



Trends in the Management and Hospital Outcome of Spontaneous Subarachnoid Hemorrhage in the Post-International Subarachnoid Aneurysm Trial Era in Greece: Analysis of 719 Patients During a 13-Year Period

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■ **BACKGROUND:** Management and outcome data on spontaneous subarachnoid hemorrhage (SAH) in Greece are scarce. We analyzed 13-year (2002–2014) retrospective data on all first-ever SAH patients referred to one of the largest neurosurgical academic departments.

■ **METHODS:** Patient demographic/clinical status, length-of-hospital stay, and hospital outcome were determined. Outcome in different treatment categories was compared and prognostic factors identified.

■ **RESULTS:** A total of 719 patients were identified (mean age, 55 ± 12 years; men:women ratio, 1:1.4). Angiography (DSA) was performed in 88% of patients ($N = 632$); it was positive in 77.5% ($N = 490$). DSA was not performed in the remaining cases mainly due to early deaths (67 of 87; 77%). Of DSA-positive patients 74.9% (367 of 490; 51% of the total sample) underwent treatment. It comprised predominantly of coiling (81.5%) and to a lesser extent of clipping (18.5%). Lack of treatment on DSA-positive patients was largely due to early deaths (66 of 123; 53.7%). Favorable outcome was recorded in 45.6% overall (328 of 719). Favorable outcome or mean length of hospital stay did not differ significantly between coiling (51.2%; 24.7 ± 49 days) and clipping (48.8%; 28.8 ± 28 days). Nevertheless, the surgery group had a significantly higher proportion of dead patients. Advanced age and poor clinical presentation were independent risk factors for bad outcome.

■ **CONCLUSIONS:** Predominance of coiling over time is consistent with current trends in Western Europe and the United States. Outcome of clipping or coiling was comparable to previous salient series. Early treatment/centralization of care remain prerequisites for extending treatment options and further improving SAH outcome.

INTRODUCTION

Subarachnoid hemorrhage (SAH) remains a devastating neurological disorder that carries a substantial mortality risk.¹⁻³ Previous regional epidemiologic studies on SAH in Greece indicate crude annual incidence rates ranging between 5 and 8 per 100,000 persons and early case fatality rates of 35%–40%.⁴⁻⁶

Neurosurgeons continue to play a central role in the management of SAH in Greece, a country with a population of nearly 11 million people (Greek national census, year 2011). An approximate population of 3.5 million persons have access to 3 state neurosurgical units in the northern part of the country. The remaining Greek population is covered by 8 major state neurosurgical units. Nevertheless an accurate estimate of the population served by each neurosurgical unit cannot be readily obtained. In addition, referrals from remote regions are admitted to several smaller state units and private hospitals. Regarding the diagnosis of SAH, computerized tomography (CT) scanning is widely available, with most community hospitals and private diagnostic centers offering

Key words

- Cerebral aneurysms
- Greece
- Hospital outcome
- Length of hospital stay
- Management
- Prognosis
- SAH
- Spontaneous subarachnoid hemorrhage

Abbreviations and Acronyms

- CT:** Computerized tomography
- DSA:** Digital subtraction angiography
- GOS:** Glasgow outcome score
- HH:** Hunt and Hess

ISAT: International Subarachnoid Aneurysm Trial

LOS: Length of hospital stay

SAH: Spontaneous subarachnoid hemorrhage

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this service. Patients suspected of having SAH are typically offered CT scanning regardless of neurological condition.

Nevertheless, there is a paucity of data on the management and outcome of SAH in Greece. Thus, the only salient available data derive from a single prospective cohort study covering a 4-year period, which was conducted more than a decade ago (1998–2001).⁷ Given the impact of the landmark findings of the International Subarachnoid Aneurysm Trial (ISAT)⁸ on treatment perspectives and practices, especially in Western Europe and the United States,^{9–14} the present study aimed in establishing trends in the management of SAH in Greece and its hospital outcome in the post-ISAT era. To achieve this goal we analyzed retrospective data on all first-ever SAH patients that were referred to one of the largest neurosurgical academic departments in Greece¹⁵ during a 13-year period (2002–2014). We identified patient demographic/clinical characteristics, type of treatment, length of hospital stay (LOS) and hospital outcome. The outcome of patients in distinct treatment categories was compared and prognostic factors with respect to demographic and clinical findings examined.

METHODS

All adult patients with a diagnosis of first-ever SAH who were admitted to the Department of Neurosurgery, University of Athens, Evangelismos Hospital, between January 2002 and December 2014 (13 years) were identified from an electronic departmental database. Craniotomies (clipping) were carried out at the Department of Neurosurgery, Evangelismos Hospital. Endovascular treatment (coiling) was carried out in collaborating hospitals after referrals. The decision for craniotomy or embolization was taken in cooperation with the endovascular interventionists (different providers at both state and private hospitals) and discussed with patients and/or their relatives. The patients with a Hunt and Hess (HH) grade <4 and SAH harboring aneurysms were offered the option of embolization, when technically feasible, or craniotomies, which were carried out as soon as possible. Surgeries took place at a later stage, typically after 2 weeks. Posterior circulation aneurysms were treated by means of embolization. An additional criterion for the treatment strategy followed was the patient's insurance policy (state or private). Postprocedural care took place at Evangelismos Hospital.

The following data were collected: 1) patient demographic characteristics (age and gender); 2) preoperative workup after admission (HH grading, Fisher grading, digital subtraction angiography [DSA] findings); 3) type of management (conservative, embolization, or craniotomy); and 4) hospitalization times. Outcome of patients, determined at hospital discharge, was dichotomized into unfavorable (Glasgow outcome score [GOS] 1, 2, 3) or favorable (GOS 4 or 5). For the analysis of outcome in relation to preoperative findings, patients were divided in 3 groups on the basis of HH grading (HH₁+2, conscious on admission and of good neurological state; HH₃, conscious on admission and of fair neurological state; HH₄+5, unconscious/poor neurological state). Patients discharged from hospital were those who were able to return to home or work, or being admitted to a rehabilitation unit.

Student's t-tests were used for the comparison of continuous variables. Differences in proportions were analyzed by means of χ^2 tests. Logistic regression analysis was used to assess associations

between clinical and demographic parameters with a favorable or unfavorable outcome. Statistical significance was set at 0.05 and analyses were conducted using SPSS statistical software (version 17.0; SPSS Inc, Chicago, Illinois, USA). The present study was approved by the Evangelismos Hospital ethics committee and was carried out in accordance to the Code of Ethics of the World Medical Association (Declaration of Helsinki).

RESULTS

A total of 719 patients with first-ever SAH were identified during the study period (Table 1). They were 304 men and 425 women (ratio men:women, 1:1.4) with a mean age \pm standard deviation of 54.28 ± 12.6 and 55.53 ± 12.59 years, respectively. Most patients (72.3%) were conscious and of good neurological status on admission (Table 1). DSA was performed within 24 hours of admission in 632 of 719 patients with SAH (88%). Twenty patients (2.6%) did not

Table 1. Demographic Characteristics, Clinical Findings and Therapeutic Management of SAH Patients

Patients with SAH (N = 719)

Demographic characteristics	
Gender (male/female)	304/425
Mean age \pm SD (years)	55 \pm 12.6
Clinical findings	
Arterial hypertension	25.3%
Admission HH grading	I = 20.3%, II = 30.5%, III = 21.5%, IV = 18.7%, V = 8%
CT Fisher grading	I = 1.5%, II = 37.5%, III = 35%, IV = 26%
DSA performed (N = 632, 88%)	Aneurysm = 490 (77.5%), negative DSA = 142 (22.5%)
Aneurysm location	AcomA = 201 (41%) ICA/AchorA/PcomA = 109 (22.2%) MCA = 107 (28%) Anterior circulation other = 21 (4.3%) Posterior circulation = 52 (10.6%)
Therapeutic management	
Interventional treatment (367/719, 51% overall) and (367/490, 74.9% of DSA-positive patients)	Embolization = 299 (41.5%) Surgery/clipping 68 (9.5%)
Conservative management (352/719, 49%)	Conservative 1* = 123 (17.1%) Conservative 2† = 142 (19.7%) Conservative 3‡ = 87 (12.1%)

CT, computerized tomography; DSA, digital subtraction angiography; SD, standard deviation; HH, Hunt and Hess; AcomA, anterior communicating artery; ICA, internal carotid artery; AchorA, anterior chordal artery; PcomA, posterior communicating artery; MCA, middle cerebral artery.

*Conservative 1, patients with positive DSA who died before intervention (N = 66), refused treatment (N = 54), or were considered unsuitable for intervention (N = 3).

†Conservative 2, patients with negative DSA.

‡Conservative 3, patients who did not undergo DSA (N = 20) or patients who died before DSA (N = 67).

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