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Early Carotid Endarterectomy for Symptomatic Internal Carotid Artery Stenosis in the Acute Ischemic Stroke

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Abstract: Objective: To research the results of the microsurgical treatment of symptomatic stenosis of the internal carotid artery by Carotid Endarterectomy in the early period of a ischemic stroke that were performed in the Neurosurgery Department of IMSP IMU.
Materials and Methods: A number of retrospective data was conducted on all patients with an ischemic stroke that was surgically treated for an extra-cranial internal carotid artery (ICA) symptomatic stenosis in the Neurosurgery Department of the Emergency Medicine Institute, in Chisinau (Rebublic of Moldova), between February 2019 and March 2021. To be included in the present study were evaluated all patients who presented with symptomatic carotid artery stenosis resolved surgically by carotid endarterectomy for up to 14 days after the onset of neurological symptoms. Subsequently, the results were evaluated by prospective follow-up of patients. First of all, we paid attention to the incidence rate of a repeated ipsilateral stroke or myocardial infarction immediately postoperatively or at a distance of 30 days, peripheral nerve injury, hematoma in the operating area and death.Secondary outcomes were the rate of other comorbidities.The results were analized according to NIHSS score and complications 30 days after surgery,and a statistic analysis were performed in order to identify any relevancy between preoperative information and postoperative results.
Results: A number of 40 subjects (10 %, n 4 bilateral and 90%, n 36 unilateral) underwent carotid endarterectomy (CEA) for symptomatic ICA stenosis. Patients were included in the study according to some criteria (22% women vs 78% men; median age 64 years, between: 54-76; median NIHSS score before operation 4, the values was between 0-18) all subjects presented with SCS were included in the present study. The average number of days before surgery was 6 days (interval: 2-14). During the hospitalization period after performing the carotid surgery on the included patients, the combined rate of stroke, myocardial infarction and death was calculated, obtaining the value of 0%. Also, the NIHSS score was calculated, which in 45.7% of the subjects improved on average by 2 points and more (the interval being 0-12). Microsurgical CEA is accompanied,in most cases by the regression of neurological symptoms and it is not correlated with the increased risk for a hemorrhagic transformation.No local and systemic complications were registered.The evaluation of outcomes according to sex, comorbidities and NIHSS score did not presented any statistical correlation neither at the one month check up.
Conclusion: In all subjects with a SCS, presented with an acute ischemic stroke, early carotid endarterectomy can be performed without any complications or worsening of somatic or neurological condition in comparison with similar cases in a longer period after a stroke.

Keywords: *carotid endarterectomy, stroke, symptomatic carotid artery stenosis.*

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Background

Systemic atherosclerosis is the condition to induce carotid stenosis (CS) that in turn determines cerebral hypoperfusion and cognitive dysfunction. The morbidity and mortality from stroke remain very high (Dharmakidari & Bhattacharya, 2017; Ranran, 2019; Saritphat & Kittipan, 2017). Every eighth of strokes are fatal at 30 days and a quarter of them decease within a year. As stated by WHO stroke is the second cause of death. Furthermore stroke is the most known reason of disability. One third of strokes are due to carotid occlusive disease. Severe CS carries a significant risk for stroke. Thus the prevention of stroke by means of CS treatment must be paramount. Medical therapy, carotid endarterectomy (CEA) and carotid stenting are treatment options in managing CS. Clinically CS may be classified as asymptomatic or symptomatic. The incidence of stroke in asymptomatic patients diminished to some extent thanks to the advancement of medical therapy. Growing availability of neuroimaging modalities and the expansion of stroke units have led to a great benefit in the early care of stroke patients. Extracranial carotid artery stenosis is accountable for unstable neurological status in stroke patients, after being thrombolysed, therefore it has to be managed and indications for early surgery reassessed since it poses a great threat of recurrent stroke (McPherson, 2001). Symptomatic CS with significant hemodynamic changes depict the need for surgical care (Barnett et al., 1998; Mayberg et al., 1991; "Randomised trial", 1998;). In order to lessen the probability of stroke CEA is the preferred treatment option in patients with moderate to severe symptomatic CS (Dharmakidari & Bhattacharya, 2017; Puccinelli et al., 2017; Wangqin Runqi et al., 2019). Timing of CEA vary in the publications owing to the various clinical efficacy. There is a lot of controversy regarding early versus delayed CEA in symptomatic patients (Ashley & Eskandari, 2015; Saritphat & Kittipan, 2017). Urgent revascularization surgery minimize the likelihood of repeated stroke, but on the other hand it holds a drawback of perioperative complications such as cerebral infarction, hemorrhagic transformation, disabling stroke and death. Compromised blood-brain barrier and dropping cerebrovascular autoregulation are responsible for hemorrhagic stroke conversion an reperfusion injury. The advantage of urgent endarterectomy for symptomatic CS was noted in a full hand of studies (Rothwell et al., 2003). Better outcome is obtained if CEA is done within 14 days of the neurological event inasmuch as more stroke recurrences are being obviated and this fact is particularly observed in patients with transient ischemic attack (TIA) and minor stroke (Ballotta et

al., 2008; Bond et al., 2003; Rothwell et al., 2004a; Rothwell et al., 2004b). CEA performed within 2 weeks and at 2 weeks from index event holds identical threat of stroke or death. Many trials have reported comparable results among urgent (less than 48 hours) and late CEA, nevertheless there is substantial support for the theory that surgery done within 48 hours from symptoms onset carries a superior risk of perioperative stroke. The objective of the early revascularization surgery is to reduce the risk of stroke and to improve neurological outcome via reperfusion of ischemic penumbra, but basically a very few data are available to endorse this hypothesis. Notwithstanding the higher risk of stroke related with urgent surgery within 14 days from index event, it appears to be inferior compared to natural history of non operated symptomatic CS (Department of Health, 2007; Salem et al., 2011). Traditionally, the time of CEA was influenced by stroke severity and stabilization of neurological status together with radiological lesions (about 4-6 weeks from onset), because early intervention on an unstable carotid plaque was deemed to be associated with higher risks of perioperative stroke (Barnett et al., 1998; European Carotid Surgery Trialists' Collaborative Group, 1991; Paraskevas & Loftus, 1996). But this perspective exposes the patient to a greater risk of recurrent stroke or even carotid occlusion as it is shown in recent literature (Gasecki et al., 1994). There is a 5% to 10% reported risk of repeated stroke or TIA in the early days of neurological event. According to a recent review first 2-3 days have a risk of subsequent stroke up to 6.4%, while within 7 and 14 days the risk is 20% and 26% respectively. Other prospective trial mention an incidence of recurrent stroke of 2.7% on day 1, 5.3% on day 3 and 11.5% on day 14. Increased rate of strokes related to the natural progression of CS along with the latest reports which present good outcomes in patient operated on CS through CEA in the setting of acute period of stroke have challenged surgery postponement paradigm (Barbetta et al., 2014; Capoccia et al., 2012; Leseche et al., 2012). The current recommendations about when to perform CEA in patients with symptomatic CS for prevention of a subsequent stroke and to reduce the incidence of periprocedural stroke rely on multiple uncertainties. The absence of evidence-based data and appropriate terminology for what means an "early" or "urgent" carotid endarterectomy surgery have led to contradictory outcomes in publications. The diversity of neurological status, proper intensive treatment and various revascularization strategies have contributed to discordant discussions regarding to the timing of CEA in symptomatic CS patients. The aim of this study is to evaluate the effect of CEA timing on postoperative outcomes in patients undergoing CEA within first month of stroke at the Institute of Emergency Medicine.

Methods

In the Department of Neurosurgery of the Institute of Urgent Medicine in Chisinau, Republic of Moldova, during the period between February 2019 and March 2021, was performed a retrospective study by collecting data on all patients who received surgical treatment for symptomatic internal carotid artery stenosis in the early period of ischemic stroke developed within 48 hours-14 days from the onset of the disease.

The total of 40 patients was divided into groups following the criteria:

- Gender: male and female
- Age
- The side of carotid stenosis: unilateral or bilateral carotid artery stenosis.
- NIHSS score
- Days of hospitalization

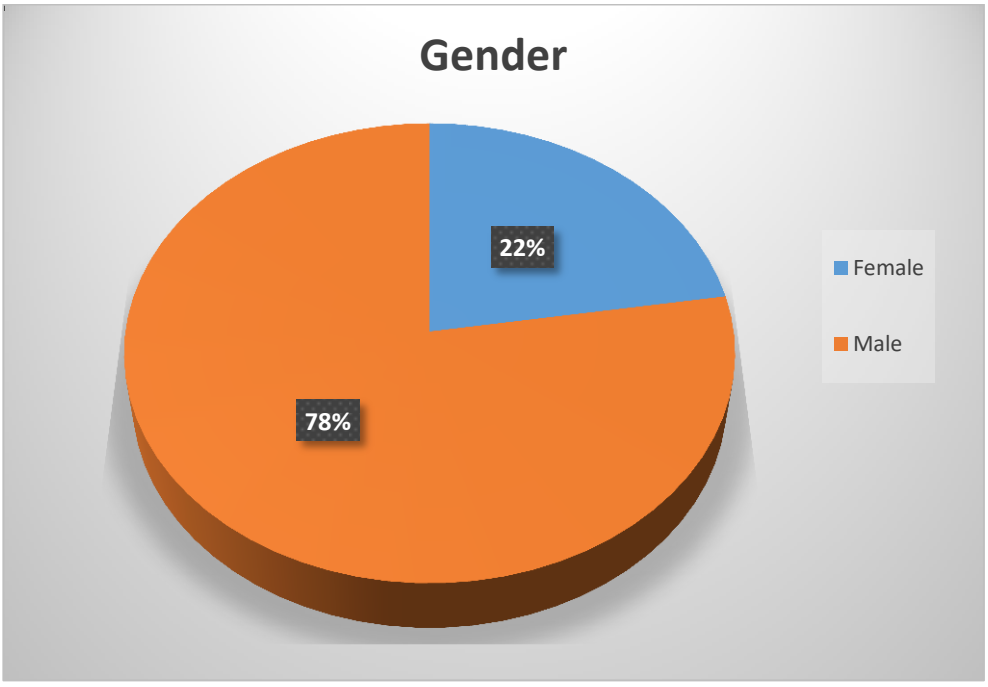


Figure 1. The diagram of the gender distribution of early carotid endarterectomy
Source: Author's own conception

It is essential to mention that gender is an unchangeable risck factor for the development of atherosclerotic disease and carotid artery stenosis

that can subsequently cause a stroke. This also results from the analysis performed exposed in the following diagram.

The average age of patients who met the inclusion criteria is 64 years, with a range between 54 and 76 years.

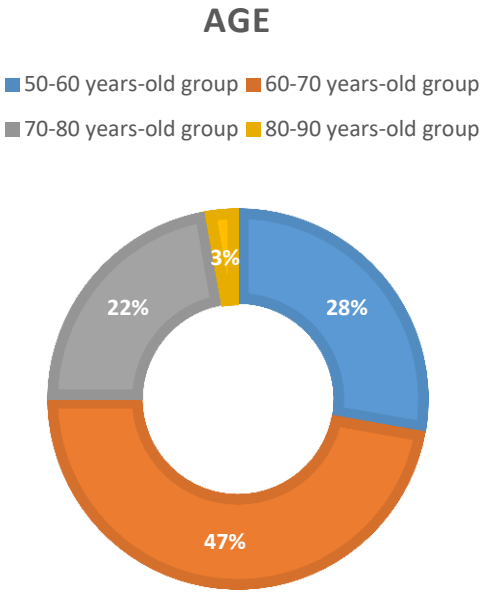


Figure 2. The diagram of age distribution of the patients

Source: Author's own conception

The side of carotid artery stenosis doesn't play any role if it is right of left but it becomes essential when the patient come back for an contralateral carotid artery stenosis.

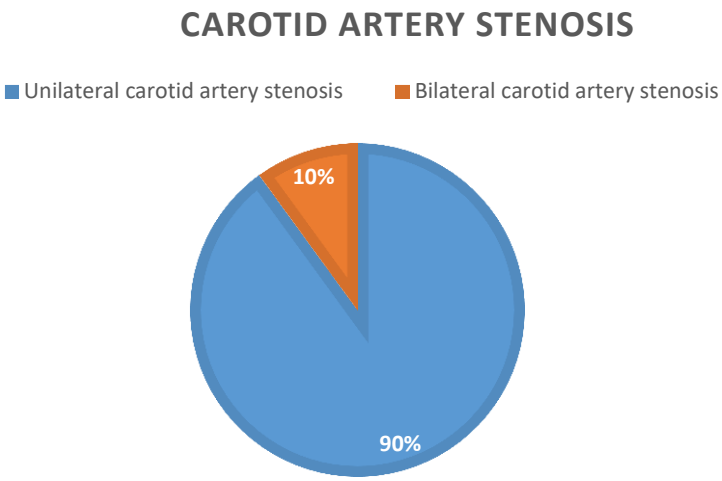


Figure 3. The diagram of differentiation between the affected patients by unilateral and bilateral carotid artery stenosis
Source: Author's own conception

The National Institutes of Health Stroke Scale (NIHSS) was created to help physicians to evaluate the severity of a stroke. Because all patients who received carotid endarterectomy were in the early post-stroke period, it was essential to evaluate the NIHSS score when hospitalizing and discharging the patient.

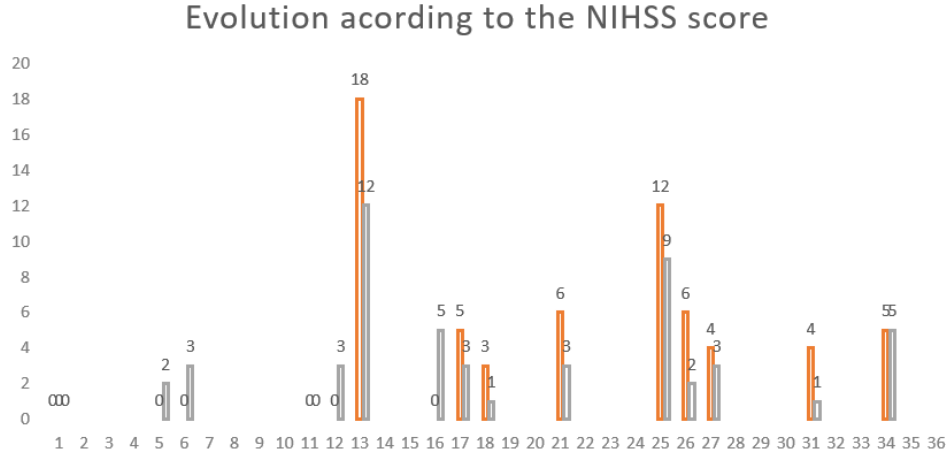


Figure 4. The diagram of evolution of the neurological status of the patients acording to the NIHHS scale.
Source: Author's own conception

The average number of days after stroke in which the surgery was performed was 6 days (range: 2-14). The number of days of hospitalization of patients varies between 6 and 28 days. It largely depends not so much on the postoperative complications or the need to monitor patients, as on the organizational and managerial aspects of the medical institution and the department.

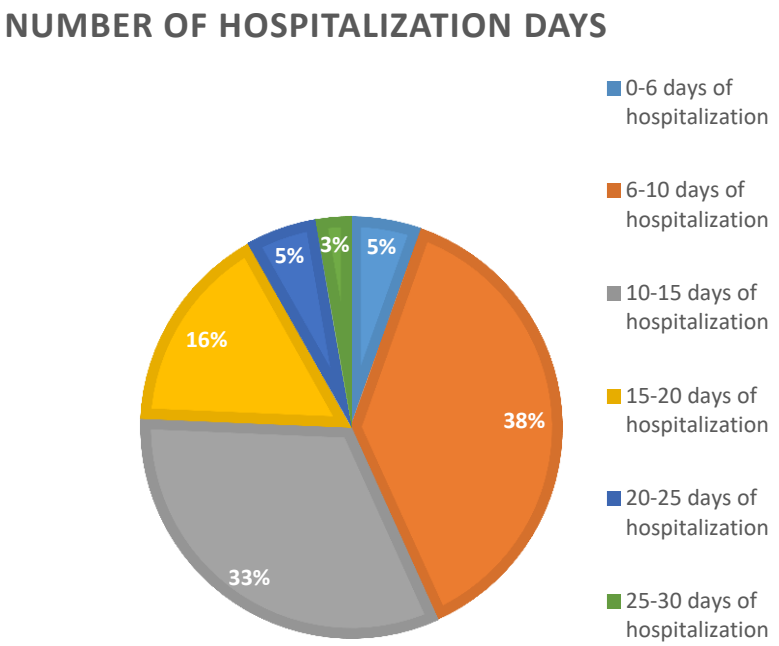


Figure 5. The diagram of the distribution of the number of hospitalization days. Source: Author's own conception

The study involved only the endarterectomy performed for symptomatic ischemic stroke with a definite period of hospitalization. Carotid artery stenosis without any symptoms, minor or major strokes that occurred more than one month after the onset of symptoms, and cases of transient ischemic stroke (TIS) were excluded.

The differentiation between an TIS and an ischemic stroke is strictly determined by the neurologist in accordance with the available clinical information. The Hippocrates medical information system database contains all the detailed information about patients needed for a preoperative conclusion that does not require a reassessment of that patient. Therefore, the study sample consisted of EA performed for subjects with semnificative carotid artery stenosis in the acute period after minor or major stroke. The

recorded data were monitored by a prospective evaluation. The primary outcomes are the incidence of perioperative ipsilateral stroke, peripheral nerve injury, hematomas in the operating area, myocardial infarction and death.

This study involve one single in-hospital group, who had endarterectomy while being admitted in the hospital. It consists of 40 patients. All of them were admitted in the Institute of emergency medicine for an acute stroke.

To compare the outcomes of the patients at one month, 6 months and 1 year after the endarterectomy, was used a statistical analysis and also to evaluate the stroke incidence, the evolution and the survival of the subjects. Statistically significant results was considered those with a *P* value less than 0,05.

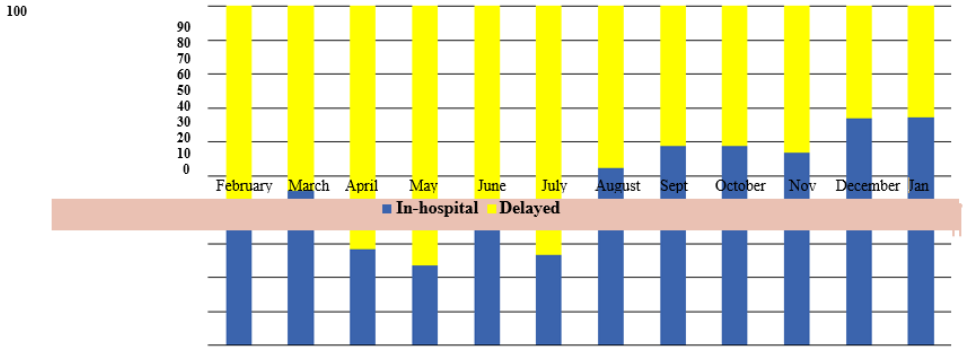


Figure 6. Trend of the ratio of in-hospital patients after an acute Stroke carotid endarterectomy (CEA) between February 2019 and Mach 2021.
Source: Author's own conception

Results

There were 40 subjects who benefited from CEA within two weeks of the symptoms onset. All patients met the inclusion criteria and were involved in the trial.

The analysis of the results showed that the percentage of men far exceeds that of women with a ratio of 78 to 22 percent. This is presented in the first diagram [Figure 1].

The prevailing age group is between 60 and 70 years, 47 percent, compared to ages 50-60 years, 28%, 70-80 years, 22%, 80-90 years, 3% [Figure 2].

It is encouraging that most patients presented with only unilateral operable carotid artery stenosis, 90% compared with those 10% with bilateral CEA [Figure 3].

In the early period after surgery the combined stroke, myocardial infarction and death calculated rate was 0%.

The NIHSS score in 45,7 % of patients improved postoperatively by two and more points (interval 0-12). Early microsurgical carotid endarterectomy performed after an acute ischemic stroke is accompanied in most cases by the regression of neurological symptoms and is not correlated with increased risks for a hemorrhagic transfomation of the stroke [Figure 4].

The short period of hospitalization is one of the goals of approaching patients with CEA. It is remarkable that in the group of operated patients the short period of hospitalization prevails: 6-10 days, 38% and 10-15 days-33%, compared to 15-20 days, 16%, 20-25 days, 5% and 25 - 30 days 3%. But of course the ideal for preventing complications and early recovery would be 0-6 days which now, in the mind is only 5% [Figure 5].

Local and systemic perioperative complications in this study group have not been established. Stratification of the results according to the value of the NIHSS score, sex and comorbidities did not show any statistical relationship at the 30-day follow-up, nor in the long term.

Conclusion

Based on the results of our experience of early carotid endarterectomies performed in a single institution, we observe that there is no statistically significant difference in patient mortality rate or incidence of distant stroke. There was also no difference in the rate of side effects depending on the length of time from the onset of the charges to the endarterectomy. In conclusion we can mention that early endarterectomy, which can be performed starting with the first two weeks after the onset of neurological symptoms, can prevent embolic events thus reducing the risk of stroke and death, but it is strictly necessary to consider the severity of cerebrovascular event and risk factors of the patient with a stroke.

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