THERAPY

Surgical or endovascular treatment of carotid stenosis

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Abstract

Carotid endarterectomy (CEA) is a proved standard treatment in stenosis of high-grade carotid artery stenosis. On the basis of new experience, percutaneous transluminal angioplasty with stent (PTAS) has gradually been established as an alternative method to carotid endarterectomy.
The aim of the three-month investigation was to evaluate PTAS, CEA and conservative medicamentous therapy. A group of 75 patients (78 stenoses) with symptomatic and asymptomatic stenoses of the carotid artery of 70 and more percent were evaluated within a unicentric retrospective study. The period of investigation commenced in August 1999, and lasted 14 months. The patients were treated by PTAS (23 patients), CEA (23 patients). Two patients were treated by bilateral stenting. One patient was subdued to both operation and endovascular treatment, while the former treatment was performed on one side and the latter on the contralateral side. This patient was included into both surgical and endovascular groups. The rest of the patients were treated solely by medicamentous therapy (30 patients).
During the period of 30 days after the intervention, one patient in both PTAS and CEA groups (4.3 %) developed a severe ipsilateral infarction. Recurrent stenoses were recorded in two patients from the PTAS group (8.7 %) (sonographically more than 50 %), and in one patient from the CEA group (4.3 %). Immediately after stent implantation, 12 patients (52.2 %) developed pinlike ischemic lesions observed by means of diffusion-weighted MR imaging (DWI). Hyperintensive signals did not lead to any neurologic deficits. After 3 months, none of the latter lesions were found in any of the patients. In the group treated by conservative therapy, only one of the patients (3 %) developed a mild infarction. After the evaluation of our experience with peri-interventional PTAS and CEA complications in our small group of investigated patients, it is possible to state that the performance of both methods can be comparably successful. However, at the moment we cannot consider PTAS as an equivalent method. ***(Tab. 6, Fig. 2, Ref. 33.)***
Key words: carotid artery stenosis, endarterectomy, stenting.

Carotid endarterectomy (CEA) is a surgical therapeutic method that has been proved beneficial in the removal of carotid stenosis and the prevention of ischemic insults. CEA thus represents a currently verified standard therapy of high-grade carotid artery stenosis. Therefore, the success rate of each new therapeutic method is to be compared with the therapy that is currently used in common practice. The latest prospective multicentric studies evaluating the current surgical practice prove that the average surgical risk arising from CEA performed in patients with high-grade symptomatic or asymptomatic stenoses is below 2.5 % (Perler, 1998; Torsello, 1997).

During the recent years, transluminal angioplasty with stent (PTSA) has gradually been introduced also in coincidence with carotid artery stenosis (Diethrich, 1996; Diethrich et al, 1996; Kachel, 1991; Yadav, 1997). Owing to growing experience, PTSA is becoming an alternative to the formerly established carotid desobliteration.

The major advantage of this method resides in the widened range of indications in patients, in whom surgery represents a considerable risk. Despite the growing number of uncontrolled cases, no randomised multicentric studies justifying the PTSA value in comparison to carotid endarterectomy have been performed.

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Since August 1999, at the Landesnervenklinik Wagner-Jauregg in Linz, patients with high-grade carotid artery stenoses were treated also by PTSA based on the permitted protocol of the Ethic Commission. However, many questions coinciding with this method of carotid artery stenosis treatment have remained unanswered. We have tried to answer some of them at least partially, using the experience gained during our therapeutic practice.

The aim of this retrospective study was to evaluate short-term treatment results (post-operative three-month investigation) in a series of patients with symptomatic and asymptomatic carotid stenoses of over 70 %, who were subdued to CEA, PTSA or to conservative medicamentous therapy during a fourteen-month period started in August 1999.

Material and methods

In the frame of the retrospective study performed at Landesnervenklinik Wagner-Jauregg in Linz, the therapy of patients with the sonographically verified diagnosis of carotid artery stenosis in range of 70–99 % was evalueated within the period from August 1999 to November 2000.

Thirty patients out of their total of 75 were treated solely by medicaments. Stenoses were treated surgically in 23 patients, and 23 patients were subdued to transluminal angioplasty with stent. Bilateral PTSA was performed in two cases. One patient was treated by both, surgery on one side and endovascular therapy on the other side. This patient was included into both, surgical and endovascular groups. Hence, the total number of patients was not 76, but 75. The endovascular therapy was applied mostly in patients, in whom either the nature of plaques, their localisation, or several risk factors did not allow surgery.

The clinical material was evaluated on the basis of mortality and morbidity, as well as on that of the incidence of recurrent stenoses or vascular occlusions. The results of magnetic resonance prior to and after the intervention were also subdued to evaluation. The profiles of patients included into the study are given in Table 1.

In compliance with the protocol of the study, the selection of PTAS or CEA was determined by the following criteria:

Stenting criteria:

— symptomatic stenosis of internal carotid artery (ICA) equal to, or over 70 %,
— asymptomatic stenosis equal to, or over 70 % (according to NASCET study criteria) (NASCET, 1991).

Tab. 1. 70–99 % symptomatic and asymptomatic carotid stenoses.

75 patients 78 stenoses		
Stenting	Surgical treatment	Conservative therapy
23 patients 25 stenoses	23 patients 23 stenoses	30 patients 30 stenoses
13 symptomatic 12 asymptomatic	15 symptomatic 8 asymptomatic	9 symptomatic 21 asymptomatic

Risk factors in patients admitted for stenting:

— contralateral ICA blockage,
— recurrent stenosis following previous surgery,
— stenoses in extremely distal locations,
— extended stenoses coinciding with systemic vascular diseases,
— cranial nerves lesions,
— arteriopathy due to radiation,
— age over 79 years,
— serious heart diseases,
— atrial fibrillation,
— serious pulmonary diseases,
— untreated high blood pressure, and diabetes mellitus,
— myocardial infarction within the past 6 months,
— combined morbidity and survival expectancy below 5 years.

Stenting contraindication criteria:

— dementia,
— pre-terminal insufficiency of the kidneys,
— allergy to contrast substance,
— patients with severe calcified stenoses,
— no compliance,
— advanced cancer,
— survival expectancy below 1 year,
— tortuous vessels.

Carotid endarterectomy criteria:

— symptomatic stenoses over 70 %,
— asymptomatic stenoses over 90 %,
— fast progressing high-grade ICA stenosis and/or silent brain infarctions.

So long as it was possible to explain the deficit by arterial stenosis, carotid stenosis was considered to be symptomatic in coincidence with infarction or TIA within 6 months.

The intervention was not performed in high-risk patients who had fulfilled the latter contraindication criteria. Surgical intervention was preferably performed in patients with severely calcified stenoses. Medicamentous therapy was used in patients who had either fulfilled the contraindication criteria for PTAS and CEA, showed combinations of several serious risk factors, or refused to undergo surgical treatment or PTAS. Prior to, or after surgical or endovascular interventions, the neurologic state was evaluated on the basis of NIH score (The National Institute of Health) (Brott, 1989), Rankin score (Van Swieten, 1988) and Barthel index (Mahoney, 1965).

The results were evaluated up to 3 days after PTAS and CEA, as well as after 30 days and 3 months. The clinical states were defined as follows:

— ipsilateral TIA: complete withdrawal of neurologic deficits within 24 hours,
— ipsilateral mild infarction: neurological functional deficit lasting for less than 7 days or the Rankin scale value lower than, or equal to 2,
— ipsilateral severe infarction: neurological symptoms lasting more than 7 days and exceeding the Rankin scale value of 2,

— infarction due to any reason,
— death due to any reason,
— infarction and death combined.

Prior to the intervention, each patient was examined by duplex sonography, transcranial Doppler sonography, magnetic resonance (T1-weighted imaging with or without contrast substance, T2-weighted flair imaging, diffuse-weighted imaging – DWI), MR angiography of neck vessels, digital substraction angiography focused on the aortic arch and brain vessels. In the group treated conservatively, angiography was not performed. MR examinations were performed by means of Magnetom Symphonie 1.5 Tesla (Siemens Medical System, Erlangen, Germany). MR angiography was supplemented by sonography and angiography, mostly in order to image the calcified stenoses and intracranial vascular bed.

In three days after the intervention, the neurological state, MR examination as well as control duplex sonography were re-evaluated.

Stenting was performed by means of self-expanding stents (Easy Wallstent, Carotid Wallstent -Boston/ Schneider Scientific corp. USA). After the surgery and stenting, we carried on with the platelet anti-aggregation therapy. The group treated conservatively was very heterogeneous. 9 patients (30 %) were taking ASS; 2 patients were taking the combination of ASS/Clopidogrel, and 5 patients (16.6 %) were taking the combination of ASS with Dipyridamol. 10 patients were treated only by Clopidogrel. The oral antiaggregation therapy was not possible in 4 patients (13.3 %). From the surgical aspect, endarterectomies were performed under general narcosis with EEG monitoring and standard shunt. An absolute majority of cases were treated without patch-plasty.

Results

Age and sex characteristics of patients are given in Table 2. Men prevailed in all three groups, however the latter prevalence was most significant in the group treated surgically (73.9 %).

The average age in the group treated conservatively was higher than in those treated by intervention. The group treated surgically showed a greater incidence of symptomatic stenoses (65 % when compared to 52 % in PTAS group).

The proportions of clinical symptoms (amaurosis fugax, TIA, infarction) in individual groups are given in Table 3. The morbidity and mortality recorded during 30 days after the intervention are given in Table 4. During the peri-interventional period, death or neurological deficits were evident in two cases. One ipsilateral infarction occurred in CEA group (4.3 %), namely in a 75-year-old patient with symptomatic carotid stenosis and pre-operative residual hemi-symptoms (NIH = 3). The infarction of the medial cerebral artery occured on the second post-operative day. Despite intensive rehabilitation, extensive neurological deficits were not eliminated (hemiplegia, global aphasia, NIH = 8). One patient died. She was subdued to unilateral PTAS, and 7 days thereafter underwent CEA performed on the counterlateral side. The carotid occlusion was found in the site of stent, on the second day after the operation. Regarding the fact that for the purpose of clinical results we have defined the group of – infarction due to any reason- and – death due to any reason-, this complication was statistically included into both, surgical and endovascular groups. The former inclusion was done due to clear causal coincidence with stenting (occlusion of the carotid in the site of stent), the latter due to the death of patient in result of infarction that took place during the 30-day morbidity and mortality. The peri-operative 30-day morbidity and mortality is thus 4.3 % (n = 1) in PTAS group, and 8.7 % (n = 2) in CEA group. After stent implantation, one patient (4.3 %) suffered from TIA attack. Repeated MR examinations did not prove any new structural lesions.

Irritation of the carotid sinus due to balloon inflation during PTAS, and subsequent hypotension and bradycardia occurred in 4 patients (17 %). After the administration of atropine, the clinical symptoms withdrew. One patient developed a post-operative haematoma that required surgical revision. No cranial nerves lesions were recorded.

Peri-interventional restenosis and occlusions are summarised in Table 5. Restenoses were judged on the basis of sonographic

Tab. 2. Age and sex characteristics of patients.

Total number Patients n=75 Stenoses n=78	Sex/Age		
	Male	Female	Age
Stenting Patients n=23 Stenoses n=25	13/23 (56.5%)	10/23 (43.5%)	62.8±10.5
Surgery Patients n=23 Stenoses n=23	17/23 (73.9%)	6/23 (26.1%)	64.4±9.64
Conservative treatment Patients n=30 Stenoses n=30	17/30 (57%)	13/30 (43%)	69±8.5

Tab. 3. Clinical symptoms in individual groups of patients.

Total number Patients n=75 Stenoses n=78	Symptomatic/Asymptomatic stenosis				
	Asymp.	Sympt.	Am.Fugax	TIA	Infarction
Stenting Patients n=23 Stenoses n=25	12/25 (48%)	13/25 (52%)	3/25 (12%)	3/25 (12%)	7/25 (28%)
Surgery Patients n=23 Stenoses n=23	8/23 (34.8%)	15/23 (65.2%)	0	7/23 (30.4%)	8/23 (34.8%)
Conservative treatment Patients n=30 Stenoses n=30	21/30 (70%)	9/30 (30%)	1/30 (3%)	1/30 (3%)	7/30 (23%)

Tab. 4. 30-day morbidity and mortality.

Total number Patients n=75 Stenoses n=78	TIA	Ipsilat. mild infarction	Ipsilat. severe infarction	Infarction due to any reason	Death due to any reason	Death or infarction
Stenting Patients n=23	1/23 (4.3%)		1/23 (4.3%)		1/23 (4.3%)	1/23 (4.3%)
Stenoses n=25			1/25 (4%)			
Sympt. n=13	1/13 (7.7%)					
Asympt. n=12			1/12 (8.3%)		1/12 (8.3%)	1/12 (8.3%)
Surgery Patients n=23			1/23 (4.3%)	1/23 (4.3%)	1/23 (4.3%)	2/23 (8.7%)
Stenoses n=23						
Sympt. n=15			1/15 (6.7%)			1/15 (6.7%)
Asympt. n=8				1/8 (12.5%)	1/8 (12.5%)	1/8 (12.5%)

examination during 3 days after the intervention. The incidence of newly occurred restenoses and occlusions prevails in the PTAS group.

Post-interventional sonographic examinations proved that after the successful introduction of stent, asymptomatic restenoses (50 %) were found in two patients (8.7 %). In one case from the CEA group, asymptomatic restenosis was removed by re-operation with patch-plasty.

The overall results after three moths are given in Table 6. During the investigated period, only one of the conservatively treated patients developed recent neurologic symptoms that were evaluated as a mild infarction. Recent neurologic deficits were observed neither in PTAS nor in CEA groups.

In the case of the patient treated by bilateral stent, restenoses of 80 % were found. Due to this finding the balloon dilatation had to be repeated. One patient treated by endarterectomy (4.3 %) with asymptomatic restenosis of 70 % was additionally treated by stent.

Out of the total of 23 patients with stent implantation, 13 (56.6 %) were found to have no pathologic findings on MR examination performed prior to the intervention. Prior to the therapeutic intervention, fresh ischemic foci were recorded in 7 patients with symptomatic carotid stenosis (30.4 %); older ischemic changes were recorded in three patients (13 %). After the stenting, new fresh ischemic lesions were revealed by

Tab. 5. Periinterventional recurrent stenoses and enclosures.

Total number Patients n=75 Stenoses n=78	Recurrent stenosis (sonogr≥50%)	Encloseres
Stenting		
Patients n=23	2/23 (8.7%)	2/23* (8.7%)
Stenoses n=25	2/25 (8%)	2/25* (8%)
Sympt. n=13		1/13 (7.7%)
Asympt. n=12	2/12 (17%)	1/12 (8.3%)
Surgery		
Patients n=23	1/23 (4.3%)	1/23 (4.3%)
Stenoses n=23		
Sympt. n=15		
Asympt. n=8	1/8 (12.5%)	1/8 (12.5%)

* One enclosure was preceded by recurrent stenosis

means of diffuse-weighted MR imaging in 12 patients (52.2 %). Three months after the stenting, the diffuse-weighted MR images of these 12 patients did not show any evidence of the latter lesions.

The progress of stenosis in the medicamentously treated group could be judged only in 14 patients in whom the comparable data were available. In the latter patients, no stenosis progression was detected.

Discussion

Large multicentric studies as NASCET (North American Symptomatic Carotid Endarterectomy Trial), ECST (European Carotid Surgery Trial) (ECST, 1991, 1996, 1998) and ACAS (Executive Committee, 1995) indicated that carotid endarterectomy provided a great chance of survival without ischemic insults. The American Heart Association has defined the carotid endarterectomy indications based on a multidisciplinary consensus. Surgery is clearly indicated in cases with symptomatic carotid stenosis of 70 %, unless the perioperative 30-day morbidity and mortality are equal to, or over 6 %. The incidence of complications below 3 % enables to carry out surgical treatment also in cases with asymptomatic stenoses (Biller, 1998; Moore, 1995).

It has been proved that patients with carotid stenosis can be successfully treated also by percutaneous transluminal angioplasty with stent. The endovascular technique is beneficial especially in patients at high risk arising from surgery, accumulation of vascular risk factors, post-operative recurrent stenoses, contralateral enclosure, co-morbidity, and arteriopathy following radiation. In these cases, stenting could be performed, however at a small risk of complications (Al-Mubarak, 2000; New, 2000; Yadav, 1997) (Fig. 1).

The selection of patients for individual therapeutic methods in our study resided in the fact that patients at high surgical risk

Tab. 6. Morbidity and mortality after 3 months.

Total number Patients n=75 Stenoses n=78	TIA	Ipsilat. mild infarction	Ipsilat. severe infarction	Infarction due to any reason	Death due to any reason	Death or infarction
Stenting						
Patients n=23	1/23 (4.3%)		1/23 (4.3%)	1/23 (4.3%)	1/235 (4.3%)	1/23 (4.3%)
Stenoses n=25						
Sympt. n=13						
Asympt. n=12	1/12 (8.3%)		1/12 (8.3%)	1/12 (8.3%)	1/12 (8.3%)	1/12 (8.3%)
Surgery						
Patients n=23			1/23 (4.3%)	2/23 (8.7%)	1/23 (4.3%)	2/23 (8.7%)
Stenoses n=23						
Sympt. n=15			1/15 (6.7%)	1/15 (6.7%)		1/15 (6.7%)
Asympt. n=8				1/8 (12.5%)	1/8 (12.5%)	1/8 (12.5%)
Conservative treatment						
Patients n=30		1/30 (3%)				1/30 (3%)
Stenoses n=30						
Sympt. n=9		1/9 (11%)				1/9 (11%)
Asympt. n=21						

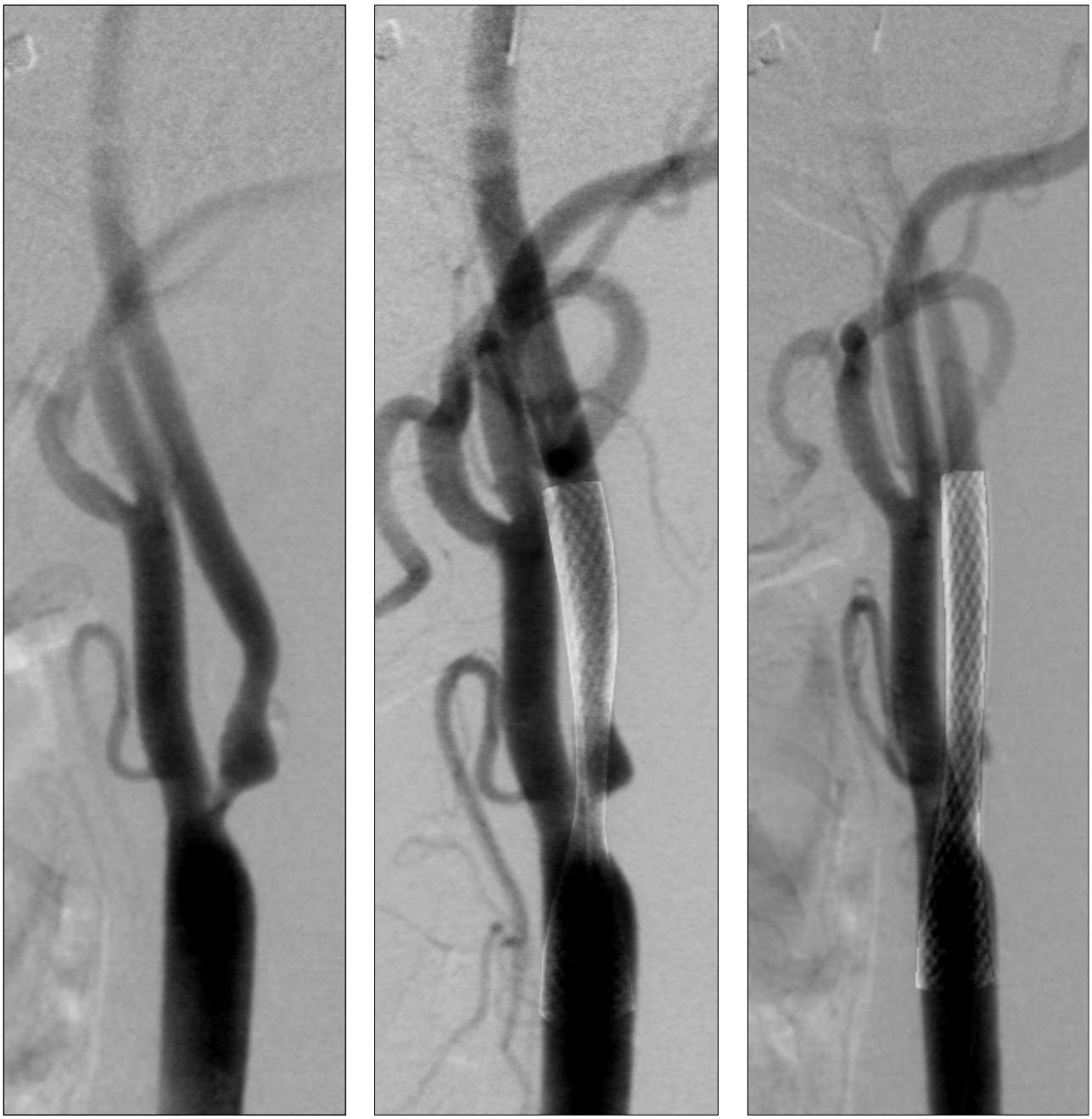

Fig. 1. Stenosis of ICA (70 %), introduction of stent (Easy Wall 8/30) along the whole stenosis up to CCA and dilatation of stent (Bijou 5/40) with moderate remnant stenosis.

were treated by stent. The decision was influenced by the accumulation of more than three risk factors presented within the PTAS group. Stents were applied also in two patients (8.6 %) with stenosis recurrence, and four patients (13 %) with coronary vascular diseases.

Post-stenting complications investigated during the course of 30 days after the stenting occurred in one (4.3 %) out of 23 patients. An extensive infarction with fatal consequences occurred only in one patient, namely on the 8th day after the stenting, and on the 2nd day after the preceding contralateral endarterectomy. The impact of the complete stent enclosure was fatal. The period of time selected between both interventions was very short. Due to the forthcoming operation, it was necessary to terminate the platelet anti-aggregation therapy 3 days prior to the intervention. This procedure has breached the study protocol. Due to this reason, it is necessary to re-evaluate the timing of interventions. It is the period of the first four weeks when post-interventional stent endothelisation takes place**.** The missing vascular endothe-

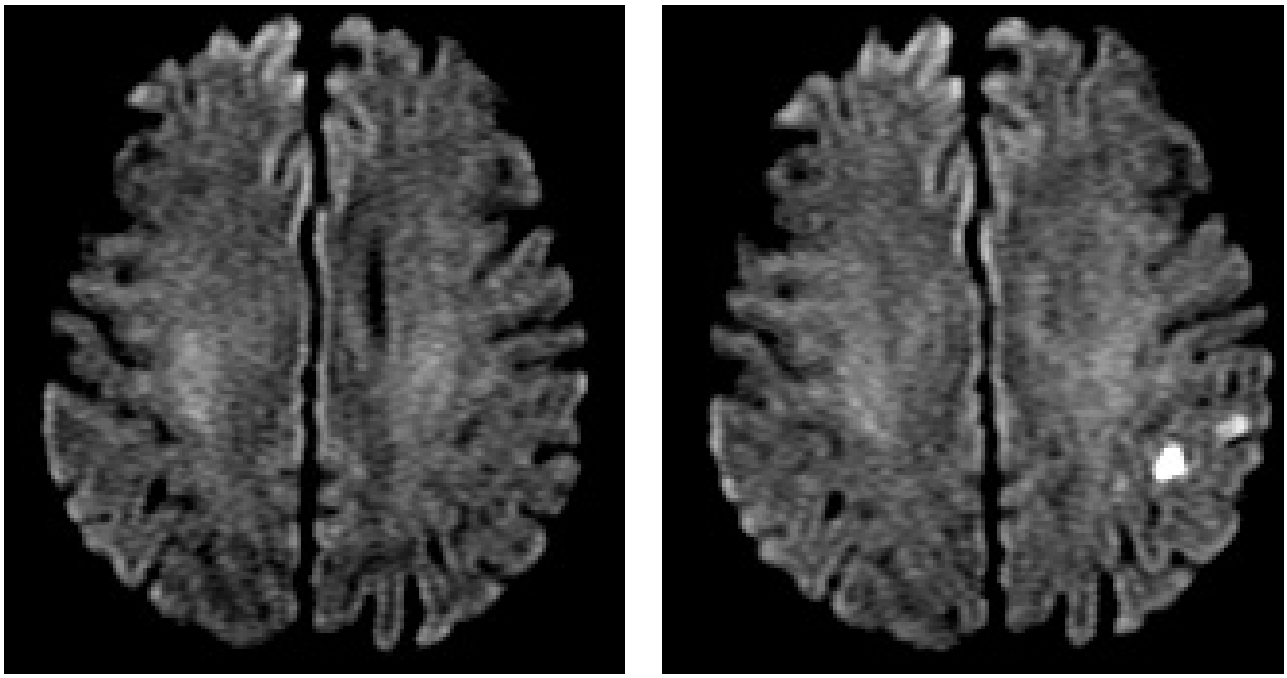

Fig. 2. Diffuse-wighted MR imaging prior to PTAS and diffuse-weighted imaging after PTAS with asymptomatic lesion in the left hemisphere.

lium and injured intima enhance coagulation and the origin of thrombi (Quereshi, 2000).

The total number of complications (4.3 %) corresponds with the results gained within international studies (Diethrich, 1996; Diethrich et al, 1996; Henry, 1998; Roubin, 2001; Wholey, 1997; 2000). Wholey (2000) presents peri-interventional complications (infarction or death) in 5.07 % out of 4757 patients. Therapeutic dilatations led to no ruptures of the carotid artery as described in cases with severely calcified plaques (Mathias, 1999). Due to the latter reasons, the presented types of stenoses were included into stent contraindication criteria.

Technical executability of PTAS defined as successful stent implantation was achieved in 96 %. In one case the intervention was interrupted after an asymptomatic spontaneous carotid enclosure.

The reasons given for stenting interruption include blocked passage within the stenosis, an insufficient allocation of the driver, as well as less frequent air embolism (Roubin, 2001).

If the introduction of stent should lead to significant hemodynamic deterioration, angioplasty could possibly be applied. During the period of 3 months after the application of self-expanding Wallstents, restenoses occurred in 12.4 % (n = 3) regarding the number of stenoses, and in 8.7 % (n = 2) regarding the number of patients.

In one patient, the restenosis can be ascribed to less technical aspects, more likely to the disposition to intimal hyperplasia. In this case the re-dilatation was successful. According to literature, stenoses, regardless of stent type, reoccur in 2 % after 6 months, and in 3.5 % after 12 months (Wholey, 2000). In one case, asymptomatic thrombosis of stent developed. The sonographic examination performed after three months revealed a complete enclosure in the site of stent.

It is assumed that ischemic complications during stenting are mainly caused by embolism by plaque particles. The diffuse-weighted MRI (DWI) is a sensitive method of the detection of very small lesions (smaller than 3 mm) already several minutes after ischemia (Fig. 2). The cellular swelling, cytotoxic oedema already at the beginning of the cascade of ischemic tissue changes can be detected by diffuse-weighted MR imaging (Moseley, 1990; Warach, 1995; Warach, 1992). Local disorders revealed by diffuse-weighted imaging could be detected in as many as 12 patients (52.2 %). The latter lesions did not lead to clinical neurological changes in any of the patients. The given fact leads to the assumption that during the dilatation and allocation of the stent, emboli can be easily released. Clinically apparent lesions represent only a part of the structural brain damage. Up to now, the proportion of asymptomatic lesions has been underestimated. Bendszus (1999) presents that silent emboli appear after diagnostic and interventional angiographies. In the series of 100 (66 diagnostic and 34 interventional) angiographies, hyperintensive lesions corresponding with cerebral embolism were detected in 23 out of 91 patients. Diffuse disorders in coincidence with diagnostic angiographies are significantly more frequent in patients with vasculopathy (Bendszus, 1999). The reduction of risk arising from embolism is expected to take place in coincidence with further development of protective endovascular techniques of picking the plaque mash (Henry, 1999).

Ipsilateral severe infarction after endarterectomy occurred in one patient (4.3 %). The total number of complications during the course of 30 days achieves 5.8 % according to NASCET

study, and 7 % according to ECST study (ECST, 1991; 1996; 1998; NASCET, 1991).

The increased number of perioperative complications can be possibly explained by random mechanisms coinciding with the small number of patients. According to NASCET and ESCT studies, the patients were selected strictly, and not all of NASCET contraindication criteria were fulfilled. This was the case of the patient, in whom the stenting was performed on the contralateral side prior to endarterectomy. This patient died after the surgery in consequence of infarctions after the enclosure of the carotid artery in the site of stent.

No disorders of cranial nerves or myocardial infarctions were observed. Surgical revision for re-bleeding in the wound was required in one patient. According to NASCET study, the injuries of cranial nerves were observed in 7.6 %, myocardial infarction in 0.9 % and bleeding in 5.5 % of cases. Asymptomatic recurrent stenosis after endarterectomy was detected in one patient (4.3 %). Restenosis determined by dissection of intima was removed immediately after the surgery by re-operation. According to CEA study, 10 % of cases develop restenoses in the first year, 3 %, in the second year and 1 % represent of cases represent a long-term risk (Frericks, 1998). In the group of conservatively treated patients, only one patient was afflicted by mild infarction during the three months of investigation. Regarding the shortness of investigation, the evaluation of the results of conservative therapy is of minor significance. The incidence of changes revealed by MR imaging after PTAS (52.2 %, n = 12) is very high. When compared with the studies of patients treated surgically, the risk after endarterectomy is substantially low (Barth, 2000).

In PTAS, the greatest risk of embolism arises from the catheterisation of aorta during the penetration through the site of stenosis, and its predilatation. The results indicate that the development of stenting techniques is going to focus especially on the use of filters, occlusive balloons and softer catheters. The protective effect can be possibly objectified by the use of diffuse-weigthed MR imaging.

The local, clinically silent lesions detected by MR imaging were found solely in two surgically treated patients. Barth et al. (2000) examined 48 patients who showed no neurological changes after endarterectomy. New hyperintensive signals were observed only in two patients (4.2 %) (Barth, 2000). The weak moment of our study resides in the small number of patients who were not randomised. Also the three-month observation period can provide merely preliminary results. The therapeutic method was dominant, and the patients were evaluated in groups treated by one single method. This fact leads to the problematic design of our study which, viewing the number of patients, has not regarded the differences between symptomatic and asymptomatic stenoses. So far, no long-term results are available in coincidence with the application of intraluminal stent due to carotic stenosis under controlled conditions.

The question as to whether the stenting of carotid stenosis can bring about a long-term comparable decrease in the risk of ischemic damage as opposed to carotid desobliteration, remains unanswered. Similarly, the questions of incidence of recurrent stenoses, or those of the enclosure of the carotid artery after stenting need to be answered. The incidence of recurrent stenoses after stenting is very high in the vascular periphery. Recurrent stenoses of the iliac artery occurring after 2 years are described in 27 % (Sullivan, 1997) and those of the femoral artery occurring after one year are reported in 78 % (Gray, 1997).

Is the risk of surgical treatment of recurrent stenoses after interventional endovascular therapy going to be acceptable when the section of internal carotid vascular wall made accessible by surgery is changed due to tissue reaction to the stent?

These are the reasons why the multicentric project of randomised German study ESPACE (Stentgestützte Perkutane Angioplastie der Carotis versus Endarterectomie) has been worked out. Currently, the latter study is in progress. The latter unanswered questions lead to the fact that stenting should be carried out in the frame of controlled clinical studies on the basis of a multidisciplinary consensus of vascular surgeons, radiologists and neurologists. The patients should be informed about the experimental nature of the intervention, and if both forms of therapy are possible (surgical or endovascular), the patients should be given the possibility of their own choice.

On the basis of our experience gained from a small number of patients, it has been proved that PTAS and CEA can be possibly carried out with a comparable peri-interventional risk.

Our experience does not express an equivalent of under-verified endovascular therapy and verified surgical therapy.

The endovascular method is associated with the high risk of asymptomatic microembolic ischemia that was proved to be reversible during the period of 3 months.

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