thatuses consecutive samplings from all patients who were admitted for TOF diagnosis and performed total correction. Hence, selection bias might occur. Secondly, this study was conducted in the tertiary teaching hospital in Surabaya whereby the cases were mostly having severe conditions and complications. Thirdly, we did not collect other data that may impact post-operative outcomes, such as pre-operative comorbidities, peri-operative management such as cardiopulmonary bypass time and aortic cross-clamp time, physician care giver and surgical expertise, which would likely confound the results of our study. Nevertheless, our study uses WHO references for deriving HAZ, WAZ, WHZ, and BMIZ, which increases the generalizability of this study.

5. Conclusion

The result of this study shows the importance of numerous nutrtitional status measurements in children, namely height, weight, and body mass index to analyze TOF children's nutritional status. Our study demonstrates a high prevalence of pre-operative malnutrition and its significant impact on the mortality of TOF patients performed total correction surgery. Assessing this modifiable pre-operative variable could possibly reduce the high mortality rate in TOF repair.

6. Competing Interests

The authors declared that there is no conflict of interest.

7. References

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