Journal of Advances in Medicine and Medical Research

Volume 35, Issue 17, Page 69-75, 2023; Article no.JAMMR.102143
ISSN: 2456-8899
(Past name: British Journal of Medicine and Medical Research, Past ISSN: 2231-0614, NLM ID: 101570965)

A Review of the Complications of Endomyocardial Fibrosis along with Their Physiological Compromise

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

Article Information

DOI: 10.9734/JAMMR/2023/v35i175111

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/102143

Review Article

Received: 19/04/2023
Accepted: 23/06/2023
Published: 05/07/2023

ABSTRACT

Endomyocardial fibrosis (EMF) is a cardiac condition characterized by the presence of fibrous tissue in the myocardium and endocardium, resulting in restricted heart function. This review focuses on the prevalence of EMF, which primarily affects the young population but can also be found in older individuals. The disease is most commonly observed in underdeveloped regions such as Uganda, Mozambique, South Asia, and South America. Recent studies have aimed to comprehensively understand this condition, and this review examines the complications associated with EMF based on case studies, clinical trials, experiments, and research. These complications include heart failure, regurgitation of the atrioventricular valves, arrhythmias, effusions in serous cavities, circulatory shock, stroke, myocardial ischemic syndromes, hepatic dysfunction, and end-organ dysfunctions. Fatalities can occur due to complications like heart failure, and the presence of left ventricular thrombosis increases the risk of systemic or cerebral thromboembolism, potentially leading to a stroke. The review also discusses management strategies that have proven effective, advancements in cardiac transplantation, and newly proposed therapeutic targets, which offer hope for mitigating the impact of EMF and its consequences.

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Keywords: Endomyocardial fibrosis; atrioventricular valves; organ dysfunctions; heart failure.

1. INTRODUCTION

"Fibrosis of the endomyocardium (EMF) was first described by diagnostician Jack N.P. Davies in 1947 in Uganda, East Africa [49-52]. EMF is an idiopathic form of cardiomyopathy characterized by the presence of fibrotic deposits and thickening of the myocardium and endocardium. This fibrosis typically extends from the ventricular apices to the valves, leading to restricted blood flow [37-45]. The fibrosis is often dense and can be localized or diffuse, primarily affecting the atrioventricular (AV) valves [46-48]. This compromises ventricular diastolic function and can negatively impact cardiac output. The progression of EMF can result in various cardiac defects and conditions, including left, right, or biventricular dysfunction" [1,2].

This study aims to provide valuable insights for decision-makers and researchers in monitoring the disease's progression and determining effective emergency approaches. One significant advantage is that accurate diagnosis of EMF cases can significantly reduce misdiagnosis, leading to appropriate therapeutic interventions. Furthermore, gaining a detailed understanding of this disease represents a significant advancement in the medical field.

Ultimately, this study aims to address the research gap regarding the complications and physiological compromises associated with EMF. By doing so, it will contribute to the overall knowledge and management of this condition.

2. LITERATURE REVIEW

2.1 History

"The discovery of endomyocardial fibrosis (EMF) can be attributed to diagnostician Jack N.P. Davies in 1947 in Uganda, East Africa. EMF is an idiopathic form of cardiomyopathy characterized by fibrous deposits and thickening of the myocardium and endocardium" [53-57]. This morphology extends from the ventricular apices to the valves, resulting in a restricted hemodynamic flow. The compromised diastolic function can have various implications depending on the progression of the disease, affecting the left, right, or both ventricles [3].

2.2 Etiology

The exact cause of EMF is still debated, but several studies have suggested risk factors such as eosinophilia, pathogen invasion, dietary factors (e.g., low magnesium, cerium content in potatoes), poverty, and inheritance.

2.3 Epidemiology

EMF is predominantly found in underdeveloped regions, particularly the tropics and sub-tropics of Africa, South America, and Asia. It primarily affects young populations, but adults and the elderly can also be affected, with the peak incidence estimated between 10 and 30 years of age. A study in a rural population in Mozambique using transthoracic echocardiography reported a high occurrence between the ages of 10 and 19 [4].

2.4 Anatomy

"The myocardial structure consists of three main layers: endocardial, myocardial, and epicardial layers. The endocardium lines the valves and chamber walls and serves as the endothelium of the great cardiac vessels. The myocardium is the thicker muscular layer responsible for myocardial systole, while the epicardium is the outermost layer associated with innervation, the lymphatic system, and coronary supply. Fibrous and serous pericardia surround the heart to prevent over-stretching during diastole" [5].

Classification:

EMF can be classified based on the affected ventricles:

1. **Left Ventricular Endomyocardial Fibrosis (LVEMF):**

"Involves fibrotic changes in the left ventricle, particularly the left apex, posterior bicuspid cusp, and left papillary muscle. It is one of the more common forms, accounting for approximately 2/5 of cases. LVEMF can be associated with pulmonary edema, left ventricular thrombus, increased risk of systemic embolism, and left atrial enlargement" [6].

2. **Right Ventricular Endomyocardial Fibrosis (RVEMF):**

"Involves fibrotic changes in the right ventricular apex, tricuspid valves, and right papillary muscles. RVEMF is a rarer form, accounting for approximately 1/10 of cases. Clinical features may include systemic congestion, elevated Jugular venous pressure (JVP), peripheral edema, ascites, and intramural thrombosis on the right side" [7].

3. **Biventricular Endomyocardial Fibrosis:**

Involves fibrotic changes in both the right and left ventricles, representing the most typical form, accounting for half of the cases. Clinical features may include a combination of RVEMF and LVEMF characteristics.

3. COMPLICATIONS AND PHYSIOLOGICAL COMPROMISES

EMF is a severe condition associated with various complications depending on the affected ventricles. Extensive research studies and clinical reports have documented these complications, aligning with findings from different healthcare centers and patients.

3.1 Heart Failure

Heart failure (HF), also known as cardiac failure, occurs when the heart is unable to effectively pump blood to meet the body's metabolic needs. In endomyocardial fibrosis (EMF), HF is commonly observed in approximately one-fifth (1/5) of cases. Diastolic HF, resulting from restrictive diastolic dysfunction imposed by EMF, is the typical outcome. HF accompanied by eosinophilia is often associated with fibrotic changes in the ventricular walls, which become stiff and rigid, leading to impaired diastolic function and a decrease in cardiac output [8].

3.2 Atrioventricular Valve Insufficiency

Atrioventricular valve insufficiency occurs when the mitral and/or tricuspid valves fail to close completely, causing hemodynamic backflow into the atria. EMF affects the atrioventricular valves by causing fibrosis of the papillary muscles and affecting the chordae tendineae. Severe mitral regurgitation has been documented as a complication of EMF.

3.3 Arrhythmias

"Arrhythmias refer to abnormal cardiac rhythms, including fast, slow, irregular, or non-normal patterns. Advanced atrioventricular valve regurgitation and the restrictive physiology imposed by EMF can lead to atrial dilatation, resulting in atrial arrhythmias such as atrial flutter and fibrillation. First-degree heart blocks and ventricular tachycardias have also been reported in EMF cases. Ventricular fibrillation, which can arise from ventricular tachycardias, increases the risk of cardiac arrest" [9].

3.4 Ascites

Ascites are the excessive accumulation of fluid in the peritoneal cavity. Right ventricular EMF has been associated with the development of ascites in less than half (1/2) of the cases, but it can also occur in left and biventricular EMF. Systemic congestion due to the restrictive physiology imposed by EMF contributes to the development of ascites, along with peripheral edema, splenomegaly, hepatomegaly, and parotid swelling.

3.5 Pericardial and Pleural Effusion

Pericardial effusion refers to the accumulation of fluid in the pericardium. It is a significant consequence of right-sided heart failure associated with EMF and is caused by increased diastolic pressures in the right side of the heart. Pleural effusions can occur due to elevated capillary pressures in the pulmonary system, leading to increased pulmonary interstitial fluid [10].

3.6 Cardiomegaly

Cardiomegaly refers to an enlarged heart size, often resulting from dilatation of the cardiac chambers. Mild cardiomegaly has been reported in EMF cases.

3.7 Thromboembolism

EMF is associated with an increased risk of thromboembolism. Thrombi are commonly found in the apical and intramural regions, with right atrial thrombus indicating right ventricular EMF. Although rare, left ventricular thrombosis has also been suggested in cases of left ventricular EMF. Cerebral embolism has been proposed as an initial indication of left ventricular EMF [11].

3.8 Death

EMF has a poor prognosis, with an estimated three-quarters (3/4) of patients experiencing mortality within 24 months of diagnosis. Physiological compromise, chronic heart failure, arrhythmias, and pulmonary thromboembolism contribute to the high mortality rate. Sudden cardiac death is a frequently observed outcome in EMF cases.

3.9 Cardiogenic Shock

Cardiogenic shock can occur at a critical stage of acute EMF or as a result of congestive heart failure induced by EMF.

3.10 Hepatic Dysfunctions

Hepatic dysfunctions include various morphological and physiological kidney alterations, such as hepatomegaly and hepatic necrosis, often seen in EMF cases.

3.11 Stroke

Stroke is a condition characterized by reduced brain oxygenation. EMF-induced stroke is less common but can occur due to systemic thromboembolism resulting from left or biventricular EMF. Recent reports have described cerebral embolism in cases of left ventricular EMF.

3.12 Myocardial Infarction

Myocardial infarction may occur as a complication of significant coronary thromboembolism resulting from left ventricular thrombosis or severely impaired systolic function in EMF cases.

3.13 Pulmonary Hypertension and Pulmonary Edema

Pulmonary hypertension and pulmonary edema are typical of left ventricular dysfunction in EMF. Pulmonary hypertension can lead to pulmonary edema and an increased risk of lung infections, such as pneumonia and tuberculosis [19-22].

3.14 End-Organ Failure

Significant reduction in cardiac output can lead to compromised functioning of multiple organs, often initiated by severe hypotension or shock [12].

4. CONCLUSION

Endomyocardial fibrosis (EMF) is a rare and often misdiagnosed condition that greatly compromises the body, leading to various complications and high morbidity and mortality rates. These complications include heart failure, regurgitations of the tricuspid or mitral valves, arrhythmias, ascites, pleural and pericardial effusions, cardiogenic shock, stroke, myocardial infarction, and end-organ damage. Early recognition and treatment are crucial in preventing these complications and improving prognosis.

4.1 Management Strategies

Both early and late recognition and management of EMF have shown improved prognosis. Treatment strategies include heart failure control with diuretics or angiotensin-converting enzyme (ACE) inhibitors, along with aspirin unless the patient is unresponsive to pharmacological therapy. In severe cases, invasive interventions such as valvular repair/replacement and endocardectomy have been traditionally employed and have shown positive outcomes [13-18]. In critical cases where the patient's physiology is severely compromised, heart transplantation has been reported as a viable option. Recent advancements, such as the xenotransplantation of genetically modified porcine hearts, show promise in addressing the challenge of finding suitable donor hearts for transplantation. While further research and improvements are needed, these advancements offer hope for heart-compromised patients and the potential to reduce mortality rates [23-28].

In summary, ongoing advancements in heart transplantation, including xenotransplantation, hold promise for improving outcomes and providing solutions for patients in urgent need of a heart transplant. Continued research and refinement of these techniques could lead to more favorable outcomes for individuals with immediate heart transplantation needs.

4.2 Therapeutic Targets

Current research is providing valuable insights into the pathophysiological mechanisms of cardiac fibrosis, which may lead to potential therapeutic targets. Some studies have shown

success in preventing ventricular remodeling through interventions such as myocardial fibrosis patchy reversion using rhACE2-electrospun. Ongoing clinical investigations are focused on understanding the mechanisms that contribute to cardiac fibrosis [29-36]. Additionally, advancements in diagnostic algorithms, such as grey-scale ultrasonographic wireless technology, have shown promise in improving the diagnosis and treatment of fibrotic conditions.

4.3 Future Studies

Future studies on endomyocardial fibrosis (EMF) will aim to further narrow down the exact pathogenesis and identify specific therapeutic targets, including those currently under investigation. Comparative studies between surgical treatments and modified xenotransplantation heart interventions will be of interest. Furthermore, future research will explore potential medications to support the management of EMF.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/102143