Analysis of Clip-induced Ischemic Complication of Anterior Choroidal Artery Aneurysms

Objective: The surgical approach for anterior choroidal artery (ACHA) aneurysm is typically similar to those used for other supraclinoid internal carotid artery (ICA) lesions. However, the surgical clipping of this aneurysm is complicated and as a result, can result in postoperative ischemic complications. The purpose of this study was to clarify the risk of clip-induced ischemic complication in ACHA aneurysm and to get the benefits for helping decision making.

Methods: We retrospectively investigated 53 cases (4.0%) of ACHA aneurysm treated surgically. We divided the ACHA aneurysm to 3 subtype according to the origin of aneurysmal neck. A type originating from the ACHA itself, J type from junction of ACHoA and ICA, and I type from the ICA itself. We evaluated brain CT about 1 week post-operative day to confirm the low density in ACHA territory.

Results: Ruptured aneurysm was 26 cases and unruptured aneurysm 27 cases. The aneurysmal subtype of A, J, and I was 13, 17, and 23 cases. Of the 53 cases who performed surgical neck clipping, twelve (22.6%) had postoperative ACHA distribution infarcts. Increased infarct after neck clipping had statistical significance in non-I subtype (p=0.005).

Conclusion: ACHA aneurysm surgery carries a significant risk of postoperative stroke. Don’t always stick to clipping only, especially in non-I type of incidental small aneurysm, which has high risk of post-clip ischemic complications.

KEY WORDS: Anterior choroidal artery infarction - Clip - Intracranial aneurysm.

INTRODUCTION

Anterior choroidal artery (ACHA) aneurysms account for 2 to 5% of all intracranial aneurysms. The surgical approach and methods for ACHA aneurysms are typically similar to those used for other supraclinoid internal carotid artery (ICA) lesions. However, because of the parenchymal area supplied by the ACHA, the surgical clipping of this aneurysm is complicated and as a result, can result in postoperative ischemic complications in 5 to 50% of cases. Occlusion of the ACHA sometimes causes significant hemiparesis, hemianesthesia, or hemianopsia, which is referred to as ACHA syndrome. ACHA syndrome occurs frequently and is one of the most serious complications of the surgery for ACHA aneurysms. The problem with ACHA aneurysms is the increased detection rate of unruptured asymptomatic ones, especially when coincidentally found during an operation. This is more likely to result in debilitating postoperative ischemic complications. To improve our surgical approach to minimize the risk associated with ACHA aneurysms, we reviewed our institutional surgical experience with 53 patients to identify factors contributing to a high risk of postoperative stroke.

MATERIALS AND METHODS

We retrospectively investigated 53 cases of ACHA aneurysm out of 1315 intracranial aneurysms, which were treated surgically by same operator at a single institute between 1984 and 2005. For each patient, we recorded demographic data, clinical presentation, aneurysm size and anatomical type, presence of other arterial aneurysms and presence or absence of ACHA aneurysm rupture. In this retrospective study, ACHA aneurysms were defined as those arising from the supraclinoid ICA in close proximity to the origin of the ACHA, or those arising from the ACHA itself. We characterized the aneurysms as A, J, or I type. A type is the sac formed on the trunk of the ACHA itself (Fig. 1). J type is the sac formed in both the ACHA and ICA.
RESULTS

In cases with a ruptured aneurysm, we identified an infarction in 5 out of 26 cases (19.2%). On the other hand, 7 of 27 unruptured aneurysm cases (25.9%) were associated with infarction. While the incidence of post-clip infarction was higher in unruptured cases compared with ruptured cases, the difference was not statistically significant (p=0.056), as shown in Table 1. The sac size was less than 5 mm in 23 cases and of these, infarction occurred in 7 cases (30.4%). Of the 30 cases with a sac size greater than 5 mm, 5 (16.7%) had infarctions. But, the difference in infarction incidence between large and small sacs was not statistically significant (p=0.235), as shown in Table 2. The frequency of infarct was the highest among the J type aneurysms, followed by A and I types, respectively. Non-I (A and J) types had a greater incidence of post-clip infarct than I type, and this difference was statistically significant (p=0.005), as shown in Table 3. Unruptured small aneurysm less than 5 mm had a higher prevalence of post-clip infarction, but it was not statistically significant. Further more, non-I type (36.7%) aneurysms were more vulnerable to post-clip infarction than I type aneurysms (4.3%).

DISCUSSION

The AChA is a very small, but important branch of the internal carotid artery. The AChA arises mainly from the postcrateral aspect of the internal carotid artery about 5.2 mm distal to the posterior commu-nicating artery and 5.2 to 6.6 mm proximal to the carotid bifurcation. The AChA supplies penetrating branches from its proximal segment to the optic tract and to the medial segment of the globus pallidus. As the artery courses posteriorly, it branches
off to the uncus, piriform cortex, amygdala, and the anterior
hippocampus and dentate gyrus, and it supplies the middle
third of the cerebral peduncle, subthalamus, and the
ventral anterior, ventral lateral, pulvinar, and reticular nuclei
of the thalamus. This artery also gives off penetrating
branches at the level of the lateral geniculate body that
supplies the posterior two thirds of the posterior limb of
the internal capsule together with its retrolenticular segment,
including the origin of the optic and auditory radiation
and the tail of the caudate nucleus. The anterior half of
the lateral geniculate body is also supplied by the AChA,
which terminates in the choroid plexus. There are many
variations and anastomoses associated with the middle
cerebral artery, the posterior communicating artery, and
the posterior cerebral artery, and the most constant branches
include the optic tract, cerebral peduncle, posterior limb
of the internal capsule and choroid plexus.

AChA syndrome was first described in 1925 by Foix et al.,
which incudes hemiplegia, hemianesthesia and hemianopsia.
Yasargil et al. reported a patient who had suffered from AChA syndrome after the clipping of
an ICA-AChA aneurysm, where the AChA was thought to be preserved. Helgason reported a patient with this
syndrome caused by vasospasm after SAH.

The causes of postoperative AChA syndrome are classified
into 'during the operation' and 'post-operation'. Due to
excessive manipulation of vessels during an operation, AChA
syndrome can result when the AChA itself or its branches
or perforators clipped with it form a thrombus. Because
of the many variations in the branches and perforators of
the AChA, cerebral ischemia occurs even when blood
flow had been confirmed after the clipping. Immediate
post-operative AChA syndrome occurred when the AChA
became entangled with the clip; cerebral ischemia occurred
as a latent response after the operation, vasospasm developed
in the AChA and the collateral blood flow reduced after the
operation. In this study, when the aneurysm was less
than 5 mm, unruptured, and non-type I, the incidence of
cerebral ischemia was high after clipping. The cause of this
result was not clearly identified, but several possibilities were
considered. As the size of the aneurysm gets smaller, the
artery is decompressed by the clip and its diameter is reduced.
It was unexpected that cerebral ischemia would be more
common in the case of un-ruptured aneurysms rather than
the case of the ruptured one. This is caused by the higher
incidence of vasospasm in ruptured cases. The opposite
outcome occurred when a small unruptured aneurysm of
AChA was accidentally found during the operation for
another ruptured cerebral aneurysm and many of them
were clipped. In case of non-type I aneurysms, cerebral

ischemia was commonly due to vessel strangulation by the
clip or a decrease of the vascular diameter and the higher
possibility of ligation of the peripheral vascular branches
than in type I. Friedman et al. reported that the cerebral
ischemia after the clipping showed a higher incidence than
in other cases, which was 44%, for type I cases. Also, it was
reported that the small and accidentally found aneurysm
that was located in this area was unlikely to have the clipping.

In cases where cerebral ischemia occurred in the region
of AChA after the operation, the strategy of the treatment
depends on the etiology. If AChA syndrome was identified
immediately after the operation, it might be that the AChA
is interrupted by a clip or the artery is entangled, which
means another clipping by reoperation should be considered
after the confirmation by angiography. In this case, a good
outcome is expected if rapid management is performed,
but it is rare that the symptoms is improved right after
the reoperation. In the case of the latent cerebral ischemia,
vasospasm and reduced lateral blood circulation are suspected,
so it is helpful to maintain hypertension and hypervolemia.

In this study, in cases of non-Type I aneurysms of the
AChA, the incidence of cerebral ischemia was high after the
clipping. The possible causes of this result involve vascular
strangulation or the low incidence of clipping of the AChA
itself and relatively low manipulation. In cases of non-Type
I aneurysms of the AChA, based on the preoperative
angiography or on the manifestations during the operation,
other methods such as wrapping might be helpful for
reducing postoperative ischemic complications.

CONCLUSION

For aneurysms of the AChA, the operation is not difficult
due to easy access, just as for other suprachoroidal aneurysms,
but the risk of the postoperative ischemic complications is
higher for aneurysms of the AChA. Especially for aneurysms
that are not Type I, less than 5 mm and non-ruptured, there
is an increased incidence of cerebral ischemia in the region
of AChA. It is important to perform the operation with care,
confirming the variations of the AChA during the operation.
Further, clipping or other methods such as wrapping are
not recommended due to the anatomical characteristics of
the AChA that can lead to a higher incidence of ischemic
complications.

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