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Original research article

Noninfectious complications of acute stroke and their impact on hospital mortality in patients admitted to a stroke unit in Warsaw from 1995 to 2015

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ABSTRACT

Background: Medical complications often worsen the prognosis after stroke. Our aim was to investigate the association between particular noninfectious complications and hospital mortality of acute stroke patients admitted to an urban Polish stroke center, and changes in their occurrence from 1995 to 2015.

Methods: This is a retrospective analysis of 5174 consecutive patients admitted for acute ischemic stroke or cerebral hemorrhage to a Polish urban stroke center between 1995 and 2015. The occurrence of complications was reported for years 1995–2000 ($n = 883$), 2001–2006 ($n = 1567$), 2006–2010 ($n = 1539$) and 2011–2015 ($n = 1183$). Odds ratios (OR) with 95% confidence interval (95% CI) for stroke unit death were calculated after adjustment for age, congestive heart failure (CHF), pre-existing disability, stroke type and baseline neurological deficit in three different time periods.

Results: Over time there was a significant decrease in the occurrence of myocardial infarction (MI) (2.2%, 1.4%, 1.0% and 0.3%, respectively), exacerbated CHF (4.6%, 5.1%, 2.6% and 2.0%) and deep vein thrombosis (DVT) (4.6%, 2.7%, 1.2% and 1.1%). Adjusted odds for stroke unit death were increased by myocardial infarction (MI) (OR 17.5, 95% CI: 8.5–35.7), exacerbated CHF (OR 15.0, 95% CI: 9.8–23.0), pulmonary embolism (PE) (OR 11.5, 95% CI: 6.1–21.6), gastrointestinal bleeding (OR 9.2, 95% CI: 4.4–18.9) and recurrent stroke (OR 5.4, 95% CI: 3.1–9.3).

Conclusions: Over the last two decades Polish urban stroke units may have achieved a significant reduction of the occurrence of some noninfectious complications (i.e. MI, exacerbated CHF and DVT). However, the list of conditions associated with stroke unit mortality includes not only MI and exacerbated CHF but also PE, gastrointestinal bleeding and recurrent stroke.

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1. Introduction

Despite significant reduction in age-standardized incidence in high-income countries and advances in treatment, the overall burden of stroke continues to increase making it one of the leading causes of death and disability worldwide [1]. This burden results not only from the brain damage but also from a variety of infectious and noninfectious complications [2,3]. Many of those complications are either fully preventable or can be effectively managed if recognized early [2]. It has been shown that increasing quality of acute stroke care decreases the risk of most medical complications [4]. One may expect that constant development and wide implementation of modern stroke care over the years has led to their a significant decrease of their occurrence. The lack of deleterious weekend effect on outcome after intravenous thrombolysis indirectly proves decent quality of contemporary acute stroke care in Poland but there are no studies that address complications [5]. Besides publications concerning early noninfectious complications of acute stroke in other countries are very heterogeneous in terms of definitions and reported occurrence [2–4,6–17], and infrequenty report changes over longer periods of time [7,14,15] or the effect on outcome [6,10–13,17].

The aim of our study was to investigate the association between particular noninfectious complications and hospital mortality in acute stroke and changes in their occurrence among patients admitted to an urban Polish stroke center between year 1995 and 2015.

2. Material and methods

2.1. Population

This is a retrospective registry-based analysis of consecutive acute stroke patients admitted to a single stroke center between July 1995 and December 2015. The center operates as a part of department of neurology and provides health services for a population of approximately 200,000–250,000 Caucasians living in a highly urbanized area (Southern Warsaw, Poland). The center consists of intensive stroke unit and early rehabilitation unit and has direct access to interventional neuroradiology, neurosurgery and rehabilitation wards.

2.2. Methods

The diagnosis of ischemic stroke or intracranial hemorrhage was routinely based on clinical symptoms and noncontrast brain computed tomography (CT) sometimes complemented or substituted with brain magnetic resonance. The event was considered acute if the onset of symptoms was within the last 7 days. Patients' data were prospectively collected in a detailed stroke registry. The registry was created in 1991 as a modification of the National Institute of Neurological and Communicative Disorders and Stroke Data Bank protocol, and was upgraded in subsequent years [18–20]. Briefly, collected data include information about patient's demographics, preexisting conditions and medications, diagnostic workup, the course of index stroke throughout hospital stay, stroke unit adverse events, stroke unit treatment and outcome at discharge to home, other ward or nursing home.

There were eight predefined complications: deep vein thrombosis (DVT), pulmonary embolism (PE), myocardial infarction (MI), exacerbated congestive heart failure (CHF), seizures, recurrent stroke, pressure sores and gastrointestinal bleeding. The diagnosis was usually made by the attending neurologist according to his best medical judgment. However, in many cases it had to be confirmed by additional examinations or by a relevant consultant (internal medicine specialist, cardiologist or surgeon). General criteria defining each above-mentioned condition are listed in Table 1. The information about occurrence of a particular complication during whole stroke unit stay was recorded in the registry as a nominal variable. Events that began before stroke and was ongoing at the time of admission to the stroke unit were not included.

Stroke severity was measured at admission and multiple times during stroke unit stay with the use of Scandinavian Stroke Scale (SSS) until year 2009 and National Institutes of Health Stroke Scale (NIHSS) later on. For the purpose of this analysis all SSS scores were converted to NIHSS using a validated equation [21]. The level of prestroke disability of any cause was measured with modified Rankin Scale (mRS).

Due to low absolute numbers of particular complications per year we decided to evaluate longitudinal changes between four consecutive time periods: (i) years 1995–2000, (ii) years 2001–2005, (iii) years 2006–2010 and (iv) years 2011–2015.

The paper follows Strengthening the Reporting of Observational Studies in Epidemiology guidelines [22].

2.3. Ethics

The registry was developed in concordance with the Declaration of Helsinki and was approved by the local Ethics Committee.

2.4. Statistical analysis

Categorical variables were presented as a number of valid observations and proportions calculated with exclusion of unknown values from the denominator. As the distribution of continuous variables was mostly non-normal, they were presented as a median with quartiles (1st quartile and 3rd quartile; Q1, Q3).

Comparisons between particular time periods were done using chi square test and Kruskal–Wallis test, as appropriate. Only if the overall test for significance was positive ($P < 0.05$), pairwise comparisons were made between the first time period (i.e. years 1995–2000) and each consecutive time period (e.g. years 1995–2000 vs. years 2011–2015). Additionally, similar comparisons were made between each following time period (i.e. years 2000–2005 vs. years 2006–2010 and years 2006–2010 vs. years 2011–2015). Such approach allows to minimize the risk of type I error without losing power by applying the Bonferroni correction.

Logistic regression was used to calculate odds ratios (ORs) with 95% confidence interval (95% CI) for stroke unit death. Multivariable analyses were arbitrarily adjusted for age (as a continuous variable), CHF, lack of prestroke dependency (mRS

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