

Heart Failure and Ischemic Stroke: Prevalence of Sick Euthyroid Syndrome and the Role of Neuroimaging in Predicting Early Neurological Deterioration

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Abstract

Heart failure (HF) and ischemic stroke are major contributors to global morbidity and mortality. Emerging evidence suggests that endocrine and neuroimaging biomarkers may provide valuable prognostic information in these conditions. Sick Euthyroid Syndrome (SES), also known as non-thyroidal illness syndrome, is characterized by altered thyroid hormone levels in the absence of intrinsic thyroid disease and is frequently observed in patients with chronic and acute heart failure. Concurrently, advanced neuroimaging techniques have shown promise in predicting early neurological deterioration (END) among patients with acute ischemic stroke. This review examines the prevalence and clinical significance of SES in heart failure and evaluates the role of neuroimaging modalities in forecasting early deterioration following ischemic stroke. Understanding these prognostic indicators may facilitate early risk stratification and improve clinical outcomes.

Keywords: Heart Failure, Sick Euthyroid Syndrome, Non-thyroidal Illness Syndrome, Ischemic Stroke, Neuroimaging, Early Neurological Deterioration

Introduction

Heart failure remains a leading cause of hospitalization worldwide and is associated with significant mortality despite advances in medical management. Neuroendocrine dysfunction has increasingly been recognized as a critical component of HF pathophysiology. Among these abnormalities, Sick Euthyroid Syndrome is particularly important due to its association with disease severity and adverse outcomes. Similarly, ischemic stroke is a time-sensitive neurological emergency. Although reperfusion therapies have improved outcomes, a substantial proportion of patients experience early neurological deterioration within the first 24–72 hours. Accurate prediction of END through neuroimaging may assist clinicians in identifying high-risk individuals and implementing timely interventions.

Sick Euthyroid Syndrome in Heart Failure

SES is characterized by reduced serum triiodothyronine (T3) levels, normal or low thyroxine (T4), and normal or slightly reduced thyroid-stimulating hormone (TSH) concentrations. The syndrome develops as an adaptive response to systemic illness but may become maladaptive in prolonged disease states.

Studies indicate that SES occurs in approximately 20–35% of patients with chronic heart failure, with prevalence increasing among individuals with advanced disease and reduced left ventricular ejection fraction. In acute decompensated heart failure, the prevalence may exceed 40%, reflecting the severity of systemic metabolic stress.

Low T3 syndrome has been associated with impaired myocardial contractility, endothelial dysfunction, reduced exercise tolerance, and increased inflammatory activity. Several observational studies have demonstrated a strong correlation between reduced T3 levels and higher mortality rates, longer hospital stays, and increased rates of rehospitalization. Furthermore, thyroid hormone abnormalities appear to parallel established prognostic markers such as natriuretic peptides and left ventricular dysfunction.

The pathophysiological mechanisms underlying SES in HF include reduced peripheral conversion of T4 to T3, increased inflammatory cytokine activity, altered deiodinase enzyme function, and impaired tissue perfusion. Consequently, assessment of thyroid hormone profiles may serve as a useful adjunct in prognostic evaluation of heart failure patients.

Neuroimaging and Prediction of Early Deterioration in Ischemic Stroke

Early neurological deterioration is a major determinant of poor functional outcomes after ischemic stroke. Neuroimaging plays a pivotal role in identifying patients at risk before clinical worsening becomes evident.

Computed Tomography (CT) remains the first-line imaging modality due to its rapid availability. CT angiography can detect large vessel occlusions, arterial stenosis, and collateral circulation status. Poor collateral circulation has consistently been associated with increased risk of END and unfavorable outcomes.

Magnetic Resonance Imaging (MRI), particularly diffusion-weighted imaging (DWI), provides superior sensitivity for early ischemic changes. Larger DWI lesion volumes have been linked to a higher likelihood of neurological deterioration. Perfusion-weighted imaging (PWI) further identifies ischemic penumbra and regions at risk of infarct expansion.

Advanced imaging biomarkers such as mismatch between diffusion and perfusion lesions, blood-brain barrier disruption, and thrombus characteristics have shown prognostic value. Recent studies incorporating artificial intelligence and machine learning algorithms have demonstrated improved accuracy in predicting END through automated analysis of imaging features. These models integrate infarct size, vascular occlusion patterns, perfusion deficits, and clinical variables to generate individualized risk assessments.

The use of multimodal imaging can therefore facilitate early identification of vulnerable patients and guide decisions regarding intensive monitoring, reperfusion strategies, and neuroprotective interventions.

Discussion

Both SES in heart failure and neuroimaging markers in ischemic stroke represent important prognostic tools that reflect underlying disease severity. While SES provides insight into systemic metabolic and endocrine disturbances associated with HF progression, neuroimaging offers objective assessment of cerebral tissue viability and vascular pathology in stroke.

Integrating endocrine biomarkers with advanced imaging techniques may contribute to more comprehensive risk stratification in cardiovascular and cerebrovascular diseases. Future prospective studies are required to determine whether targeted correction of thyroid hormone abnormalities and AI-assisted imaging analysis can improve patient outcomes.

Conclusion

Sick Euthyroid Syndrome is highly prevalent among patients with heart failure and is associated with increased disease severity and mortality. In ischemic stroke, neuroimaging modalities such as CT angiography, diffusion-weighted MRI, and perfusion imaging provide valuable predictive information regarding early neurological deterioration. Recognition of these prognostic indicators may enhance early intervention strategies and improve clinical outcomes. Further research is warranted to establish standardized protocols for their incorporation into routine clinical practice.

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