MANAGEMENT OF RUPTURED INTRACRANIAL ANEURYSM

Thesis

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List of Common Abreviations

ACA	Anterior cerebral artery
Acha	Anterior choroidal artery
ACoA	Anterior communicating artery
AICA	Anterior inferior cerbellar artery
BA	Basilar artery
CCA	Common carotid artery
CS	Cavernous sinus
ECA	External carotid artery
GA	Giant aneurysms
ICA	Internal carotid artery
IOR	Intraoperative rupture
MCA	Middle cerebral artery
PCA	Posterior cerebral artery
PCoA	Posterior communicating artery
PICA	Posteriaor inferior cerbellar artery
SAH	subarachnoid hemorrhage
VA	Vertebral artery
VBA	Vertebrobasilar artery

CONTENTS

Page

Introduction &

Aim of Work

Approaches to Aneurysms

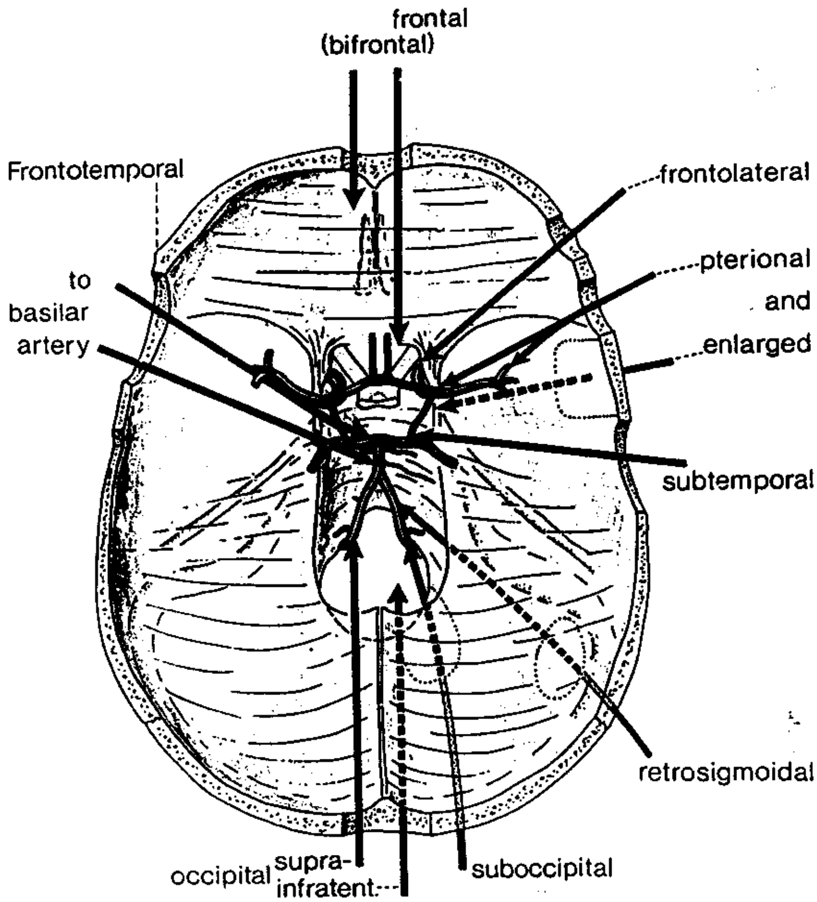


Fig (1)

INTRODUCTION AND AIM OF WORK

The most common presentation of cerebral aneurysm is that of subarachnoid hemorrhage (Yasargil, 1984).

Ruptured intracranial aneurysms are a cause of significant mortality and morbidity (Sengupta et al., 1975).

In the past two decades, significant strides are made in surgical techniques (operating microscope, bipolar coagulation, clips, ...) as well as advances in anesthesia and reanimation, together resulted in parallel remarkable improvement in surgical outcome.

The timing of aneurysm surgery is one of the most important factors in determining the surgical outcome.

The protocol of the modulated timing of aneurysm surgery had evolved in the Department of Neurosurgery in the Neurosurgical Center of Lyon since 1985 after the results of the first series of 328 patients managed according to the protocol of deferred surgery over 12 years period (1972-1984) where the results were much more satisfactory in young (below 50 years) and alert patients (grade I and II). The second series of 140 patients operated upon according to the protocol of modulated surgery depending on the two main parameters: the clinical grade before surgery and the patient's age, as follows: (1) Young (below 50 years) and alert patients underwent routine early surgery. (2) Patients above 50 years with disturbed level of consciousness underwent routine late surgery. (3) In intermediate cases, i.e. old and alert patients, or young patients with disturbed consciousness level, the timing of surgery is tailored to each case according to the two main parameters; preferably early surgery in young patients and late surgery in old patients.

When comparing the results of the first and second series, we noted a marked improvement of the satisfactory outcome and reduction of death rate in the second series, this encouraged us to continue in the same direction.

Aim of Work

This series comprises 120 patients operated on as well according the protocol of the modulated surgery as the last series to confirm the efficacy of this protocol. So the results of this series will be compared with those of the previous series taking as a standard the results of the cooperative study of timing of aneurysm surgery published on 1990. Results will be evaluated in terms of the immediate surgical results as well as long-term results to evaluate the impact of aneurysmal subarachnoid hemorrhage on cognitive and psychological functions which may prevent resumption of previous patient's activities.

Review of Literature

SURGICAL ANATOMY OF CEREBRAL VESSELS

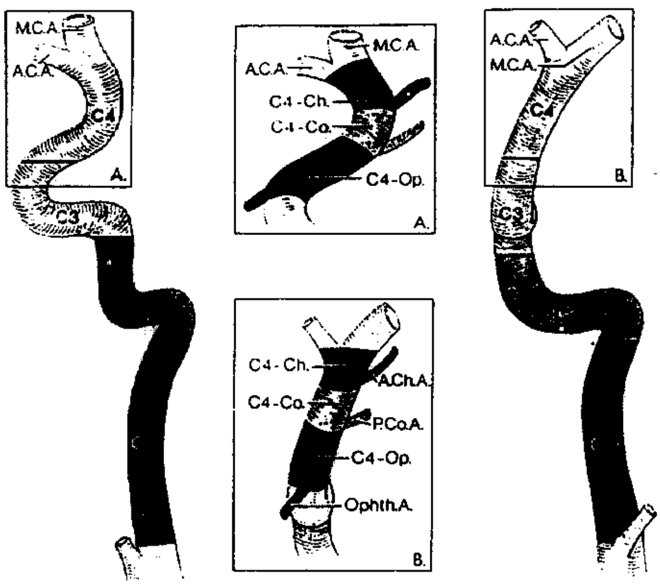
Supraclinoid Carotid Artery

The supraclinoid (C4) portion of the ICA is one of the most frequent sites of intracranial aneurysms (Dandy, 1969 and Gibo et al., 1981).

This portion of the ICA is divided into the ophthalmic, communicating, and choroidal segments as illustrated in Fig. (2).

Aneurysms of the C4 portion of the ICA arise at four sites; the upper surface at the origin of the ophthalmic artery, the posterior wall at the origin of the PCoA, the posterior wall at the origin the AchA, and at the apex of the bifurcation (Rhoton, et al.,1979).

Several facts must be stressed concerning the perforating branches and aneurysms of the ICA. Firstly, the perforators of the ICA are in close relationship to the mouth, neck, sac and fundus of ICA aneurysms. Secondly, their orifices can be incorporated into the mouth of an aneurysm, and their extra cerebral segments may be stretched around or incorporated into the neck, fundus, and sack of an aneurysm.

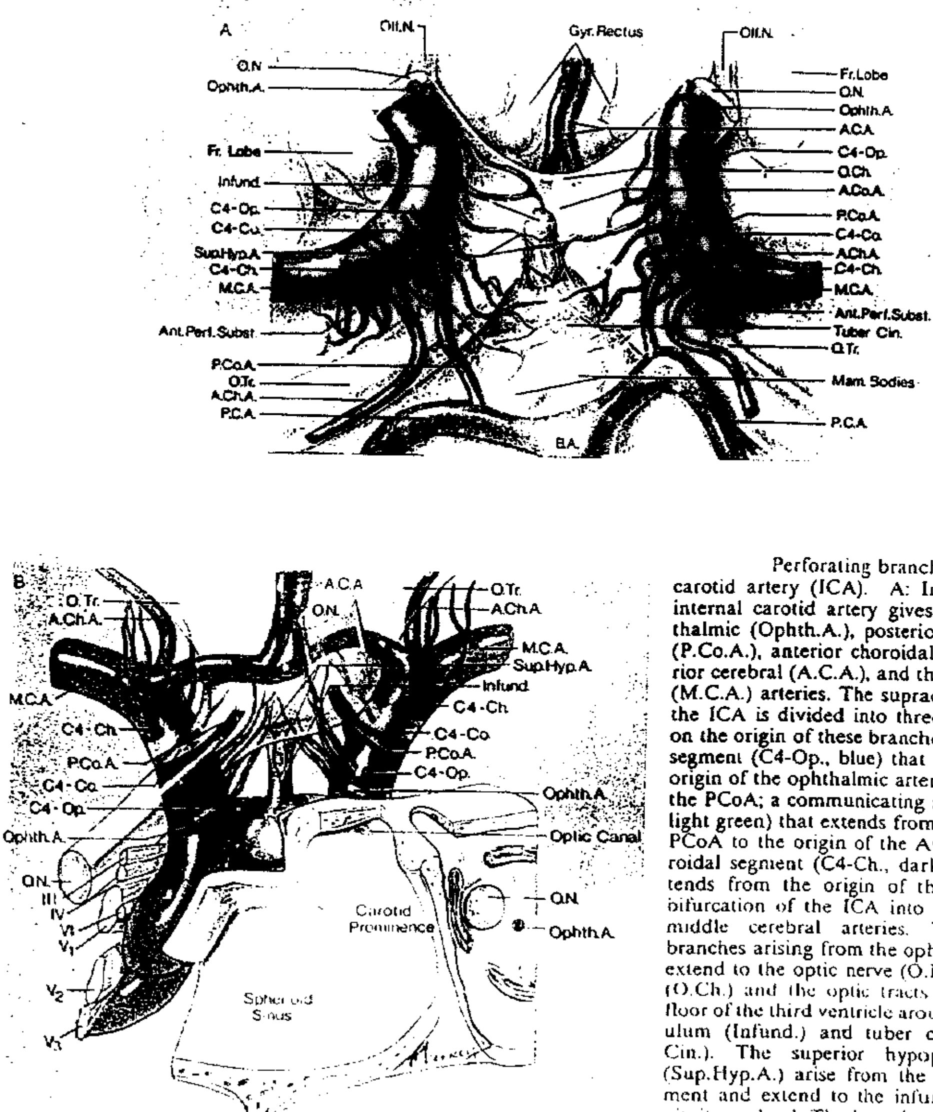


Lateral *(left)* and anterior views *(right)* of the left internal carotid artery (ICA) and A and B segments of the supraclinoid (C_4) portion. A. Lateral view of the C_4 portion. B: Anterior view of the C_4 portion. The ICA is divided into four parts. These parts, from proximal to distal, are the C_1 through the C_4 portions. The cervical portion (C_1, red) extends from the origin of the ICA to the external orifice of the carotid canal in the petrous temporal bone. The petrous portion (C_2, orange) extends from the external orifice of the carotid canal to where the artery exits the carotid canal to enter the cavernous sinus. The cavernous portion (C_3, yellow) begins where the artery enters the cavernous sinus and terminates where it emerges from the dura mater on the medial side of the anterior clinoid process to enter the intracranial cavity. The intracranial (supraclinoid) portion (C_4, beige) begins where the artery enters the cranial cavity medial to the anterior clinoid process and terminates below the anterior perforated substance where the artery bifurcates into the anterior and middle cerebral arteries. The ICA gives rise to the ophthalmic (Ophth.A.), posterior communicating (P.Co.A.), anterior choroidal (A.Ch.A.), anterior cerebral (A.C.A.), and the middle cerebral (M.C.A.) arteries. The supraclinoid portion of the ICA is divided into three segments based on the origin of these branches: the ophthalmic segment (C4-Op., dark blue) extends from the origin of the ophthalmic artery to the origin of the posterior communicating artery; the communicating segment (C4-Co., light green) extends from the origin of the posterior communicating artery to the origin of the anterior choroidal artery; and the choroidal segment (C4-Ch., dark green) extends from the origin of the anterior choroidal artery to the bifurcation of the internal carotid artery into the anterior and middle cerebral arteries.

Fig(2)

Thirdly, the ICA perforators supply important regions of the brain, such as the genu of internal capsule, globus pallidus, and thalamus. Fourthly, anastomoses are absent among perforating branches of the ICA. Taking all this into account, it is clear that neurosurgeons must take an effort to spare the ICA perforators during surgery (Marinkovic, et al, 1990).

Carotid-ophthalmic aneurysms usually have their neck on the superior wall of the C4 portion just distal to the origin of the ophthalmic artery. They arise above the roof of the cavernous sinus, where the superiorly directed C3 segment turns posteriorly to become the C4 segment. At this turn the maximum hemodynamic thrust is against the superior wall of the carotid artery just distal to the ophthalmic artery, and aneurysm points upward against the optic nerve. Exposure of the neck of this aneurysm may be facilitated by removal of the anterior clinoid process, by incision of the falciform process of the dura mater, and possibly by unroofing the optic foramen to allow some mobilization of the optic nerve. The perforating branches of the ophthalmic segment arise from the medial and posterior side of the C4 portion. These aneurysms typically point upward, away from the perforating branches. The perforating arteries and the hypophyseal vascular supply may be compromised if the aneurysm expands medially. Diabetes insipidus



Perforating branches of the internal carotid artery (ICA). A: Inferior view. The internal carotid artery gives rise to the ophthalmic (Ophth.A.), posterior communicating (P.Co.A.), anterior choroidal (A.Ch.A.), anterior cerebral (A.C.A.), and the middle cerebral (M.C.A.) arteries. The supraclinoid portion of the ICA is divided into three segments based on the origin of these branches: an ophthalmic segment (C4-Op., blue) that extends from the origin of the ophthalmic artery to the origin of the PCoA; a communicating segment (C4-Co., light green) that extends from the origin of the PCoA to the origin of the AChA; and a choroidal segment (C4-Ch., dark green) that extends from the origin of the AChA to the bifurcation of the ICA into the anterior and middle cerebral arteries. The perforating branches arising from the ophthalmic segment extend to the optic nerve (O.N.), optic chiasm (O.Ch.) and the optic tracts (O.Tr.) and the floor of the third ventricle around the infundibulum (Infund.) and tuber cinereum (Tuber Cin.). The superior hypophyseal arteries (Sup.Hyp.A.) arise from the ophthalmic segment and extend to the infundibulum of the pituitary gland. The branches arising from the communicating segment reach the optic tracts.

Fig(3A,B)

and amenorrhea have been reported following occlusion of these branches (Yasargil et al., 1977).

The most common aneurysm site on the C4 portion is on the posterior wall of the communicating segment immediately above the level of origin of the PCoA. The initial part of the C4 portion is directed posterolaterally, but distally it curves gently forward to complete the upper half of the S-shaped curve comprising the carotid siphon. The carotid posterior communicating aneurysm arise from the posterior wall of the communicating segment near the apex of the curve forming the upper one half of the siphon. The PCoA is found on the inferomedial side of the aneurysms, and the AchA is superior or superolateral to it. These aneurysms expand posteriorly and compress the oculomotor nerve near the point where it enters the dura. Fortunately, Fewer perforating branches arise from the communicating segment than from the ophthalmic or choroidal segments. As the aneurysm enlarges, it may stretch the perforating branches arising from the PCoA, AchA, and ICA around its neck and fundus.occlusion of these perforating branches may cause sequelae similar to those ascribed to vasospasm (Gibo et al., 1981) (Fig. 3 A, B & C).

Aneurysms of the AchA arise from the C4 portion at the level of, or just distal to the AchA between the AchA and the bifurcation. They point posteriorly or posterolaterally. Aneurysms arising below the