

Epidemiological, Diagnostic and Therapeutic Aspects of Cardiogenic Shock in Children at the Albert Royer Children's Hospital in Dakar

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Abstract

Introduction: The objective of this study was to evaluate the epidemiological, diagnostic and therapeutic aspects of cardiogenic shock in children at the Albert Royer Children's Hospital in Dakar. **Methods:** This was a retrospective, descriptive and analytical study from January 2020 to February 2021, including all children aged 2 months to 16 years hospitalised for cardiogenic shock diagnosed on the basis of clinical and ultrasound criteria. **Results:** During the study, 38 patients were hospitalised for cardiogenic shock. The hospital prevalence was 4.2%. The mean age of onset of shock was 64 months, and there was a predominance of females with a sex ratio of 1.92. Consanguinity was found in 42% of the patients. Consanguinity was found in 42% of patients. Infection was identified as a trigger for cardiogenic shock in 18 (52.9%) of our patients. The most common type of heart disease was rheumatic heart disease in 12 (32%) of the patients. The mortality rate was 65.8%. **Conclusion:** Cardiogenic shock is a diagnostic and therapeutic emergency. Its prevalence and mortality are still high in developing countries.

Keywords

Heart Disease, Consanguinity, CMDH, Shortening Fraction, Senegal

1. Introduction

Cardiogenic shock is an acute circulatory failure due to impaired myocardial

contractility resulting in decreased cardiac output and pulmonary congestion [1]. It is an immediate life-threatening emergency. More frequent in adults, in whom it represents the main cause of mortality of patients hospitalised for myocardial infarction, cardiogenic shock is much rarer in children [2]. In children and infants, it can occur *de novo* in a healthy heart or in pre-existing congenital or chronic heart disease [3]. Heart failure in paediatric populations is a major public health problem. It is associated with high rates of hospitalisation, disability and mortality in high-income countries, but its burden is poorly documented in developing countries [4]. There are few published studies on cardiogenic shock in children worldwide and none in Senegal. It is in this context that we conducted this study to evaluate the epidemiological, diagnostic and therapeutic aspects of cardiogenic shock in children.

2. Methodology

This work was carried out at the Centre Hospitalier National d'Enfants Albert Royer (CHNEAR), which is the only exclusively paediatric level 3 public health establishment (EPS) in the Dakar region. It houses a paediatric cardiology department where the majority of children with congenital or acquired heart disease are followed. The study was retrospective, descriptive and analytical over a period of 14 months (from 01 January 2020 to 28 February 2021). Epidemiological, diagnostic, therapeutic and evolutionary parameters were collected from medical records and hospital registers. We included all children aged 2 months to 16 years hospitalised for cardiogenic shock confirmed on the basis of clinical criteria such as: tachycardia, prolonged skin recolouration time, arterial hypotension associated with signs of heart failure (hepatomegaly, gallop rhythm, cardiomegaly, oedema of the lower limbs) and echographic criteria: alteration of the RF (shortening fraction). The data were entered in Excel and analysed using SPSS (Statistical Package for Social Sciences) Statistics version 25. The significance threshold was retained for a p-value < 0.05. Patients were initially hospitalised in the reception and emergency department for stabilisation before being transferred to the paediatric cardiology department for follow-up. The duration of follow-up will depend on the patient's progress and the type of heart disease.

3. Results

During the period of our study 894 patients were hospitalised, of whom 164 for heart disease and 38 for cardiogenic shock, *i.e.* a hospital prevalence of 4.2%. Cardiogenic shock occurred in 23% of patients hospitalised for heart disease. The mean age was 64 months with a standard deviation of 67, the sex ratio was 1.92 in favour of girls. Parental consanguinity was found in 16 (42%) of our patients. The socio-economic level of our patients was considered low in 28 patients (74%), 26 (68%) of the patients came from the suburbs of Dakar. The socio-demographic characteristics are summarised in **Table 1**. Heart disease was diagnosed before the onset of cardiogenic shock in 24 (89%) patients. Infection

Table 1. Socio-demographic characteristics.

Parameters		Percentage %
Sex	Feminine	66
	Masculine	34
Age	0 - 23 months	55
	24 - 59 months	5
	60 - 120 months	11
	More than 120 months	29
Socio-economic level	Low	74
	Medium	26
Address	Suburbs of Dakar	68
	Dakar	14
	Outside the Dakar region	18

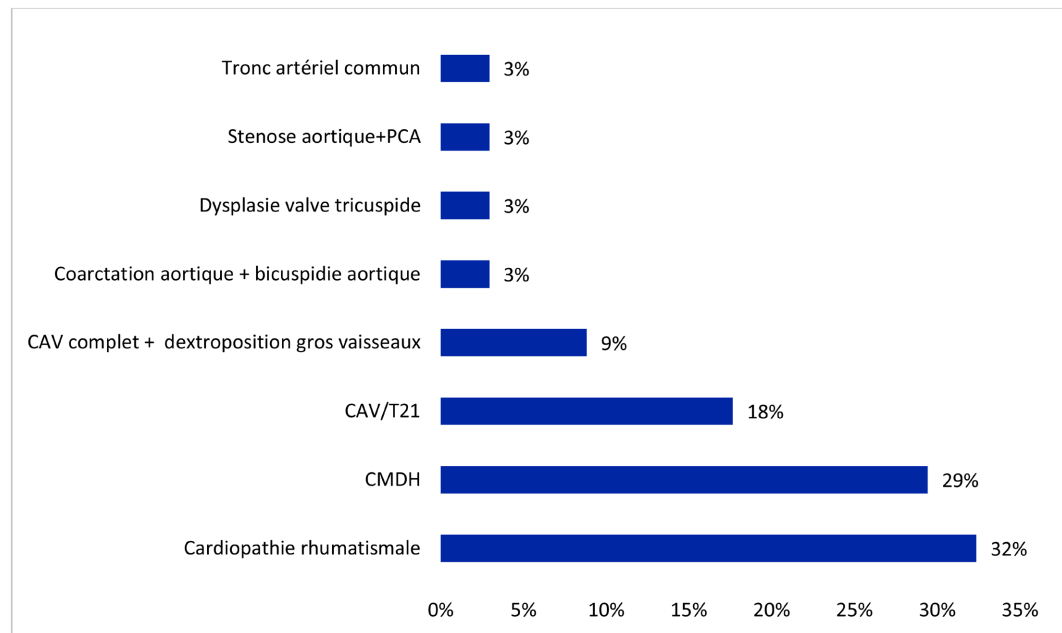
Table 2. Distribution according to the triggering factor of cardiogenic shock.

Triggering factor	Staff	Percentage (%)
Infection	18	52.9
Therapeutic rupture	8	23.6
Anaemia	2	5.9
Not found	6	17.6
Total	34	100

was identified as a trigger for cardiogenic shock in 18 (52.9%) of our patients (**Table 2**). The most common type of heart disease was rheumatic heart disease in 12 (32%) of the patients (**Figure 1**). The most common clinical signs were tachycardia, which was present in all our patients, as well as dyspnoea and cold extremities (**Table 3**). Respiratory distress was severe in 31 patients (81.6%) according to the clinical classification (CRS). All our patients had received dobutamine and oxygen therapy, 36 patients had received furosemide, 16 (42%) were intubated and ventilated. The evolution was marked by death in 25 of our patients; that is 65.8% (**Table 4**). All our deceased patients had respiratory distress classified as moderate or severe according to the CRS. All patients with a shock duration of more than 12 hours died (**Table 5**). All patients admitted with a shortening fraction (RF) on cardiac ultrasound of less than 16 (44%) died. Patients admitted with a RF of more than 22 had a favourable outcome.

4. Discussion

During the study period, 894 patients were hospitalised at the CHNEAR reception and emergency department, including 164 for heart disease and 38 for cardiogenic shock, *i.e.* a hospital prevalence of 4.2%. This prevalence is comparable



CMDH: Hypokinetic Dilated Cardiomyopathy; PCA: Persistence of the Arterial Canal; T21: Down syndrome.

Figure 1. Type of heart disease found.

Table 3. Clinical signs of cardiogenic shock.

Signs	Staff	Percentage (%)
Hepatomegaly	38	100
Turgor of jugular veins	24	63
Chinstrap hepatic reflux	34	89
Edema of the lower limbs	13	34
Dyspnoea	38	100
Cold ends	34	89
Profuse sweats	9	23
Skin recoloration time	38	100
Tachycardia	38	100

Table 4. Patient progress.

Evolution	Staff	Percentage (%)
Favorable	13	34.2
Death	25	65.8
Total	38	100.0

Table 5. Evolution according to the duration of the shock.

Duration (hours)		Evolution		Total
		Unfavourable	Favorable	
Duration (hours)	≤12 h	18	13	31
	13 h+	7	0	7
Total		25	13	38

to that found by Abrik *et al.* in Morocco in 2017 (3.7%) [5]. The higher prevalence in our study could be explained by the lack of paediatric cardiologists in the periphery. Most of our patients, 31% or 81%, came from the Dakar region. These results are comparable to the results of Sylla *et al.* in 2017 [6]. Dakar is the location of the CHNEAR which is a referral centre that polarises the population of Dakar and its suburbs. The socio-economic level was low in 73% of our patients. Azagoh-Kouadio *et al.* [7] found 61% of low socio-economic level in Côte d'Ivoire. Our results are in line with the literature which identifies low socio-economic level as a risk factor for the occurrence of acquired heart disease [8] [9]. Cardiogenic shock in children occurs most often in the presence of known heart disease [1] [10]. Indeed, in our series, 89% of the patients already had a known heart disease. However, we noted that 11% of our patients had no known cardiac disease. This could be explained by the number of under-diagnosed heart diseases linked to the lack of cardio pediatricians in Senegal. In our series, the etiologies found are similar to the data found in the literature. Indeed, Paut *et al.* in 2010, found 30% of congenital heart disease in the etiologies of cardiogenic shock [11] [12]. Furthermore, Chebab *et al.* in 2005 found a predominance of rhythm disorders and coronary birth defects (ALCAPA) in the etiologies of cardiogenic shock in children. These aetiologies were not found in our series and this could be due to an under-diagnosis because of the lack of exploration means such as the paediatric ECG. Rhythm disorders and coronary birth defects have been found in several European series and constitute the main etiology of cardiogenic shock in children [13] [14]. Blood pressure was unstopable in 39% of our patients. However, Randrianarison *et al.* in 2013 found unstopable blood pressure in 22% of patients [15]. The higher rate of impregnable blood pressure in the study could be explained by the fact that the majority of our patients came from the periphery, which delayed management. However, the recognition of cardiogenic shock is a diagnostic and above all a therapeutic emergency, as any delay in initiating appropriate treatment may lead to irreversible visceral damage. The presence of arterial hypotension is a sign of the advanced stage of cardiogenic shock in children [5].

The main therapeutic means used in our study were dobutamine and noradrenaline. In addition, 16 of our patients received mechanical ventilation. Other molecules are increasingly used in the treatment of cardiogenic shock, notably phosphodiesterase III (PDE III) inhibitors such as milrinone [16]. None of our patients benefited from ECMO (Extracorporeal Membrane Oxygenation) which is a therapeutic means indicated in refractory cardiogenic shock [17] [18]. The death rate in our series was 65%. The higher mortality in our study could be explained by several factors. Indeed, in our study, several therapeutic means were not used, notably second-line means in case of refractory shock, and the delay in the management of patients coming from the periphery. This can be explained by the technical platform which is still at a low level in our developing countries. Several means of resuscitation are not available in our hospitals.

The evolution of the patients depended on the severity of the cardiac damage. Indeed, in our study, all the patients who had an RF below 16 died and those with an RF above 22 evolved well. In several scientific series, the RF was considered as a prognostic element. Indeed, Bounhoure *et al.* in 2002 demonstrated that the lower the RF, the higher the risk of death [19].

5. Conclusion

Cardiogenic shock is a diagnostic and therapeutic emergency. It is a rare pathology in the pediatrics setting with little data available, especially in developing countries. Its diagnosis is often late in our country and its mortality is still very high. The improvement of the mortality rate could be achieved by improving the technical platform and the training of health personnel.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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