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The Effects of a "Transient Ischemic Attack Unit" on the Early Diagnosis and Treatment of Stroke and Other Vascular Events

Geçici İskemik Atak Ünitesinin İnme ve Diğer Vasküler Olayların Erken Tanı ve Tedavisi Üzerine Etkileri

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Abstract

Objective: Identifying the etiology and early treatment following a transient ischemic attack (TIA) or minor stroke may prevent patients from having a disabling ischemic stroke. The primary aim of this study was to increase awareness of the symptoms of TIA and minor ischemic stroke and provide early intervention via a TIA unit. In addition, the benefits provided by the TIA unit were analyzed in terms of prognosis and length of hospital stay.

Materials and Methods: Before beginning the study, brochures and posters containing information about the symptoms of a TIA and minor ischemic stroke, along with the mobile phone number of a research fellow, were distributed in the clinics and hung on the main boards of the Ankara University Faculty of Medicine Hospitals. A presentation on the TIA unit was also given to the healthcare professionals of the hospitals. Afterward, 69 patients consecutively admitted with symptoms of a TIA or minor ischemic stroke [with a National Institutes of Health Stroke Scale (NIHSS) score of ≤5] between September 16, 2019, and September 15, 2020, were prospectively included in the study group. The hospital charts of 90 consecutive patients admitted with a TIA or minor ischemic stroke (with an NIHSS score of ≤5) were retrospectively evaluated as the control group from September 16, 2018, to September 15, 2019. The timing of the etiological diagnoses and treatments, the length of the hospital stay, and the prognoses of these two groups of patients, one comprising patients admitted before and the other comprising patients admitted after the TIA unit was established, were compared.

Results: The two groups had no significant difference in vascular events and mortality. However, in the logistic regression analysis, the length of the hospital stay was significantly shorter in the study group (P = 0.015).

Conclusion: A TIA and a minor stroke should be recognized quickly, and diagnostic tests should be performed as soon as possible to shorten the period of the hospital stay and reduce the costs and complications related to longer hospitalization.

Keywords: Transient ischemic attack, minor stroke, prognosis, length of hospital stay, TIA unit

Öz

Amaç: Geçici iskemik atak (GİA) ve minör inme sonrasında etiyolojik nedenin hızlıca bulunması ve uygun tedavinin başlanması hastaların özürlülük yaratacak şiddette iskemik inme geçirmesini önleyebilir. Bu çalışmanın primer amacı GİA ve minör inmenin farkındalığını artırmak ve GİA ünitelerine erken başvuruyu sağlamaktır. Ayrıca GİA ünitesinin, prognoz ve hastanede kalış sürelerine sağladığı faydayı araştırmaktır.

Gereç ve Yöntem: Çalışmaya başlamadan önce, kliniklere GİA ve minör inme belirtileri hakkında bilgi veren ve hastaların ulaşabilmesi için araştırma görevlisinin telefon numarası bulunan broşürler dağıtılmıştır, posterler asılmıştır ve Ankara Üniversitesi Tıp Fakültesi Hastaneleri sağlık çalışanlarına GİA

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ünitesinin tanıtımı yapılmıştır. Daha sonra 16 Eylül 2019 - 15 Eylül 2020 arasında GİA veya minör iskemik inme semptomları (NIHSS ≤5) ile başvuran ardışık 69 hasta prospektif olarak çalışma grubuna dahil edilmiştir. 16 Eylül 2018 - 15 Eylül 2019 arasında GİA veya minör iskemik inme (NIHSS ≤5) ile başvurmuş ardışık 90 hastanın kayıtları kontrol grubu olarak retrospektif değerlendirilmiştir. GİA ünitesi öncesi ve sonrası başvuran iki grup hastanın etiyolojik tanı ve tedavi zamanlaması, hastanede kalış süresi ve prognoz açısından karşılaştırılmıştır.

Bulgular: İki grup arasında vasküler olaylar ve vasküler mortalite açısından anlamlı bir fark bulunmamıştır. Yapılan lojistik regresyon analizinde, hastanede yatış süresi çalışma grubunda anlamlı olarak daha kısa tespit edilmiştir (P = 0,015).

Sonuç: GİA ve minör inme hastaları hızlıca tanınmalı ve kalış süresini kısaltmak, hastane maliyetlerini ve olası komplikasyonları azaltmak için araştırma tetkikleri en kısa sürede yapılmalıdır.

Anahtar Kelimeler: Geçici iskemik atak, minör inme, prognoz, hastanede kalış süresi, GİA ünitesi

Introduction

A transient ischemic attack (TIA) is a clinical syndrome characterized by short-term symptoms of acute, focal cerebral, or monocular dysfunction due to blood flow insufficiency that lasts less than 24 hours (1,2,3,4). According to the previous TIA definition, an acute ischemic lesion detected on diffusion-weighted imaging (DWI) is not considered a TIA, even if the patient's symptoms have improved (3,4,5).

A TIA is a significant precursor to an ischemic stroke. The risk of an ischemic stroke after a TIA is relatively high in the early period following the index transient ischemic event (3,4,6,7,8,9,10). The rapid determination of the etiology of the TIA and early treatment may prevent patients from having a future disabling ischemic stroke after a TIA (3,4,6,7,8,9,10,11,12,13,14). Likewise, the risk of a disabling ischemic stroke could be reduced by the more rapid investigation and treatment of patients who have had a minor stroke (7,15).

The primary aim of this study is to increase awareness of TIA and minor stroke symptoms via brochures, posters, and presentations to healthcare professionals to ensure early intervention within 72 hours of a TIA or minor stroke patient being admitted to the TIA unit of the hospital. The effects of the TIA unit on the patients' prognosis and length of hospital stay were also analyzed by comparison with a period prior to the establishment of the TIA unit.

Materials and Methods

Before beginning the study, brochures and posters with information about the symptoms of a TIA and minor ischemic stroke, along with the mobile phone number of a research fellow (MA), were distributed in the clinics and hung on the main boards of the Ankara University Faculty of Medicine Hospitals. A presentation on the TIA unit was also given to the healthcare professionals of the hospitals.

In the stroke center, a TIA unit was established as an inpatient/outpatient clinic to perform diagnostic workups for stroke patients more quickly and thoroughly. The distinguishing feature of the TIA unit compared with the stroke unit was that patients with transient neurological symptoms could reach MA by phone 24 hours a day, seven days a week, and the diagnostic and etiologic workup was completed within 72 hours for those patients whose complaints were compatible with a TIA or minor ischemic stroke. The patients did not need to be hospitalized to have their investigations completed. Thus, the diagnostic workup, such as echocardiography (ECG) and 24-hour Holter cardiac rhythm monitoring, was performed earlier in the study patients.

The research fellow, MA, was trained on the symptoms of TIA and minor ischemic stroke and was available 24 hours a day, seven days a week. Patients who called MA, were admitted to the emergency department or an outpatient clinic, or were already hospitalized in other clinics with symptoms of a TIA or minor ischemic stroke comprised the study group. The patients were evaluated by a stroke neurologist on the same day of admission, and those with a final diagnosis of TIA or minor ischemic stroke were referred for further evaluation. A diagnostic workup of ischemic stroke etiology was completed, and appropriate treatment for secondary prevention was started within 72 hours in the patients in the study group.

Sixty-nine consecutive patients who presented with symptoms of a TIA or minor ischemic stroke [with a National Institutes of Health Stroke Scale (NIHSS) score of ≤5] between 16th September 2019 to 15th September 2020 were included in the study prospectively. The medical records of 90 consecutive patients admitted with a TIA or minor ischemic stroke (with an NIHSS score of ≤5) from September 16, 2018, to September 15, 2019, were retrospectively evaluated as the control group. The TIA diagnosis was based on the National Institute of Neurological Disorders and Stroke diagnostic criteria, and a minor ischemic stroke was defined as acute neurological deficits with an NIHSS score of ≤5 and ischemic infarcts on brain imaging (1,2,3,4). If DWI could not be performed, control brain computed tomography (CT) scans were performed 24 hours later. A TIA was dignosed as a clinical improvement if acute ischemia was not observed in the control brain CT. All patients were evaluated by the same stroke neurologists and experienced stroke nurses.

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Patient demographic data, risk factors for stroke, such as hypertension, diabetes mellitus (DM), hyperlipidemia, atrial fibrillation, congestive heart failure, coronary artery disease (CAD), a previous TIA or stroke, peripheral artery disease, and smoking status, the NIHSS score at admission, and the ABCD3-I score (https://medschool.co/tools/abcd3i) were recorded using a standard data collection form (16).

Hypertension was defined as blood pressure ≥140/90 mmHg on repeated measurements or prior to the use of antihypertensive medication; DM as fasting blood glucose level ≥126 mg/dl on repeated measurements, HbA1c ≥6.5%, or the use of medications to lower blood glucose; atrial fibrillation by previous history or if detected on an ECG or 24-hour Holter cardiac

rhythm monitoring; hyperlipidemia as fasting blood low-density lipoprotein cholesterol level ≥100 mg/dl; and CAD as a history of myocardial infarction, coronary artery bypass surgery, or coronary angioplasty with stenting. The data relating to smoking status (active smokers or stopped smoking within the last six months) was also recorded.

A single rater determined the etiologic stroke subtypes using the automated Causative Classification System (CCS), available at https://ccs.mgh.harvard.edu (17). The CCS subtypes included supra-aortic large artery atherosclerosis, cardio-aortic embolism, small artery occlusion, other causes, and undetermined causes. In addition, all patients had cranial CT and/or DWI. An etiologic workup involved vascular imaging studies, such as carotid Doppler ultrasonography, CT angiography, magnetic resonance angiography, digital subtraction angiography, transthoracic or transesophageal ECG, 24-hour Holter cardiac rhythm monitoring, and laboratory tests for hypercoagulability and vasculitis.

The diagnostic workup duration, hospitalization duration, and reason for prolonged hospitalization were recorded. In addition, the vascular events, including TIA/stroke recurrence, acute coronary syndrome or cardiovascular death (fatal acute coronary syndrome, fatal stroke, fatal intracranial hemorrhage, and fatal pulmonary embolism), and the modified Rankin scale (mRS) scores were recorded at follow-up visits or phone calls to patients.

Statistical Analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 11.5 (SPSS Inc. Chicago, Illinois, USA). Descriptive statistics were expressed as means ± standard deviations. Quantitative variables were given in medians (minimum–maximum), and qualitative variables were expressed in numbers (percent). The Mann–Whitney U test was used to compare the differences between the two independent groups when the dependent variable was numerical but not normally distributed. The Chi-squared test was used to compare group rates. Additionally, logistic regression was used to analyze independent variables that determine the risk factors for a qualitative dependent variable with two categories, revealing a statistically significant risk factor for that dependent variable. A P value <0.050 was statistically significant.

Results

A total of 69 (43.4%) patients in the study group [29 women (42%), mean age 69.62 ± 11.1 years] and 90 (56.6%) patients in the control group [36 women (46%), mean age 66.31 ± 9.04 years] were included in the study ($P > 0.050$) (Table 1). The onset to hospital admission time was 4.78 ± 4.03 days in the study group and 0.64 ± 1.37 days in the control group ($P < 0.001$).

A DWI could not be performed on nine patients in the study group. A control brain CT was carried out on these patients 24 hours later. Clinical recovery was complete in only one patient, while in the other eight patients, acute ischemia was not observed on the control brain CT, and they were categorized as having had a TIA. In the control group, a DWI of three patients could not be performed, and a control brain CT was conducted 24 hours later. Only one of these patients had a TIA.

Statistical analyses did not reveal any differences between the two groups in the risk factors for stroke, the mean NIHSS score at admission, the etiologic stroke subtypes, and the mean ABCD3-I score ($P > 0.050$) (Table 1).

Sixty-two patients (89.9%) in the study group and 43 (47.8%) in the control group completed a diagnostic workup evaluation of ischemic stroke within 72 hours ($P < 0.001$). The mean hospitalization duration was 5.45 ± 3.68 days in the study group and 9.4 ± 16.07 days in the control group. The length of hospital stay was significantly shorter in the study group compared with the control group ($P = 0.003$). The most common reason for prolonged hospitalization was infections in both groups [study group n = 2 (2.9%), control group n = 8 (8.9%)] (Table 2).

The follow-up information was accessible for 57 (82.6%) patients in the study group and 60 (66.7%) patients in the control group. The mean mRS was 1.39 ± 1.13 (0–6) in the study group and 1.20 ± 1.592 (0–6) in the control group during the follow-up period ($P = 0.051$). The two groups had no significant difference in vascular events and mortality (Table 3).

In logistic regression analysis, the length of hospital stay was significantly shorter in the study group ($P = 0.015$) (Table 4).

Discussion

In this study, 69 consecutive patients admitted with symptoms of a TIA or minor ischemic stroke (NIHSS score of ≤5) between September 16, 2019, and September 15, 2020, were included in the study group prospectively. The hospital charts of 90 consecutive patients admitted with a TIA or minor ischemic stroke (NIHSS score of ≤5) from September 16, 2018, to September 15, 2019, were retrospectively evaluated for the control group. The difference between the study group and the control group was that patients with symptoms of a TIA or minor stroke in the study group could call the TIA unit 24 hours a day, seven days a week, and the diagnostic workup evaluation of ischemic stroke etiology was completed within 72 hours. The two groups had no significant difference in vascular events and mortality. However, in logistic regression analysis, the length of the hospital stay was significantly shorter in the study group ($P = 0.015$).

The SOS-TIA study by Lavallée et al. (11) included 1.085 patients with a suspected TIA between January 2003 and December 2005. In this study, patients were first evaluated by phone. After that, the patients with a suspected TIA or minor stroke were quickly assessed for stroke etiology and risk factors. A total of 701 (65%) patients had a TIA or minor stroke, and 144 (13%) patients were considered as having had a probable TIA. Nine hundred forty-eight (87%) patients had at least one vascular risk factor (a body mass index ≥30 kg/m^2, hypertension, hypercholesterolemia, DM, a history of cardiovascular and cerebrovascular disease, or smoking). A stroke prevention program was initiated in all patients with a confirmed or probable TIA, 43 (5%) patients underwent emergency carotid revascularization, and 44 (5%) patients were treated with anticoagulants for atrial fibrillation. Lavallée et al. (11) reported that the length of the hospital stay and the risk of stroke could be significantly reduced through 24-hour access, immediate initiation of preventive treatment, and use of TIA clinics.

In a population-based study by Kamal et al. (12) in Pakistan, 545 people aged 35 and over were questioned through face-to-face interviews about stroke and TIA symptoms. A questionnaire was administered to all participants consisting of four parts. Socio-demographic characteristics, experienced stroke symptoms (based

on the Stroke Symptom Questionnaire and the TIA Symptom Questionnaire), TIA symptoms experienced in the last 12 months, and known risk factors were explored in this questionnaire. Patients were evaluated and examined by a vascular neurologist. A stroke was diagnosed in 104 patients, a TIA was diagnosed in 53 (9.7%) patients, and a stroke and/or TIA was diagnosed in 119 patients. Female gender, older age, high blood glucose, and smoking were found to be risk factors. In the first 90 days after a TIA, the risk of stroke was reported at 10%, and half occurred within the first 48 hours. It has been suggested that an 80% relative risk reduction could be achieved with early intervention (12).

In the study by Al-Khaled et al. (13), all patients over the age of 18 who presented with a diagnosis of TIA in the first 48 hours according to the World Health Organization's definition were included. The patients' age, gender, TIA symptoms, vascular risk factors, medical history, diagnostic and treatment procedures (transesophageal ECG, 24-hour Holter cardiac rhythm monitoring carotid Doppler ultrasonography), vital signs, cranial CT and magnetic resonance imaging (within 24 hours) results, hospital stay, secondary prevention treatments, 90-day stroke rate, and mortality rate were recorded. In this study, the stroke unit and the conventional approach were compared. A total of 2.200 TIA (43% female, aged 70 ± 12 years) patients were included. In this study, 1.347 patients were treated in the stroke unit, and 853 patients were treated with the conventional approach. Although there was no difference between the stroke during hospitalization and stroke and mortality rates after 90 days between the two groups, the 90-day stroke rates after treatment by the stroke unit were statistically significantly lower than the conventional approach (P = 0.033) (13).

In the community-based study by Corrao et al. (14), 7.776 patients with their first TIA were retrospectively evaluated. Patients in the same age group without a TIA or vascular event were included in the control group. It was reported that the patients who received medical care had a 59% reduced risk of a disabling stroke, other cardiovascular events, and death (95% confidence interval, 50%–66%) compared with those who did not use any of these services (14).

The main aim of this study was to change the approach to patients with a TIA or minor stroke in the hospital. As in the SOS-TIA study, the first evaluation was made by telephone (11). Posters containing information about TIA and minor ischemic

Table 1. Epidemiologic and clinical characteristics of the study and control groups

	Study group n = 69	Control group n= 90	*P*
Age, year, mean ± SD	69.62 ± 11.10	66.31 ± 9.04	0.152
Sex (F/M), n (%)	29/40, (42/58)	36/54, (40/60)	0.769
TIA/minor stroke, n (%)	11/58, (15.9/84.1)	16/74, (17.8/82.2)	0.926
Risk factors			
Hypertension, n (%)	56 (81.2)	70 (77.8)	0.746
Diabetes mellitus, n (%)	28 (40.6)	47 (52.2)	0.145
Atrial fibrillation, n (%)	23 (33.3)	23 (25.6)	0.284
Hyperlipidemia, n (%)	46 (66.7)	72 (80)	0.085
CAD, n (%)	21 (30.4)	28 (31.1)	0.927
CHF, n (%)	3 (4.3)	5 (5.6)	0.999
Previous TIA/stroke history, n (%)	14 (20.3)	30 (33.3)	0.100
PAH, n (%)	2 (2.9)	1 (1.1)	0.580
Smoking, n (%)	18 (27.3)	14 (31.8)	0.764
Admission NIHSS score Mean ± SD Median (min–max)	 2.14 ± 1.298 2 (0–5)	 2.19 ± 1.648 2 (0–5)	0.890
ABCD3-I score Mean ± SD Median (min–max)	 6.35 ± 2.202 6 (1–11)	 6.81 ± 2.198 7 (2–11)	0.167
CCS classification, n (%)			
Large-artery atherosclerosis	14 (20.3)	29 (32.2)	
Cardio-aortic embolism	27 (39.1)	25 (27.8)	
Small artery occlusion	8 (11.6)	16 (17.8)	0.117
Other causes	4 (5.8)	1 (1.1)	
Undetermined causes	16 (23.2)	19 (21.1)	

SD: Standard deviation, TIA: Transient ischemic attack, CAD: Coronary artery disease, CHF: Congestive heart failure, PAH: Peripheral artery disease, NIHSS: The National Institutes of Health Stroke Scale, CCS: Causative Classification System, M: Male, F: Female

Table 2. New diagnosis of risk factors, length of hospital stay, and completed diagnostic workup evaluation of ischemic stroke within 72 hours in the study and control groups

	Study group n = 69	Control group n = 90	*P*
Risk factors			
Hypertension, n (%)	8 (11.6)	10 (11.1)	0.873
Diabetes mellitus, n (%)	5 (7.2)	3 (3.3)	0.109
Atrial fibrillation, n (%)	17 (24.6)	12 (13.3)	0.174
Hyperlipidemia, n (%)	28 (40.6)	43 (47.8)	0.164
Length of hospital stay (days) Mean ± SD	5.45 ± 3.68	9.4 ± 16.07	**0.003**
Completed diagnostic workup evaluation of ischemic stroke <72 hours, n (%)	62 (89.9)	36 (40)	**<0.001**
Prolonged hospitalization due to infections, n (%)	2 (2.9)	8 (8.9)	0.189

SD: Standard deviation

Table 3. Vascular events of the study and control groups at the hospital and during the follow-up period

	Study group n = 69	Control group n = 90	*P*
Clinical progression at hospital, n (%)	0 (0)	3 (3.3)	0.258
Follow-up stroke/TIA in first month, n (%)	0 (0)	2 (3.3)	0.496
Follow-up stroke/TIA, n (%)	3 (4.3)	5 (5.5)	0.718
Follow-up MI/angina pectoris, n (%)	2 (3.5)	2 (3.3)	0.671
Follow-up vascular mortality, n (%)	2 (3.5)	3 (5.0)	0.524
Follow-up vascular events, n (%)	4 (7.0)	7 (11.7)	0.586
Follow-up mRS Mean ± SD Median (min–max)	1.39 ± 1.13 1 (0–6)	1.20 ± 1.592 1 (0–6)	0.051

TIA: Transient ischemic attack, MI: Myocardial infarction, mRS: Modified Rankin scale, SD: Standard deviation, min: Minimum, max: Maximum

Table 4. Logistic regression analysis of the study and control groups

	Beta	95% CI	*P*
Length of hospital stay (days) Mean ± SD	0.114	0.814 –0.978	**0.015**

SD: Standard deviation, CI: Confidence interval

stroke symptoms and the TIA unit were hung on the main boards in the large and crowded areas of the Ankara University Faculty of Medicine Hospitals. In addition, informative brochures covering TIA and minor ischemic stroke symptoms and their importance were distributed in the clinics of the hospitals. Unfortunately, the study was conducted during the coronavirus disease-2019 (COVID-19) pandemic, and the number of patients and their relatives who attended the hospital decreased due to the cessation of elective procedures, the lack of routine patient check-ups, and the closure of specific polyclinics, while emergency hospitalizations and procedures continued. Therefore, the brochures were seen by fewer people than planned and the number of people reached was less than targeted due to the reduced number of hospital admissions because of the pandemic.

All of the patients included in the study were those who attended the emergency department or neurology outpatient clinic or were consulted while they were hospitalized in another service. During the study period, it was observed that the number of hospital admissions of patients with a TIA or minor ischemic stroke decreased due to the COVID-19 pandemic. A TIA was detected in 11 patients, and a minor stroke was diagnosed in 58 patients in the study group.

Sixty-two patients (89.9%) in the study group and 43 (47.8%) patients in the control group had completed a diagnostic workup evaluation and secondary prevention of ischemic stroke treatment within 72 hours of being admitted to the hospital ($P < 0.001$). The investigations for the etiology of stroke were completed quickly to prevent ischemic stroke recurrence due to the protocol of this

study. The patients' subtype of stroke etiology was determined by using the CCS, and the appropriate treatment was started as soon as possible for secondary prophylaxis according to the guidelines for the early management of patients with acute ischemic stroke (18,19,20). As a result, awareness of rapid examination and treatment plans for a TIA or minor ischemic stroke in branches other than neurology increased. Also, a shorter hospital stay was significantly associated with the study group (P = 0.003). Thus, this study's results suggest that TIA units may reduce hospital stay length for patients with a TIA or minor stroke.

The follow-up information was accessible for 57 (82.6%) patients in the study group and 60 (66.7%) patients in the control group. No difference in vascular events and mortality between the two groups was thought to be due to the fact that both groups were evaluated and managed by vascular neurologists.

Study Limitations

This study has several limitations, including being carried out in a single medical center with a small number of patients. However, the most important limitation of this study was that the brochures were distributed only to patients and their relatives who were admitted to the Ankara University Faculty of Medicine Hospitals. Another important limitation was the retrospective evaluation of the control group. Furthermore, the prepared brochures reached fewer people than planned due to a reduction in the number of patients who were admitted to the hospitals during the COVID-19 pandemic. The study and control groups were treated via the same algorithms developed by the same stroke neurologists.

Conclusion

Although the number of cases was limited, the results of this study revealed that TIA units shorten the length of hospital stays of patients with TIA and minor ischemic stroke and are important in reducing costs and complications related to longer hospitalization. Furthermore, major stroke prevention can be achieved by early determination of TIA or minor stroke etiology and initiation of treatment; therefore, the spread of TIA units nationwide is very important.

Ethics

Ethics Committee Approval: Ethics Committee of Ankara University Faculty of Medicine (approval ID: 01-02-18; approval date: August 1, 2018).

Informed Consent: All study participants prospectively signed the study's informed consent form.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: M.H.S., Z.Ö.A., S.E., M.A., A.G.Ç., D.K.Ö., N.Ö., E.P., C.T.K., K.Y., M.E., C.T.I., Concept: M.H.S., Z.Ö.A., S.E., C.T.I., Design: M.H.S., C.T.I., Data Collection or Processing: M.H.S., Z.Ö.A., S.E., M.A., Analysis or Interpretation: M.H.S., M.E., Literature Search: M.H.S., Z.Ö.A., S.E., C.T.I., Writing: M.H.S., C.T.I.

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