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Improved survival after non-traumatic subarachnoid haemorrhage with structured care pathways and modern intensive care

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ABSTRACT

Objective: Patients with subarachnoid haemorrhage (SAH) often require multidisciplinary management and their treatment is difficult to standardize. The aim was to describe baseline characteristics, care pathways and discharge status in an unselected group of patients with first ever non-traumatic SAH, and to examine whether their care pathways and outcomes vary.
Methods: Patients admitted with first ever non-traumatic SAH to a neurosurgical unit (NSU) in Sweden during a period of 18 months in 2009–2010 were included. The data was retrospectively collected from patient charts.
Results: A total of 131 patients were admitted with first ever non-traumatic SAH. Forty-nine (37%) patients initially sought medical care nearby the NSU and 82 (63%) in other parts of the catchment area. The average age was 55.5 years and 79 (60%) were female. In 98 (75%) cases, a ruptured aneurysm was found to be the cause of SAH. There was a significant correlation between poor clinical grade at admission and poor patient outcome ($p < 0.0005$). No significant correlation between early aneurysm treatment and improved clinical outcome were seen. No significant differences in outcome were seen between patients who initially sought medical care nearby the NSU and those in other parts of the catchment area. There was no difference seen in the number of patients who had follow-up at the NSU depending on where they initially sought help.
Conclusion: This study shows an improvement in survival after SAH compared to earlier studies in Sweden. The results are indicative of effective management of all patients with SAH in the catchment area that are treated at the NSU. A nationwide registry to assess the overall management of patients treated for SAH would be useful to further investigate patients with SAH.

1. Introduction

Subarachnoid haemorrhage (SAH) is a serious condition that accounts for approximately 5% of strokes [1]. However, the years of productive life lost are equivalent to that for cerebral infarction or intracerebral haemorrhage since it occurs at a fairly young age and is often fatal [2,3]. There is a wide variation in the incidence of SAH with age, gender and region [4]. Ruptured aneurysms are by far the most common cause of non-traumatic SAH, and have a high disability rate. The case fatality rate after aneurysmal SAH is estimated to be around 50% [5], out of which about 10–15% die before reaching hospital [6]. Patients admitted with SAH often require care at the intensive care unit (ICU) and long hospital stays. Recurrent bleeding, secondary ischemia and hydrocephalus are the three main neurological complications in patients with a ruptured intracranial aneurysm, contributing to the poor prognosis [1]. In addition, systemic complications may significantly affect the outcome of patients with SAH [1]. Early prevention, detection and treatment of these complications are vital for a good outcome. Aneurysmal SAH poses a considerable health-economic burden [7]. Just under half of the survivors are believed to be dependent on others for their normal activities of daily living [5]. Due to the severity of the disease and its many complications, patients with SAH require multidisciplinary management. Their treatment by a team including neurosurgeons, anaesthesiologists and rehabilitation physicians is challenging and requires individualized management based on a multitude of parameters [3]. It is difficult to standardize the care given to patients with SAH and in many cases the physician-indicated therapies are different from

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evidence-based recommendations [8]. Nonetheless, the prognosis of SAH is influenced in part by therapeutic interventions and management procedures. The European Stroke Organization has provided guidelines for the management of intracranial aneurysms and SAH by giving evidence-based information through an extensive literature search from 1960 to 2010 [9]. The monitoring of the quality of stroke care by registers and regular audits has been strongly recommended in European guidelines by the World Health Organization (WHO)-Europe and the European Stroke Counsel (The Helsingborg declaration) [10]. As yet, no such measures to assess the management of patients with SAH have been implemented in Sweden. Because of this lack of overview of the management process, there is concern from the disciplines involved that these patients are not receiving optimal and equal care. Furthermore, since studies suggest that early timing of endovascular treatment for aneurysmal SAH achieves improved outcomes [11,12], there is a concern that patients who initially seek help in rural areas have less favourable outcomes.

While there are not many studies of SAH covering a specific catchment area with representative data, one was found [13] but this was published more than 30 years ago and perhaps lacks relevance to modern management of SAH [14].

The purpose of this present study was to describe baseline characteristics, care pathways and discharge status in an unselected group of patients with first ever non-traumatic SAH hospitalized in a Neurosurgical Unit (NSU), and to explore whether the care pathway and outcomes vary in different patient groups.

2. Methods and materials

A retrospective study was carried out that included patients admitted with first occasion of SAH in the NSU in Gothenburg, Sweden during a period of 18 months between February 4, 2009 and December 2, 2010, with two breaks (in total 145 days) for administrative reasons. No relevant changes have been applied in the medical management of patients with SAH since the data were gathered. The inclusion criteria for the study were: (1) first ever non-traumatic SAH, defined according to WHO criteria [15], by clinical assessment and imaging or lumbar puncture, (2) living in the geographical catchment area of the NSU. The NSU had one emergency department with the possibility of direct admission. The catchment area included two other hospitals nearby (within 15 km), as well as hospitals in other parts of the region (six with emergency departments) and one hospital in another region. The patients from the hospital in another region generate higher income for the NSU. There was no exclusion by age or other medical conditions.

Qualified patients were identified from the hospital records according to the WHO's International Classification of Diseases 10; diagnosis code I60. Consequently, the first author screened all the patient charts and confirmed the diagnosis followed by a systematic review of the charts. The following demographic variables were extracted from patient medical records: age, gender, hereditary factors, smoking habits, date and time of ictus, date of admission, admission status at the emergency department of their home hospital versus the NSU, time from home hospital to arrival at the NSU, underlying aneurysm, date and course of treatment, ICU days, secondary neurological complications and their treatments, systemic complications, date of discharge, status at discharge and follow-up at the NSU after 2–12 months. In addition, the patient's city of residence, initial hospital visit/admission and discharge destination from the NSU were identified. The Glasgow Coma Scale (GCS) system, which is incorporated in the World Federation of Neurological Surgeons (WFNS) [16] grading scale of patients with SAH, was used to evaluate patients' level of consciousness upon arrival at the home hospital and at the NSU to give baseline data. The grading system of Hunt and Hess (H&H) [17] was used to standardize the clinical classification of patients with SAH based on the initial neurologic examinations at the home hospital and at the NSU. The discharge status from NSU and the status on follow-up at the NSU within 2–12 months were assessed from the medical charts using the modified Rankin Scale (mRS) [18]. The level of consciousness were assessed with the Reaction Level Scale 85 (RLS) [19] in the charts, and converted into GCS scores [20] by the first author. The first author made an assessment of H&H and mRS based on information provided in the patient charts.

The study was approved by the Regional Ethics Committee in Gothenburg Sweden, registration number 225-08. According to Swedish law on personal particulars data from 1998 (personuppgiftslagen, Swedish law No. SFS 1998:204), no informed consent was needed for this study since data were gathered for clinical purposes and quality control.

2.1. Statistical methods

All statistical analyses were performed using SPSS for Windows version 16.0. Descriptive statistics were calculated for all variables, including means and standard deviations, and where appropriate median and range. Since the material was not normally distributed as well as contained ordinal data, non-parametric statistics were applied. The Mann-Whitney *U*-test was used for differences between two independent groups on a continuous measure. The Kruskal-Wallis test was applied to compare of scores on variables for three or more groups. Spearman's rho (p) correlation coefficients were used to assess correlations between variables. A statistician was consulted for each statistical analysis. A p value < 0.05 was considered statistically significant.

3. Results

During the study period, a total of 131 patients, living in the geographical catchment area of the NSU, were admitted with first ever non-traumatic SAH. The average age was 55.5 years (17–85 years) and 79 (60%) were female. For the entire sample, demographic data and timing of symptom onset is presented in Table 1 as well as the clinical assessments at the home hospital and upon arrival at the NSU. Forty-nine (37%) initially sought medical help directly at the NSU or the hospitals nearby and 82 (63%) were diagnosed and transported from other parts of the catchment area (Fig. 1). Ninety-one (70%) arrived at the NSU within 6 h after they sought medical care at their home hospital and 38 (29%) after 6 h. The time of arrival at the NSU from the home hospital was missing in two patient charts.

Following arrival to the NSU patients were, with two exceptions, transferred to the Intensive care unit (ICU). In 98 (75%) cases a ruptured aneurysm was found to be the cause of SAH. In the remaining 33 (25%) patients, an aneurysm was not detected during investigation or the patient's condition was too critical to proceed with further investigation. CT angiography was the first diagnostic test for SAH, and if the result was negative a conventional angiography was usually performed. If both CT-angiography and conventional angiography were negative, the investigation was sometimes completed with another conventional angiography after one week. In 95 out of 98 cases of ruptured aneurysms it was possible to establish time from ictus to treatment of aneurysm. Twenty (21%) patients received treatment within 24 h and a total of 65 (68%) patients were treated for their aneurysm within 48 h. An overview on patient care at the NSU, including the course of treatment and length of stay in the ICU, is presented in Table 2. A number of neurological and systemic complications occurred in the patients who suffered SAH (Table 3).