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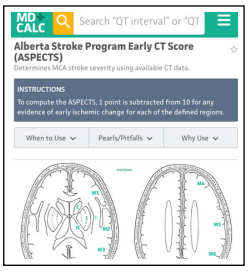

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Alberta Stroke Program Early CT Score (ASPECTS)

The ASPECTS determines middle cerebral artery stroke severity using available computed tomography data.

About the Score

The Alberta Stroke Program Early CT Score (ASPECTS) quantifies computed tomography changes in early middle cerebral artery stroke. Increased frequency of early changes seen on computed tomography suggests poorer outcome from stroke. Patients with scores ≥ 8 have a better chance for an independent outcome.

The tool should be used for patients presenting in the first minutes and hours of a stroke with clinical suspicion for middle cerebral artery occlusion. Identifying patients with a greater likelihood of poor functional outcome (scores < 8) may be helpful in the early stages of care for supporting transfer or therapy decisions.

It is important to note that the score does not consistently predict treatment response or intracranial hemorrhage, or offer nuanced prognostic information. ASPECTS has mainly been studied in patients treated with or eligible for stroke reperfusion therapy (ie, tissue plasminogen activator), for which many stroke patients do not qualify.

Evidence Appraisal

There appears to be a lack of consistency in studies evaluating the interrater reliability of ASPECTS. A 2018 trial compared the evaluation of 43 patients using ASPECTS among senior radiology residents, a neuroradiology fellow, and 2 senior neuroradiologists. The study found agreement varied from 0.486 to 0.678 in Cohen's kappa when comparing the senior neuroradiologists to the fellow, and 0.198 to 0.491 when comparing the senior neuroradiologists to the senior radiology resident (Kobkitsuksakul 2018).

Using the binary outcome, a 2003 study of 34 cases found only 42% agreement for ASPECTS, with a kappa of 0.34 (Mak 2003). In contrast, a 2014 trial of 214 patients using the binary outcome compared evaluation in real time with later evaluation by an expert assessor; the study found the interobserver agreement to be substantial, with a weighted kappa of 0.69 (Coutts 2004).

More recent studies have evaluated ASPECTS on the basis of the entire scale, as well as dichotomous (< 8 vs ≥ 8) or trichotomous (0-4, 5-7, and 8-10) divisions, but few robust prospective trials have been conducted (Prakkamakul 2017).

Instructions

To compute the ASPECTS, 1 point is subtracted from 10 for any evidence of early ischemic change for each of the defined regions.

Use the Calculator Now

Click here to access the ASPECTS on MDCalc.

Calculator Creator

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Original/Primary Reference

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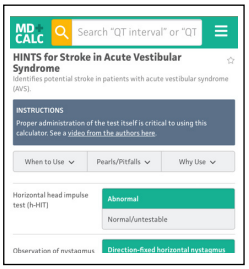

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HINTS for Stroke in Acute Vestibular Syndrome

The HINTS score identifies potential stroke in patients with acute vestibular syndrome.

About the Score

The Head Impulse, Nystagmus, Test of Skew (HINTS) score requires some specialized experience to perform, and sensitivity is reduced in non–neuro-ophthalmologists (Kerber 2015). See a video from the authors here. Ruling out stroke in patients with a moderate or high pretest probability may not be possible for nonspecialists. Only use the HINTS score in patients with continuous vertigo. Do not use in patients with episodic vertigo (eg, benign paroxysmal positional vertigo) or in patients whose dizziness has resolved by the time of assessment.

Acute vestibular syndrome is a common presentation in emergency departments, outpatient clinics, and inpatient services. Differentiation between central and peripheral etiologies is important in narrowing the differential diagnosis and facilitating emergent therapies.

Acute (< 24-48 hours) magnetic resonance imaging (MRI) has lower sensitivity for posterior fossa ischemia than HINTS, when scored by a specialist (Kattah 2009). Acute MRI may also initially show a false negative due to lower resolution in the posterior fossa during this time frame, so a "normal" MRI in this population cannot be relied upon to provide complete reassurance. In nonexpert hands, consideration of the patient's overall vascular risk (eg, ABCD² Score) improves the sensitivity of the assessment. Delayed or repeat MRI (> 48 hours) may be useful in ambiguous cases.

Ischemia in the territory of the anterior inferior cerebellar artery can mimic a peripheral etiology and should be kept in the differential when the HINTS localizes to the periphery but the patient has vascular risk factors, experiences sudden onset of symptoms, and/or has associated ipsilateral hearing loss.

A "benign" HINTS examination, in the absence of other neurological deficits, suggests a peripheral localization, and investigation and management can be directed at this possibility. A "dangerous" HINTS examination strongly supports a central lesion, and appropriate workup is required. An important exception is that acute ischemia of the anterior inferior cerebellar artery territory can produce a "benign" HINTS examination. This possibility should be considered in patients with vascular risk factors, sudden-onset symptoms, or concurrent ipsilateral hearing loss.

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Evidence Appraisal

The HINTS examination was evaluated in a cohort of 101 patients presenting with acute vestibular syndrome to a single institution. Patients were screened by a single neuro-opthalmologist who performed the history and examination (Kattah 2009). Because referrals were predominantly from emergency department or other institutions (ie, referrals typically given when a simple peripheral etiology to vertigo was not apparent on assessment by a non–neuro-ophthalmologist), the cohort was older (mean 62 years), mostly male (65%), and overall at higher risk of vascular disease (70% had ≥ 2 stroke risk factors). Most patients were seen after 24 hours of symptom onset, with a mean examination time for the entire cohort of 26 hours. Acute MRI was performed in 97% of patients, with repeat imaging at 2 to 10 days for the 8 patients with central localization but initial negative MRI for stroke. Peripheral localization was confirmed with caloric testing. Seventy-six patients were found to have a central lesion, and overall the authors found the HINTS examination to be 100% sensitive and 96% specific. For comparison, the sensitivity of early MRI (< 48 hours) for brainstem infarction was 72%.

Following the initial work, the same authors reanalyzed the tool in comparison with the ABCD² Score for TIA in the same cohort after a longer period of study, thereby including a higher number of patients (Newman-Toker 2013). This found a comparable sensitivity (96.8%) and specificity (98.5%) for any central cause.

An important limitation of these initial studies includes the assessment being performed by a specialist neuro-ophthalmologist, making it difficult to generalize the high sensitivities of the testing to nonsubspecialist practitioners.

Kerber et al (2015) then reevaluated the HINTS examination in a larger cohort (272 patients) with a more diverse demographic (stroke comprised only 10.7% of the final diagnoses compared to 68% in the initial HINTS study) and a broader range of examiners (including a vascular neurologist and emergency physician). This study found a lower sensitivity, with a 5.9% risk of missed stroke with HINTS alone. The authors recommended a more nuanced approach using a combination of vascular risk factors (ABCD² Score), general neurological examination, and MRI to optimize the differentiation of stroke and other vestibular diagnoses.

Use the Calculator Now

Click here to access the HINTS Score on MDCalc.

Calculator Creator

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Click here to read more about Dr. Newman-Toker.

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Original/Primary Reference

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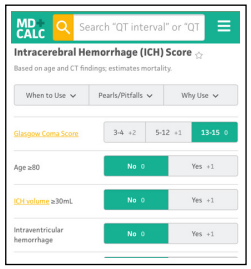

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Intracerebral Hemorrhage (ICH) Score

The ICH score grades intracerebral hemorrhage severity and subsequent 30-day mortality based on age and CT findings.

About the Score

The Intracerebral Hemorrhage (ICH) score allows clinicians with diverse clinical backgrounds and varying levels of training to grade ICH severity in a succinct and universal manner. This tool helps clinicians quickly and accurately prognosticate patients who are admitted for ICH and can be used to help decide the appropriate level of care and whether to transfer the patient. It is often used in conjunction with the FUNC Score, which indicates the likelihood of a patient's functional independence 90 days after ICH. It's important to note that the ICH score is primarily used as a clinical grading scale and communication tool. It is not meant to provide prognostic information and should not be used as a primary means to predict the outcomes of patients with ICH.

The ICH score is intended to be used after the diagnosis of ICH is made, and is generally not used as a continual marker of the patient's neurologic status (such as the Glasgow Coma Score). Although the score can be a marker for ICH severity, it should not be used to guide treatment modality. The score is sometimes criticized because the fact that clinicians and families previously used gestalt to make the decision to withdraw care may have introduced bias to the validation.

Evidence Appraisal

The ICH score was developed to provide a clinical grading scale for ICH to standardize clinical treatment protocols and clinical research studies. The score was developed at the University of California, San Francisco, with the original study analyzing 161 patients who presented with ICH at the university hospital from 1997 to 1998. The analysis provided information about the degree of severity of ICH as well as 30-day mortality rates that helped guide decision-making.

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Use the Calculator Now

Click here to access the ICH Score on MDCalc.

Calculator Creator

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References

Original/Primary Reference

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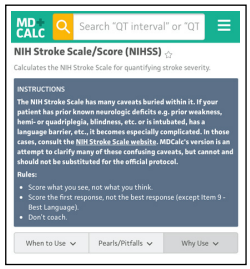

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NIH Stroke Scale/Score (NIHSS)

The NIH Scale/Score is used to quantify stroke severity.

About the Score

Stroke is the fifth leading cause of death in Americans. There are nearly 800,000 cases of acute stroke in the United States every year, with 140,000 associated deaths. The National Institutes of Health Stroke Scale (NIHSS) was developed to help clinicians objectively rate the severity of ischemic strokes.

When assessed within the first 48 hours following a stroke, NIHSS scores have been shown to correlate with clinical outcomes at the 3-month and 1-year mark. Higher scores indicate more severe strokes and have been shown to correlate with the size of infarctions on both computed tomography and magnetic resonance imaging evaluation. Patients with a total score ≤ 4 generally have favorable clinical outcomes and have a high likelihood of functional independence regardless of treatment.

It is important to note that many guidelines and protocols warn that administering tissue plasminogen activator (tPA) in patients with a high NIHSS score (> 22) is associated with increased risk of hemorrhagic conversion. These patients, however, are also the most severely debilitated and dependent from their strokes. Some components of the NIHSS have lower interrater reliability (eg, facial movement, limb ataxia, neglect, level of consciousness, and dysarthria), and some may be quite limited due to altered mental status. Even patients with large-territory posterior circulation stroke syndrome may still have low or normal NIHSS scores, highlighting one of the tool's important limitations. A simpler, modified version of the NIHSS has been found to have greater interrater reliability with equivalent clinical performance, although it has not been as widely adopted as the original NIHSS.

Evidence Appraisal

The first iteration of the NIHSS was derived by Brott et al in a pilot study of 10 patients who were evaluated within 3 weeks of having an ischemic stroke. The authors applied the Toronto Stroke Scale, the Oxbury Initial Severity Scale, and the Cincinnati Stroke Scale to these patients; analyzed the results; and then created a composite scale. This was intended for use in a National Institutes of Health-sponsored trial of naloxone for stroke (Brott 1989). Brott's Cincinnati/Naloxone stroke scale was modified by Lyden et al (1994) for use in the National Institute of Neurological Disorders and Stroke study on tPA in patients with ischemic stroke (National Institute of Neurological Disorders and Stroke rt-PA Stroke Study Group 1995).

A retrospective review of 1281 subjects with ischemic stroke found that for every 1-point increase in the NIHSS, the likelihood of an excellent outcome was decreased by 24% at 7 days and 17% at 3 months (Adams 1999).

A trial of 94 patients found that each 1-point increase in the NIHSS, when performed within 24 hours of the stroke, correlated with a decreased likelihood of the patient being discharged (Schlegel 2003).

A study of 893 patients found that the initial NIHSS score (performed within 72 hours of the ischemic event) was predictive of whether the patient would need to be placed in a nursing home or sent to rehabilitation. Patients with moderate (6-13 points) or severe (≥ 14 points) NIHSS scores were 3 times more likely to be placed in a nursing home after discharge and 8 times more likely to require rehabilitation therapy (Rundek 2000).

A study of 377 patients found that when performed 24 to 48 hours after an ischemic stroke, the NIHSS was broadly predictive of group outcomes at 1 year, with 75% of patients who had a score ≤ 4 being functionally independent (Appelros 2004). The median score in this study was 6, with 33% of patients dying within the first year after their event.

A prospective trial of 54 patients found that combining diffusion-weighted magnetic resonance imaging with the NIHSS score was more predictive of clinical outcomes at 3 months (70%) than using the score (43%) or imaging (54%) alone (Yoo 2010).

An analysis of 312 subjects from the National Institute of Neurological Disorders and Stroke trials found that an NIHSS score > 20 was associated with a 17% rate of intracranial hemorrhage with tPA versus a 3% hemorrhage rate in patients with a score < 10 (NINDS t-PA Stroke Study Group 1997).

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Instructions

The NIHSS has many caveats buried within it. If a patient has prior known neurologic deficits (eg, prior weakness, hemi- or quadriplegia, blindness, etc) or is intubated, has a language barrier, etc, scoring becomes especially complicated. In those cases, consult the NIHSS website. MDCalc's version is an attempt to clarify many of these confusing caveats, but it cannot and should not be substituted for the official protocol.

Rules: Score what you see, not what you think. Score the first response, not the best response (except Item 9 - Best Language). Don't coach.

Use the Calculator Now

Click here to access the NIHSS on MDCalc.

Calculator Creator

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Original/Primary Reference

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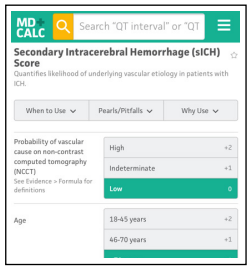

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Secondary Intracerebral Hemorrhage (sICH) Score

The sICH score quantifies the likelihood of underlying vascular etiology in patients with intracerebral hemorrhage..

About the Score

The secondary intracerebral hemorrhage (sICH) score predicts the likelihood that a given intracerebral hemorrhage (ICH) is secondary to an underlying vascular abnormality based on clinical and radiographic characteristics. The score determines whether patients with ICH should undergo computed tomography angiography (CTA) if CTA is not routinely performed for workup of ICH at specific institutions. Use the sICH score for patients with ICH who have had noncontrast computed tomography.

In some cases, sICH score can help clinicians decide whether or not a patient should undergo catheter angiogram for definitive diagnosis of an underlying vascular diagnosis despite the risks of the procedure, which include but are not limited to renal injury, pseudoaneurysm, and arterial dissection. The sICH score may help with operative planning when emergent neurosurgery for ICH is indicated and either CTA or catheter angiogram cannot be done safely. In a patient with an sICH score < 2 and a CTA result that is negative for vascular abnormality, the procedural risks of catheter angiogram may outweigh the benefits of identifying an underlying vascular etiology. In some patients with an sICH score > 2 and a CTA result negative for vascular abnormality, catheter angiogram should be considered after careful evaluation of procedural risks and benefits.

Do not use catheter angiogram for patients with a subarachnoid hemorrhage in the basal cisterns; a clear-cut, pre-established acute ischemic infarct with secondary hemorrhage within the area of infarct; a known intracranial vascular abnormality or mass lesion; or a known probable cerebral amyloid angiopathy per Boston criteria.

The tool does not predict morbidity or mortality in ICH. Differences in discriminatory performance according to imaging interpretations by neurologists vs. radiologists has not been determined.

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Evidence Appraisal

The sICH Score was developed by Almandoz et al in 2010 based on retrospective derivation (n = 623) and prospective validation (n = 222) cohorts. In this study, areas under the curve (AUCs) were not significantly different between the derivation and validation cohorts, and the AUC for the combined cohort was 0.87 (95% confidence interval 0.84-0.89), with a cut-point of > 2 corresponding to 86% sensitivity and 72% specificity (P < .0001). The study was limited by the use of a retrospective derivation cohort, as well as selection bias from only including patients with ICH who ultimately underwent CTA.

Because CTA was originally used to determine the presence of vascular abnormality, the sICH was then validated by the same group in 2012 in a retrospective cohort (n = 341) using catheter angiography or intraoperative findings. Again, higher sICH scores were associated with increasing likelihood of harboring an underlying vascular etiology, as follows:

- sICH 0: 0% positive cases
- sICH 1: 1.6%
- sICH 2: 7.8%
- sICH 3: 18.8%
- sICH 4: 39.0%
- sICH 5: 79.2%

The AUC in this study was 0.82 with a cut-point of > 2 corresponding to sensitivity and specificity of 82% and 66.1%, respectively.

Use the Calculator Now

Click here to access the sICH Score on MDCalc.

Calculator Creator

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References

Original/Primary Reference

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