Association between size and type of ventricular septal defect and nutritional status in children

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Abstract. Ventricular septal defect (VSD) is often associated with malnutrition. Nutritional status in VSD is affected by inadequate energy intake or increase energy requirement. The objective of this study to assess the association between size and type of VSD and nutritional status. A cross-sectional study was conducted at Dr. Mohammad Hoesin Hospital Palembang. Data were collected from medical record and statistical analysis Chi square. All of 401 VSD patients were 68.1\% perimembranous outlet, 25.7\% doubly committed subarterial, 2.7\% perimembranous outlet extension to inlet, 2.5\% muscular and 1\% inlet. The size of VSD were 133 (33.2\%) small, 219 (54.6\%) moderate, 49 (12.2\%) large. There were 43 (10.7\%) severely underweight, 278 (69.3\%) underweight, 80 (20\%) well nourished; 41 (10.2\%) stunting, 360 (72\%) normal height; 18 (4.5\%) severely wasting, 242(60.3\%) wasting and 141 (35.2\%) well nourished based on WAZ, HAZ and WHZ measurement respectively. There were a significant association between size of VSD and underweight (OR 18.147; 95\% CI 9.47 to 34.76; p=0.00) and wasting (OR 25.09; 95\% CI 14.55 to 43.26; p=0.00). There was a significant association between type of VSD and stunting (p=0.02). Our conclusion that significant association between size, underweight and wasting, also between type and stunting.

1. Introduction

One of the most common acyanotic congenital heart disease that was occured in children is ventricle septal defect (VSD). The incidence of VSD approximately 20\% of all congenital heart disease. Therefore, VSD may be classified as a perimembranous outlet, inlet, muscular and doubly committed subarterial defect. The defect vary in size and divided into small, moderate and large [1].

There is an association between energy intake, consumption of energy, nutritional status, and growth in infants and children with VSD. Although children born with congenital heart disease have normal birth weight, malnutrition and growth failure often appears in the first months of life. Wasting and underweight most common occur in children with acyanotic congenital heart, while stunting most common in cyanotic congenital heart disease [2–6].

It is multifactorial can cause malnutrition in VSD, such as inadequate energy intake. Feeding difficulty, recurrent upper respiratory tract infections, fluid restriction, side effects of giving diuretic drugs are many factors that cause the inadequate energy intake. Moderate to large VSD cause hemodynamic disturbances so that it will affect feeding difficulty [6–9].

Many previous studies have been reported the association between nutritional status with cyanotic and acyanotic CHD. Several studies have assessed malnutrition in VSD, but only a few studies have assessed the association between size, type of VSD and nutritional status. The objective of this study to assess the association between size and type of VSD and nutritional status.
2. Methods

This study a cross-sectional study was conducted at outpatients Pediatric Cardiology Clinic Dr. Mohammad Hoesin Hospital Palembang from January 2012 until December 2017. Data was collected retrospectively from medical records of 433 patients with VSD. The inclusion criteria were all VSD patients with a single lesion whose medical record data was complete. Exclusion criteria were VSD patients in complex heart disease and data from medical records were incomplete. Four hundred one including as a subject in this study.

Body weight measurements are performed using a standing electronic scale and baby scales by Seca®. Body height measurements are performed using the height measuring device by Seca®. To determine the size and type of VSD, echocardiography is examined with a Phillips HDX7® Echocardiography. Anthropometric measurement included weight in kilogram and height in centimeter. Nutritional status for weight for age (WAZ), height for age (HAZ) and weight for height (WHZ) was calculate by using the Anthropometric calculator module of WHO. For children more than 5 years old using curve of CDC.

Classification nutritional status based on WAZ measurements is divided into severely underweight if WAZ <-3SD, underweight if WAZ -3SD to -2SD, well-nourished if WAZ -2SD to 2SD, overweight if WAZ is more than 2 SD. Classification nutritional status based on HAZ measurement is divided into severely stunting if HAZ <-3SD, stunting if HAZ -3SD to -2SD, normal height if HAZ -2SD to 2SD and high if HAZ is more than 2SD. Classification based on WHZ measurement is divided into severely wasting if WHZ <-3SD, stunting if WHZ -3SD to -2SD, well-nourished if WHZ -2SD to 2SD, overweight if WHZ is more than 2SD.

Data were processed using SPSS version 20 software. The association between size, type of VSD and nutritional status was analyzed by Chi-square test with 95% confidence intervals, with significance value if p-value <0.05.

3. Results

The total data were collected from medical records 433, which met the 401 data inclusion criteria. Table 1 shows the characteristics of the study population.

| Characteristic                        | Frequency (n= 401) |
|---------------------------------------|--------------------|
| Sex, n (%)                            |                    |
| Male                                  | 228 (56.9%)        |
| Female                                | 173 (43.1%)        |
| Age, month, mean; SD (range)          | 77.6; 51 (2–284)   |
| Body weight, kg, mean; SD (range)     | 10.66; 9.8 (4–65)  |
| Body height, cm, mean; SD (range)     | 80; 29.5 (48–168)  |
| Type of VSD, n,%                      |                    |
| Perimembranous outlet                 | 273 (68.1%)        |
| Doubly committed subarterial         | 103 (25.1%)        |
| Inlet                                 | 4 (1%)             |
| Muscular                              | 10 (2.5%)          |
| Outlet extension to the inlet         | 11 (2.7%)          |
| Size of VSD, n (%)                    |                    |
| Small                                 | 133 (33.2%)        |
| Moderate                              | 219 (54.6%)        |
| Large                                 | 49 (12.2%)         |

In Table 1 it can be seen that the most type of VSD is the perimembranous outlet and the most size of VSD size is moderate. The study flowchart from this study can be seen in figure 1. In this study, the most nutritional status based on WAZ measurement is underweight and based on WHZ measurement is wasting. However, the nutritional status based HAZ measurement most of them is normal.
In table 2 there is a significant association between the size of VSD and underweight (OR 18.147; 95% CI 9.47 to 34.76; p=0.00) and there is a significant association between the size of VSD and wasting (OR 25.09; 95% CI 14.55 to 43.26; p= 0.00) respectively.

In table 3 there is a significant association between the size of VSD and stunting (p=0.02). Stunting occurs in 41 VSD patients with a mean age of 7 years. Twenty-four of the 41 VSD patients who suffered from stunting were the perimembranous outlet type. In this study stunting more common in patients with moderate to large VSD than small VSD.

4. Discussions
The size of the defect can affect nutritional status in patients with VSD. In our study, 10.7% were obtained severely underweight and 69.3% with underweight based on WAZ measurements. There were 10.2% with stunting based on HAZ measurements. It obtained 4.5% severely wasting and 60.3% wasting from WHZ measurements. This finding is similar to previous studies reported wasting [3], stunting, and underweight respectively 41.1%, 28.8%, and 20.5%. The other study was reported by Hasan BA et al., nutritional status in acyanotic congenital heart disease was 14.47% underweight,
11.84% wasting and 57.89% stunting[10]. In another study, showed the prevalence of wasting in CHD 41% [11]. The results of our study showed that the size of the defect varies, 33.3% small, 54.6% medium and 12.2% large. Similar to the research conducted by Salih AF in Iran, 40% of the study subjects were under 3 percentile and there were association between body weight, head circumference and size of VSD with p<0.05[12]. In Salih AF study also concluded 35.3% patients of moderate VSD with body weight below percentile 3[12]. In this study, there are also variations in the type of VSD which is 68.1% Perimembranous outlet, 25.7% DCSA, 2.5% muscular and 2.7% outlet extension to inlet and 1% inlet.

| Nutritional Status | Size of VSD       | OR    | 95% CI          | P value |
|--------------------|-------------------|-------|-----------------|---------|
|                    | Moderate to large | Small |                 |         |
| WAZ, n, %          |                   |       |                 |         |
| Underweight        | 250 (95.1)        | 13 (4.9) | 18.147 | 9.47–34.76 | 0.000  |
| Normal             |                   |       |                 |         |
| WHZ, n, %          |                   |       |                 |         |
| Wasting            | 230 (87.5)        | 30 (21.7) | 25.091 | 14.55–43.26 | 0.000  |
| Normal             | 33 (12.5)         | 108 (78.3) |       |           |         |
| HAZ, n, %          |                   |       |                 |         |
| Stunting           | 25 (9.5)          | 16 (11.6) | 0.80  | 0.41–1.57 | 0.5    |
| Normal             | 238 (90.5)        | 122 (88.4) |       |           |         |

| Variable                  | Nutritional status | HAZ measurement | P value* |
|---------------------------|-------------------|-----------------|---------|
| Type of VSD, n (%)        |                   |                 |         |
| Perimembranous outlet     | 24 (8.7)          | 252 (91.3)      | 0.02    |
| Doubly committed subarterial | 16 (16)       |                 |         |
| Inlet                     | 0 (0)             |                 |         |
| Muscular                  | 0 (0)             |                 |         |
| Outlet extension to inlet | 1 (9.1)          | 10 (90.9)       |         |

There was a significant association between type of VSD and stunting (p = 0.02). The mean age of children who suffered from stunting in this study was 7 years. According to the research conducted by Okoromah et al, stunting occurred due to chronic hypoxia in cyanotic CHD. This is possible because the natural history of VSD occurs heart failure which can influence weight gain in the acute process and height in the chronic process. While research conducted by Daymont et al compared the growth of children with congenital heart disease with varying severity with the growth of children without congenital heart disease. In this study showed that the growth acceleration occurred in the first 4 months, after the age of 36 months, there was no visible achievement of catch up growth in children with congenital heart disease [9,13]. This is possible because of the different characteristics of the subjects between Daymont et al. study with our study. In Daymont et al. study, cyanotic CHD was included in the study, which might influence the results of the study, where the reduction in body weight and height had occurred in the first 4 months of life. In the study conducted by Costello et al, concluded that there was a significant association between feeding difficulties and malnutrition based on standard measurements of body weight to age (WAZ) and height to age (HAZ) with p = 0.019 and p = 0.049 in patients with congenital heart disease[14]. Twenty-four of the 41 VSD patients who suffered from stunting were the perimembranous outlet type. In this study stunting more common in patients with moderate to large VSD than small VSD. This is possible by chronic growth disorders due to large defects and average age of more than 7 years. Of the 25 patients who were stunted with VSD PMO, there were 19 patients with moderate to large defects. But there were 6 patients with small defects. Stunting in small PMO patients is caused by other factors such as low birth weight due to
prematurity, intrauterine growth restriction and several syndromes that cause the chronic difficult problem in feeding that was not assessed in this study.

There are limitations of this study, including retrospective study, so that the other factors that affect nutritional status cannot be processed because there were no previous examinations, and also did not assess the incidence of recurrent upper respiratory tract infections, diarrhea and other acute infectious diseases which can influence nutritional status.

5. Conclusions

There is a significant association between the size of VSD, underweight and wasting. There is a significant association between type of VSD and stunting

Longitudinal follow-up studies on nutritional status are needed with many factors that affected malnutrition in patients with congenital heart disease.

6. References

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