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The diagnostic value of complete blood count parameters in patients with subarachnoid hemorrhage

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ABSTRACT

Objectives: Diagnosis of subarachnoid hemorrhage (SAH) in patients presenting with headache is challenging and there has been any biomarker studied for excluding of SAH in those patients. We aim to determine the sensitivity of leukocytosis or left shift to exclude the diagnosis of SAH in ED patients presenting with headache.

Method: Adult patients with headache who received a computed tomography (CT) with the diagnosis of SAH and had a complete blood count (CBC) represent the case group, headache patients with normal CT and had a CBC represent the control group. The white blood cell (WBC) count and percentage of polymorphonuclear cells (PMNs%) taken during admission and within the first 6 and 12 h of admission were recorded.

Results: A hundred ninety seven patients with SAH and 197 patients without SAH were enrolled in to study. Sensitivity, specificity, NPV and PPV of leukocytosis or increase in PMNs% (left shift) in the diagnosis of SAH was 89.8% (84.5–93.5, 95% CI), 46.7% (39.6–53.9, 95% CI), 82.1% (73.5–88.4, 95% CI) and 62.8% (56.8–68.4, 95% CI) respectively on initial emergency department (ED) admission.

Conclusion: CBC should be considered as a noninvasive test for the exclusion of SAH in ED patients with 6 h observation.

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1. Introduction

Headache constitutes 2.2% of emergency department (ED) admissions.¹ One of the most important differential diagnoses in emergency department patients with headache is subarachnoid hemorrhage (SAH).² The most useful standard test in diagnosis of SAH is noncontrast computed tomography (CT), but it is not appropriate to routinely use CT in patients with a headache, because of high cost and radiation exposure.^{3,4} There is no noninvasive diagnostic test to differentiate SAH in patients with headache. Our goal is to present the sensitivity of leukocytosis or increase in PMNs% in the diagnosis of SAH in patients who admit to

the emergency department with a complaint of headache.

2. Materials and methods

This retrospective, case-control study was conducted in a tertiary ED that has approximately 190,000 visits annually. Approval of the local ethics committee was received before the study.

Adult patients that admitted to ED between the January 2008 and November, 2013 who received a head CT with the pre-diagnosis of SAH were detected by the hospital automation system. Patients aged 14 years or older, who were diagnosed with nontraumatic SAH with noncontrast head CT and who had a complete blood count (CBC) during the ED admission constituted the study group.

Patients who were admitted to the ED during the same dates with complaint of headache and that were discharged after being diagnosed with a nonspecific headache (ICD-10 code R51) with a

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normal noncontrast head CT, were identified. Among these patients, those who are at the same age and of same gender as the study group were selected by using vassarstats randomization program (<http://vassarstats.net/rand01.html>), and thus formed the control group. For each patient in the SAH group, first patient with the same age and gender in the control group was selected. If multiple patients were present with the same age and gender, patients in the control group were selected consecutively. Patients with a history of trauma, patients who did not have CBC during admission to the ED, and patients who had a history of hematologic diseases were excluded from the study.

Hospital electronic records of patients in the study group and control group were reviewed and age, gender, white blood cell (WBC) count and percentage of polymorphonuclear cells (PMNs%) values taken during admission and within the first 6 and 12 h of admission, and patient's outcomes were recorded on the data collection form. Noncontrast head CT images of patients with SAH were reviewed by a neurosurgeon through picture archiving and communication system (PACS). Also, noncontrast head CT scans of patients in the control group were reviewed by a neurosurgeon and the results were confirmed to be negative for SAH. Each patients' CT scan was administered with 5 mm slices for the fossa and 10 mm slices for other areas through Siemens Somatom Emotion 16 slices helical CT scanner.

The WBC, PMNs% counts were determined by a technical hematological cell counter (LH 780 Analyzer, Beckman Coulter Inc., Miami, FL, USA). All samples were analyzed within 2 h, using ethylenediaminetetraacetic acid (EDTA) containing tubes. The expected WBC and PMNs% values in our laboratory ranged between 4.2 and 10.6 K/ μ L and 37–80%, respectively. The criterion for leukocytosis required the WBC value to exceed 10.600 K/ μ L and a differential with PMNs% over 80% was considered to be increase in PMNs%.

2.1. Analysis

All statistical analyses were performed with SPSS version 17.0

for Windows (SPSS Inc., IL, USA). Normally distributed variables were expressed as mean and SD, whereas those that were asymmetrically distributed were expressed as median and interquartile range (IQR). To compare proportions and rates, χ^2 tests and a Fisher's exact test were used for categorical variables, an independent sample *t*-test was used for parametric variables, and a Mann Whitney *U* test was used for nonparametric variables. Two-tailed *p* values less than 0.05 were considered to be statistically significant.

3. Results

Five hundred fifty four out of 1339 ED patients, who were received a noncontrast head CT, with the prediagnosis of SAH during the study, were confirmed by CT to have SAH. Among these patients, 318 of them had a traumatic SAH, four of them did not have a CBC and head CT images of 35 of them were not found in PACS and consequently were excluded from the study. The study group consisted of 197 patients. 5037 patients who were admitted to the ED during the study, and who were discharged with the diagnosis of a nonspecific headache, as their CT results were negative for SAH, were identified. A hundred ninety seven of these patients formed the control group after randomization (Fig. 1).

Forty-six percent ($n = 92$) of patients in the control and study groups were males, with a median age of 58 years (IQR:47–67). Mean WBC count and PMNs% count of SAH patients admitted to the ED were found to be higher than those of the control group (Table 1). Sensitivity, specificity, negative predictive value (NPV) and positive predictive value (PPV) of leukocytosis or an increase in PMNs% in the diagnosis of SAH was 89.8% (84.5–93.5, 95% CI), 46.7% (39.6–53.9, 95% CI), 82.1% (73.5–88.4, 95% CI) and 62.8% (56.8–68.4, 95% CI), respectively. Control CBC count was repeated within 6 h (mean \pm SD 154.4 \pm 85.3 min) after ED admission in 52 (26.3%) of the study patients and within 12 h (mean \pm SD 302.7 \pm 200.1 min) in 89 (45.1%) of them. Leukocytosis or an increase in PMNs% were positive in all of the patients with SAH administered a control CBC count within the first 6 and 12 h

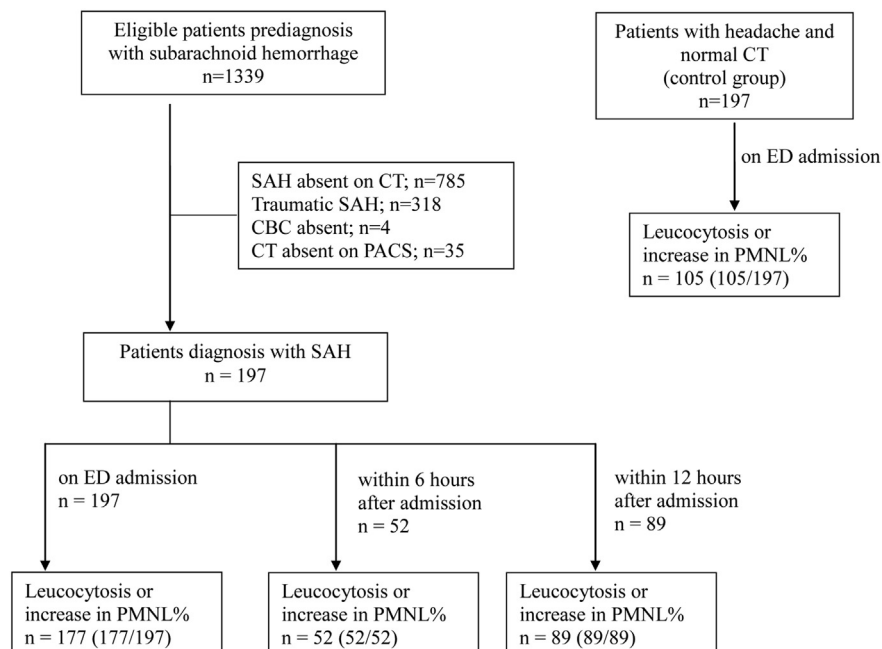


Fig. 1. Study flow chart. ED: emergency department, CT: computed tomography, SAH: subarachnoid hemorrhage, CBC: complete blood count, PMNL%: percentage of polymorphonuclear cells, PACS: picture archiving and communication system.

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