# ОРИГИНАЛЬНЫЕ СТАТЬИ

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## STRATEGIES OF CERVICAL INTERNAL CAROTID STENOSIS TREATMENT: ENDARTERECTOMY OR STENTING? INSTITUTIONAL BASED EXPÉRIENCE

***Background:*** *Carotid artery stenosis (CS) is a major cause of ischemic stroke. Treatment of CS consists of best medical treatment and carotid revascularization (CR), including carotid endarterectomy (CEA) and carotid artery stenting (CAS). Aim of this study is to find out the selection criteria for good outcome in patients with Cervical internal carotid artery stenosis and to evaluate the factors determining the outcome of the procedure.*
***Materials And Methods:*** *We report a retrospective analysis of 49 patients operated in Fujita Health University – Banbuntane Hotokukkai Hospital during a period of four years (From September 2014 to September 2018) for carotid artery stenosis. We selected patients who met criteria for carotid revascularization and divided into two categories like Symptomatic and Asymptomatic patients. All the patients underwent Carotid Revascularisation (CR) with CEA or CAS. Outcome was evaluated in the post-operative period using the modified Rankin Scale (mRS).*
***Results:*** *Out of 49 patients operated for carotid artery stenosis there were 32 patients who were asymptomatic and 17 patients were symptomatic. There were 45 male patients and 4 female patients. Left sided carotid artery stenosis was seen in 27 patients. Hypertension and Hyperlipidemia was the most common risk factor. 3 Patients had to undergo CEA after unsuccessful CAS. Mean age of patients was 72.93 ±7.31 Years. Management of CS either CEA or CAS both were correlating with the outcome (p value 0.045).*
***Conclusion:*** *Management of CS is complicated and has been studied for a long time. Stroke prevention without complications is the main goal of successful treatment. Our study demonstrates that carotid endarterectomy could be performed safely with low risk of perioperative stroke or death in the setting of symptomatic and asymptomatic carotid artery disease.*
***Key words:*** *Carotid Artery Stenosis; Carotid Endarterectomy; Carotid Artery Stenting; Carotid Revascularisation; modified Rankin Scale.*
***Abbrevations:*** *CS- Carotid Artery Stenosis, CR- Carotid Revascularisation, CEA- Carotid Endarterectomy, CAS- Carotid Artery Stenting, mRS-Modified Rankin Scale, NASET- North American Symptomatic Endarterctomy Trial, DSA-Digital Substraction Angiography, DM-Diabetes Mellitus, HTN-Hypertension, HL-Hyperlipidemia, CREST- Carotid Revascularization Endarterectomy Versus Stent Trial, ICSS-International carotid stenting study.*

### Introduction

Carotid artery stenosis (CS) accounts for up to 20–25% of all ischemic strokes [1]. Treatment of this disease consists of the best medical treatment (BMT) and carotid revascularization (CR), including carotid endarterectomy (CEA) and carotid artery stenting (CAS). CEA and CAS are recommended for symptomatic patients who have more than 50% stenosis or asymptomatic patients who have more than 70% stenosis [2]. Although CEA is the standard treatment and has been shown to benefit patients who have had indications of CS for a long time [3–5], it has some limitations because of patients' comorbidities, unfavorable neck anatomy and surgical complications. CAS, therefore, has been developed to increase safety and provide a minimally invasive procedure. However, there are also concerns associated with CAS because of its periprocedural complications, especially stroke. Therefore, whether CS is optimally managed with CEA or CAS remains controversial. Carotid endarterectomy became the mainstay of treatment for patients with symptomatic carotid artery stenosis after two randomized trials established the benefit of endarterectomy compared with medical treatment [6, 7]. In recent years, endovascular treatments (first balloon angioplasty and then stenting) have been increasing-

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ly used as an alternative to endarterectomy, despite the paucity of evidence that endovascular treatment offers the same level of early safety and long-term effectiveness as surgery does. Several randomized trials have compared endovascular treatment with endarterectomy for carotid stenosis, but none have been of sufficient duration to report outcome after longer than 4 year [8].

**Materials and methods**

In this study, we report a retrospective analysis of 49 patients operated in Fujita Health University – Bantane Hospital during a period of four years (From September 2014 to September 2018) for carotid artery stenosis. All the patients underwent carotid revascularization with CEA or CAS.

**Indication for surgery (inclusion criteria):**

1. Symptomatic patients with >70% stenosis
2. Symptomatic patients with ulcerated plaque >60% stenosis
3. Symptomatic patients with 50% to 69% stenosis if no other etiologic basis for the ischemic symptoms can be found.
4. Asymptomatic patients with progressive increase in stenosis over and above 60%, despite medical management
5. Asymptomatic patients with <60% stenosis with contralateral carotid occlusion

Patient's demographic details, operative procedure accounts and post-operative follow up were noted from the hospital records.

All patients were evaluated with CT/MRI brain as per Stroke protocol followed in our institute. Neck vessel Doppler was also done to measure the velocities across the stenosis. Degree of stenosis was calculated by CTA/MRA images (NASCET Criteria) and by DSA. Apart from routine blood investigations (which included hemogram, coagulation profile, liver and renal function test), all patients underwent baseline non invasive cardiac workup including ECG, echocardiogram and chest X-ray. Blood pressure and glycemic profile were monitored and controlled accordingly. Outcome was evaluated in the post-operative period using the modified Rankin Scale (MRS).

We collected and analyzes the following variables`

- The demographic data as sex and age. Patients were divided into three groups regarding their age (50-65, 66-80and >80 years old)
- Risk factor as Hypertension, DM, Hyperlipidemia, Cardiac diseases.
- Complications using the modified Rankin Scale (mRS)

Symptomatic patients:- Patients with carotid stenosis are considered symptomatic if they present with a history of stroke, amaurosis fugax, or transient ischemic attacks (TIA) involving the ipsilateral carotid territory that occurred within 180 days of the initial assessment.

Asymptomatic patients: - Patients with no neurologic symptoms referable to the cerebral hemisphere ipsilateral to the carotid stenosis or a history of previous neurologic events without subsequent event within 180 days.

Stroke: - Defined as a cerebral infarction that manifests as sudden onset of focal neurological deficits that persists for more than 24 hours.

Transient Ischemic Attacks: Defined as a temporary focal neurologic deficit that persists for <24 hours with a return to baseline or complete resolution of the event.

Minor stroke: - A new neurologic event that persists for more than 24 hours but completely resolves or returns to baseline within 30 days with NIHSS score of ≤4.

Major stroke: - A new neurologic event that persists for >24hours with NIHSS score >4.

Post Procedural myocardial Infarction:- Chest pain or equivalent symptoms consistent with myocardial ischemia and ECG evidence of ischemia including new ST segment with elevation of cardiac enzymes (CK-MB or Troponin T) to a value 2 or more times the institute's laboratory upper limit of normal .

Cranial Nerve injury: -Temporary or permanent deficits secondary to injury to cranial nerves that occurred as a result of a carotid intervention, particularly that have not resolved by 30 days and 6 months after the initial procedure.

For patients who underwent CAS for CR they received dual antiplatelet therapy of Aspirin of 75 mg and Clopidogrel 75 mg twice a day after food which was started one week before the procedure. We performed balloon angioplasty and use of embolic protection device was done in all our patients. Statistical study was performed using EPI Info 7 software, continuous variables were presented as mean ± standard deviation, demographic variables as sex and age, risk factors, surgical management (CEA or CAS). Univariate and multivariate analysis was done using the same software. p value < 0.05 was considered stat-

ically significant. Clinical data and outcome results were provided by the senior author.

**Results**

Demographic study

We had 49 patients enrolled in the study. Majority were male patients (45). Left sided carotid stenosis was seen in 27 patients. Demographic details of the study are summarized in Table 1.

TABLE 1

| DEMOGRAPHIC DETAILS AND RISK FACTORS | | |
|---|---|---|
| | NUMBER | % |
| TOTAL NUMBER (n) | 49 | |
| MALE | 45 | 92 |
| FEMALE | 4 | 8 |
| MEAN AGE | 72.93 Years ±7.31 | |
| RISK FACTORS | | |
| PRESENT | 39 | 80 |
| HTN, HL | 13 | 34 |
| HTN | 8 | 23 |
| DM | 5 | 12 |

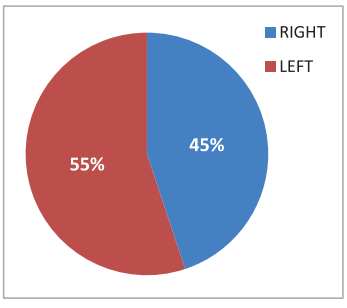


Chart 1: Showing site of occlusion of Internal Carotid Artery

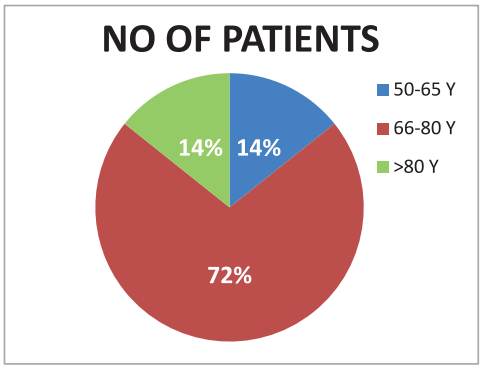


Chart 2: Showing age wise distribution of patients

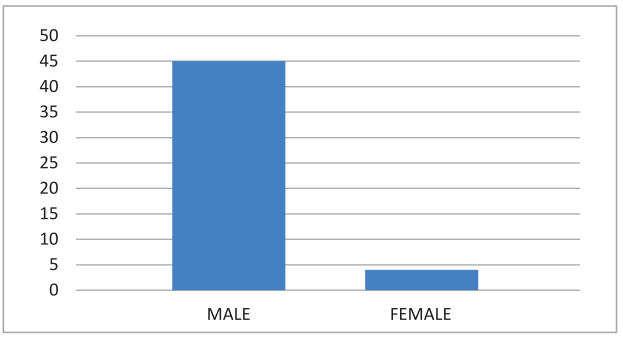


Chart 3: Sex wise distribution of patients.

**Risk factors**

Hypertension with Hyperlipidemia was the main risk factors in our study, it was seen in 13 cases followed by Hypertension in 8 cases, Diabetes mellitus was risk factor in 5 patients. In several cases, more than one risk factor has been seen. Only 9 patients out of 49 had habit of smoking. Risk factor like smoking and diabetes mellitus were not statistically significant with p value of 0.65 and 0.45 respectively.

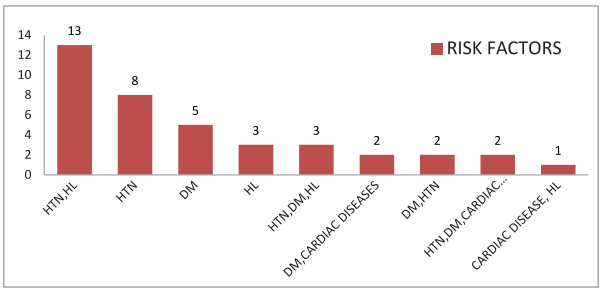


Chart 4: Showing the risk factors

**Disease status**

We divided patients as asymptomatic those who did not have any symptoms of TIA or Stroke and those having these symptoms as Symptomatic. We had 32 asymptomatic patients and 17 symptomatic patients. Out of 32 asymptomatic patients 4 patients who underwent CR had less than 60% stenosis with contralateral carotid occlusion. We tabulated these patients in Degree of stenosis. Disease Status details is summarized in Table 2.

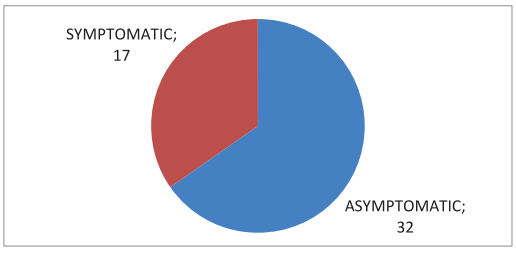


Chart 5: Showing Disease Status

Table 2

| DISEASE STATUS | NUMBER | % |
|---|---|---|
| ASYMPTOMATIC | 32 | 65 |
| Degree of stenosis | | |
| <60 | 4 | 12 |
| >60 | 28 | 88 |
| Mean | 71.84 ± 12.54 | |
| PROCEDURE | | |
| CAS | 20 | 62 |
| CEA | 11 | 35 |
| CEA AFTER CAS | 1 | 3 |
| SYMPTOMATIC | 17 | 34 |
| Degree of Stenosis | | |
| 50-70% | 3 | 18 |
| >70 | 14 | 82 |
| Mean | 77.70 ±13.76 | |
| PROCEDURE | | |
| CAS | 12 | 70 |
| CEA | 3 | 18 |
| CEA AFTER CAS | 2 | 12 |

**Management (CEA AND CAS)**

CEA was done in 17 patients in both symptomatic and asymptomatic patients. In three patients they underwent CEA after CAS as one had hyper perfusion injury after undergoing CAS and in two CAS was not possible due to tortuous anatomy. In our study DSA was correlating with the management (either CAS or CEA, p value 0.006). Management (CEA or CAS) was correlating with the outcome which was done as per modified Rankin Scale (mRS) in both symptomatic and asymptomatic patients (p vale 0.045).

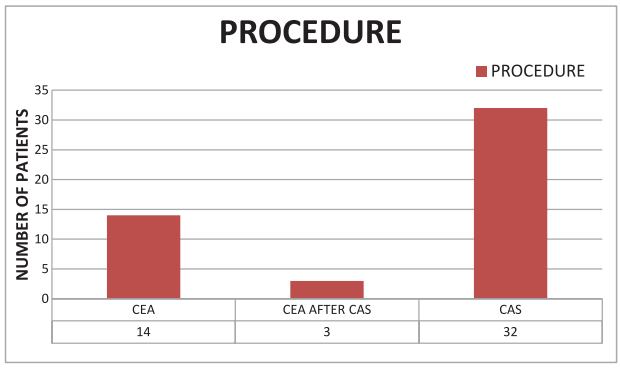


Chart 6: Showing the procedure CEA and CAS

**Discussion**

Association between the extracranial carotid artery disease and ischemic stroke was known since 19th century, the most important breakthrough was contributed by publications of C. Miller Fischer, who studied on pathophysiological correlation between the occlusion of carotid artery disease and the ischemic stroke [9]. He first predicted the surgical treatment for the carotid atherosclerosis can prevent the risk of ischemic stroke. Successful first carotid endarterectomy (CEA) was done in 1953 by Debakey [10]. In 1954, Eastcott et al described the first successful surgery of carotid occlusive disease in which the bifurcation of the carotid artery was resected and then internal common carotid artery was anastomosed with the internal carotid artery [11]. There is robust clinical evidence for safety and efficacy of carotid endarterectomy in preventing subsequent stroke in patients with symptomatic and asymptomatic carotid artery disease [4]. The recommended benchmark for post CEA combined event rate (stroke and mortality) is 1.5% for asymptomatic patients and 5% for symptomatic patients [12]. In our present study, the asymptomatic patients formed majority of the study population, i.e. 32 patients out of total 49 patients. No adverse events were observed in them. Among the symptomatic patients there were no perioperative major stroke rate and mortality. One patient had hyperperfusion injury after CAS and had to undergo CEA later on. Total of three patients had to undergo CEA after CAS. Two patients it was tortuous anatomy and CAS was not possible. Reports from latest randomized controls trials such as ICSS and CREST, failed to prove non inferiority of CAS when compared to CEA and still CEA remains the treatment of choice especially in symptomatic patients [13, 14]. Various individual risk factors are considered to influence the outcome of CEA which includes age >80yrs, female sex, co-morbid illness, anatomical factors (previous ipsilateral CEA, high or low bifurcation, previous neck irradiation), tandem lesions in intracranial vessels, significant vertebrobasilar disease, contralateral carotid occlusion, symptomatic status (asymptomatic/TIA/Stroke) and ipsilateral cerebral symptoms within 2 weeks before surgery [15, 16]. And these risk factors are quoted as an indication to choose CAS rather than CEA as a modality of treatment. Percentage of female patients in the study group was also less (8%) to be considered as a major factor and none of the patients had previous ipsilateral CEA. In the current study none of these other factors influ-

enced poor post-operative outcome (both perioperative poor neurological outcome and mortality). May be the event rate is very low in our study, hence we couldn't get a significant value when assessing these factors. Studies have also shown similar results, with only anatomical/local risk factors have slightly raised adverse events and in all other patients CEA can be performed successfully with low morbidity and mortality [16]. The selection of patients for either carotidartery stenting or carotid endarterectomy may require attention to age, with younger patients having a slightly better outcome with carotid artery stenting and older patients having a better outcome with carotid endarterectomy [17]. In this study we did not have any correlation with the age and the outcome. Patient at younger age undergoing CE had similar results like old patients undergoing CAS. Various studies have been done to settle the debate between CAS and CEA in better management of CS. The definite outcome stating which is better is not achieved. Studies found that management can be dependent on the risk groups [18]. It is usually believed that CAS procedure is less invasive compared to the CE and be advantageous for older patients. However, it is also said at older age posted for the surgery is associated with periprocedural morbidity and mortality [19, 20]. We advise that if proper care and meticulous dissection is done and use of shunt system during CE it can decrease morbidity. In our study we had around two third of the patients who were in age group more than 65 years and we performed both CE and CAS in those group of patients and have found similar outcome. The largest trial done to compare CAS and CE is CREST which showed endarterectomy to be superior to carotid angioplasty and stenting with respect to the outcomes of ischemic stroke, perioperative stroke or death in both asymptomatic and symptomatic patients [21]. However, addressing the primary end point of any stroke, myocardial infarction, or death up to 4 years after intervention, both procedures proved equal [22]. Our results also states that both modalities of management holds strong in management of carotid artery stenosis.

**Procedure:**

**Carotid endarterectomy**

**Illustrative case:**

60 year right handled gentleman presented with complaints of multiple episodes of transient ischemic attacks. CT angiography revealed left carotid artery stenosis more then 60 % stenosis (Figure 1). MRI revealed small water shed infarcts at the left MCA territory. CEA was performed. Patient is positioned with neck extended and chin turned to opposite side. Incision is along the anterior border of sternocleidomastoid muscles (SCLM), from the angle of mandible to 5 cm above clavicular head (Figure 2). The carotid sheath is opened and the common carotid artery (CCA) is dissected and looped for control. External carotid artery (ECA) and Superior thyroid artery (STA) are controlled and looped. Without disturbing the carotid bifurcation, the distal internal carotid artery (ICA) beyond the disease is dissected and looped for control (Figure 3). ICA, CCA, ECA and STA are clamped in sequence. We perform In vivo optical spectroscopy (INVOS) to check regional oxygen saturation (Figure 4) and routinely used shunt during the procedure which is first inserted into the CCA end followed by ICA end and snugged (Figure 5). The arteriotomy begins 2 cm on the distal CCA and proceeded over the carotid bulb, gradually extending to visualize the atheromatous endpoint in ICA. A subintimal plane is created and the plaque is extracted feathering away from ICA with gentle traction (Figure 6). The endarterectomized artery is then carefully irrigated with heparinized saline and any loose intimal tags are peeled off. The arteriotomy is then repaired. ECA first and then CCA clamp was released, and initial perfusion restarted to ECA. ICA was perfused a minute later. Hemostasis is well secured.

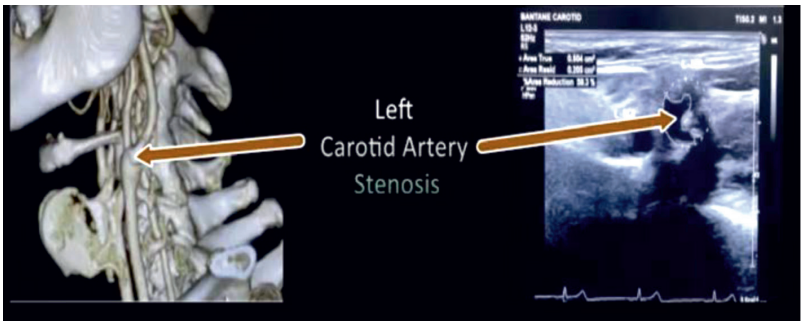


Figure 1 - Showing left ICA stenosis

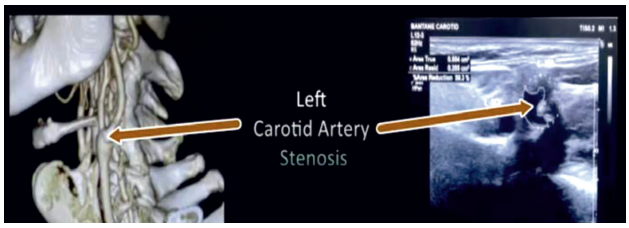


Figure 2 - Showing position of the Patient and skin incision.

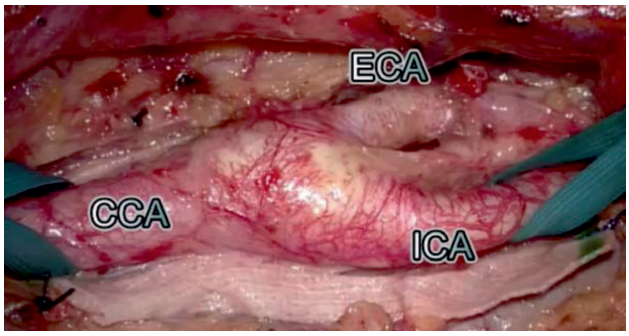


Figure 3 - Showing CCA, ECA and ICA of left side

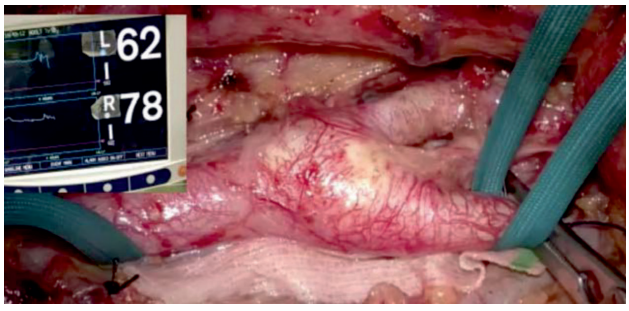


Figure 4 - Showing use of In vivo optical spectroscopy (INVOS) to look for regional oxygen

**Saturation**

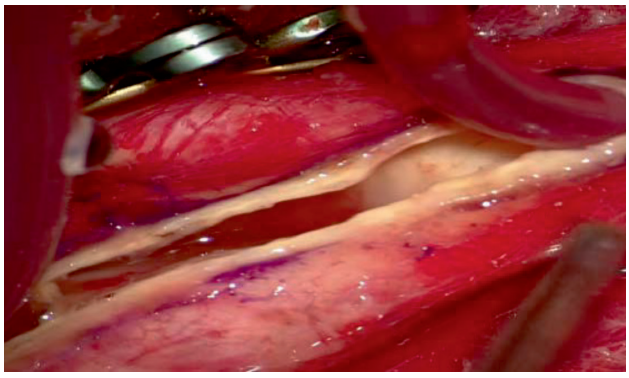

Figure 5 - Showing use of Shunt

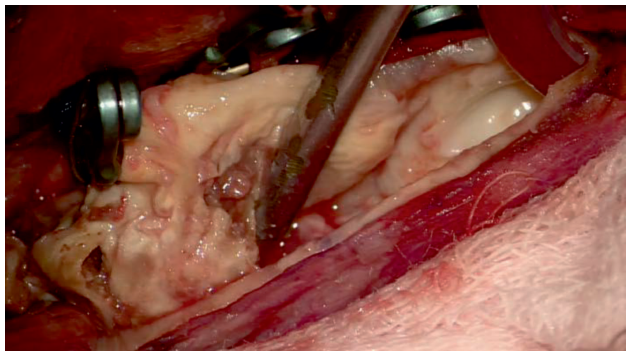

Figure 6 - Showing subintimal plane and the plaque is extracted feathering away from ICA

**Carotid artery stenting (cas)**

For carotid artery stenting, the protocol specified is always use of the stent and embolic protection device. At least 48 hours before carotid artery stenting, patients received aspirin, at a dose of 75 mg twice daily, and clopidogrel at a dose of 75 mg twice daily. When carotid artery stenting was scheduled for within 48 hours after randomization, 300 mg of aspirin and 300 mg of clopidogrel were given 4 or more hours before the procedure. After the procedure, patients received one or two 75 mg doses of aspirin daily for 30 days and clopidogrel, 75 mg twice daily for 4 weeks. The continuation of single antiplatelet therapy for more than 4 weeks after the procedure is given for all patients who had undergone carotid-artery stenting.

**Conclusion**

The management of CS is complicated and has been studied for a long time. Stroke prevention without complications is the main goal of successful treatment. Our study demonstrates that carotid endarterectomy could be performed safely with low risk of perioperative stroke or death in the setting of symptomatic and asymptomatic carotid artery disease. Risk–benefit assessment should be discussed with individual patients, and should be based on patient status, plaque characteristics and procedural risk, rather than on the argument between CEA and CAS. The CAS procedure is a valid alternative to CEA for selected patients who have an indication for revascularization and are at high surgical risk. In the near future, analyses of the results of large ongoing and recently completed trials comparing CEA with CAS will likely help clarify the role of these procedures for different subgroups of patients with carotid artery disease.

**Limitation of our study**

We consider that our series is not enough large to allow a strongest conclusion. A larger data and longer follow up may allow a better study in the future.

**Disclosure**

We declare that we don't have any conflict of interest

**Financement**

**Nil**

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# ІШКІ КАРОТИД СТЕНОЗЫН ЕМДЕУ СТРАТЕГИЯЛАРЫ: ЭНДАРТЕРЭКТОМИЯ НЕМЕСЕ СТЕНТТЕУ? ИНСТИТУТ ТӘЖІРИБЕСІ

***Қысқаша сипаттамасы.*** *Каротидті стеноз (КС) - бұл ишемиялық инсульттің негізгі себебі. КС емдеу каротид артериясының эндартерэктомиясын (ЭСА) және каротид артериясын стенттеуді (КАС) қоса алғандағы, каротид артериясын (КА) реваскуляризациядан және үздік емдеуден тұрады. Зерттеудің мақсаты ішкі каротид артериясының стенозы бар науқастарға жақсы нәтиже алудың емдеу критерийлерін анықтау және нәтижесін айқындайтын факторларды бағалау болып табылады.*
***Материалдар мен әдістер.*** *Мақалада Fujita денсаулық университеті - Banbuntane Hotokukkai ауруханасында төрт жыл бойы (2014 жылғы қыркүйектен бастап 2018 жылдың қыркүйек айы) каротидті стеноз үшін ота жасалған 49 науқастың деректерін ретроспективті талдау нәтижелері келтірілген. Біз каротидті реваскуляризациялау критерийлеріне сай келетін науқастарды таңдадық және оларды екі санатқа бөлдік: белгілері бар және белгілері жоқ. Барлық науқастарға каротидті реваскуляризация (КР) ЭСА немесе КАС арқылы жүргізілді. Нәтиже Ранкин шкаласы (mRS) арқылы операциядан кейінгі кезеңде бағаланды.*
***Нәтижелері.*** *Каротидті стеноз себебінен ота жасалған 49 науқастың 32-і асимптоматикалық, 17-і белгілері бар, 45-і ер адам және 4-і әйел. 27 науқаста сол жақ каротид артериясының стенозы байқалды. Гипертония және гиперлипидемия қауіп факторлары болып табылады. Сәтсіз КАС-тан кейін 3 науқасқа ЭСА жасалды. Пациенттердің орташа жасы 72,93 ± 7,31 жыл болды. КАС немесе ЭСА бойынша КР емдеу екі жағдайда да емдеудің нәтижесімен байланысты (p = 0,045).*
***Қорытынды.*** *КС емдеу өте күрделі және ұзақ уақыт бойы зерттеліп келеді. Инсультты асқынусыз алдын-алу - табысты емдеудің басты мақсаты. Біздің зерттеуімізде каротидтік эндартерэктомия қауіпсіз жүргізілуі мүмкін екендігін көрсетеді, бұл ретте периоперациялық инсульт немесе симптоматикалық және асимптоматикалық каротид артериясының ауруы кезінде өлім қаупі төмен болады.*

***Негізгі сөздер:*** *каротидті стеноз, каротид эндартерэктомиясы, каротид артериясын стенттеу, каротид артериясының реваскуляризациясы, Ранкин модификацияланған шкаласы.*

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# СТРАТЕГИИ ЛЕЧЕНИЯ ВНУТРЕННЕГО КАРОТИДНОГО СТЕНОЗА: ЭНДАРТЕРЭКТОМИЯ ИЛИ СТЕНТИРОВАНИЕ? ОПЫТ ОДНОГО ИНСТИТУТА

***Краткое описание.*** *Стеноз сонной артерии (СС) является основной причиной ишемического инсульта. Лечение СС состоит из лучшего медицинского лечения и реваскуляризации сонной артерии (СА), включая эндартерэктомию сонной артерии (ЭСА) и стентирование сонной артерии (ССА). Целью данного исследования является выяснение критериев лечения для наилучшего результата у пациентов со стенозом внутренней сонной артерии и оценка факторов, определяющих исход процедуры.*

***Материалы и методы.*** *В статье даны результаты ретроспективного анализа 49 пациентов, оперированных в Университете здоровья Fujita - Banbuntane Hotokukkai Hospital в течение четырех лет (с сентября 2014 года по сентябрь 2018 года) по поводу стеноза сонной артерии. Мы отобрали пациентов, которые соответствовали критериям реваскуляризации сонной артерии и разделили их на две категории: пациенты с симптомами и без. Все пациенты перенесли каротидную реваскуляризацию (КР) с ЭСА или ССА. Результат оценивался в послеоперационном периоде с использованием модифицированной шкалы Ранкина (mRS).*

***Результаты.*** *Из 49 пациентов, оперированных по поводу стеноза сонной артерии, было 32 пациента с бессимптомным течением и 17 пациентов с симптомами, 45 мужчин и 4 женщины. Стеноз левой сонной артерии наблюдался у 27 пациентов. Гипертония и гиперлипидемия были наиболее распространенным факторами риска. 3 пациентам пришлось пройти ЭСА после неудачной ССА. Средний возраст пациентов составил 72,93 ± 7,31 года. Лечение СС путем ЭСА или ССА в обоих случаях коррелировали с исходом лечения (значение p 0,045).*

***Заключение.*** *Лечение СС является сложным и изучается достаточно давно. Профилактика инсульта без осложнений является основной целью успешного лечения. Наше исследование демонстрирует, что каротидная эндартерэктомия может быть выполнена безопасно с низким риском периоперационного инсульта или смерти в условиях симптоматической и бессимптомной болезни сонной артерии.*

***Ключевые слова.*** *Стеноз сонной артерии, Каротидная эндартерэктомия, Стентирование сонной артерии, Реваскуляризация сонной артерии, модифицированная шкала Ранкина.*