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Carotid insufficiency has overshadowed the problem of vertebral insufficiency. This impression is not only valid for the clinical history and diagnosis of vertebral insufficiency but applies also to surgery on the vertebral artery. The dogmatic attitudes of vascular surgery have contributed to this state of affairs, in that reconstructive surgery for carotid insufficiency is conceded priority over the treatment of vertebral insufficiency. However, it is questionable if there should be unqualified acceptance of this attitude. From 1970 to 1979 altogether 1023 vascular reconstructive operations were performed on the carotid and 32 on the vertebral artery (Table 1); the remaining interventions on the supra-aortic branches are outside the scope of this paper. There were 24 men

Table 1: Arterial reconstructive operations

Carotid	1023	
ertebral 32		
Table 2		
Material		
24 men – average age 58 years		
8 women- average age 52 years		
Table 3: Operations		
Vertebral stenosis unilateral	18	
bilateral	2	
with elongation	3	
with contralateral	1	24
occlusion	n	
Vertebral occlusion		1
Vertebral elongation/tortuosity		4
Explorations – no operation		
Stenosis		1
Occlusion		1
Elongation		1
		32

Reconstructive Surgery on the Vertebral Artery*

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Fig. 1: Filiform stenosis at the origin of the left vertebral artery.

and 8 women, whose average ages were 58 and 52 respectively (Table 2). Thus, the male/female ratio was 3/1. Their ages varied from 31 to 71 years, with an average age of 56.

The predominant indication (Table 3) was a stenosis at the origin of the vertebral artery (Fig. 1). Eighteen of the operations were unilateral, two were bilateral, one was combined with an occlusion of the opposite vertebral artery and three with an elongation. One occlusion of the left vertebral artery was

^{*} Dedicated to Professor Dr. K. J. Zülch on the occasion of his 70th birthday.

successfully reconstructed. Four interventions involved elongation and tortuosity of the vertebral artery with kinking and stenoses. In three explorations the situation was found to be inoperable: one stenosis at the origin, one occlusion and one elongation of the vertebral artery. In this connexion the inoperability was accentuated by an elongation so that the constricted right vertebral artery arose from the posterior wall of the subclavian artery and the vertebral origin was displaced still further dorsally by an elongation of the subclavian artery. Such anatomical variations of the origin of the vertebral artery should always be borne in mind, particularly when interpreting the angiograms. One should pay attention to more posteriorly placed stenoses (Fig. 2).



Fig. 2: Posteriorly situated stenosis in the fourth part of the vertebral (after Rieben).

On two occasions respectively, the ipsilateral internal carotid or subclavian artery was reconstructed at the same session. Four times the internal carotid, and twice the subclavian artery were dealt with at a second session one week later (Table 4).

There was no direct operative mortality. Two patients died during their stay in hospital and one actually died from a previously undiagnosed brainstem glioma, which was only found at autopsy. Another patient who had operations on the verte-

Table 4

Simultaneous interventions	
at one session	
Vertebral & carotid – on same side	2
Vertebral & subclavian – on same side	2
at two sessions	
Vertebral & carotid – on same side	1
Vertebral & carotid – on opposite sides	3
Vertebral & subclavian – on same side	1
Vertebral & subclavian – on opposite sides	1
• •	

bral and internal carotid arteries at the same session, died three weeks post-operatively from a pneumonia after a transient neurological deficit.

According to the clinical severity of the complications (Table 5) the two transient hemiplegias should be mentioned first of all. There were two patients in whom the vertebral and internal carotid arteries on one side were operated on at the same session. Although the carotid reconstruction was undertaken with the protection of an intra-luminal shunt, we were unable to avoid the hemiplegia. One patient was deeply unconscious for two weeks, but then woke up completely within twelve hours and he showed not the slightest neurological deficit at the time of his discharge, either from the intellectual or psychological point of view. In spite of this favourable outcome we are quite sure that a reconstruction of the carotid and vertebral simultaneously on the same side is not advisable.

The occurrence of a Horner's syndrome is probably unavoidable; ont the three occasions where it occurred, it was temporary. The sympathetic chain was not disturbed in any of the operations and for the most part it was not even seen. However, as a precaution the patient should be warned preoperatively of the possibility of this complication. The phrenic paresis did not show any evidence of recovery in a follow-up period of three weeks. The postoperative bleeding and the lymphatic fistula did not require any further operation and, with conservative treatment they both settled down spontaneously and without complications.

Table 5

Complications	
Transient hemiplegia	2
Horners syndrome	7
Post-operative haemorrhage	1
Lymphatic fistula	1
Phrenic paresis	1
Operative mortality	0
Died in hospital	2

The neurological results generally were satisfactory, and in some cases impressive. This applies particularly to the vertebral artery occlusions.

H. R. 60-year-old male. Unable to follow his employment on account of increasing disturbances of balance. No longer able to walk straight. Considerable disturbance of speech. Pre-operative angiogram – occlusion of the right vertebral artery, stenosis of the origin of the left vertebral artery. At operation it became apparent that in the meantime the left-sided stenosis had become a complete block. An 8 cm segment of blocked artery was removed and a plastic widening of the origin of the vertebral artery carried out. Post-operatively – completely symptom-free. Recurrence of the block $3\frac{1}{2}$ years later.

For correction of a stenosis at the vertebral origin it is not always necessary to undertake a disobliteration (Fig. 3). Even this procedure cannot be whole-heartedly recommended, as the vessel wall can be left too thin after the endarterectomy. This can cause quite considerable difficulties for the subsequent suturing. Each case must be decided on its merits, as to whether at the origin should be excised or whether one should be content with a plastic widening procedure. What material is used for this is, in our experience, irrelevant; one can use not only an endogenous vein graft (Fig. 4) but also synthetic/plastic material (e. g. knitted Dacron).

With tortuous, redundant vessels (Fig. 5) we have undertaken a segmental resection, then after suture of the posterior wall we have carried out a plastic widening of the incision in the anterior wall. The incision should always be extended far enough into the proximal subclavian artery. In our experience, a block in the vertebral artery need not initially be regarded as inoperable. According to our observations we did not definitely know that a complete block had developed in the period which had elapsed

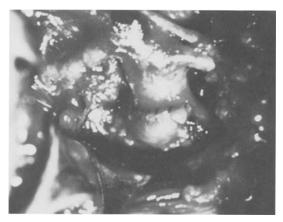


Fig. 4: Plastic widening at the origin of the left vertebral artery using an endogenous vein graft.



Fig. 3: Disobliterated stenosis at the origin of the left vertebral artery.

after the angiogram. The actual indication for operation was the preoperative occlusion of the contralateral vertebral artery. We feel quite definitely that a direct reconstructive operation is prefereble to a vertebral bypass, although in certain cases this might also provide a solution. Since the first successful endarterectomy of the vertebral artery in 1959 by DeBakey et al. (4) and by Cate and Scott (2), the



Fig. 5: Elongation and tortuosity of the first part of the left vertebral artery.

references to this in the literature have been very scanty. Natali et al. (8) reported 13 cases and Cormier and Laurian (3) wrote regarding the treatment of 119 vertebral elongations. Much more than these figures is shown by the relationship they bear to the operations on the carotid. In 1968 Morris et. al. (7) reported on 2465 carotid (2100) and vertebral (365) reconstructions, out of which the latter formed 17.4%. In our material the vertebral operations form only 3.1% compared with the carotid.

Stenosis at its origin and at the site of kinks or tortuosities of the vertebral artery have a much greater significance in the development of basilar insufficiency than lateral osteophytes, which can displace or narrow the vertebral artery (6). According to a detailed investigation by Rieben (9), exostoses related to the lateral mass produce only slight narrowings of the lumen of the vertebral artery. The most severe sclerotic changes with the production of stenosis of the lumen are found at the origin of the vertebral from the subclavian artery. Evidently the elongations and tortuosities of the vertebral artery are still not sufficiently appreciated, although their haemodynamic effect in particular positions or movements of the head cannot be doubted (5). Rieben (9) was able to show by studies of flow in the vertebral artery that a mechanical effect on the speed of the flow is produced by movements of the head and the cervical spine. This obstruction or even interruption of the blood flow can result even more when there is elongation and tortuosity of the vertebral artery, so that this finding is thus of importance in the illness. In our opinion the operable causes of vertebrobasilar insufficiency at the proximal segment of the vertebral artery merit more attention. The stress imposed by this operation is slight, even considering what might be expected of patients at an advanced age. The post-operative results suggest that a more active, agressive attitude should be adopted towards reconstructive surgery of the vertebral artery. Zeumer and Hauke (10) had expressed the view that the number of vertebral reconstructive operations will rise, when functional tests are undertaken in various positions of the cervical spine. We hope that Doppler-sonography will encourage further special investigations and smooth the way for selective angiography. Perhaps those who practice neurology should consider the question: Is vertebral insufficiency really so uncommon or is too little stress placed on its recognition?

Summary

In the last nine years 32 reconstructive operations were performed on the vertebral artery. In proportion to the 1032 operations on the carotid artery, is not the number of vertebral operations, at 3.1% unusually small? Is vertebro-basilar insufficiency too rarely recognized?

Key words

Vertebral insufficiency Vascular surgery Atherosclerosis.

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Zusammenfassung

In den letzten 9 Jahren wurden 32 rekonstruktive Gefäßoperationen an der Arteria vertebralis vorgenommen. Im Verhältnis zu 1032 Eingriffen an der Arteria carotis ist der Vertebralis-Anteil mit 3,1% auffallend gering. Wird die Vertebralisinsuffizienz zu selten erkannt?

Schlüsselwörter

Vertebralis-Insuffizienz – Gefäßchirurgie – Arteriosklerose

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