

**PRACTICE PARAMETER:  
NEUROIMAGING IN THE EMERGENCY PATIENT  
PRESENTING WITH SEIZURE**

**(Summary Statement)**

Report of the Quality Standards Subcommittee of the American Academy of Neurology in cooperation with American College of Emergency Physicians, American Association of Neurological Surgeons, and American Society of Neuroradiology\*

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Neuroimaging (NI) can help determine whether seizures result from a structural abnormality of the brain or its surroundings. NI can be a useful tool in a variety of clinical settings in the evaluation of patients who present with seizures. Patients may report seizure-related symptoms to their primary care provider, prompting neurologic evaluation, or a sudden convulsive episode may hasten medical care through an emergency department (ED). CT has been in clinical use since the mid-1970s and is accessible to most clinical practitioners. In our present environment, MRI is becoming more readily available (emergency availability in some centers), replacing or complementing the traditional neuroimaging role of CT.

In an ED, the medical staff evaluates the patient to determine the nature of the event, performs diagnostic studies, begins treatment when appropriate, and arranges disposition or follow-up care. The nature of the event is best determined by historical observations from the patient or witnesses. Diagnosis is determined primarily from history and physical examination findings but may be supported by ancillary studies. Treatment decisions and disposition depend on the cumulative results of the patient evaluation.

The practitioner's decision to order a test must include knowledge of resource availability. In the case of NI, the decision for emergency NI may require reprioritizing patients for available scan time and, in some locations, may lead to mobilization of equipment or manpower resources. The physician must ensure the patient's clinical status and stability before referral for imaging. The management of status epilepticus is beyond the scope of this report because patient stabilization is required before imaging is feasible. Therefore, this report makes no recommendation concerning the timing of NI in status epilepticus. Assuming that NI is useful in the evaluation of a patient after a seizure, the role and timing of this test in the spectrum of emergency care is the subject of this report.

A panel representing the American Academy of Neurology (AAN), American College of Emergency Physicians, American Association of Neurological Surgeons, and American Society of Neuroradiology convened to examine the available evidence concerning the use of NI in the ED setting. The panelists chosen were recommended by their organizations' practice parameters development group. CT literature was chosen because of the more universal availability of this technology in an emergency setting compared with other imaging modalities (e.g., MRI).

**Description of the Process.** We performed a MEDLINE search for articles published between 1980 and 1993 using the key words "computerized tomography," "seizure," "emergency," and "emergency care." Terms were expanded as appropriate. Text word searches were also performed using these terms. A titles search produced 502 references. Titles were reviewed for either clinical studies, reviews, or articles dealing with CT findings in seizure patients or the use of CT in the ED. From this list, the panel reviewed 58 abstracts. Additionally, we did a secondary search of the bibliographies of these articles to identify those published before 1980. Studies dealing solely with status epilepticus were not included (see previous explanation). Using this strategy, we found 21 additional articles for 82 articles. After excluding case reports, letters, and reviews without original data, 51 articles remained. These articles were reviewed in their entirety. Two members of the panel reviewed each paper, scored them for level of evidence, and abstracted information on a data collection form. Data tables were then generated from the raw data and combined where possible. By consensus, elements for evaluation included age stratification, likelihood of abnormal CT, types of CT lesions or abnormalities, and outcome data. In addition, any of the following covariables

were sought: first seizure, seizure type, signs of CNS infection, persistent altered mental status, recent trauma, meningismus, new focal abnormality, history of anticoagulation/coagulopathy, immunosuppression, malignancy, systemic disease, and headache. The panel decided by consensus to consider the clinical circumstances for which NI would most likely result in a change in treatment. To facilitate this report, the panel developed the following consensus definitions to indicate the need (appropriateness) and urgency of NI scanning:

- **Emergent** (scan immediately): Essential for a timely decision regarding potential life-threatening or severe disabling entities.
- **Urgent** (scan appointment is included in the disposition or performed before disposition when follow-up cannot be ensured): Essential to enable the timely appropriate clinical disposition or discharge of acute condition.
- **Routine**: Indicated for management and diagnosis but not for immediate disposition.
- **Not Indicated**: Not indicated for the routine management of the presenting condition.

It should be noted that most of the articles reviewed did not directly examine the issue of timing of NI. The above definitions are a result of a consensus formulation by the committee based on a combination of clinical presentation, likelihood of uncovering a specific abnormality, and the degree of change in outcome which might result.

*Literature classification criteria.* The authors reviewed the literature on “CT, seizure, and emergency care” against the literature classification in the definitions below. We found no Class I articles, 18 Class II articles, and 33 Class III articles.

A draft of this report was circulated to the sponsoring organizations for input. In addition, the paper was distributed to selected outside organizations and provider review network for review and comment (appendix).

**Summary.** The goal of the panel was to use data collected from the literature review to help define the role and timing of NI in the spectrum of emergency care of patients with seizures. Insufficient data on timing of NI were found to draw data-based conclusions. The panel chose to apply the consensus definitions below to the information found in the literature. When structural lesions were found, most were due to stroke or neoplasm. Cerebral atrophy was frequently described in reports where seizure epidemiology was the focus of the studies or in studies of CT findings in children with seizures. The number of patients with subdural hematomas, intracerebral hematoma, and infection was small in all study groups, except for studies on alcohol-related and head injury-related seizures in which a disproportionate number of patients had intracranial bleeding.

Data were available regarding some of the review covariables. Not surprisingly, patients with focal findings on neurologic examination were found to have a much higher likelihood of abnormal CT than patients with normal examinations, but often the type of lesions found could not be extracted from the papers. There was a small increase in the likelihood of finding an abnormality with partial-onset seizures when compared with generalized seizures. However, there was a greater percentage of tumor or stroke in the partial-onset seizure subgroup. Lesions found in the new onset seizure subgroups were mainly represented by stroke, neoplasm, and trauma-related lesions. The combination of infection, subdural hematoma, and intracerebral hematoma made up about 1% of the new onset seizure patients. The likelihood of stroke or tumor increased with advancing age. Patients over age 40 years had a conspicuous increase in the likelihood of an abnormal CT, with an increase proportion with tumor beginning at age 40 and strokes in the over 60 year age group. Seizures in immunosuppressed patients, as was demonstrated in AIDS patients, are frequently associated with mass lesions from infectious causes.

**Recommendations.** Data are available that can help predict the likelihood of NI abnormalities in selected seizure patients. This report addressed the usefulness and timing of NI in the emergency patient with seizure and not the overall utility of NI in diagnosis of patients with seizures or epilepsy. These recommendations are based on literature review (Class II and III) and panel consensus.

A provider should first ensure stabilization of the emergency patient before pursuing an imaging study. The decision to obtain an imaging study in the ED must take the following into consideration: clinical findings, the likelihood of confirming a specific clinical entity based on those findings or excluding an alternate or serious cause, the natural history of both the suspected disorder and alternative diagnoses in the differential, and the availability of adequate follow-up for the patient. Knowledge of the patient's other condition (e.g., immunosuppression, anticoagulation therapy, history of cancer) may favor performance of an emergent NI or militate against the study (e.g., history of epilepsy, previous trauma or stroke with no change in neurologic findings). A typical febrile seizure in a child is not an indication for neuroimaging.

A chronic lesion found in the ED will not usually lead to acute changes in management; however, that finding may change disposition. For example, in the absence of increased intracranial pressure, delay of diagnosis of a brain tumor by referral for urgent or routine NI is unlikely to change patient outcome. Patients with seizure(s) associated with acute stroke (including intracerebral and subarachnoid hemorrhage) will be managed based on the underlying clinical condition, and this management usually includes NI. Although there is very little evidence showing that the emergency management of patients presenting to the ED with a seizure is changed by NI (except in those where infection or intracranial hemorrhage are suspected), the decisions for patient management, disposition, or both may be dependent on the NI findings. A key element of follow-up is long-term care by a physician with experience and training in neurologic disease.

For patients presenting with seizure(s), neurologic assessment is required, and NI may be performed in their evaluation. Because most life-threatening conditions associated with seizures are related to hemorrhage, brain swelling, or mass effect, an unenhanced (noncontrast) CT may be all that is necessary on an emergent basis. A decision for an enhanced (contrast) CT or MRI may be subsequently made. The priority for performing a procedure should consider the following clinical circumstances. First, for patients with first time seizure:

**Emergent NI (scan immediately)** should be performed when a provider suspects a serious structural lesion. Clinical studies have shown a higher frequency of life-threatening lesions in patients with new focal deficits, persistent altered mental status (with or without intoxication), fever, recent trauma, persistent headache, history of cancer, history of anticoagulation, or suspicion of AIDS (**Guideline**).

**Urgent NI (scan appointment is included in the disposition or is performed before disposition when follow-up of the patient's neurologic problem cannot be ensured)** should be considered for patients who have completely recovered from their seizure and for whom no clear-cut cause has been identified (e.g., hypoglycemia, hyponatremia, tricyclic overdose) to help identify a possible structural cause. Because adequate follow-up is needed to ensure a patient's neurologic health, urgent NI may be obtained before disposition when timely follow-up cannot be ensured (**Option**).

Additionally, for patients with **first time seizure**, emergent NI should be considered if any of the following are present (**Option**): age >40 years or partial-onset seizure.

Second, for patients known to have epilepsy with recurrent seizure(s):

**Emergent NI (scan immediately)** should be performed when a provider suspects a serious structural lesion. Clinical studies have shown a higher frequency of life-threatening lesions in patients with new focal deficits, persistent altered mental status (with or without intoxication), fever, recent trauma, persistent headache, history of cancer, history of anticoagulation, or suspicion of AIDS (**Guideline**).

**Urgent NI (scan appointment is included in the disposition or performed before disposition when follow-up of the patient's neurologic problem cannot be ensured)** should be performed for patients who have completely recovered from their seizure and for whom no clear-cut cause has been identified (e.g., hypoglycemia, hyponatremia, tricyclic overdose) to help identify a possible structural cause. Because adequate follow-up is needed to ensure a patient's neurologic health, urgent NI may be obtained before disposition when timely follow-up cannot be ensured (**Option**).

Additionally, for patients with **recurrent seizure** (history of seizures) emergent NI should be considered if any of the following are present (**Option**): new seizure pattern or new seizure type or prolonged postictal confusion or worsening mental status.

Finally, patients with typical febrile seizures or typical recurrent seizures related to previously treated epilepsy are unlikely to have life-threatening structural lesions. These patients do not require emergent or urgent NI (**Guideline**).

*Recommendations for future research.* Areas of research that will improve clinical decision-making include studies that measure therapeutic impact or patient outcome as they are affected by the timing of NI performance. How NI is used in the sequence of diagnostic modalities and NI's changing role in the era of advancing technologies (e.g., MRI, functional MRI) are also vital topics for study.

**Conclusion.** This statement is provided as an educational service of the AAN, American College of Emergency Physicians, American Association of Neurological Surgeons, and American Society of Neuroradiology. It is based on an assessment of current scientific and clinical information. It is not intended to include all possible proper methods of care for a particular neurologic problem or all legitimate criteria for choosing to use a specific procedure. Neither is it intended to exclude any specific alternative methodologies. The AAN recognizes that specific patient care decisions are the prerogative of the patient and the physician caring for the patient, based on all

of the circumstances involved.

### Acknowledgments

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Medical societies invited to comment on this practice parameter (\* indicates those who provided comment): American College of Radiology,\* American College of Physicians, American Academy of Family Practice,\* American Academy of Pediatrics, American Epilepsy Society,\* Epilepsy Foundation of America,\* and AAN Neuroimaging Section.\*

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**Note.** This statement is provided as an educational service of the American Academy of Neurology. It is based on an assessment of current scientific and clinical information. It is not intended to include all possible proper methods of care for a particular neurologic problem or all legitimate criteria for choosing to use a specific procedure. Neither is it intended to exclude any reasonable alternative methodologies. The AAN recognizes that specific patient care decisions are the prerogative of the patient and the physician caring for the patient, based on all the circumstances involved.

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### DEFINITIONS

#### *Strength of Recommendations*

**Standards.** Generally accepted principles for patient management that reflect a high degree of clinical certainty (i.e., based on Class I evidence or, when circumstances preclude randomized clinical trials, overwhelming evidence from Class II studies that directly addresses the question at hand or from decision analysis that directly addresses all the issues).

**Guidelines.** Recommendations for patient management that may identify a particular strategy or range of management strategies and that reflect moderate clinical certainty (i.e., based on Class II evidence that directly addresses the issue, decision analysis that directly addresses the issue, or strong consensus of Class III evidence).

**Practice options or advisories.** Other strategies for patient management for which the clinical utility is uncertain (i.e., based on inclusive or conflicting evidence or opinion).

**Practice parameters.** Results, in the form of one or more specific recommendations, from a scientifically based analysis of a specific clinical problem.

*Quality of Evidence Ratings*

**Class I.** Evidence provided by one or more well-designed randomized controlled clinical trials, including overviews (meta-analyses) of such trials.

**Class II.** Evidence provided by one or more well-designed clinical studies such as case-control studies, cohort studies, and so forth.

**Class III.** Evidence provided by expert opinion, nonrandomized historical control subjects, or one or more case reports.

This summary statement is based on the background paper with complete bibliography written by Drs. Michael K. Greenberg, W.G. Barsan, and S. Starkman (*Neurology* 1996;47:26-32). The background paper is available from the American Academy of Neurology upon request.

This summary statement is the result of a joint, cooperative project among the American Academy of Neurology, the American College of Emergency Physicians, the American Association of Neurological Surgeons, and the American Society of Neuroradiology.

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