

SUBDURAL HEMATOMA

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Subdural Hematoma: An Overview of Neurological Impact and Clinical Management

The Core Definition and Pathophysiological Mechanism

A Subdural Hematoma (SDH) is fundamentally defined as a severe form of traumatic brain injury characterized by an accumulation of blood situated between the inner layer of the dura mater and the arachnoid mater, a region known as the subdural space. This serious clinical event occurs specifically when a blood vessel, typically a bridging vein that traverses the subdural space, ruptures due to sudden acceleration, deceleration, or rotational forces applied to the head. The resulting collection of blood forms a mass that exerts pressure on the underlying brain tissue, leading to a spectrum of neurological deficits. The severity of SDH is highly variable, ranging from mild, often chronic presentations that develop slowly over weeks, to acute, rapidly expanding hematomas that constitute life-threatening emergencies requiring immediate neurosurgical intervention.

The core mechanism behind SDH involves mechanical stress. When significant head trauma occurs, the brain shifts within the skull. Because the bridging veins are anchored to both the rigid dura mater and the mobile brain surface, this rapid movement causes tension, leading to their tearing and subsequent hemorrhage into the potential subdural space. The speed and volume of this hemorrhage determine the patient's prognosis and the urgency of treatment. Immediate diagnosis and therapeutic intervention are therefore considered essential to mitigate the risk of permanent neurological damage or mortality associated with the mass effect and elevated intracranial pressure (ICP).

Etiology and Historical Clinical Understanding

Historically, the understanding and classification of SDH have evolved alongside advancements in medical imaging, but the primary cause remains consistent: external force applied to the head. While the specific key researchers and dates are often tied to general neurosurgery rather than a single psychological theory, the clinical recognition of the distinct nature of subdural bleeding--as opposed to epidural or intracerebral bleeding--developed significantly throughout the 20th century, spurred by improved anatomical knowledge and better techniques for surgical drainage. The categorization of SDH severity, which dictates treatment protocols, is crucial in its modern clinical context.

SDH is most commonly precipitated by significant external trauma, making it a critical aspect of managing patients who have suffered falls, motor vehicle accidents, or assaults. However, it is important to note that milder trauma can also lead to SDH, particularly in vulnerable populations such as the elderly, who may have brain atrophy that stretches the bridging veins, or individuals on anticoagulant medications. The classification system currently utilized separates SDH into acute

(symptoms presenting within 72 hours of injury), subacute (3 to 21 days), and chronic (more than 21 days), reflecting the rate of blood accumulation and clot degradation, which significantly impacts the patient's initial presentation and the subsequent therapeutic approach.

Clinical Presentation and Symptomatology

The clinical manifestation of a Subdural Hematoma is highly diverse, largely dependent on the size of the hematoma, the speed of its accumulation, and the patient's underlying neurological resilience. The most common symptoms, particularly in acute cases following significant trauma, are severe and persistent **headache**, worsening **confusion**, and a gradual or sudden **loss of consciousness**. These symptoms arise as the expanding blood collection displaces and compresses the cerebral hemisphere, leading to localized dysfunction and often global neurological decline.

In more severe instances, the pressure exerted by the hematoma can lead to signs indicative of acutely increased intracranial pressure (ICP). During a physical examination, clinicians may observe the classic triad of symptoms known as Cushing's reflex, which includes **bradycardia** (slow heart rate), **hypertension** (high blood pressure), and respiratory irregularity. Additionally, the examination might reveal papilledema (swelling of the optic nerve head), which is a delayed but highly suggestive sign of sustained elevated ICP. Recognizing these subtle or overt neurological changes is paramount, as they signal an immediate threat to life and necessitate rapid surgical evaluation to prevent herniation and irreversible brain damage.

The Diagnostic Process and Imaging Studies

The accurate and timely diagnosis of SDH relies upon a cohesive evaluation incorporating detailed medical history, a focused physical examination, and advanced neuroimaging studies. The medical history is crucial, focusing specifically on establishing any history of recent head trauma, even if seemingly minor, and charting the patient's baseline neurological status before the injury occurred. This historical context helps differentiate between acute, subacute, and chronic presentations and influences the urgency of intervention.

Following the initial clinical assessment, imaging studies are indispensable for confirming the presence, location, and size of the hematoma. The primary diagnostic tool utilized in emergency settings is Computed Tomography (CT) scanning. CT provides rapid, high-resolution images of the brain structure and is highly effective at identifying fresh blood collection, which typically appears as a hyperdense (bright) crescent-shaped lesion overlying the cerebral hemisphere. For certain cases, particularly those involving chronic or complex subdural collections, Magnetic Resonance Imaging (MRI) may be employed. MRI offers superior soft-tissue contrast, allowing for better differentiation between various stages of blood degradation, aiding in the precise dating of the

injury, and offering detailed visualization of underlying brain injury that might be obscured on CT scans.

Treatment Modalities: Medical and Surgical Management

The prescribed treatment for a Subdural Hematoma is tailored strictly to the severity of the injury and the patient's overall clinical status. In instances of **mild SDH**, where the hematoma is small and the patient remains neurologically stable without signs of significant mass effect or elevated intracranial pressure, medical management may be the initial and sufficient course of action. This regimen often includes the administration of **corticosteroids** to reduce cerebral edema and **anticonvulsants** to prevent seizure activity, which can be a complication of underlying cortical irritation. Close monitoring through serial neurological examinations and repeated imaging studies is mandatory to ensure the hematoma does not expand unnoticed.

Conversely, in cases of more **severe SDH**, characterized by large volume collections, significant midline shift, or progressive neurological deterioration, immediate surgical evacuation is necessary. The overarching goal of surgical intervention is to physically reduce the volume of blood in the subdural space, thereby decompressing the brain, preventing further secondary injury, and decreasing the risk of potentially fatal complications such as brain herniation. Common surgical procedures include craniotomy (opening the skull to access and remove the clot) or, for chronic hematomas, Burr hole drainage (drilling small holes to drain the liquid blood). The choice of technique is highly dependent on the hematoma's age, consistency, and volume, emphasizing the critical role of neurosurgical expertise in optimizing patient outcomes.

Prognosis and Recovery Factors

The prognosis following an SDH varies widely and is fundamentally dependent on two critical factors: the initial severity of the injury and the promptness with which definitive diagnosis and treatment are delivered. For the majority of patients who experience **mild SDH** and receive timely, appropriate medical management, recovery is often complete, with minimal to no long-term neurological deficits reported. This favorable outcome is typically seen when the hematoma size is small and there is no evidence of underlying diffuse axonal injury or cerebral contusion.

However, severe or rapidly expanding acute SDH carries a much more guarded prognosis. These severe injuries frequently lead to lasting neurological deficits, which may include cognitive impairment, motor weakness (hemiparesis), or chronic seizure disorders. Tragically, severe acute SDH remains a leading cause of mortality among all types of traumatic brain injury. The speed of intervention is arguably the single most important modifiable factor influencing the final outcome; delays in surgical decompression, particularly when the patient exhibits signs of high intracranial pressure, drastically increase the risk of poor recovery or death.

Real-World Illustration: A Case Study Application

To illustrate the application of these principles, consider the case of an elderly individual who suffers a seemingly innocuous fall at home, striking their head lightly. They initially seem fine but, over the course of the following week, begin to complain of persistent, unusual headaches and their family notes increasing lethargy and confusion. This scenario demonstrates the subtle nature of a subacute or chronic SDH, where symptoms develop gradually as the blood accumulates slowly, often causing vague symptoms that mimic other conditions.

The application of the diagnostic and treatment principles in this scenario follows a defined sequence:

Initial Assessment: The patient is brought to the emergency department due to increasing confusion. The medical history focuses on the recent fall, even though it was minor, identifying the potential mechanism of injury.

Imaging Confirmation: A stat Computed Tomography (CT) scan is performed. The CT reveals a crescent-shaped fluid collection that is isodense or hypodense (darker) compared to fresh blood, confirming a subacute or chronic Subdural Hematoma exerting significant pressure on the brain.

Treatment Decision: Based on the symptoms (confusion, neurological decline) and the size of the hematoma, the decision is made for surgical intervention, likely Burr hole drainage, which is less invasive than a full craniotomy and highly effective for liquid, chronic clots.

Prognosis: Following successful surgical evacuation and reduction of pressure, the patient's confusion and headaches resolve rapidly, illustrating how prompt, tailored neurosurgical intervention can reverse neurological deterioration caused by mechanical compression.

Significance and Impact in Clinical Medicine

The concept of SDH holds immense significance within the fields of neurosurgery, neurology, and emergency medicine, primarily because it represents one of the most common and potentially lethal sequelae of head trauma. Its study has profoundly influenced emergency medical protocols globally, emphasizing the need for rapid neurological assessment--particularly the Glasgow Coma Scale (GCS)--for any patient presenting after a head injury. The management of SDH is a cornerstone of neurocritical care training, driving research into optimal pressure management techniques and surgical timing.

Furthermore, understanding SDH has significant implications for public health and preventative care. The high incidence of chronic SDH in the elderly population underscores the importance of fall prevention programs. In trauma centers, SDH protocols guide the immediate use of advanced

imaging and dictate the rapid mobilization of surgical teams, ensuring that the critical window for intervention--often mere hours--is not missed. This continuous refinement of clinical guidelines based on the pathophysiology of SDH is directly responsible for improving survival rates among severe trauma victims.

Connections and Relation to Other Neurological Concepts

Subdural Hematoma belongs squarely within the broader category of **Traumatic Brain Injury** (TBI) and **Neurosurgery**. It is essential to differentiate SDH from other forms of intracranial hemorrhage that also result from trauma. The most commonly confused related concept is the **Epidural Hematoma** (EDH). While both involve bleeding between the meningeal layers, EDH occurs between the dura mater and the skull (epidural space), typically resulting from arterial bleeding, which is often faster and presents with a classic "lucid interval." SDH, in contrast, involves venous bleeding in the subdural space, leading to the characteristic crescent shape on imaging and often a slower onset of symptoms.

Other related concepts include **Intracerebral Hemorrhage** (ICH), which is bleeding directly into the brain parenchyma, and **Subarachnoid Hemorrhage** (SAH), which involves bleeding into the layer beneath the arachnoid. All these conditions fall under the umbrella of traumatic intracranial pathology, but the precise location of the blood collection--whether subdural, epidural, intracerebral, or subarachnoid--is critical because it determines the source of the bleeding (arterial vs. venous) and dictates the necessary surgical approach. The differentiation among these conditions is often the primary task of diagnostic imaging, specifically MRI and Computed Tomography, forming the basis of specialized trauma neurology.