Editorial

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When the brain floods with blood: intraoperative aneurysm rupture

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Aneurysm refers to dilations that occur at weak points along the arterial circulation within the brain. They may vary in size (< 0.5 mm to 25 mm). Aneurysms have three types, that is, saccular, fusiform, and mycotic. In saccular, there is a thin or absent tunica media and an absent or severely fragmented internal elastic lamina. Fusiform (circumferential) or mycotic (infectious) aneurysms are rare in occurrence. In the fusiform type, there is nonsaccular dilatation of the entire vessel wall for some distance. The majority of cerebral aneurysms are silent and may be found incidentally on neuroimaging or upon autopsy. Subarachnoid hemorrhage (SAH) usually occurs with rupture and is associated with a high rate of morbidity and mortality[1].

Intraoperative aneurysm rupture (IOR) is one of the most dreaded complications of intracranial aneurysms. IOR refers to the bleeding that changes the course of a microsurgical procedure, and it does not include minor bleeding that can be easily controlled surgically[2]. 'Brain flooded with blood' is the obvious phraseology to explain the disastrous scene of an intraoperative rupture. Data from the literature suggests that the incidence of IOR in cerebral aneurysms is estimated at 5–50%. In older studies IOR is more common, probably as a result of the lack of surgical experience in the pioneering era of microsurgery. Today's rate of IOR is much lower during endovascular procedures and is considered to be between 2.4 and 2.9%, depending on the published series[3].

The literature says that giant aneurysms, aneurysms of the basilar artery, and aneurysms of the anterior communicating artery all have a higher risk of IOR. However, it's not clear what the relationship is between location and the risk of IOR. According to Batjer and Samson, the intraoperative rupture of an aneurysm can be expected at three moments: the initial phase of surgery, during craniotomy, opening the dura, or retraction of the brain (mortality 75% and incidence of 7%); the second phase, during aneurysm preparation for clipping as a result of blunt or sharp preparation of aneurysm (incidence 48%); and the third phase, during clip placement (incidence 45%)[4].

A study conducted in the United States of America over 2 years (1996–1998) with a follow-up of 5 years included 1010 patients aimed at reporting the predictors of intraprocedural rupture (IOR) during coiling and clipping. According to this study, IOR occurred in 14.6% of the total cases, of which 19% were categorized under the clipped group and 5% in the coiled group. In the clipped group, 31% of patients with IOR had periprocedural death or disability as compared to 18% with no IOR. The coiled group in this study reported that 63% of patients had periprocedural death or disability. This study, also called the Cerebral Aneurysm Rerupture After Treatment (CARAT) study, is one of the largest cohort studies that studied the clinical implications of IOR[5].

The intensity of IOR bleeding can be divided into minor, moderate, and severe. The degree of IOR-related bleeding is directly related to the outcome because severe bleeding increases the likelihood of neurological complications more than minor bleeding does[6]. Despite major advancements in microvascular surgeries and endovascular procedures, rupture of aneurysms is associated with high mortality rates of around one-third and severe disability in nearly one-sixth of the patients[7].

According to several authors, the use of a temporary clip in the dissection of aneurysms dramatically reduces the incidence of IOR. While the experience of the operating neurosurgeon has been shown not to affect the incidence of IOR, it has a positive effect on the ability to find a solution for disastrous bleeding, reduces the time of temporary clipping, reduces surgical mortality, and thus improves the outcome. Anticipating difficulties and continuous skill improvement enhance the effectiveness of surgeons, ultimately leading to better outcomes. IOR is very likely to increase the chance of permanent neurological deficit or death and may be a risk factor for the development of vasospasm and delayed ischemia[8,9].

Among aneurysms at all sites, ACoA aneurysm demonstrates a higher frequency of IOR (30%), followed by posterior communicating artery aneurysm (26%) and middle cerebral artery aneurysm (18%) in descending order. IOR must be better avoided than treated[10].

Risk factors for IOR:

(1) aneurysms located on the anterior communicating artery;
(2) irregular aneurysm shape (bi-lobed or multi-lobed) and the presence of a visible bleb or nipple;
(3) aneurysms larger than 3.5 mm;
(4) parent artery tortuosity;
(5) presence of previous SAH;
(6) intraoperative hypertension may possibly increase the chances of IOR[11];
(7) alcohol consumption and smoking are associated factors that may contribute to IOR[12].

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Dreaded events of IOR can be prevented by meticulous surgical technique, sharp circumferential dissection prior to clip application around the aneurysm, and the use of temporary clips over the proximal artery before attempting clipping of the aneurysm, which may help reduce the IOR. Training in cerebrovascular surgery under an expert surgeon performing these complex procedures is paramount to achieving excellent results with minimal complications[13,14].

Some basic tips can be applied when an aneurysm ruptures intraoperatively: (a) keep yourself calm, (b) tell the anesthetics to reduce the blood pressure, (c) apply tamponade over aneurysm, (d) keep on good suctioning and if necessary add extra suction tube, (e) arrange proximal and distal control with temporary clipping, (f) finally apply permanent clip to aneurysm neck, and (g) rupture site can be covered by small cottonoids.

It is concluded after the above discussion that the most dreaded complication of aneurysm surgery is IOR, which can be avoided by proper preoperative planning, taking into account the radiological size and morphology of the aneurysm. Besides this, extra care should be taken preoperatively, which includes proper training at a center of excellence, using proper magnification and illumination, and fine microneurosurgical techniques.

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