

Cardiogenic Stroke: Bridging the Gap Between Cardiology and Neurology

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Abstract

Cardiogenic stroke is primarily caused by emboli, which originates in the heart. This process is the connection between cardiac and neurological health. It leads to a critical subset of ischemic stroke. This review aims to elucidate the mechanisms, risk factors, diagnostic strategies, and multidisciplinary management of cardiogenic stroke and also the necessity for integrated care between cardiology and neurology. According to the findings obtained from the analysis of literature, several primary mechanisms are presented which include atrial fibrillation, valvular heart disease, cardiomyopathy, myocardial infarction, and patent foramen ovale. In addition, there are also risk factors like hypertension, diabetes mellitus, hyperlipidemia, smoking, age, and obesity. Fundamental diagnostic approaches including neurological examinations, neuroimaging, cardiovascular monitoring, echocardiography, and laboratory investigations require more attention. The analysis of the literature shows that the most efficient strategy in the management of cardiogenic stroke is multifactorial, including acute measures such as thrombolysis and endovascular therapy, chronic anticoagulation, surgeries, and secondary prevention. This integrated approach between cardiology and neurology is vital in the improvement of diagnosis, short-term and long-term management as well as prevention. It is crucial to utilize enhanced interdisciplinary cooperation for developing therapeutic interventions, reducing the burden of cardiogenic stroke, and improving patients' outcomes.

Keywords

Cardiogenic Stroke, Atrial Fibrillation, Valvular Heart Disease, Patent Foramen Ovale, Ischemic Stroke, Embolism, Anticoagulation, Interdisciplinary Collaboration

Introduction

Cardiogenic stroke is one of the most common and severe types of ischemic stroke. It is primarily linked to the generation of emboli of cardiac origin, which underlines the relevance of cardiovascular and cerebrovascular health. Therefore, the management of both cardiology and neurology entails a multidisciplinary and integrative approach. The aim of this review is to present a comprehensive account of cardiogenic stroke involving the

pathological process, contributing factors, diagnostic approaches, and therapeutic approaches, with an emphasis on the need to establish and promote interprofessional practice in managing the condition and improving patient outcomes.

Main body

Mechanisms of Cardiogenic Stroke

Pathophysiology of cardiogenic stroke mainly involves the embolism arising from the heart, it is driven by several key mechanisms:

1. Atrial Fibrillation (AF): AF is an irregular heart rhythm that results in increased thrombus formation in the left atrium; when these clots move to the brain, they can lead to ischemic stroke. The CHA2DS2-VASc score helps in the evaluation of stroke risk in AF patients (Table 1).

Table 1-CHA2DS2-VASc Score for Stroke Risk in Atrial Fibrillation

| Risk Factor | Points |
|---|--------|
| Congestive heart failure/LV dysfunction | 1 |
| Hypertension | 1 |
| Age ≥ 75 years | 2 |
| Diabetes mellitus | 1 |
| Stroke/TIA/thromboembolism | 2 |
| Vascular disease (prior MI, PAD, aortic plaque) | 1 |
| Age 65-74 years | 1 |
| Sex category (female) | 1 |

Scoring:

- a. 0 points: Low risk - No anticoagulation recommended.
 - b. 1 point: Moderate risk - Consider anticoagulation.
 - c. ≥ 2 points: High risk - Anticoagulation recommended.
2. Valvular Heart Disease: Conditions such as mitral stenosis and prosthetic heart valves, encourage the formation of thrombi, thereby increasing the risk of embolic stroke. Management consists of strict anticoagulation and in certain circumstances, surgical intervention is required.
 3. Cardiomyopathy: Thrombus formation takes place in cardiac chambers in both dilated and hypertrophic cardiomyopathies due to the alterations of the hemodynamics, thus it contributes to increasing the risk of cerebral embolism.
 4. Myocardial Infarction (MI): The post-MI patients are at a higher risk for thromboembolic events because of myocardial damage and wall motion abnormalities. In the acute phase, it is necessary to monitor strictly.
 5. Patent Foramen Ovale (PFO): In this condition, the thrombi that developed in the veins are allowed to circulate freely or pass directly to the arterial side through this congenital anomaly, then increasing the risks of paradoxical embolization and possible stroke.

Risk Factors

Cardiogenic stroke's risk factors include numerous cardiac and systemic characteristics:

1. Hypertension: Aggravates endothelial lesions and thrombus formation, that significantly enhance the risk of stroke.
2. Diabetes Mellitus: exacerbates the atherogenesis process and increases the possibility of stroke and other cardiovascular conditions.
3. Hyperlipidemia: Promotes the formation of atherosclerotic plaque and subsequent embolic events.
4. Smoking: Aggravates the course of cardiovascular and cerebrovascular events, thereby increasing the risk of a stroke.
5. Age and Obesity: As the patients get older and gain weight, the risk of developing Atrial Fibrillation (AF) and other cardiogenic embolism conditions increases.

Diagnostic Strategies

Precise diagnosis of cardiogenic stroke requires a coordinated neurologic and cardiac assessment:

1. Neurological Evaluation: Tools such as the National Institutes of Health Stroke Scale (NIHSS) are used to assess the severity of neurological deficits.
2. Neuroimaging: Computed tomography (CT) and magnetic resonance imaging (MRI) both support ischemic stroke diagnosis, and diffusion-weighted imaging (DWI) helps pinpoint acute infarcts.
3. Cardiac Monitoring: Electrocardiography (ECG) detects AF and other arrhythmias, additionally Holter monitors and implantable loop recorders identify paroxysmal AF.
4. Echocardiography: Transthoracic echocardiography (TTE) and transesophageal echocardiography (TEE) are used to visualize cardiac structures, and identify intracardiac thrombi, valvular abnormalities, and Patent Foramen Ovale (PFO).
5. Laboratory Tests: Cardiac biomarkers as well as clotting profiles are some of the initial laboratory tests that identify underlying risk factors and determine required management.

Multidisciplinary Management

Treatment of cardiogenic stroke requires both acute care as well as long-term management, which needs cooperation between cardiac and neurological departments:

1. Acute Management:
 - a) Thrombolysis: Intravenous tissue plasminogen activator (tPA) is injected within its specific therapeutic timeline.
 - b) Endovascular Therapy: Mechanical thrombectomy is used for patients with large vessel occlusions, and improves their outcomes.
2. Cardiac-Specific Interventions:
 - a) Anticoagulation Therapy: In AF and high-risk conditions, it is recommended to use long-term anticoagulation (e.g., warfarin, DOACs) to prevent recurrent stroke.
 - b) Cardioversion and Ablation: In patients with AF, correct sinus rhythm to decrease the risks of thromboembolic incidences.
 - c) Surgical Interventions: Manage valvular defects and also are used to close PFO, thereby decreasing the embolic dangers.
3. Secondary Prevention:
 - a) Pharmacotherapy: Comprises antiplatelet agents, statins, and antihypertensive to control cardiovascular risk factors.
 - b) Lifestyle Modifications: It is focused on encouraging patients to stop smoking, maintain a healthy

weight, increase physical activity, and consume a heart-healthy diet plan.

- c) **Regular Monitoring:** Cardiovascular and neurological monitoring for a long time is important to modify therapeutic approaches according to the risk change.

Conclusion

Cardiogenic stroke is the association between cardiology and neurology; promoting the diagnosis, treatment, and prevention of this complication needs a multidisciplinary approach. Multidisciplinary collaboration in research, practice, and education for this disabling disease and its management should be encouraged. Interdisciplinary collaboration will bring novel developments in managing and preventing cardiogenic stroke for patients and global health improvement.

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Appendices

1. National Institutes of Health Stroke Scale (NIHSS)

The NIHSS is a systematic assessment tool to quantify the severity of the stroke. It examines a given patient's neurologic impairment due to a stroke. It evaluates the following areas:

- a) Level of consciousness
- b) Best gaze
- c) Visual fields
- d) Facial palsy
- e) Motor function (arm and leg)
- f) Limb ataxia
- g) Sensory function
- h) Language
- i) Speech (dysarthria)
- j) Extinction and inattention (neglect)

2. Diagnostic Imaging Modalities

- a) **Computed Tomography (CT):**
 - i. Non-contrast CT is often used as the first imaging study to exclude hemorrhage in patients.
 - ii. CT angiography (CTA) is useful in the evaluation of the extracranial vasculature as well as the intracranial vasculature.
 - iii. CT perfusion (CTP) imaging aids in the assessment of cerebral blood flow and depiction of ischemic penumbra.
- b) **Magnetic Resonance Imaging (MRI):**
 - i. Diffusion-weighted imaging (DWI) detects acute ischemic changes.
 - ii. Magnetic resonance angiography (MRA) evaluates blood vessels.
 - iii. Perfusion-weighted imaging (PWI) assesses cerebral blood flow and volume.

3. Echocardiographic Techniques

- a) **Transthoracic Echocardiography (TTE):**

- i. Safe and accessible to the majority of patients.
- ii. Helpful to use for visualization of cardiac chambers and understanding the state of their walls, and functions of the heart in general.
- b) Transesophageal Echocardiography (TEE):
 - i. Improves visualization of the left atrium, atrial appendage, and atrial septum.
 - ii. More sensitive in diagnosing left atrial thrombi, PFO, and valvular diseases.

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