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Delayed intraoperative rupture of clipped aneurysm during the awaking from anaesthesia

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ABSTRACT

Introduction. Intraoperative rupture (IOR) of an aneurysm is a frightful complication that causes significant morbidity and mortality worldwide. IOR can be attributed to various parameters, including hypertension, increased intracranial pressure (ICP), fragility of the vessels, and inadequate anaesthesia. IOR due to insufficient anaesthesia is scarcely reported in the literature. Here, we describe a re-ruptured anterior communicating artery (ACoA) after incomplete clipping of the neck during craniotomy closure due to unintended early wake-up from anaesthesia with a discussion about the management.

Case description. A 38-year-old male suddenly developed a severe headache, a brief loss of consciousness, and vomiting. Computed tomography (CT) scan showed a subarachnoid haemorrhage in the basal cistern. CT angiography showed a bilobed right ACoA aneurysm with a wide neck and Murphy's teat. The patient was considered for surgery. Clipping of the aneurysm neck was done through two curved clips. During craniotomy closure, the patient started coughing and gagging then a huge IOR was encountered. These events can be mainly attributed to unintended inadequate anaesthesia, particularly muscle relaxants. The bleeding ceased after two suction catheters were inserted, temporary clips were applied, and the readjustment of permanent clips. After surgery, the patient showed a left-sided weakness. His postoperative CT scan showed a right distal anterior cerebral artery (ACA) territory infarction. The weakness improved in the follow-up period.

Conclusion. Delayed IOR due to early awaking from anaesthesia should be considered a potential source of complications and bad outcomes in aneurysm surgery.

Keywords
microsurgical clipping, intraoperative rupture, inadequate anaesthesia

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Introduction

Intraoperative rupture (IOR) of aneurysm is a dreadful complication that causes significant morbidity and mortality worldwide [2]. The overall incidences of IOR are 6.7 percent per aneurysm and 7.9 percent per surgery [10]. IOR can be classified according to specific times within the surgery into pre-dissecting, dissecting, clipping, and post-clipping [10]. Regarding its causes, IOR can be attributed to a variety of parameters, including hypertension, increased intracranial pressure (ICP), the fragility of the vessels due to comorbidities, procedural related, and inadequate anesthesia [4,5]. In surgery, re-rupture of the aneurysm intraoperatively due to insufficient anesthesia is scarcely reported. Here, we described a case of a re-ruptured anterior communicating artery (ACoA) aneurysm after incomplete clipping of the aneurysmal neck during craniotomy closure due to unintended early wake-up from anesthesia.

Case description

An otherwise healthy 38-year-old male suddenly developed a severe headache, brief loss of consciousness, and vomiting. The patient presented no weakness and uncontrollable hypertension, and he is a heavy smoker. His initial computed tomography (CT) scan showed subarachnoid hemorrhage (SAH) in the basal cistern. CT angiography exhibiting a bilobed right inferiorly directed ACoA aneurysm (9 mm) with a wide neck and Murphy's teat. The patient was considered for surgery. The endovascular option is usually not applicable in Iraq due to its high cost and absence of proper health insurance.

Following the typical operative steps of the right supra-orbital approach, the aneurysm was identified. The application of a temporary clip was performed on the ipsilateral A1 for proximal control. Clipping of the aneurysm neck was done through two curved clips. However, Severe arachnoid adhesions due to SAH renders the confirmation of complete clipping, which is not feasible. Next, muscle wrapping is applied around the aneurysmal neck to enforce the clipping construct, followed by hemostasis.

During the closure, the patient suddenly moved his head and started coughing (resisting the endotracheal tube). Concretely, a huge IOR has been encountered, and bleeding fills the operative field. These events can be mainly attributed to unintended inadequate anesthesia, particularly muscle relaxants. Here, two suction catheters were used to control the bleeding with the application of temporary clips under a microscope. To be noticed, the permanent clips were moved after the IOR. Eventually, the clips were adjusted to include the whole aneurysmal neck, and the IOR stopped. This takes around seventeen minutes from the moment of rupture. Postoperatively, the patient showed a left-sided weakness grade of 0 on The Medical Research Council of Canada (MRC) scale. His postoperative CT scan showed a right distal anterior cerebral artery (ACA) territory infarction (Figure 1). The weakness improved to grade 4 over the next three weeks. At a 3-month follow-up, the patient was neurologically intact with the imaging showed no aneurysm.

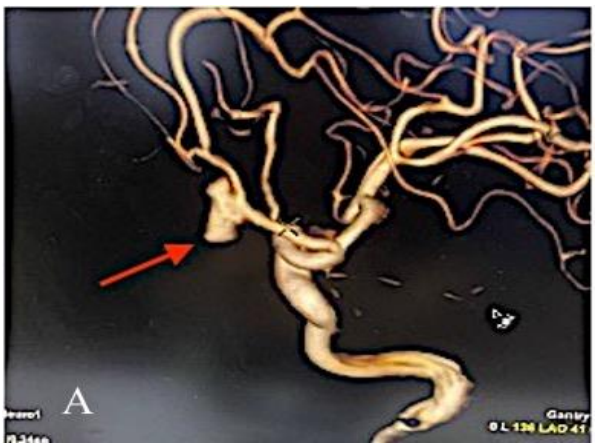

Figure 1. (**A**) (Pre-Operative) 3D constructed imaging of cerebral catheter angiography showing a right bilobed inferiorly directing anterior communicating artery aneurysm (Red arrow) with a superiorly directing Murphy's teat. (**B**) (Post-Operative) CT scan (axial view) showing ipsilateral anterior communicating artery (ACA) distal territory infarction.

Discussion

The incidence of overall IOR has recently varied between 15 and 50 % [7]. Leipzig TJ et al, reported that the ruptured aneurysms rate is significantly higher than the unruptured (10.7 versus 1.2 %, P <0.0001). Among the 970 ruptured aneurysms treated surgically, 104 of the cases have IORs, and its rate in the ruptured aneurysms constitutes 92 % of all IORs [10]. They also reported that IOR in the ruptured aneurysms during clipping occurred in 49 cases (47.1%) while occurred in 42 cases (40.4%) during the dissection [10]. However, pinpointing the exact cause of IOR is quite challenging.

The location of the aneurysm is a major risk factor for IOR. The ACoA and posterior communicating artery aneurysms and the posteroinferior cerebellar artery aneurysm were more likely to rupture intraoperatively [4,10]. However, Sundt et al, discovered no association between aneurysm site and IOR [13]. Aneurysms originating from the ACoA and anterior cerebral artery had a greater incidence of IOR, with a rate of 36.9%, according to Schramm and Cedzich [12]. In contrast, neither Giannotta et al nor Houkin et al found evidence that ACoA aneurysms had greater IOR rates [7,9]. Middle cerebral artery aneurysms were found to have lower IOR rates in various studies [7]. In our report, the site was inferiorly directed ACoA aneurysm.

Other factors predisposing to IOR can be categorized into preprocedural and intraprocedural [4]. Preprocedural rupture of cerebral aneurysms, though uncommon, can result in devastating consequences with a high fatality rate. This phase of IOR is influenced by factors associated with anesthesia. There is a delicate balance Between mean arterial pressure, ICP, and transmural pressure (TMP). Acute changes in hemodynamics during the induction, surgical incision, and skull pin fixation may raise transmural pressure and may predispose IOR [8]. Sudden coughing or gagging at this stage can cause an abrupt increase in blood pressure and ICP, resulting in a premature rupture [15]. On the other hand, intraprocedural-related factors are primarily determined by arterial wall fragility, which can be influenced by various comorbidities such as a history of coronary artery disease, hyperlipidemia, COPD, and race [6]. IOR can be encountered during different phases of surgery, such as in the pre-dissection phase, dural and arachnoid opening, clipping, hematoma evacuation, or during brain retraction [4,6].

On the other hand, brain swelling is a significant factor for IOR during the dissection phase [9]. During the clipping phase, IOR may occur due to 1) increased turgor in the aneurysm's dome due to pressure transmitted from the neck while applying the clip, 2) detachment of an adherent dome as the clip closure slightly moves the aneurysm, 3) tearing of the neck due to clip misapplication, or 4) shearing of the aneurysmal neck from the parent arterial wall [10]. In our case, the IOR occurred during craniotomy closure (post clipping) which is a very rare phenomenon and an equally challenging situation. The main factor that contributed to the IOR during the closure, in this case, is the unintended inadequate anesthesia resulting in the patient awakening during the craniotomy closure, where he experiences recurrent coughing and gagging.

This was attributed to insufficient muscle relaxant dosing or quality that resulted in a sudden increase in the ICP and eventually the IOR. Despite the patient history of heavy smoking and uncontrollable hypertension, these risk factors may lead to early rupture rather than delayed (post clipping) rupture.

The confirmation of complete clipping is usually difficult due to the challenging anatomy of the ACoA complex and thick adhesions from the SAH, which led to constructing the clipping with muscle wrapping. This step is usually sufficient to protect the aneurysm from rupture. However, in our case, the early waking from anesthesia made the clipping construct fails and resulted in IOR.

The management of IOR has surgical and non-surgical aspects. Surgery-wise, the use of temporary clipping aid in accurate aneurysm clipping and reduce the risk of IOR [1,3,14]. Factors that influence the success of temporary clipping may include aneurysm location, duration of application, and age [11]. The non-surgical aspects of IOR management may consist of cerebral protection, temperature regulation (hypothermia), hemodynamic set points adjustment, and neurophysiological monitoring. These treatment options may all have an impact on temporary occlusion results. However, the current evidence on the usage and benefit of each option is debatable [16]. The prevention of IOR will depend on identifying all potential factors and treating them accordingly. Thus, ensuring IOR-related complication

avoidance and improving the overall patient outcome.

The current literature is mixed regarding the outcome of IOR and its long-term neurological outcomes in the form of stroke. Some studies have found that intraoperative rupture has a negative impact on the outcome; however, these findings should be interpreted in light of a variety of parameters, including size, location, treatment (clipping vs. coiling), age, management strategies, and the surgeon expertise. The outcome of IOR with its re-rupture in our case is an ischemic stroke in the distal circulation territory of ipsilateral (right) ACA due to prolong application of the temporary clip after re-rupture. However, our patient is fortunate enough that the deficit is eventually resolved with rehabilitation.

In summary, patients with delayed IOR during the post-clipping phase can be managed with the typical steps of treating Intraoperative bleeding with a relatively higher risk of complications. Prevention of the delayed IOR can be achieved with adequate anesthesia toward the end of surgery. When construction of the clipping is not straightforward, it may become vulnerable to external circumstances.

Conclusions

Intraoperative rupture during aneurysm surgery closure due to early wakeup from anesthesia should be highlighted as a potential source of complications and poor outcomes. Sufficient anesthesia is necessary to prevent delayed intraoperative rupture.

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