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Selected Topics: Neurological Emergencies

NEUROLOGIC CAUSES OF CARDIAC ARREST AND OUTCOMES

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☐ **Abstract—Background: Sudden cardiac arrest as a complication of neurologic disorders is rare, occasionally acute neurologic events present with cardiac arrest as initial manifestation. Objective: Our aim was to describe neurologic disorders as a cause of cardiac arrest in order to enable better recognition. Methods: We retrospectively analyzed prospectively collected resuscitation data of all patients treated between 1991 and 2011 at the emergency department after cardiac arrest caused by a neurologic event, including diagnosis, therapy, and outcomes. Results: Over 20 years, 154 patients suffered cardiac arrest as a result of a neurologic event. Out-of-hospital cardiac arrest occurred in 126 (82%) patients, 78 (51%) were male, median age was 51 years (interquartile range 17 to 89 years). As initial electrocardiogram rhythm, pulseless electrical activity was found in 77 (50%) cases, asystole in 61 (40%), and ventricular fibrillation in 16 (10%) cases. The most common cause was subarachnoid hemorrhage in 74 (48%) patients, 33 (21%) patients had intracerebral hemorrhage, 23 (15%) had epileptic seizure, 11 (7%) had ischemic stroke, and 13 (8%) had other neurologic diseases. Return of spontaneous circulation was achieved in 139 (90%) patients. Of these, 22 (14%) were alive at follow-up after 6 months, 14 (9%) with favorable neurologic outcome, 8 of these with epileptic seizure, and most of them with history of epilepsy. Conclusions: Subarachnoidal hemorrhage is the leading neurologic cause of cardiac arrest. Most of the patients with cardiac arrest caused by neurologic disorder have a very poor prognosis.** © 2014 Elsevier Inc.

☐ **Keywords—cardiac arrest; subarachnoid hemorrhage; intracerebral hemorrhage; stroke; cause of death**

INTRODUCTION

Sudden cardiac arrest as a complication of neurologic disorders is rare (1,2). Even rarer is the presentation of acute neurologic events with cardiac arrest as initial manifestation (3). We have found descriptions of subarachnoidal hemorrhage (SAH) and sudden unexpected death in epilepsy (SUDEP) in the literature, but there are few publications about intracerebral hemorrhage (ICH) and ischemic stroke as cause of cardiac arrest.

SAH is the most common intracranial bleeding leading to sudden cardiac arrest (1,4). We have published a case series of these patients and found that SAH complicated by cardiac arrest is almost always fatal (5). Most deaths after SAH occur almost immediately and are due to initial hemorrhage with cardiorespiratory complications, such as dysrhythmias or respiratory arrest (6,7). Although ICH and ischemic stroke occur far more often than SAH, there are only a few reports describing these as a cause of nontraumatic sudden death (8–10).

In contrast, SUDEP is widely recognized and accounts for 7% to 17% of deaths among people with known epilepsy (11–13). Most deaths were associated with convulsive seizures (14,15). Postictal laryngospasm may represent another potential cause of SUDEP (16,17).

To enable better recognition of a nontraumatic neurologic disease as cause of cardiac arrest, we retrospectively analyzed cardiac arrest data, diagnosis, therapy, and outcome in these patients.

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METHODS

From July 1, 1991 to December 31, 2011, resuscitation data of all patients admitted to the Department of Emergency Medicine after cardiopulmonary resuscitation, were prospectively documented. The Department of Emergency Medicine is an interdisciplinary emergency department (ED) at the Medical University of Vienna. It is a complete 14-bed intensive care unit (ICU), where patients are routinely treated after resuscitation for up to 24 h and in isolated cases 72 h.

Most patients in this study were brought to our ICU by ambulance service after suffering out-of-hospital cardiac arrest. Some patients suffered cardiac arrest at the ED during workup. Another small group of patients suffered cardiac arrest in other places in the hospital and were managed by our code team.

The study procedures were in accordance with the ethical standards of the Responsible Committee on Human Experimentation and with the Helsinki Declaration of 1975, as revised in 1983.

Cardiac Arrest Registry and Inclusion Criteria

Data for all patients were registered according to a specific protocol. Among other details, this includes sex and age of the patients, location of cardiac arrest, whether or not the event was witnessed (the patient was witnessed to suddenly collapse), initial electrocardiogram (ECG) rhythm, and time until restoration of spontaneous circulation (ROSC). Surviving patients were followed up to 6 months after the index event. We retrospectively enriched this registry by adding data, which were helpful to clarify the definitive cause of the cardiac arrest. All patients with neurologic cause of nontraumatic cardiac arrest were enrolled in the study. This included patients who were initially clinically diagnosed with a neurologic cause for their cardiac arrest, as well as patients who were diagnosed by computed tomography (CT) or autopsy later. A tentative diagnosis of the different neurologic events was based on history and clinical examination. This clinical diagnosis was verified in most of the patients by cranial computed tomography (CCT) and further confirmed by autopsy in nonsurvivors.

In those patients who had suffered epileptic seizure, there were those without prior known epilepsy, as well as patients with SUDEP. This was defined as sudden, unexpected, nontraumatic, nondrowning death in an individual with epilepsy, witnessed or nonwitnessed, in which postmortem examination did not reveal an anatomic or toxicologic cause for the death (1). In these patients, we tried to rule out other possible causes to sustain the diagnosis of epileptic seizure. Nontraumatic ICH was defined as bleeding into the parenchyma of the brain that may have extended into the ventricles and, in rare cases, into the subarachnoid space (18).

Outcomes

The primary outcome was defined as being alive in favorable neurologic condition at 6 months after the index event. Cerebral function was assessed prospectively on arrival and 6 months after ROSC, and was expressed in terms of the Glasgow-Pittsburgh cerebral performance categories (CPC): CPC 1 indicates good capability; CPC 2 indicates slight disability; CPC 3 indicates severe disability, CPC 4 indicates coma or vegetative state; CPC 5 indicates cerebral death. We considered a CPC score of 1 or 2 as favorable and a CPC score of 3, 4, or 5 as unfavorable functional neurological outcome.

Study Design and Statistical Methods

According to the cause of cardiac arrest, patients were assigned to one of five subgroups: SAH, ICH, ischemic stroke, epileptic seizure, and other neurologic diseases. We evaluated incidence, demographic data, and outcome according to these subgroups. Data are expressed as median and interquartile range (IQR). Percentages were determined for dichotomous variables.

RESULTS

Over 20 years, 154 patients suffered cardiac arrest with a neurologic cause. Distribution of causes of cardiac arrest is shown in Table 1. Of all patients, 16 (10%) were admitted under ongoing resuscitation. Cardiac arrest occurred out of the hospital in 126 patients, at home in 82 (65%) patients, in a public place in 30 (24%) patients, during transport to the hospital in 12 (9%) patients, and in a physician's office in 2 (2%) patients. Cardiac arrest occurred in the hospital in 28 patients, at the ED in 14 (50%) patients, in a regular ward in 8 (29%) patients, in the radiology department 4 patients (14%), and in a public area within the hospital in 2 (7%) patients.

A cranial computed tomography (CCT) was performed in 123 (80%) of all 154 patients. Overall, autopsy was performed in 72 patients. In 44 patients where the CCT was radiologically diagnostic, autopsy confirmed the radiologic diagnosis. In another 28 (18%) patients without CCT examination, the diagnosis was only established at autopsy. In the remaining 4 (3%) of all patients in whom neither CCT nor autopsy had been performed, we established the cause of cardiac arrest to be of neurologic origin by the patient's history and clinical presentation. The distribution of diagnoses on the causes of cardiac arrest is presented in Figure 1.

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