LIGATION OF THE INTERNAL CAROTID ARTERY IN THE NECK

PREVENTION OF CERTAIN COMPLICATIONS

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The sudden interruption of normal blood flow through the internal carotid arteries extracranially is recognized as a hazardous procedure in that it may result in temporary or permanent disability. The fact that many ingenious methods of ligation of the internal carotid artery have been described indicates that occlusion with a single ligature is not safe. In my experience there is no safe method of ligation. It should be executed only when an absolute emergency arises in an attempt to save life after every means known today have been utilized to determine the adequacy of the collateral circulation of the circle of Willis to carry sufficient blood supply to the hemisphere in which the direct flow will be greatly diminished by the ligation of an internal carotid artery.

Unfortunately, the circle of Willis in many instances is malformed, especially in the region of the posterior communicating arteries and, to a lesser degree, of the anterior communicating arteries. In these patients, ligation of an internal carotid artery is almost certain to be attended with a high morbidity as well as mortality, regardless of the method of ligation or occlusion.

The competency of the collateral circulation can usually be predicted with reasonable accuracy by temporary interruption of the blood flow through the internal carotid artery with digital compression. False impressions may be gathered from digital compression of an internal carotid artery. A patient with normal collateral circulation will tolerate complete occlusion by digital compression indefinitely; usually 10 minutes suffices to determine whether or not a patient can tolerate occlusion permanently. In many patients, untoward symptoms, such as dizziness, slowing of the pulse, numbness or weakness of the contralateral side or syncope, may be initiated within a few seconds or minutes after digital compression has been instituted. It is important to determine whether these symptoms are the result of ischemia from a faulty collateral circulation or of vasospasm produced by an irritable carotid sinus. The differential diagnosis can usually be determined by occluding the internal carotid artery well above or well below the carotid sinus. If similar subjective symptoms are produced by pressure well away from the carotid sinus, one must assume that the symptoms are the result of inadequacy of the collateral circulation. Another relatively satisfactory method is to interrupt the carotid sinus temporarily with local infiltration of procaine. It is difficult at times to be certain that the carotid sinus has been adequately anesthetized. If no untoward subjective symp-
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toms occur from the digital compression following infiltration of the carotid sinus with a local anesthetic agent, one is justified in assuming that an irritable carotid sinus was responsible for producing the symptoms, and not a faulty collateral circulation.

The indications for ligation of the internal carotid artery in the neck are becoming more frequent since intracranial saccular aneurysms are being visualized before death by the use of arteriograms.\textsuperscript{3,4,5,6,7} Ligation of the internal carotid artery may be necessary in an acute emergency arising from gunshot wounds, lacerations, or erosion of the wall of an internal carotid artery by a malignant lesion or a knife wound. In these patients immediate ligation is necessary to save life, repair of the rupture being rarely possible.

In the elective ligation such as deemed necessary for intracranial lesions, the method of occlusion is highly important. I fully realize that any method utilized in a large number of patients may seem perfectly safe. However, in my previous experiences\textsuperscript{1,2} with partial occlusion or occlusion in stages, satisfactory results were obtained in the first 40 patients, then 3 tragic delayed hemiplegias followed. Every effort should be made to prevent temporary or partial complete disability from ligation of the internal carotid artery if a patient has adequate collateral circulation which has been demonstrated to be true for a period of 36 to 48 hours, and then the patient be subjected to a sudden catastrophe due to thrombosis or embolus. It is important, therefore, when the collateral circulation has been demonstrated to be satisfactory, that every precaution is utilized to prevent these delayed tragedies. The cause of thrombosis in many instances is injury of the intima of the artery at the site of ligation. I believe that ligation of the internal carotid artery is less dangerous than ligation of the common carotid artery. The reason for this impression is that the caliber of the common carotid artery is usually $1\frac{1}{2}$ to 2 times that of the internal carotid artery. I realize that theoretically the danger of ligation of the common carotid artery should be materially less since interruption of the internal carotid artery diminishes the blood flow into the ipsilateral hemisphere much more completely than does ligation of the common carotid artery (Fig. 1). With the latter the blood flow is still possible by retrograde circulation through the external carotid artery into the internal carotid artery (Fig. 2), whereas with ligation of the internal carotid artery all blood that supplies the hemisphere is interrupted from the neck, with the possible exception of the slight collateral circulation of the external carotid artery through the ophthalmic artery.

Ligation of the internal carotid artery is less dangerous than ligation of the common carotid artery because first, the caliber of the common carotid artery is greater than that of the internal carotid artery, and second, atheromatous plaques in the common carotid artery in the immediate vicinity of the carotid bulb are much more common than in the internal carotid artery. A ligature placed over an atheromatous plaque may well cause a fracture of the plaque, resulting in injury to the intima, thus developing an excellent precursor to ascending thrombosis or embolus. That