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DOES 16-DETECTOR COMPUTED TOMOGRAPHY IMPROVE DETECTION OF NON-TRAUMATIC SUBARACHNOID HEMORRHAGE IN THE EMERGENCY DEPARTMENT?

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□ **Abstract—The diagnosis of subarachnoid hemorrhage remains difficult to establish, yet the sensitivity of increasingly available 16-detector computed tomography (CT) has not been evaluated. The objective of this study was to estimate the sensitivity of 16-detector CT for the diagnosis of non-traumatic subarachnoid hemorrhage in the Emergency Department (ED). A retrospective review was performed in an academic tertiary care hospital. Patients presenting to the ED from September 2003 through December 2004 with symptoms suggestive of subarachnoid hemorrhage and having a final diagnosis of non-traumatic subarachnoid hemorrhage were eligible for study. Diagnosis was established by positive 16-detector CT examination of the brain, or spinal fluid analysis. Patient demographics and results of CT, angiogram, and spinal fluid analysis were reviewed. Sensitivity of 16-detector CT was calculated by comparing CT results and cerebral angiogram results. Refined Wilson Simple Asymptotic 95% confidence intervals were calculated. Sixty-one consecutive patients met the study criteria and had a final diagnosis of non-traumatic subarachnoid hemorrhage. One of these patients did not have subarachnoid hemorrhage identified by 16-detector CT, but had a positive lumbar puncture and an aneurysm confirmed on cerebral angiography. Sensitivity of 16-detector CT for subarachnoid hemorrhage was 97% (95% confidence interval 84–100%). Sixteen-detector CT did not improve detection of non-traumatic subarachnoid hemorrhage when compared with studies using single-detector CT. If there is high clinical suspicion for non-traumatic subarachnoid hemorrhage and non-contrast 16-detector CT scan is negative, further evaluation is suggested. © 2009 Published by Elsevier Inc.**

□ **Keywords—non-traumatic subarachnoid hemorrhage; multi-detector computed tomography; cerebral angiography; lumbar puncture; emergency department diagnosis**

INTRODUCTION

Background

The diagnosis of subarachnoid hemorrhage remains challenging, despite an accepted algorithm that includes computed tomography and lumbar puncture. Its presentation is often indistinguishable from other non-lethal causes of cephalgia, which makes diagnosing subarachnoid hemorrhage on clinical grounds alone unreliable. Early and accurate diagnosis and treatment, however, is associated with improved patient outcome (1). Non-traumatic subarachnoid hemorrhage affects approximately 30,000 patients each year in the United States, but the diagnosis can be elusive, as more than 3 million patients present to the Emergency Department (ED) with a chief complaint of headache (2,3).

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Importance

Computed tomography (CT) is a readily available, fast, and non-invasive method of evaluating patients with suspected subarachnoid hemorrhage and is the initial study of choice in most patients. However, because CT is not 100% sensitive for subarachnoid hemorrhage and because the consequences of subarachnoid hemorrhage misdiagnosis can be dire, Emergency Physicians may proceed to lumbar puncture in patients with suspected subarachnoid hemorrhage when the initial CT examination is negative for hemorrhage (4). Lumbar puncture, however, is invasive, time consuming, and has potential complications. Post-lumbar puncture headache is reported in up to 38% of patients (5). In addition, interpretation of cerebrospinal fluid analysis can be difficult, especially in cases of traumatic lumbar puncture. Although as many as 20% of lumbar punctures may be considered "traumatic," a lower rate of traumatic lumbar puncture (10–15%) is encountered in the ED (6,7). Even these relatively rare cases can pose a diagnostic problem, however. Although decreasing numbers of red blood cells in successive tubes of cerebrospinal fluid are expected in these cases, there are no research- proven criteria that define what is acceptable as "traumatic" (8). In addition, there is controversy surrounding xanthochromia as a diagnostic tool for evaluation of subarachnoid hemorrhage (9–12). Given the current difficulties of accurately excluding subarachnoid hemorrhage, a non-invasive study such as 16-detector CT with 100% sensitivity would be welcomed in clinical practice.

Goals of This Investigation

As shown in Table 1, studies from the 1990s have evaluated the sensitivity of single-detector CT in diagnosis of subarachnoid hemorrhage and found overall sensitivities ranging from 91% to 100% (13–16). Some studies divided patients into early and late CT examinations after symptom onset and found increased sensitivities in the first 12–24 h after symptom onset compared with more delayed examinations (13,14,16). One group found 100% sensitivity of CT performed within 6 h of symptom onset (17). To the best of our knowledge, there has been no study evaluating the sensitivity of 16-detector CT in diagnosis of subarachnoid hemorrhage (18). The purpose of this study was to evaluate the sensitivity of 16-detector CT and compare it with the previously published sensitivities for single-detector CT.

MATERIALS AND METHODS

Study Design

The hospital medical information system and radiology information system were queried to identify all patients with a discharge diagnosis of non-traumatic subarachnoid hemorrhage (International Classification of Diseases - 9th revision, Code 430.0) who presented to the ED during the 16-month period from September 2003 through December 2004. Patient records were retrospectively reviewed, and patients who had 1) a non-contrast 16-detector CT examination of the brain in the ED and 2) a discharge diagnosis of non-traumatic subarachnoid hemorrhage, were selected for the study. Patients transferred from an outside institution were included in the study if they had a 16-detector CT examination in our ED. The medical records of these patients were then reviewed for time of symptom onset, time of CT scan, patient demographics, spinal fluid analysis, and cerebral angiogram results. The decision to pursue or forego lumbar puncture was made by the ED attending physician in an academic, tertiary care center. The hospital is an urban tertiary care facility and neurosurgical referral center for the region with an average annual ED patient volume of 115,000

Table 1. Reported CT Sensitivity for Subarachnoid Hemorrhage

Study Author/Year	CT Detector Rows	Early Sensitivity of CT for SAH	Late Sensitivity of CT for SAH	Pooled Sensitivity of CT for SAH
Van der Wee et al., 1995 (16)	1	98% (117/119) if < 12 h symptom duration	—	98% (117/119)
Sames et al., 1996 (13)	1	93% (134/144) if < 24 h symptom duration	84% (31/37) if > 24 h symptom duration	91% (165/181)
Sidman et al., 1996 (14)	1	100% (80/80) if < 12 h symptom duration	82% (49/60) if > 12 h symptom duration	92% (129/140)
Morgenstern et al., 1998 (15)	1	—	—	90% (18/20)
Boesiger and Shiber, 2005 (18)	4	—	—	100% (6/6) non-traumatic
Perry et al., 2004 (17)	1	100% (43/43) if < 6 h symptom duration	81% (26/32) if > 6 h symptom duration	92% (69/75)
Current study, 2007	16	—	—	97% (36/37)

CT = computed tomography; SAH = subarachnoid hemorrhage.