OBSERVATIONS ON PATENCY OF CERVICAL CAROTID ARTERY FOLLOWING SURGICAL TREATMENT FOR THROMBOSIS*

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The recent literature has contained some publications regarding the surgical treatment of thrombosis of the carotid artery in the neck. The reader gains the impression that the results have been quite encouraging. However, the follow-up has been extremely limited in value in assessing the usefulness of the various procedures because of the lack of any post-operative angiograms demonstrating restoration of circulation through the surgically treated thrombotic area. At the present time there are 4 surgical methods employed in the treatment of a thrombosed carotid artery in the neck. These are: 1) excision of the thrombosed segment and anastomosis of the severed ends of the artery, 2) excision of the thrombosed segment and replacement with an arterial or venous graft, 3) simple excision of the clot, and 4) thrombo-endarterectomy. Thrombo-endarterectomy seems to have gained the greatest popularity in the actual number of procedures carried out for this disorder. We wish to present 3 patients with symptoms caused by a thrombosed carotid artery in the neck proven by arteriography and surgically treated, with follow-up arteriograms and surgical explorations in 2 patients. All 3 patients improved following operation in the neck on the thrombosed artery—yet in 2 cases circulation had not re-established itself through the thrombosed segment.

The current interest in thrombosis of the carotid artery may have obtained its impetus from the surgical report of Webster et al., in 1950 and from Fisher's study of the pathology and frequency of this condition published in 1951. Webster et al., had reported 4 cases of spontaneous thrombosis of the carotid arteries in the neck in which the thrombosed segments were removed and the vessels were ligated. One patient surprisingly improved following this procedure. Denman et al., in 1955, reported a patient in whom the thrombosed segment was excised and replaced with an arterial homograft. This would seem to be an excellent method, but the results have not been encouraging. Eastcott et al., in 1954, reported restoration of arterial continuity in a case in which direct anastomosis of the internal to the common carotid artery was done after excising a partially occluded carotid

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bifurcation and ligating the external carotid artery. However, there was no postoperative arteriogram, and the sole evidence of improvement was the relief of the patient's intermittent attacks of hemiplegia and absence of abnormal neurological findings. Lin et al., in 1956, reported the only successful restoration of circulation through the thrombotic area by means of excision of the bifurcation of the carotid artery and replacement by a saphenous vein graft. Three months later angiograms proved the graft to be patent. Arnstein recently treated 10 patients by thrombo-endarterectomy. He stated that the simple excision of a thrombosed segment had been carried out by several different investigators and that he was not aware of any single reported patient being benefited following this procedure and that it had been tried in a sufficiently large number of cases by different surgeons. He also reported no success in anastomosing the common to the internal carotid artery after excising the thrombosed segment. However, some of the results following thrombo-endarterectomy were encouraging. He felt that the earlier a patient was operated upon the better the results would be. Again, no arteriographic or exploratory procedures were carried out to demonstrate adequate circulation through the previously thrombosed segment. Recently, Webster et al. recorded 70 patients with thrombosed carotid arteries in the neck, of which 41 had an exploration and excision of the thrombosed vessel. In only 1 patient was there bleeding from the distal portion of the carotid artery after excision of the thrombosed segment, suggesting that the vessel might have been patent above the level of thrombosis. All patients showed evidence of atherosclerosis and none exhibited any canalization that appeared to be functioning. However, they gave no statistical analysis of the surgical results. Three of their patients were treated by reconstruction of the bifurcation after excision of the atheromatous segment and in each re-thrombosis occurred. They merely stressed the clinical picture, the ability to diagnose, and suggested the possibility of treatment by arterial graft. They hoped by excising the thrombosed segment, there would be no further emboli propagating from the thrombus.

Therefore, although the literature contains reports of surgically treated patients with this condition there is no adequate analysis of the results other than to say that there has been some improvement neurologically with cessation of attacks but no direct proof that the surgical procedure itself re-established circulation.

The purpose in presenting the following 3 cases is to suggest that the clinical improvement frequently observed after surgery on the thrombosed carotid artery in the neck may well be unrelated to the operative procedure as evidenced by our postoperative arteriograms and re-explorations.

CASE REPORTS

Case 1 (U.H. #9535-F). F.R., a 51-year-old white male, was admitted to the Neurosurgical Service of the John Sealy Hospital on Feb. 14, 1956 with the history of a sudden onset of hemiplegia and aphasia in September, 1949. He had had several
previous admissions since 1949, with a diagnosis of thrombosis of the left middle cerebral artery. Over the past few years speech and right-sided movement had improved. However, he had begun to experience seizures and headaches of progressive severity.

Examination revealed right spastic hemiparesis with a moderate degree of aphasia. On Feb. 17, 1956, pneumoencephalography showed a contracting lesion of the left cerebral hemisphere. On the same date, a left carotid arteriogram demonstrated thrombosis of the cervical portion of the left internal carotid artery. On Feb. 27, 1956 an arteriosclerotic plaque and clot were removed from the internal carotid artery and an anastomosis of the external carotid artery to the internal carotid artery above the thrombosed segment was done in order to attempt to re-establish circulation. The proximal portion of the internal carotid artery was ligated.

At the time of discharge from the hospital the patient felt improved. Objectively there was slight improvement of movement of the right hand and speech was slightly better.

The patient continued to improve. In order to determine the patency of the anastomosis, he was re-admitted 3 months later. On May 15, 1956, left percutaneous carotid arteriography was attempted but we were unable to puncture the artery. The vertebral angiography was unintentionally entered. A week later, the left carotid artery was explored in the neck. A thin, cord-like, bloodless structure representing the remnants of the carotid artery was found. It should be pointed out that weak pulsations were felt preoperatively in the neck which in retrospect were caused by tugging of the aorta on the completely thrombosed carotid.

Comment. Certain important conclusions can be drawn from our observations on this patient. The aorta can tug sufficiently on a thrombosed, cord-like carotid artery to produce the effect of pulsations to the examiner. More important, the patient improved even though the vessel was completely thrombosed. After the anastomosis he improved further, suggesting that circulation had been re-established. However, exploration of this vessel 3 months later revealed only a solid cord of tissue, indicating that the surgical procedure had actually increased the degree of thrombosis which now involved the common, external and internal carotid vessels. In spite of this, the patient’s clinical picture was improving, indicating an increasing development of an adequate collateral circulation from the opposite carotid artery. The left middle and anterior cerebral vessels were not visualized in the vertebral angiogram, suggesting that any collateral circulation must take place from the opposite carotid system. Had the re-exploration of the operative site been omitted, one would have felt that the anastomosis had contributed to the patient’s improvement.

Case 2 (U.H. #2793-M). K.F.S., a 52-year-old white male, was admitted to the Neurosurgical Service of John Sealy Hospital in June, 1956, with a history of progressive weakness of the left upper extremity beginning 2 weeks before admission and then improving.

However, on admission the patient had weakness of his left hand and increased left deep tendon reflexes. Carotid arteriography revealed an incomplete thrombosis of the right internal carotid artery (Fig. 1). Several days later a thrombo-endarterec-
tomy was done. Postoperatively the paresis improved for 2 weeks followed by regression.

He was re-admitted on July 24, 1956, with weakness of the left leg and arm which was more pronounced than on the first admission. The following day, a carotid arteriogram showed complete obstruction of the right internal carotid artery at its origin (Fig. 2). Therefore, 2 days later, the right internal carotid artery in the neck was re-explored. At surgery the external carotid artery appeared somewhat larger than normal and was pulsating. The internal carotid artery appeared as a mere piece of scar tissue and did not pulsate. It is dubious as to whether the internal carotid artery could even have been identified if it were not for its relation to the external and common carotid arteries. The internal carotid artery was incised and a small thrombus was removed together with a considerable amount of calcified and degenerated intima. The entire length of the internal carotid artery in the neck was completely obliterated and, therefore, no anastomosis could be done. Postoperatively, this patient did show some improvement in his hemiparesis and even at this writing 7 months later, improvement is still evident.

Comment. In reviewing the second arteriogram, which showed complete occlusion of the internal carotid artery in the neck, filling of the carotid siphon intracranially was seen. The filling of the carotid siphon can be traced to the external carotid artery via the ophthalmic artery, as shown in Fig. 2.
TREATMENT OF THROMBOSIS OF CAROTID ARTERY

Therefore, this patient's improvement was not ascribable to the thrombo-endarterectomy but merely to the establishment of the collateral circulation of the external carotid artery and ophthalmic artery, as is well demonstrated. However, if the second exploration and arteriogram had been omitted with the patient continuing to improve as he has done, one would have felt that the initial thrombo-endarterectomy was beneficial.

Case 3 (U.H. #27168-M). O.A.H., a 46-year-old white male, was admitted on June 13, 1956, with a 2-week progressive loss of the use of his right upper extremity. Neurological examination revealed an increase in the right deep tendon reflexes and weakness of the right upper extremity. A left carotid arteriogram demonstrated complete obstruction of the internal carotid artery. On June 28, 1956, a thrombo-endarterectomy was performed. Postoperatively, the patient improved. No follow-up procedures have been done.

DISCUSSION

The surgical treatment of thrombosis of the carotid artery in the neck is relatively new and the impression that one gains from the literature is generally encouraging. Thrombo-endarterectomy has been most frequently employed. Another procedure used occasionally is an anastomosis of the external carotid into the internal carotid artery above the thrombosed
segment. The replacement of the thrombosed segments by arterial grafts has been advocated, though rarely done. From our perusal of the literature we find only 1 example of arteriography or re-exploration of the thrombosed areas after surgical repair.

Clinical improvement has been reported following thrombo-endarterectomy. Such was observed in our Case 2, although postoperative angiography and re-exploration revealed complete thrombosis. This patient’s improvement was probably caused by an increased circulation to the affected hemisphere through the collateral supply of the external carotid and ophthalmic arteries and not through the site of the thrombo-endarterectomy. This is adequately demonstrated in Fig. 2 showing filling of the carotid siphon from the ophthalmic artery. This increase in collateral circulation was pointed out previously by Vaernet. He described 4 patients with thrombosis of the carotid artery in the neck and collateral circulation through the external, ophthalmic and intracerebral vessels on the affected side. None of these patients was a surgical patient. These examples should certainly caution one against sacrificing the external carotid artery in patients with thrombosis of the internal carotid artery. One might well assume that the improvement of many of the patients subjected to thrombo-endarterectomy was actually caused by an increased collateral circulation via the external carotid artery and not by restoration of circulation through the site of the previous thrombosis. Of course, one is always aware of the fact that the collateral circulation can also come from the opposite carotid artery or the vertebral system.

In Case 1, the patient improved following the anastomosis of the external carotid artery to the internal carotid artery above the thrombosed segment, as has been reported by others. It should be noted that this patient had slowly improved over the years after his initial thrombosis but improved further following our surgical procedure. It, therefore, appeared that the patient had benefited from this anastomosis as evidenced by his improvement in speech and movements of the hand. However, the re-exploration demonstrated very clearly that circulation had not been re-established. Actually, the thrombosis was more extensive, involving the common and external carotid arteries; and obviously, the patient’s improvement must have occurred from collateral circulation either from the opposite carotid artery or basilar system. However, in this instance it was probably not from the basilar artery, as evidenced by the vertebral angiogram, in which there was no filling of the anterior or middle cerebral arteries.

We wish to suggest that the previously reported improvements in patients with carotid artery thrombosis in the neck following a thrombo-endarterectomy or arterial shunt are the result of various collateral systems coming into play and are probably unrelated to the operation. However, this does not mean that further surgical attempts should be denied but that the procedure itself must be perfected and it must also be proven by post-operative angiograms or exploration that this segment is now functioning.
SUMMARY

Three patients are presented with thrombosis of the cervical portion of the internal carotid artery treated by thrombo-endarterectomy or anastomosis of the external carotid artery to the internal carotid artery above the thrombosis. All patients improved postoperatively. However, postoperative angiograms and surgical exploration revealed further thrombosis rather than re-establishment of circulation.

We wish to emphasize caution in the interpretation of favorable results.

REFERENCES