Use of CT Scans for the Investigation of Headache: A Report from ASPN, Part 1

Lorne A. Becker, MD; Larry A. Green, MD; David Beaufait, MD; Jack Kirk, MD; Jack Froom, MD; and William L. Freeman, MD, MPH

Toronto, Ontario; Denver, Colorado; Hanover, New Hampshire; Stony Brook, New York; and Albuquerque, New Mexico

Background. Clinicians in the Ambulatory Sentinel Practice Network (ASPN) order computed tomography (CT) scans for approximately 3% of patients with headache. This study was undertaken to provide information about the reasons for ordering CT scans and the results obtained.

Methods. Weekly return cards were used to collect data on every patient for whom a CT scan was ordered to investigate a headache during a 19-month period. Copies of CT reports were reviewed, and a chart audit was performed to collect further clinical information whenever an intracranial tumor, subarachnoid hemorrhage (SAH), or subdural hematoma (SDH) was reported.

Results. Clinicians in 58 practices ordered 349 CT scans. Only 52 patients (15%) had abnormalities noted on neurological examination. Most CT scans were ordered because the clinician believed that a tumor (49%) or an SAH (9%) might be present. Fifty-nine (17%) were ordered because of patient expectation or medicolegal concerns. Of the 293 reports reviewed, 14 indicated that a tumor, an SAH, or an SDH was present. Two of the 14 (14%) were false positives. Forty-four (15%) of the reports noted incidental findings of questionable significance.

Conclusions. Because there are no clear guidelines for the use of CT for the investigation of headache, physicians must exercise good clinical judgment in their attempts to identify treatable disease in a cost-effective manner. ASPN clinicians made selective use of CT scans based on a combination of factors that included physician and patient concerns. CT was an imperfect tool in this setting. Most of the positive results represented false positives or incidental findings that could have led to adverse effects and additional costs.

Key words. Tomography, x-ray, computerized; headache; clinical protocols; physician practice patterns.
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Family physicians are frequently asked to evaluate a patient with a new headache. This can be a difficult and challenging task. The headaches of only a small minority of patients result from serious intracranial disorders such as tumor or intracranial hemorrhage. These must be accurately diagnosed without subjecting the many patients who have benign headaches to expensive and potentially harmful[1-3] overinvestigation. Even after taking a thorough history and performing a physical examination, the precise diagnosis is frequently in doubt. The diagnostic classification of the Ad Hoc Committee on Classification of Headache,[4] in use until recently, was vague and imprecise. Family physicians found that three quarters of their patients' headaches could not be categorized definitively using these criteria.[5] The recently developed diagnostic criteria of the International Headache Society (IHS)[6] are more precise and allow researchers to classify the majority of headaches.[7] Unfortunately, the IHS criteria are too complex and cumbersome for clinicians to

ASPN denotes Ambulatory Sentinal Practice Network, an office-based network of primary care practices. For a list of participating practices, see Acknowledgments.

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From the Department of Family and Community Medicine, University of Toronto, Ontario, Canada (L.A.B.), the Department of Family Medicine, University of Colorado Health Sciences Center, Denver (L.A.G.), the Department of Community and Family Medicine, Dartmouth Medical School, Hanover, New Hampshire (D.B., J.K.), the Department of Family Medicine, State University of New York at Stony Brook, Stony Brook, New York (J.F.), and the Indian Health Service, Albuquerque, New Mexico (W.L.F.). Requests for reprints should be addressed to Linda Niebauer, Ambulatory Sentinel Practice Network, 1180 Clermont St, Denver, CO 80220.

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use on a regular basis.[8] Whatever diagnostic scheme they employ, primary care physicians are well aware that some patients with headache due to significant intracranial disease are initially misdiagnosed.

Imaging procedures such as magnetic resonance imaging (MRI) and computed tomography (CT) are relatively sensitive and specific for the detection of intracranial disease.[9,10] The use of these tests for all new headaches would be prohibitively expensive, however, and would result in many false-positive findings. The existing medical literature provides little direction concerning the appropriate use of MRI for patients with headaches in primary care. Although more has been written on the use of CT scans for these patients, the recommendations are conflicting. Some authors have suggested that more or earlier use of CT scans for patients with headaches could be beneficial.[11,12] Others have proposed that CT is unnecessary, since serious intracranial disease can be detected by neurological examination.[13] A National Institutes of Health (NIH) consensus development conference on the use of CT scans[14] suggested that CT scans be used for only a minority of patients with headaches. The NIH report suggested that the test be considered only for patients whose headaches are "severe, constant, unusual, or associated with abnormal neurological signs."

In a previous study of the investigation and management of headache in primary care practice,[15] CT scans were ordered for approximately 3% of patients presenting with a headache. The current study was undertaken to provide additional information about the results obtained when this test was done. The use of MRI was not included in the study because it was not widely available to most clinicians in our sample at the time.

Methods

The Ambulatory Sentinel Practice Network (ASPN) is a group of community primary care practices in the United States and Canada formed to carry out collaborative clinical research. The ASPN practices, patients, and data collection methods have been described elsewhere.[16] This study used two data collection methods previously tested by ASPN: weekly return cards[17] and chart audits.[18]

Participating clinicians provided information about each patient for whom they ordered a cranial CT scan (or patient referral to another physician with the expectation that a cranial CT scan would be performed) to investigate a patient problem that included headache as one of its symptoms. Data collection was carried out with pocket-sized weekly return cards on which participating physicians noted the severity and symptom characteristics of the headache, presence or absence of papilledema, abnormalities on neurological examination, or other symptoms suggesting the presence of an intracranial mass or bleed (such as seizures, loss of consciousness, changes in strength, sensation, or neurological function, changes in headache pattern or severity, or headaches that awakened the patient from sleep). In addition, participating physicians were asked their reason for ordering a CT scan. Completed return cards were mailed to ASPN weekly. Participating physicians were also asked to send copies of the radiologists' reports of these patients' CT scans to ASPN. To preserve confidentiality, patients' names and other identifying data were deleted from CT scan reports and replaced with the patient's ASPN identification number and date of birth. Each CT report was reviewed by three family physicians who decided independently whether the report indicated the presence of any significant abnormality. Data collection began March 17, 1986, and continued through October 4, 1987. During the same period, the same group of ASPN clinicians participated in a study of all patients in their practices with a newly diagnosed intracranial bleed, mass lesion, or pseudotumor cerebri.[19]

A chart audit for each patient whose CT scan report indicated the presence of a tumor, subarachnoid hemorrhage (SAH), or subdural hematoma (SDH) was performed by the ASPN physician at the end of the recording period. The audit form developed for the study required the physician to abstract specific details concerning the headache evaluation from the chart. Information was once again obtained concerning the severity and symptom characteristics of the headache, presence or absence of papilledema, abnormalities on neurological examination, and presence or absence of other symptoms that could indicate the presence of intracranial problems.

At the end of every calendar year, each ASPN practice provides a report about the sex and year of birth of each patient who has made one or more visits to the practice during the preceding 2 years ("active patient").[7] Data from these individual age and sex reports were aggregated to provide a denominator of patients at risk for estimation of rates within the participating ASPN practices.

Results

Sixty-two ASPN practices provided data using the weekly return cards. We were unable to use data from four of these practices because they dropped out of the ASPN network before the audit portion of the study was completed. Only the data from the 58 practices that

Table 1. Reasons for Ordering Computerized Tomography (CT) Scans (n = 339)

Reason	CT Scans Ordered, %
Mass lesion suspected	48.4
Patient expected it	12.4
Subarachnoid hemorrhage suspected	8.8
Consultant advised it	5.3
Medicolegal concerns	5.0
Other	20.1

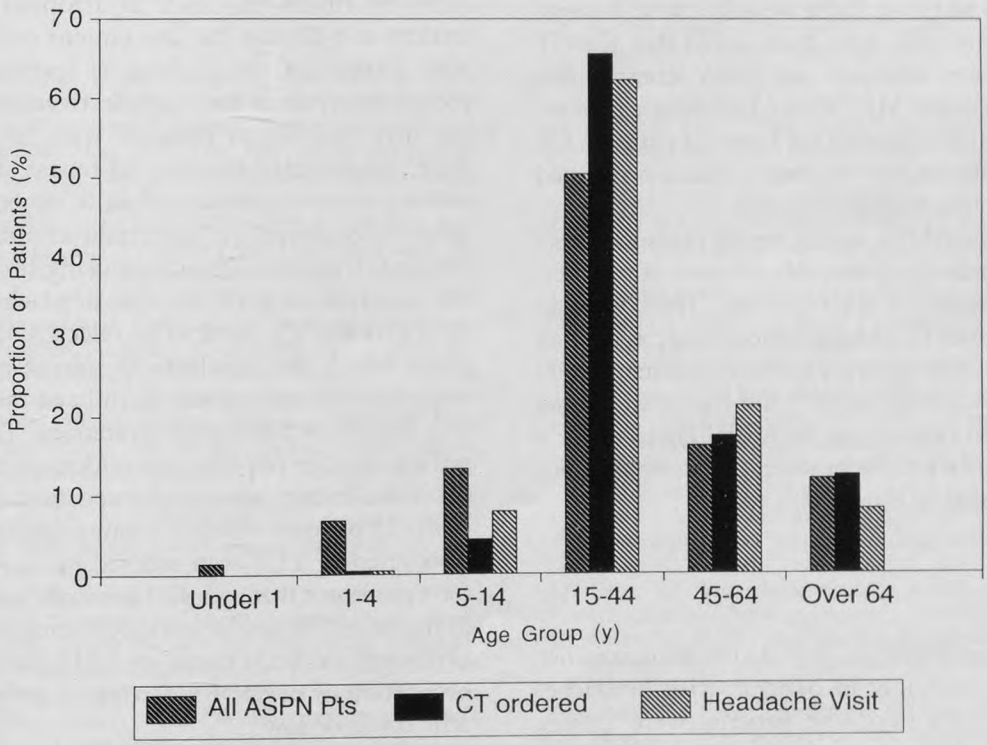
participated in the entire study are included in this report.

During the study period, ASPN physicians ordered 349 CT scans to investigate patient headache. Ten of these were never performed. Copies of 293 CT scan reports were sent to ASPN for review. This represents 86% of the 339 CT scans completed.

The physicians' reasons for ordering CT scans are shown in Table 1. Almost half were ordered because the physician suspected the presence of an intracranial mass. Suspected subarachnoid hemorrhage was a much less frequent reason for ordering the test. Sixty-eight CT scans were ordered for a variety of other reasons. Most of these CT scans were ordered for patients whose headaches were unusual in their severity, persistence, or pattern, or had changed in frequency or intensity. Four CT scans were ordered because the clinicians wished to reassure the patient with a normal test result. In two of these four cases, the patient's mother had previously been diagnosed as having a brain tumor or aneurysm. Abnormalities on neurological examination were noted for only 52 (15%) of the patients for whom CT scans were ordered.

In the Figure, the age distribution of patients receiving CT scans for headache is compared with the age distributions of the overall ASPN patient population (as estimated from age and sex reports) and the age distribution of patients with headache visiting ASPN practices.[15] Almost two thirds of the CT scans were ordered for patients 15 to 44 years of age, whereas patients older than 44 years of age received only 30% of the CT scans.

The abnormalities noted on the 293 CT scan reports reviewed from this group of patients are listed in Table 2. One fifth of the reports indicated the presence of a possible problem. Fourteen reports (5%) suggested clinically significant and potentially treatable abnormalities that could have been related to the patients' headaches (5 tumors, 5 SAHs, and 4 SDHs). Another 44 (15%)



Comparison of the age distribution of all patients (N = 260,709) of the Ambulatory Sentinel Practice Network (ASPN), all ASPN patients who made a visit for headache during a previous ASPN study (n = 3847), and those patients for whom a computerized tomography scan was ordered (n = 349).

Table 2. Abnormalities Described on Computerized Tomography (CT) Scan Reports

Diagnosis	No. of Abnormalities on CT Scans
True positives (n = 12)	
Subarachnoid hemorrhage	5
Tumor	4
Subdural hematoma	3
False positives (n = 2)	
Acoustic neuroma	1
Subdural hematoma	1
Incidental findings (n = 44)	
Atrophy	14
Anatomical variants	8
Infarctions	6
Calcifications	6
Probable artifact	1
Miscellaneous*	9

**Miscellaneous findings included osteoporasis, expansile lesion in maxillary sinus, pituitary at upper limits of normal, bright white matter, multiple hypodense lesions, hyperostosis frontalis interna, possible vasculitis, and possible Binswanger's disease.*

reports indicated a finding of questionable clinical significance. While the radiologists' opinions in most of these cases suggested a benign finding, there were often hedging statements indicating that the clinical significance was "uncertain" or "doubtful" and suggesting repeat testing, angiography, or MRI scans if "clinical findings indicated" such tests. In addition, there were two false-positive CT reports. In one case, the report stated that the CT scan clearly indicated the presence of an acoustic neuroma, but a subsequent MRI showed no tumor present. The small acute SDH detected on a second patient's CT scan was not confirmed by another CT scan performed on the same day at a different hospital.

Our use of the ASPN weekly return cards to collect data for two studies simultaneously allowed us to determine the completeness of the reporting. There were an additional seven cases in which a tumor (four cases) or an SAH (three cases) was reported in the concurrent ASPN study of new intracranial events[19] and had been discovered by a CT scan ordered by an ASPN clinician for a patient with a headache. These seven CT scans were not reported or included in the current study.

Discussion

As noted in previous studies,[15,20] ASPN clinicians use CT scans rather sparingly in patients with headache. Although visits from headache patients were a daily occurrence, the practices in this study ordered, on average, only six CT scans during the 19-month study period. Clearly ASPN clinicians did not consider CT as a routine tool in the investigation of new headaches. However, neither did they base the decision to use CT entirely on the neurological examination, since only 15% of patients investigated had neurological abnormalities. The need for a precise diagnosis was apparently not the only factor involved in the decision to perform a CT scan. Although most of the tests were ordered because of the clinician's own concern about the possibility of an organic cause for the headache, a significant minority were done to satisfy patient concerns or for medicolegal reasons.

One might expect CT scans to be used more for older patients, as the incidence of significant intracranial disease increases with age,[21,22] and the incidence and prevalence of primary headache syndromes decline in older patients.[23] However, the age of the patient did not appear to be an important factor in the decision to order a CT scan. The age of patients whose headaches were investigated more aggressively paralleled the age distribution of all patients with headaches seen in ASPN practices.

The use of CT in this study was not without its drawbacks. Almost one of six CT scan reports noted some abnormal or questionable finding other than a tumor, an SAH, or an SDH. Presumably other investigations were required to follow up on some of these abnormalities. Even those CT findings known to require no follow-up (such as atrophy) could lead to anxiety and distress for any patient or family member who learned of the finding or happened to see the report. Analyses of the cost-effectiveness of CT scans in the investigation of patients with headache[12,13,24,25] have not included the cost of repeat studies or other investigations required to follow up on the many abnormalities noted as "uncertain clinical significance" on the CT reports. Physicians using broader criteria in the selection of patients with headache for CT scanning may find the need to be selective in their decision about which abnormalities to pursue in such patients once the CT scan reports have been received.

This study has several limitations. The most serious is the possibility of physicians underreporting their use of CT scans. In fact, some underreporting did occur. Seven of the 21 patients who had a tumor, an SAH, or an SDH discovered by a CT scan ordered by an ASPN physician for a syndrome that included headache were not reported in this study. If similar underreporting occurred for patients with no brain tumor or SAH, our estimate of the proportion of negative CT scans in patients with headache could be low.

Finally, the participating physicians in this study were chosen because of their willingness to subject their practices to scrutiny, and thus may not be representative of other physicians providing primary care.

Conclusions

In this series, CT scans were usually done for patients aged 15 to 44 years on the basis of clinical judgment, patient expectation, patient anxiety, or, infrequently, because of medicolegal concerns. Only 15% of scans were for patients with abnormal neurological findings. Exactly how the decision to use CT scanning was made remains unclear. The observed yield included approximately four times more incidental findings of questionable significance than true-positive findings. Further assessment of the use of CT scans in the evaluation of headache in primary care should attempt to define the basis of the clinical suspicion that triggers the infrequent decision to do CT scanning, and evaluate the balance of desired benefits and unintended consequences.

Acknowledgments

Ambulatory Sentinel Practice Network (ASPN)
Participating Practices

Canada
British Columbia: Valley Medical Group, Maple Ridge. *Quebec*: Centre de Medecine Familiale de Wakefield, Ltd, Wakefield. *Alberta*: Foothills Family Medicine Centre, Black Diamond. *Ontario*: Family Medical Centre, Hamilton; Steve Nantes MD, Kitchener; Peter Whitby MD, Waterloo.

United States
Alaska: Resurrection Bay Health Center, Seward. *Colorado*: Crow Family Medical Center at Conifer, Conifer; Marny Eulberg, MD, Denver; Mountain/Plains Family Practice, Denver; Orchard Family Practice, Englewood; Mary Jo Jacobs, MD, Glenwood Springs. *Florida*: James Andersen, MD, Fort Lauderdale; Domingo Gomez, MD, Hialeah; Family Medicine Associates, Miami; South Beach Family Medicine Associates, Miami. *Georgia*: Curtis Hames, MD, Claxton; Titus Taube, MD, Cochran; Frank Don Diego, MD, Palmetto; Al Mooney, MD, Statesboro; Bill Hogan, MD, Thomasville; Tri-County Family Medicine Center, Warrenton. *Louisiana*: Linda Stewart, MD, Baton Rouge. *Massachusetts*: Fitchburg Family Practice Residency Program, Fitchburg; Peter Barker, MD, Swampscott. *Michigan*: Bay de Noc Family Health Center, Escanaba. *Minnesota*: Eagle Medical, Excelsior. *New Hampshire*: David Beaufait, MD, and Mark Parker, MD, Enfield; Richard Douglass, MD, Hillsboro; Manchester Family Health Center, Manchester; Monroe Clinic, Monroe; New London Medical Center, New London. *New York*: Afton Family Health Center, Afton; Central Square Health Services Center, Central Square; Alan S. Cooper, MD, Setauket; Maury Greenberg, MD, Stony Brook. *North Carolina*: Bakersville Community Medical Clinic, Bakersville; Daniel Vinson, MD, Banner Elk; Roanoke Amaranth Community Health Group Inc, Jackson. *Oklahoma*: Madill Medical Associates, Madill. *Oregon*: Dunes Family Health Care, Inc, Reedsport. *Pennsylvania*: Dennis Allen, MD, Hallstead; Highland Physicians, Ltd, Honesdale; Family and Community Health Associates, York. *Tennessee*: Michael Hartsell MD, Greeneville; Family Medical Center, Lenoir City; Overton County Medical Center, Livingston. *Texas*: Decatur Family Clinic, Decatur; Larry Myers, MD, and Brian Caplan, MD, Mansfield; Isaac Kleinman, MD, Rosenberg. *Vermont*: Community Health Center, Enosburg Falls; The Health Center, Plainfield. *Virginia*: Aylett Medical Center, Aylett; Beaverdam Family Practice, Beaverdam; June Tunstall, MD, Surry; Duane Lawrence, MD, Virginia Beach. *Washington*: Family and Internal Medicine Associates, Anacortes; Cle Elum Family Medicine Center, Cle Elum. *West Virginia*: New River Family Health Center, Scarboro. *Wisconsin*: Group Health of EauClaire, EauClaire; Family Medical Center, Merrill; Kronenwetter Clinic, Mosinee; Doctors Park Family Physicians, Platteville.

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