Neurologic and Functional Long-term Outcome after Carotid Endarterectomy

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Background: The aim of this research was to assess the neurologic status of patients a year after endarterectomy with the use of National Institutes of Health Stroke Scale (NIHSS) and the degree of disability using the modified Rankin Scale (mRS) and to examine the patients' subjective evaluation of their health. *Methods:* One hundred two patients with symptomatic internal carotid artery stenosis who underwent endarterectomy and attended a 1-year follow-up examination were enrolled in the study. The material comprised 72 (70.6%) men and 30 (29.4%) women. Before the surgery, the patients' neurologic status was assessed according to the NIHSS, and their functional status was rated with the mRS. Additionally, the patients were asked to assess their life quality on a 10-point Likert scale. *Results:* The mean NIHSS score before the operation was 2.76 points (SD 2.47), whereas a year after it was 2.05 points (SD 1.84) ($P < .0001$). The NIHSS scores that improved significantly a year after endarterectomy were level of consciousness-questions and commands, motor leg, and sensory ($P < .05$). *Conclusions:* The patients' neurologic status assessed with the NIHSS improved significantly 1 year after carotid endarterectomy mostly because of the improvement in their verbal and motor communication ability, physical condition and agility, and reduction in sensory disturbances. The observed changes in the neurologic status were reflected in the functional status and subjective life quality assessment, which appeared to be significantly better a year after the surgical treatment. **Key Words:** Endarterectomy—stroke—NIHSS—Rankin scale.

Introduction

Stroke survivors have to deal with psychological and physical disabilities. In most cases, they are dependent on others' help, even in simple everyday activities. Life after stroke does not only change for the patient but also in many cases all family members' lives must be reorganized. Treatment and rehabilitation of such patients are long lasting and pose a large burden for the healthcare system worldwide.

It was estimated that cerebrovascular disease including stroke is the second leading cause of deaths in the world. Stroke predominantly occurs in middle-aged and in older adults. According to the World Health Organization data, stroke caused 5.7 million deaths worldwide in 2005, which makes 9.9% of all deaths. More than 85% of cases occurred in people living in low- and middle-income countries and one third of them in people aged less than 70 years.[1] Also in Europe, stroke is a major cause of disability and deaths. According to the surveys conducted in 2009, cerebrovascular diseases (including stroke) are the cause of death of 397.4 persons per 100,000 in Europe.[2] Wojtyniak and Goryński indicate

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that in Poland the statistics look even worse. Cerebrovascular diseases are the cause of death of 516.4 persons per 100,000. Approximately .2% of people have ischemic stroke each year and the long-term prognosis for many of them is unfavorable—1 in 6 patients dies within the first month after stroke. Almost half of the patients after stroke had different kinds of disability.[3] According to the National Institute of Public Health in Poland, mortality of the Polish patients after stroke is higher than in the other European countries.[4] Therefore, the primary and secondary stroke prophylaxes and the treatment of acute stroke phase are of great importance.[5] The multicenter, randomized studies showed that the best results of treatment are achieved by immediate revascularization. Large, randomized, multicenter, prospective trials evaluating the results of pharmacological reperfusion with intravenous or intra-arterial thrombolysis on selected groups of patients proved that such therapy could reduce the severity of neurologic sequelae and that reperfusion of the ischemic area of the brain could be performed with acceptable risk.[6-10] Some studies reported that early carotid endarterectomy (CEA) had a beneficial outcome taking into consideration neurologic sequelae.[11,12] Despite this fact, some clinicians are unwilling to perform CEA immediately after the onset of stroke because of the risk of hemorrhagic transformation of infarcted brain area.[13,14] Sbarigia et al[15] emphasize the crucial role of surgical CEA soon after stroke. According to their results, time is one of the most important parameters and surgical treatment should take place not later than 1.5 days after stroke. According to the previously mentioned study, CEA is also considered to be the safest treatment method in ischemic stroke. Approximately 40% of patients after CEA manifested no neurologic deficits at discharge.[15] The alternative method of restoring internal carotid artery (ICA) patency is carotid artery stenting (CAS). According to the World Health Organization guidelines, CAS is recommended only in some patients, namely those with severe symptomatic carotid stenosis, when endarterectomy is contraindicated, also in restenosis after CEA, and in stenosis after irradiation. Some studies report that although CEA is considered to be more beneficial for patients in overall assessment, the treatment method should be chosen on the basis of individual specific patient characteristics.[16,17]

To assess the severity of the patients' clinical condition, treatment outcome, and prognosis, several scales were designed. Some measure the severity of selected neurologic signs and symptoms and allow to assess their progression and remission within time (National Institutes of Health Stroke Scale [NIHSS], Scandinavian Stroke Scale [SSS], Israeli Vertebrobasilar Stroke Scale [IVBSS], and Orgogozo and Mathew Scale).[18-20] According to Bessenei et al,[19] NIHSS that measures the overall degree of neurologic impairment and can predict autonomic dysregulations is the most popular and sensitive scale for detecting changes in clinical status of the patients in acute cerebral stroke.[21,22] Various scales are used to determine the degree of patients' independence and disability of basic activities. The most commonly used are Rankin Scale, modified Rankin Scale (mRS), the Barthel Index, and Stroke-Adapted Sickness Impact Profile (SA-SIP30).[23-25]

The aim of this research was to assess the neurologic status of patients a year after endarterectomy with the use of NIHSS scale, the degree of disability using the mRS, and to examine the patients' subjective evaluation of their health.

Materials and Methods

Participants

One hundred two patients with ICA stenosis who underwent endarterectomy in the Department of Vascular, General, and Oncologic Surgery and attended a 1-year follow-up examination were enrolled in the study. Only patients with an uncomplicated course of endarterectomy were included (with no signs of cerebral ischemia after cross-clamping and perioperative stroke or death within 30 days). All of them were symptomatic and had a transient ischemic attack, amaurosis fugax, or cerebral stroke (confirmed by computed tomography imaging). All the patients underwent ICA Doppler ultrasonography that assessed the degree of stenosis. Patients qualified for surgical treatment had 70%-84% or 85%-99% stenoses according to the North American Symptomatic Carotid Endarterectomy Trial criteria. In case of patients with bilateral high-grade stenoses, the artery with higher stenosis was chosen for surgery during 1 hospitalization. Demographic features and cardiovascular risk factors of the examined group were collected from medical documentation (Table 1).

Procedure

All examined patients underwent classical endarterectomy under local anesthesia within 4 weeks to 6 months after stroke. The technique of the artery closure depended on the diameter and the lumen of the ICA. If the diameter of the ICA was more than 4-5 mm, a simple sewing-up technique was used, otherwise venous patches were used. No carotid shunts were used during CEA in this group of patients. During the operation, verbal contact with the patient was maintained and blood pressure was continuously monitored and lowered if exceeding 160 mm Hg. The patients were observed in a postoperative unit for 4-6 hours and those in stable condition were transferred to the vascular ward where the blood pressure was controlled. The day before the surgery, all these patients were examined by a vascular surgeon. Their neurologic status was assessed according to the NIHSS, and their functional status was rated with the mRS. The testing was done by 1 vascular surgeon (P.K.) who was trained by the neurologist. Additionally, the patients were asked to assess their life quality on a 10-point