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Characterization of Radiological Features in Pediatric Sickle Cell Disease-Associated Stroke

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Introduction

Sickle cell disease (SCD) is a genetic hematologic disorder characterized by the production of abnormal hemoglobin, leading to the deformation of red blood cells into a crescent or sickle shape. These abnormally shaped cells cause blockage of blood flow, leading to ischemic events and damage to various organs, including the brain. Pediatric stroke associated with SCD is a critical and severe complication, as it can result in long-term neurological impairment and cognitive deficits. Early detection and characterization of stroke in children with sickle cell disease are crucial for timely intervention to reduce morbidity and improve outcomes. Radiological imaging plays a pivotal role in diagnosing, characterizing, and monitoring the progression of strokes in pediatric patients with SCD. This article focuses on the radiological features of stroke in children with sickle cell disease, with an emphasis on MRI, MR angiography, and other imaging techniques that are used to assess stroke and related complications [1].

Pathophysiology of Stroke in Sickle Cell Disease

Stroke in pediatric SCD patients typically occurs due to cerebral infarction, resulting from the blockage of cerebral blood vessels by sickled red blood cells, which leads to tissue ischemia. The abnormal red blood cells tend to cause vascular occlusion, particularly in smaller blood vessels, leading to a reduced blood supply to the brain. This ischemic event can result in a variety of clinical manifestations, including hemiparesis, speech deficits, seizures, and in some cases, long-term cognitive impairments. Stroke in children with sickle cell disease is most common between the ages of 2 and 16 years and is more prevalent in those with moderate to severe forms of the disease, such as hemoglobin SS or hemoglobin Sβ^0 thalassemia [2]. The occurrence of stroke in children with SCD can be attributed to a combination of factors, including chronic anemia, hemoglobin polymerization, and the increased tendency for blood clots to form. These factors impair normal blood flow, leading to an elevated risk of both ischemic and hemorrhagic strokes. Sickle cell disease can also lead to the formation of cerebral microvascular abnormalities, such as moyamoya disease, which increases the risk of stroke by narrowing the blood vessels in the brain [3].

Role of MRI in Pediatric Sickle Cell Disease-Associated Stroke

Magnetic resonance imaging (MRI) is the most commonly used imaging modality for the detection and characterization of stroke in pediatric SCD patients. MRI provides detailed images of the brain parenchyma and can identify areas of ischemia, infarction, and other structural changes associated with stroke. One of the key advantages of MRI in this context is its ability to detect subtle changes in brain tissue that may not be visible on other imaging modalities, such as CT scans [4]. In the acute setting, MRI is particularly effective in identifying early ischemic changes, such as cytotoxic edema and restricted diffusion in the affected brain regions. Diffusion-weighted imaging (DWI), a specific MRI sequence, is highly sensitive in detecting acute ischemia by measuring the movement of water molecules in the tissue. In stroke, restricted diffusion in the affected brain areas indicates a lack of blood flow and is a hallmark of ischemic injury. These changes typically appear as hyperintense areas on DWI and hypointense on apparent diffusion coefficient (ADC) maps, which further characterize the degree of ischemia [5]. In chronic stroke or infarct, MRI can show areas of brain atrophy and gliosis, which are indicative of long-term damage. T2-weighted and FLAIR sequences can reveal areas of chronic ischemia as hyperintense lesions, which are often seen in the white matter and subcortical regions. These lesions correspond to areas where the brain tissue has been permanently damaged due to a lack of blood supply. MRI can also identify areas of hemorrhage, which can occur in certain types of stroke in SCD patients [6].

MR Angiography in the Assessment of Cerebrovascular Changes

Magnetic resonance angiography (MRA) is a non-invasive imaging technique that can provide detailed images of the blood vessels in the brain, making it especially useful in evaluating cerebrovascular changes in pediatric SCD patients with stroke. MRA can detect stenosis, occlusions, and abnormal vessel growth, which are common in SCD-associated strokes [7]. In children with SCD, MRA can reveal narrowing or occlusion of the cerebral arteries, particularly in the distal portions of the middle cerebral artery (MCA) and the internal carotid arteries (ICA). Additionally, MRA can identify the presence of moyamoya vessels, which are characteristic of certain SCD-related strokes. Moyamoya disease is a condition where the brain's blood vessels become narrowed and blocked, leading to the formation of abnormal collateral vessels. These vessels, although compensatory, are fragile and prone to rupture, further increasing the risk of hemorrhagic events in SCD patients [8]. Another important feature that MRA can detect is the presence of vascular malformations, which can complicate stroke management and affect treatment Janisions. MRA is non-invasive and provides high-resolution images of the cerebral vasculature, making it an essential tool for evaluating stroke in pediatric SCD patients.

CT Imaging in Pediatric Sickle Cell Disease-Associated Stroke

While MRI is the primary imaging modality for evaluating stroke in children with sickle cell disease, computed tomography (CT) imaging

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can also be useful in certain clinical scenarios. CT is more widely available and faster than MRI, making it a helpful tool in acute settings where immediate diagnosis is needed, especially when MRI facilities are not readily accessible. CT can quickly detect large hemorrhagic strokes, which may occur in patients with SCD due to vascular rupture or increased intracranial pressure. However, CT is less sensitive than MRI in detecting early ischemic changes. In the acute phase of stroke, CT may not show any abnormalities until several hours after the event, whereas MRI with diffusion-weighted imaging can identify ischemia within minutes. Despite its limitations in early detection, CT is still an important diagnostic tool for evaluating stroke and guiding treatment Janisions in pediatric patients with SCD.

Ultrasound and Other Imaging Modalities

In addition to MRI, MR angiography, and CT, ultrasound is another imaging technique used to assess cerebrovascular health in pediatric patients with SCD. Transcranial Doppler ultrasound (TCD) is particularly useful for detecting abnormal blood flow in the major cerebral arteries, which can help identify children at high risk for stroke. Elevated blood flow velocities in the middle cerebral artery (MCA) are considered a risk factor for stroke and are often used as an indication for more aggressive treatment and surveillance. While ultrasound is an excellent tool for screening and monitoring cerebrovascular changes in SCD patients, it does not provide the same level of detail as MRI or MRA for characterizing stroke or its underlying causes. However, it is a valuable complementary tool in the overall management of pediatric SCD and stroke risk.

Clinical Implications and Management

The early detection of stroke and associated cerebrovascular abnormalities in pediatric SCD patients is crucial for initiating appropriate treatment and preventing further neurological damage. Radiological imaging, particularly MRI and MR angiography, plays a key role in diagnosing stroke, characterizing its type and extent, and identifying underlying vascular changes such as moyamoya disease and vessel occlusions. Early identification of these abnormalities allows for timely intervention, including the use of blood transfusions, hydroxyurea therapy, and in some cases, surgical interventions like vascular reconstruction. In addition to the direct management of stroke, regular surveillance using imaging modalities such as MRI and MRA can help monitor for further cerebrovascular changes in children with SCD, allowing for ongoing adjustments to treatment plans.

Conclusion

Radiological imaging is a cornerstone in the diagnosis and management of pediatric sickle cell disease-associated stroke. MRI, MR angiography, and other imaging techniques provide valuable information about the presence, type, and extent of stroke, as well as any associated vascular abnormalities such as moyamoya disease. By identifying stroke early, clinicians can intervene promptly to reduce the risk of long-term neurological damage in children with sickle cell disease. The integration of advanced imaging modalities into routine clinical practice is essential for improving outcomes and quality of life for these patients.

References

1. Walcott BP, Nahed BV, Brastianos PK, Loeffler JS (2013) Radiation Treatment for WHO Grade II and III Meningiomas. Front Oncol 3: 227.
2. Lichtenstein GR, Loftus EV, Isaacs KL, Regueiro MD, Gerson LB, et al. (2018) ACG clinical guideline: management of Crohn's disease in adults. Am J Gastroenterol 113: 481-517.
3. Rogers L, Barani I, Chamberlain M, Kaley TJ, McDermott M, et al. (2015) Meningiomas: knowledge base, treatment outcomes, and uncertainties. A RANO review. J Neurosurg 122: 4-23.
4. Combs SE, Adeberg S, Dittmar JO, Welzel T, Rieken S, et al. (2017) Skull base meningiomas: long-term results and patient self-reported outcome in 507 patients treated with fractionated stereotactic radiotherapy (FSRT) or intensity modulated radiotherapy (IMRT). BMC Cancer 17: 254.
5. Sahgal A, Weinberg V, Ma L, Chang E, Chao S, et al. (2013) Probabilities of radiation myelopathy specific to stereotactic body radiation therapy to guide safe practice. Int J Radiat Oncol Biol Phys 85: 341-347.
6. Goldsmith BJ, Wara WM, Wilson CB, Larson DA (1994) Postoperative irradiation for subtotally resected meningiomas. A retrospective analysis of 140 patients treated from 1967 to 1990. J Neurosurg 80: 195-201.
7. Buerki RA, Horbinski CM, Kruser T, Horowitz PM, James CD, et al. (2018) An overview of meningiomas. Future Oncol 14: 2161-2177.
8. Rogers L, Zhang P, Vogelbaum MA, Perry A, Ashbyet LS, et al. (2018) Intermediate-risk meningioma: initial outcomes from NRG Oncology RTOG 0539. J Neurosurg 129: 35-47.