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Prevalence of Congenital Heart Disease and Pediatric Rhythm Disorder or Arrhythmia in Children in Rantau-Prapat City, North Sumatra, Indonesia

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ABSTRACT

Background: Cardiovascular diseases (CVD) are responsible for the leading cause of a 30% global mortality rate and are a major contributor to reducing the quality of life. Approximately 25% of the cardiovascular mortality rate is caused by sudden cardiac deaths and cardiac arrhythmias are one of the causes of sudden cardiac deaths. Besides that, Congenital Heart Disease (CHD) also contributes mortality rate in children. Long-term experience has provided evidence that systematic screening, with 12-lead ECG, after history and physical examination, is effective in identifying individuals with potentially lethal cardiovascular disease for early intervention. However, in Indonesia screening for heart abnormalities and rhythm disorder in children has not yet been systematically established.

Method: This study was a descriptive study conducted through a cross-sectional study design. The primary objective was to assess the congenital heart disease (CHD) and Arryhtmia prevalence in children in Rantau City. Data was collected from interviews and on-the-spot examination with validated measurement tools. Data was analyzed using SPSS version 26. Categorical variables were presented using frequency (n) and percentage (%), and numerical variables with normally distributed data were presented with mean and standard deviation (SD). In non-normally distributed data, numerical variables were presented using the median and interquartile range.

Results: There were 157 children included in this study. Most subjects were female (n=94, 59.9%) in the age range of 12 to 16 years old. Most subjects (n=129, 82.2%) had normal sinus rhythm. The only rhythm disorder that was found in this study was sinus tachycardia (n=28, 17,8%). One subject (0,9%) had congenital heart disease, which was a secundum atrial septal defect.

Conclusion: In the children population in Rantau-Prapat city, the most common arrhythmia found in children was sinus tachycardia. The atrial septal defect was the only congenital heart disease found.

Keywords: Congenital heart disease, arrhythmia, pediatric rhythm disorder, children

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ABSTRAK

Latar Belakang: *Penyakit kardiovaskular (CVD) bertanggung jawab terhadap penyebab utama 30% angka kematian global dan merupakan kontributor utama penurunan kualitas hidup. Sekitar 25% angka kematian kardiovaskular disebabkan oleh kematian jantung mendadak dan aritmia jantung yang merupakan salah satu penyebab kematian jantung mendadak. Selain itu Penyakit Jantung Bawaan (PJB) juga turut menyumbang angka kematian pada anak. Berdasarkan Pengalaman jangka Panjang telah memberikan bukti bahwa skrining secara sistematis, dengan EKG 12 sadapan, setelah dilakukan anamnesis dan pemeriksaan fisik, terbukti efektif dalam mengidentifikasi individu dengan penyakit kardiovaskular yang mematikan untuk kepentingan intervensi dini. Namun di Indonesia, skrining kelainan jantung dan gangguan irama jantung pada anak belum dilakukan secara sistematis.*

Method: *Penelitian ini merupakan penelitian deskriptif yang dilakukan melalui desain studi cross-sectional. Tujuan utamanya adalah untuk menilai prevalensi penyakit jantung bawaan (PJB) dan Arryhtmia pada anak-anak di kota Rantau. Data dikumpulkan melalui wawancara dan pemeriksaan secara langsung dengan alat ukur yang telah tervalidasi. Analisis data menggunakan SPSS versi 26. Variabel kategori disajikan dengan frekuensi (n) dan persentase (%), variabel numerik dengan data berdistribusi normal disajikan dengan mean dan standar deviasi (SD). Pada data yang berdistribusi tidak normal, variabel numerik disajikan dengan menggunakan median dan rentang interkuartil*

Hasil: *Ada 157 anak yang dilibatkan dalam penelitian ini. Sebagian besar subjek adalah perempuan (n=94, 59,9%) dengan rentang usia 12 hingga 16 tahun. Sebagian besar subjek (n=129, 82,2%) memiliki ritme sinus normal. Satu-satunya gangguan ritme yang ditemukan pada penelitian ini adalah sinus takikardia (n=28, 17,8%). Sebanyak 1 subjek (0,9%) mempunyai penyakit jantung kongenital yaitu defek septum atrium sekundum.*

Kesimpulan: *Pada populasi anak di Kota Rantau, aritmia yang paling banyak ditemukan pada anak adalah sinus takikardia. Cacat septum atrium merupakan satu-satunya penyakit jantung bawaan yang ditemukan.*

Kata kunci: *Penyakit jantung bawaan, aritmia, gangguan ritme pada anak, anak-anak*

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1 Introduction

Cardiovascular diseases (CVD) are responsible for the leading cause of a 30% global mortality rate and are a major contributor to reducing the quality of life. Nearly 80% of CVD-related deaths take place in low and middle-income countries, CVD began to assume the role of the world's major cause of premature mortality and morbidity toward the end of the 20th century.[1] In 2017, there were reportedly 55 million fatalities worldwide, of which 17.7 million were attributable to CVD. Approximately 25% of the cardiovascular mortality rate is caused by sudden cardiac deaths and cardiac arrhythmias are one of the causes of sudden cardiac deaths. Besides that, Congenital Heart Disease (CHD) also contributes mortality rate in children. [2,1]

Pediatric rhythm disorders or arrhythmias in children are a common challenge due to their diverse etiologies ranging from benign variants to malignant arrhythmias. In the pediatric population, sinus tachycardia is the most commonly reported arrhythmia, followed by supraventricular tachycardia (SVT) and bradycardia.[3,4] In all dysrhythmias cases, 50% of them are sinus tachycardia. Sinus tachycardia is a tachycardia originating from the sinus nodes and is not considered part of SVT. Many conditions can cause sinus tachycardia, including fever, hypovolemia, medication, hyperthyroidism,

and illicit drug use. The major risk of arrhythmia is that it causes either severe tachycardia or bradycardia leading to decreased cardiac output, or it degenerates into more critical arrhythmias such as ventricular tachycardia and ventricular fibrillation which subsequently may lead to sudden death.[5,6]

Congenital heart disease (CHD) is the most common major congenital malformation, having a prevalence of 9 per 1000 live births. Over the past 70 years, survival among patients with CHD has effectively increased: >90% of such children born in the year 1990s reached adulthood.[7] Evidence from a15-year time trend analysis (2001–2015) of preventable child mortality in 34 members of the Organization for Economic Co-operation and Development, including the United States, Canada, Japan, Australia, New Zealand, and Europe, showed that congenital heart defects (CHDs) were the second leading cause of mortality in infancy (< 1year), the leading cause of mortality in children aged 1 to 4 years, and the third cause in older children (5–14 years old).[8]

The fundamental strategies for the prevention of sudden cardiac death include electrocardiographic screening of the general population, risk profiling, and interventions among patients with identified cardiac disease.[9] However, in Indonesia screening for heart abnormalities and rhythm disorder in children has not yet been systematically established. This situation affects the number of undiagnosed and uncorrected CHD in adulthood and also the outcome of corrective management in late-finding cases. Long-term experience has provided evidence that systematic screening, with 12-lead ECG, after history and physical examination, is effective in identifying individuals with potentially lethal cardiovascular disease for early intervention, and saves lives. For CHD patients, ideally for accurately estimating unrecognized CHD, especially for school-aged children we should use echocardiography for population-based screening.[10,11] Indonesia is the fourth most populated country in the world, and it is no different from the rest ofthe globe in that cardiovascular diseases (CVDs) pose a considerable health burden. Nearly one-third of all fatalities and the primary cause of disability in Indonesia are attributed to CVDs. Similar difficulties are faced by Rantau-Prapat City in reducing the frequency of CVDs, especially for rhythm disorders in children and congenital heart disease in children. Specifically for Rantau Prapat City, this research attempts to emphasize the significance of early screening as a proactive strategy to identify and address rhythm disorder in children and congenital heart disease in children.[12,13]

This study aims to screen for rhythm disorders and congenital heart disease profiles in the people of Rantau-Prapat City especially in childhood to prevent the development of these disorders

2 Method

This research was a descriptive study with a cross-sectional research design of people who participated in the examination at the Community Service Program of the Department of Cardiology

and Vascular Disease, Universitas Sumatera Utara. The study was held on March 8th, 2023 at Balai Kartini, Rantau Prapat City, and the study was conducted after obtaining approval (ethical clearance).

The sample is an affordable population that meets the inclusion criteria, children with age between 10 and to18 years old who want to participate in the study after being informed consent by their parents. Demographicvariables such as age and sex were obtained by interviewing the participants. Variables related tocardiometabolic were obtained by the spot examination by investigators. All participants had been told about the procedures of the examination and that the result of the study would be published. Participants had been signing the informed consent before the examination. The electrocardiograph (ECG) was obtained by using a KardiaMobile machine connected by Bluetooth to a mobile phone. The data obtained was ECG rhythm if it was sinus or sinus tachycardia or others. Body weight and height were measured by the GEA ZT-120 body weight scale that had been validated, and body mass index (BMI) was obtained by dividing the body weight by body height square.

Statistical Analysis

All data were processed and analyzed statistically using SPSS ver.26. Categorical variables are presented with frequency (n) and percentage (%). Numeric variables are presented with mean and standard deviation (SD) values for normally distributed data. As for the normal non-distributed data numerical variables are presented with the middle value (median) and the interquartile range.

3 Result

All subjects in the study (n=157) were 63 male and 94 female. Most subjects were female (n=94, 59.9%) in the age range 12 to 16 years old. Most subjects (n=129, 82.2%) had normal sinus rhythm. The only rhythm disorder that was found in this study was sinus tachycardia (n=28, 17.8%). One subject (0.9%) had congenital heart disease, which was a secundum atrial sepal defect. By the body weight, we found 27 underweight, 104 Normal weight, and 26 obesity. By the valve condition, the most participant is the normal valve (n=142, 90.4%), for the PR Mild (n=5, 3%), PR trivial (n=2, 1,3%), TR Mild (n=1, 0.6%), MR mild (n=1, 0.6%), AML Thickness (>3mm) (n=1, 0.6%), AML Prolaps + Thickening > 3 mm (n=1, 0.6%), PR mild + TR Mild (n=1, 0.6%), AML Thickening + MR mild (n=1, 0.6%), MR Mild + PR Mild + TR Mild (n=1, 0.6%). By the interatrial septal most participant was intake (n=156, 99.4) and defect (n=1, 0.6%), IAS, IVS, and PDA all participant was normal. The dimension of the heart chamber of all participants was normal (Table 1).

Table 1 Demografi Data

Variabel	Frekuensi (n=157)	Persentase (%)
Age (Mean±SD)	13.8 ± 0.8	
Gender		
Man	63	40.1
Woman	94	59.9
Body weight (Mean±SD)	48.1 ± 9.7	
Height (Mean±SD)	148.12 ± 9.5	

BMI		
Underweight	27	17.2
Normal	104	66.2
Obese	26	16.6
Father's last education		
Tidak sekolah	1	0.6
SD	15	9.6
SMP	22	14.0
SMA	91	58.0
S1	27	17.2
S2	1	0.6
Mother's last education		
No school	1	0.6
Primary School	23	14.6
Junior High School	24	15.3
High School	86	54.8
S1	23	14.6
S2	0	0
Income		
< IDR 3 million	83	52.9
IDR 3-10 million	73	46.5
>IDR 10 million	1	0.6
Number of rooms at home		
None	24	15.3
2 bedrooms	84	53.5
3 bedrooms	5	3.2
>3 bedrooms	44	28.0
Valve abnormalities		
Normal	142	90.4
PR mild	5	3.0
PR trivial	2	1.3
TR mild	1	0.6
MR mild	1	0.6
AML Thickness (>3mm)	1	0.6
AML prolapse tanpa regurgitasi	1	0.6
AML Prolaps + Thickening > 3mm	1	0.6
PR mild + TR Mild	1	0.6
AML Thickening + MR mild	1	0.6
MR Mild + PR Mild + TR Mild	1	0.6
The frequency of flu in families		
None	47	29.9
Rarely (1 time / 3 months)	13	8.3
Occasionally (1times / month)	84	53.5
Often (1times / week)	13	8.3
Aortic valve		
Normal	157	100
Abnormal	0	0
IAS		
Intact	156	99.4
Defect	1	0.6
IVS		
Intact	157	100
Defect	0	0
PDA		
Not Found	157	100
Found	0	0
Heart chamber dimensions		
Normal	157	100
Abnormal	0	0
IVC		
Normal	157	100
Abnormal	0	0
MPA		

	Normal	157	100
	Dilation	0	0
EKG			
	Sinus rhythm	129	82.2
	Sinus tachycardia	28	17.8

Regurgitation; MR, Mitral Regurgitation; PR, Pulmonary Regurgitation; TR, Tricuspid Regurgitation; IVC, Inferior Vena Cava; MPA, Main Pulmonary Artery; EKG, Elektrokardiogram; PVC, Premature Ventricular Contraction

4 Discussion

Out of 194 children studied, 53/194 (27.3 %, 95 % CI 21.0 – 33.6) children had arrhythmias. Of the CHD children, 44/194 (22.7 %, 95 % CI 16.8 – 28.6) had first-degree AV block while 9/194 (4.6 %, 95 % CI 1.7 – 7.6) children had either ectopic atrial rhythm, premature atrial contractions, junctional rhythm, complete atrioventricular (AV) dissociation or premature ventricular contractions. Children using digoxin were more likely to have first-degree AV block (OR 3.75, 95 % CI 1.60–8.86) while those aged 5 years and below were less likely to have first-degree AV block (OR 0.16, 95 % CI 0.07–0.37).[14] Within 24 hours of surgery, 59% of the neonates and 79% of the older children developed arrhythmias. Junctional ectopic tachycardia occurred in 9% of neonates and 5% of non-neonates and ventricular tachycardia in 3% and 15%, respectively. For neonates, male sex and longer cross-clamping time independently increased the risk for arrhythmias (odds ratios 2.83 and 1.96/minute, respectively). Ventricular septal defect repair was a strong risk factor for junctional ectopic tachycardia in neonates and older children (odds ratios 18.8 and 3.69, respectively). For infants and children, older age (odds ratio 1.01/month) and closure of atrial septal defects (odds ratio 2.68) predisposed to arrhythmias of any type.[15] The absence of arrhythmias in our study sample could be attributed to various factors, or the study population may have a lower prevalence of arrhythmias compared to the general pediatric population. It's also important to consider the sensitivity and specificity of the diagnostic methods used, as well as the patient selection criteria. Despite the lack of arrhythmia cases in this study, it is crucial to remain vigilant and acknowledge the potential for arrhythmias in pediatric patients. Regular screenings and comprehensive clinical assessments should continue to be an integral part of pediatric cardiology practice to ensure the early detection and management of arrhythmias, even if they were not observed in this particular sample. Further research with larger, more diverse samples may be needed to provide a more comprehensive understanding of the prevalence and types of arrhythmias in the pediatric population. It's essential to continuously update and refine our knowledge in this area to enhance the care and outcomes of pediatric patients.

This study did not identify any cases of arrhythmia in the sampled pediatric patients, it underscores the importance of ongoing research and vigilance in the field of pediatric cardiology.

The results of this study deviate from previous research which posited that a specific percentage of asymptomatic healthy children may encounter arrhythmias. This discrepancy may arise from differences in sample demographics, methodology, or other contributing factors that warrant further

investigation. Additionally, it is crucial to consider potential variations in diagnostic criteria and monitoring techniques employed across different studies, which could influence the reported prevalence of asymptomatic arrhythmias in this population. Further research and comparative analyses are needed to gain a comprehensive understanding of this phenomenon and its implications for pediatric cardiac health.

5 Conclusion

In the children population in Rantau-Prapat city, the most common arrhythmia found in children was sinus tachycardia. The atrial septal defect was the only congenital heart disease found.

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