Traumatic intracerebral hemorrhage

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Definition

AKA Hemorrhagic contusion.

(TICH). The definition is not uniformly agreed upon. Often considered as hyperdensity areas on CT (some exclude areas <1 cm diameter [1]).

A contusion is a TBI with CT findings that may include:

● High attenuation areas (AKA “hemorrhagic contusions” AKA traumatic intraparenchymal hemorrhages): usually produce less mass effect than their apparent size. Most common in areas where sudden deceleration of the head causes the brain to impact on bony prominences (e.g., frontal and occipital bones, sphenoid wing, petrous bone). Contused areas may progress (or “blossom” in neuroradiological jargon) to frank parenchymal hematomas. Surgical decompression may be considered if herniation threatens.

● Low attenuation areas: representing associated edema

Epidemiology

Traumatic intracerebral hemorrhage epidemiology.

Classification

see Delayed traumatic intracerebral hemorrhage.

Contusion in the motor strip, internal capsule….

see Frontal traumatic intracerebral hemorrhage.

Bifrontal Traumatic intracerebral hemorrhage

Etiology

Traumatic intracerebral hemorrhages is a traumatic intracranial hemorrhage result from either nonpenetrating or penetrating trauma to the head.

Examples:

Deep Brain Stimulation,……

Risk factors

Several risk factors can contribute to the development of traumatic ICH. These risk factors include:

Severity of Trauma: The force and severity of the trauma play a significant role. Severe head injuries, such as those sustained in car accidents, falls from height, or high-impact sports, are more likely to result in traumatic ICH.

Location of Impact: The specific area of the head that was impacted can affect the risk of traumatic ICH. Injuries to the frontal and temporal lobes, as well as the areas around the temples, are more commonly associated with bleeding.

Age: Older individuals, especially those over 65 years of age, are at a higher risk of traumatic ICH due to age-related changes in blood vessels and brain tissue.

Anticoagulant or Antiplatelet Medications: Individuals taking blood-thinning medications, such as anticoagulants (e.g., warfarin, heparin) or antiplatelet agents (e.g., aspirin, clopidogrel), have a higher risk of bleeding after head trauma.

Alcohol and Substance Abuse: Chronic alcohol consumption and the use of illicit drugs can increase the risk of traumatic ICH by affecting blood vessel integrity and clotting factors.

Pre-existing Medical Conditions: Certain medical conditions, such as hypertension (high blood pressure), vascular malformations, and bleeding disorders, can make individuals more susceptible to bleeding after head trauma.

Cerebral Amyloid Angiopathy: This is a condition where amyloid protein accumulates in the walls of blood vessels in the brain, making them more prone to bleeding. Cerebral amyloid angiopathy increases the risk of traumatic ICH.

Gender: There is some evidence to suggest that males may be at a higher risk of traumatic ICH compared to females, possibly due to differences in physical activity and risk-taking behaviors.

Genetics: Certain genetic factors may influence an individual's susceptibility to traumatic ICH and how their body responds to brain injury.

Impact Acceleration-Deceleration: Rapid acceleration and deceleration of the head, commonly seen in motor vehicle accidents or high-impact falls, can lead to shearing forces within the brain tissue, increasing the risk of bleeding.

Helmet Use: In some cases, the use of helmets during high-risk activities (e.g., cycling, motorcycle riding, contact sports) can reduce the risk of traumatic ICH by providing protective cushioning for the head.

The presence of APOEε4, an elevated international normalized ratio, and a higher glucose level (≥ 10 mmol/L) are predictors of progressive traumatic intracerebral hemorrhage. Additionally, APOE ε4 is not associated with traumatic coagulopathy and patient outcome [2].

Clinical features

From asymptomatic to coma.

Diagnosis

Traumatic intracerebral hemorrhage diagnosis

Treatment

see Traumatic intracerebral hemorrhage treatment.

Outcome

Traumatic intracerebral hemorrhage outcome.

Case series

van Erp et al. conducted a study to understand how different treatments affect patients with a specific type of brain injury called traumatic intracerebral hemorrhage (t-ICH). They looked at patients who had a large t-ICH and were treated either with early surgery or conservative (non-surgical) treatment. The main thing they wanted to measure was how well these patients were doing in terms of their overall brain function after 6 months. They used a scale called the Glasgow Outcome Scale Extended (GOSE) to assess this. Study Findings:

They included a total of 367 patients in the study. Out of these, 160 had early surgery, and 207 received conservative treatment. Patients who got early surgery tended to be younger and had more severe injuries compared to those who got conservative treatment. When they looked at all the patients together, they found that early surgery didn't show a significant advantage in terms of improving overall brain function at 6 months compared to conservative treatment. Subgroups:

However, when they looked closer at different groups within their patient population, they found some interesting results:

For patients with moderate traumatic brain injury (TBI) and isolated t-ICH: Early surgery seemed to be associated with better outcomes. This means that for patients with a moderate level of brain injury and t-ICH happening on its own (without other significant brain injuries), early surgery might be a good choice.

For patients with mild TBI and smaller t-ICH (less than 33 cc): Conservative treatment appeared to result in better outcomes. So, for patients with mild brain injury and smaller t-ICH, not doing surgery and opting for non-surgical treatment seemed to work better.

Conclusion:

In summary, the researchers found that the choice between early surgery and conservative treatment for t-ICH depends on the severity of the brain injury and whether the t-ICH is isolated or not. Early surgery might be more beneficial for those with moderate TBI and isolated t-ICH. On the other hand, conservative treatment might be a better option for patients with mild TBI and smaller t-ICH. These findings align with the results of another trial called the STITCH(Trauma) trial, which studied a similar question. So, in essence, the study helps doctors make better decisions about when to opt for early surgery or conservative treatment for patients with traumatic intracerebral hemorrhage (t-ICH) based on the specific characteristics of the injury and the patient. [3].

Twenty-two patients with traumatic cerebral contusion (diagnosed on initial noncontrast head computed tomography [CT]) who initially did not require surgical intervention were enrolled in this study. Contrast-enhanced and perfusion CT scans were performed within 6 hours of injury, and follow-up noncontrast CT scans were performed at 24 hours and 72 hours.

In each noncontrast CT scan, the volumes of the contusion hemorrhage and edema were calculated using computerized planimetric techniques. The initial Glasgow Coma Scale, hemorrhage progression, clinical deterioration, and the need for subsequent surgery were recorded. The early radiologic findings were compared with these parameters and functional outcome at 6 months to identify predictive radiologic signs. CE was present in 9 of 22 patients (41%) and was highly associated with hemorrhage progression ($p < 0.05$), clinical deterioration ($p < 0.01$), and need for subsequent surgery ($p < 0.01$). In addition, patients with CE had a greater volume of edema at 24 hours ($p < 0.01$) and 72 hours ($p < 0.01$) than those who did not have CE. However, CE was not found to be associated with poor outcome.

Early parenchymal CE is associated with hemorrhage progression, cerebral edema, clinical deterioration, and need for subsequent surgery. These patients should be monitored closely, and early surgery may be needed if deterioration occurs. Further elucidation of the pathophysiology is needed to formulate effective treatment for these high-risk patients [4].

In severe traumatic brain injury (TBI), contusions often are worsened by contusion expansion, or “hemorrhagic progression of contusion” (HPC), which may double the original contusion volume and worsen outcome. In humans and rodents with contusion-TBI, sulfonylurea receptor 1 (SUR1) is upregulated in microvessels and astrocytes, and in rodent models, blockade of SUR1 with glibenclamide reduces HPC. SUR1 does not function by itself, but must co-assemble with either KIR6.2 or TRPM4 to form KATP (SUR1-KIR6.2) or SUR1-TRPM4 channels, with the two having opposite effects on membrane potential. Both KIR6.2 and TRPM4 are reportedly upregulated in TBI, especially in astrocytes, but the identity and function of SUR1-regulated channels post-TBI is unknown. Here, we analyzed human and rat brain tissues after contusion-TBI to characterize SUR1, TRPM4 and KIR6.2 expression and, in the rat model, to examine the effects on HPC of inhibiting expression of the three subunits using intravenous antisense oligodeoxynucleotides (AS-ODN). GFAP immunoreactivity was used to operationally define core versus penumbral tissues. In humans and rats, GFAP-negative core tissues contained microvessels that expressed SUR1 and TRPM4, whereas GFAP-positive penumbral tissues contained astrocytes that expressed all three subunits. Förster resonance energy transfer imaging demonstrated SUR1-TRPM4 heteromers in endothelium, and SUR1-TRPM4 and SUR1-KIR6.2 heteromers in astrocytes. In rats, glibenclamide as well as AS-ODN targeting SUR1 and TRPM4, but not KIR6.2, reduced HPC at 24 hours post-TBI. Our findings demonstrate upregulation of SUR1-TRPM4 and KATP after contusion-TBI, identify SUR1-TRPM4 as the primary molecular mechanism that accounts for HPC, and indicate that SUR1-TRPM4 is a crucial target of glibenclamide [5].

Case reports

A 62-year-old man was admitted to the hospital after a fall due to intoxication. His initial Glasgow Coma Scale (GCS) score was 14. Initial computed tomography (CT) revealed a right temporal skull fracture, bilateral frontal and right temporal tip contusions, and acute subdural hematoma. During admission, his condition deteriorated to a GCS score of 6 points, and follow-up CT showed hemorrhagic progression of left frontal and right temporal contusion with midline shift and brainstem compression. Emergency surgery was performed for TICH in the left frontal lobe and right temporal lobe. A burr hole was made in each of the left frontal and right temporal regions, and we used a neuroendoscope to assist in the evacuation of the hematoma. Postoperative CT showed adequate evacuation of the hematoma. The patient regained consciousness and was discharged after 2 months.

Conclusion: Bilateral TICH was rapidly and sequentially removed by burr-hole craniotomy and endoscopic hematoma evacuation without rapid decompression by craniotomy. The hematoma did not increase. This report demonstrates that the endoscopic-assisted technique allows the safe treatment of bilateral TICH [6]

2015

Petrela et al. report a complication of catheter ablation that, to their knowledge, has never been previously reported. A 63-year-old man had undergone successful transvenous catheter thermoablation for atrial fibrillation. The patient remained well until 3 days prior to further admission when he noticed itching in the right frontal area of his scalp. On palpating his scalp, he discovered a metallic body projecting out of it and he proceeded to extract 20 cm of wire from his head. The following day a progressive left hemiplegia developed, and the patient experienced a deteriorating level of consciousness. A CT scan of the brain showed a right frontotemporal intraparenchymal hemorrhage and revealed a metallic structure in the middle of the hematoma. The hematoma was evacuated and a decompressive craniectomy was performed. The guidewire was identified, but it was only possible to extract part of it. It was covered by fibrous tissue, secondary to inflammatory reaction. To the authors' knowledge, this is the first report of guidewire-induced brain hemorrhage. The guidewire apparently had not been removed and had spontaneously migrated from the heart to the brain and beyond to the scalp where it then exited the patient's head. The patient had been well before he attempted to pull out the wire. Earlier identification of the iatrogenic complication of a retained guidewire might have prevented the fatal outcome in this case [7].

Forensic medicine

In forensic medicine, objective and, if possible, the most accurate determination of the age - the time of the brain contusion, has practical significance. In our previous work, we discussed the importance of the neuron cytoskeleton proteins - neurofilaments, in this area. The purpose of this paper is to present the possibilities of using the phenomenon of angiogenesis in the brain contusions, to determine its age, on the basis of previous studies in animal models and in human biological material. The current review of the literature showed no conclusive data that would allow use morphological changes in angiogenesis to determine the age of the brain contusion in forensic medical practice. For these reasons, it is reasonable to take a broader research on the human material [8].

Test and Answers

What is the primary characteristic of a traumatic intracerebral hemorrhage (TICH)?

a) Accumulation of cerebrospinal fluid in the brain b) Collection of air within the brain tissue c) Accumulation of blood within the brain tissue d) Presence of a tumor in the brain

How are TICH contusions often identified on a CT scan?

a) Low attenuation areas b) High attenuation areas c) High fluid content d) Low blood volume

What risk factors contribute to the development of traumatic ICH?

a) Use of helmets during high-risk activities b) Young age c) Chronic alcohol consumption d) Genetic factors

Which of the following statements regarding the location of impact and TICH is true?

a) Injuries to the frontal and temporal lobes are less commonly associated with bleeding b) The location of impact has no effect on the risk of TICH c) Injuries to the frontal and temporal lobes are more commonly associated with bleeding d) Only injuries to the occipital lobe lead to TICH

What is the primary goal of surgery for traumatic intracerebral hemorrhage?

a) To remove cerebrospinal fluid b) To prevent infection c) To evacuate the accumulated blood and relieve pressure d) To implant a brain stimulator

What scale is commonly used to assess the overall brain function of patients with traumatic intracerebral hemorrhage?

a) Intracranial Pressure Scale b) Glasgow Outcome Scale Extended (GOSE) c) Traumatic Hemorrhage Severity Scale d) Brain Function Assessment Score

According to the study by van Erp et al., which patient group might benefit more from early surgery for t-ICH?

a) Patients with mild traumatic brain injury and small t-ICH b) Patients with moderate traumatic brain injury and isolated t-ICH c) Patients with severe traumatic brain injury d) Patients with no t-ICH

What does CE stand for in the context of traumatic intracerebral hemorrhage?

a) Contrast Enhancement b) Contusion Evolution c) Cerebral Edema d) Central Excitation

What is the primary factor associated with hemorrhagic progression of contusion (HPC) in traumatic brain injury?

a) Overuse of blood-thinning medications b) Acceleration-deceleration forces in the brain c) Genetic factors d) Chronic alcohol consumption

In the context of TICH, what is SUR1-TRPM4?

a) A surgical procedure for brain hemorrhage b) A scale used to assess brain injury severity c) A molecular mechanism associated with contusion expansion d) A type of contrast-enhanced imaging technique

Answers:

c) Accumulation of blood within the brain tissue b) High attenuation areas c) Chronic alcohol consumption c) Injuries to the frontal and temporal lobes are more commonly associated with bleeding c) To evacuate the accumulated blood and relieve pressure b) Glasgow Outcome Scale Extended (GOSE) b) Patients with moderate traumatic brain injury and isolated t-ICH a) Contrast Enhancement b) Acceleration-deceleration forces in the brain c) A molecular mechanism associated with contusion expansion

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