Clinical Case: Complications after Endovascular Treatment of Intracranial Aneurysm in a Patient after Subarachnoid Hemorrhage

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Abstract: Intracranial aneurysm is one of the most common neurovascular complications. During the recent years the accepted treatment of enraptured cranial aneurysm is noninvasive endovascular coiling. This technique is modern but it is not without complications which can be serious and life-threatening. A clinical case of a patient admitted to the ICU of Military Medical Academy - Sofia with sub arachnoid hemorrhage is described. After a positive clinical course, the check-up magnetic resonance showed intracranial aneurism of the right carotid artery. The patient underwent angiographic endovascular treatment. Vasospasm of the middle and right brain artery and thrombosis were detected during the procedure. Attempt of thromboaspiration was made without success. This article reviews published data on broad-spectrum researches concerning complications of endovascular coiling of intracranial aneurysms and the ways to prevent and reduce them.

Keywords: Intracranial Aneurysm, Endovascular Coiling, Subarachnoid Hemorrhage.

INTRODUCTION

Over the last few decades, the method of choice for the treatment of unruptured cerebral aneurysm has been the prevention of the rupture. Treatment of already ruptured aneurysm is focused mainly on the prevention of second bleeding. Endovascular coiling is the base of intracranial aneurysm management. This method is well known to lower morbidity and mortality but is definitely associated with certain complications (1).

"…And it will fall out as in a complication of diseases, that by applying a remedy to one sore, you will provoke another; and that which removes the one ill symptom produces others." Thomas More

CLINICAL CASE

47 year-old patient was admitted to the emergency department of the Military Medical Academy (MMA) with very strong headache and history of bad control of arterial hypertension. Computer tomography of the brain was performed and subarachnoid hemorrhage (SAH) with intracerebral hyperdensity zone-hematoma was found. (figure 1).

Clinical discussion with neurosurgeons was performed and the final decision was to leave the patient on conservative treatment. Patient was conscious, adequate and communicative. He was admitted to the ICU of MMA for active monitoring and treatment. A second CT scan of the brain was carried out two days later: without significant dynamics of the SAH volume and collection into the interpedicular system and along the medial cerebral arteries, in the prepontine system and occipital corns of the lateral ventricles. Reduced volume of the collection in the perimesencephalon was seen in the left with no brain edema. Selective cerebral angiography was also made and there were no data for cerebral aneurysm or arterio-venous malformation.

During the next days the patient became somnolent to soporific. The pupils were differing in diameter and with slower light reaction. Kernig's sign and neck rigidity were positive at neurological examination. There was no significant reduction in the movements. Arterial pressure tended to be higher and antihypertension drugs were applied. Therapy included: antibiotics, anti-edematous, anti-convulsive medicaments. The patient's temperature was subfebrile to normal. Breathing was spontaneous, supplemental oxygen was given via facial mask. The arterial blood gas values were normal.

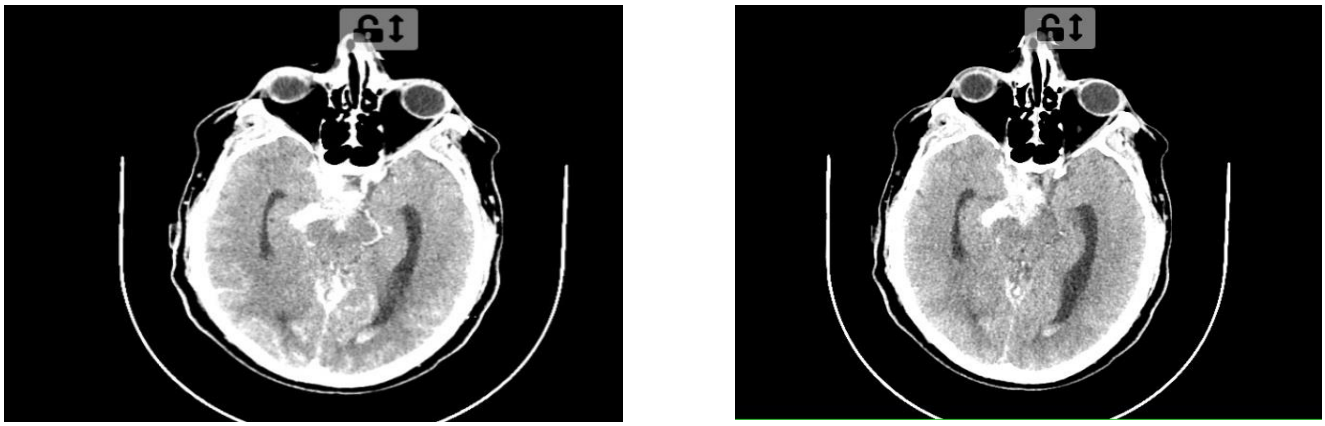

Figure 1: CT scan of the patient.

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Light left sided hemi paresis was observed in the next days which was more obvious for the hand. Nimotop was added to the therapy. The patient was relatively stable, somnolent, answered to voice commands, with persisting neck rigidity and stable hemodynamics. Breathing was spontaneous. Enteral feeding was restored with good tolerance. There was an episode of polyuria which passed away with the appropriate treatment.

On the 8-th day of ICU stay the patient was in stable state with persisting symptoms: neck rigidity, left hemiparesis, somnolence. His vital signs being good the patient did not have intensive care problems. He was transferred from ICU to the neurological ward to continue his treatment.

The same day magnetic resonance of the head with angiography was performed and an aneurysm of the internal right carotid artery was found together with the vasospasm of the same artery in the intracavernous part. Zones of lacunar ischemia with different timing was also seen on the magnetic resonance.

Multidisciplinary discussion was initiated including anesthesiologist, neurosurgeon and angiography specialist. The decision was to perform endovascular surgical treatment of the detected aneurysm.

The patient was put under general anesthesia with intubation and endovascular treatment was started. After catheterization and contrast injection in the right internal carotid artery strong vasospasm was found in the right middle cerebral artery, right anterior cerebral artery and supraclinoid segment of the internal carotid artery. This was followed by thrombosis of the middle and anterior right cerebral artery with a negative shadow in the lumen of the right carotid artery. In this situation embolization of the aneurysm was not possible.

Medical council decided not to make intraarterial thrombolysis (concerning the recent SAH). A trial for mechanical aspiration of the thrombus in the internal carotid artery was performed. Unfortunately, it was not successful because of the strong vasospasm of the carotid artery in the extracranial part. Treatment with surgically inserted clips was not appropriate because of the proximal and distal vasospasm and recent SAH.

The patient was transferred again to the ICU. His medical condition was critical and unstable. He rested under mechanical ventilation, arterial pressure was unstable and needed support with norepinephrine and antiarrhythmic.

The control CT scan of the next day showed diffuse brain edema, large ischemic zone of the right brain hemisphere and dislocation of the middle structures. Angiographic data for thrombosis of the right carotid artery and vasospasm of the left medial cerebral artery.

The patient was in terminal state, GCS – 3 points. The pupils –dilated and unreactive. From the rest brain death criteria: blink and corneal reflexes were missing, also oculovestibular, oculocephalic, cough and pharyngeal reflexes. The apneic test was with single breathings-4/min. Persistent polyuria. After few days the patient died.

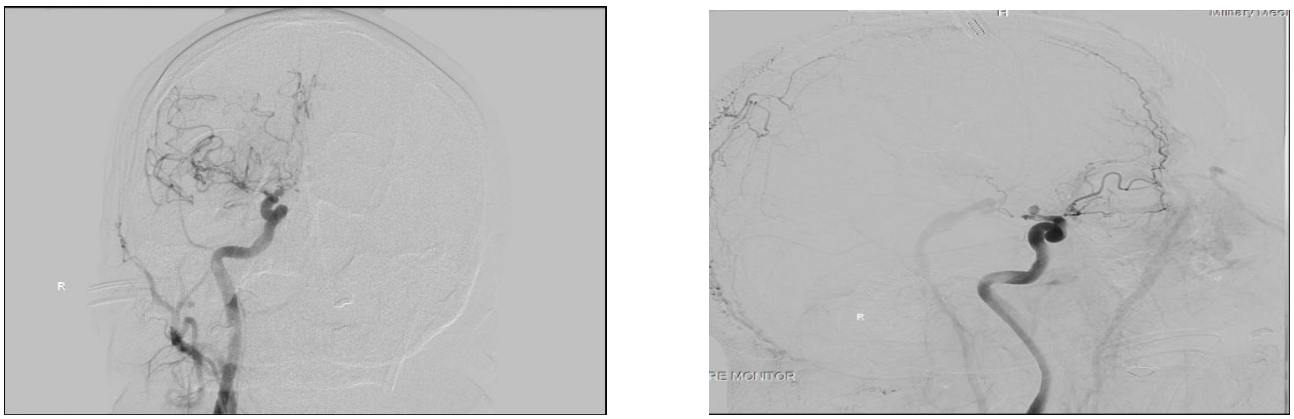

Figure 2(a): Angiography and magnetic resonance images during endovascular coiling attempt:

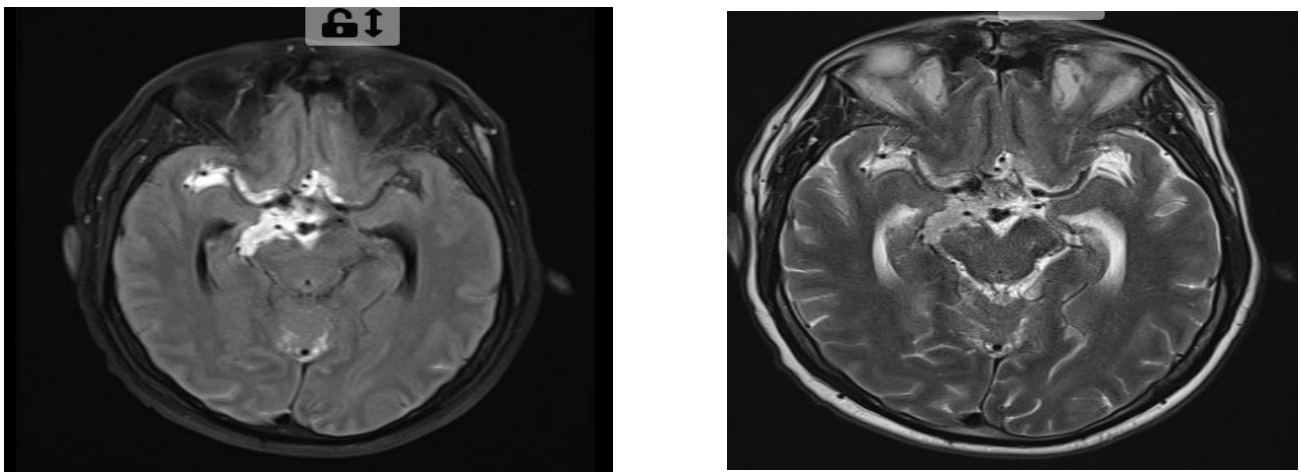

Figure 2(b): Angiography and magnetic resonance images during endoscopic procedure

LITERATURE DATA AND DISCUSSION

Endovascular coiling of cerebral aneurysms is a standard treatment all over the world. The method is non-invasive but more and more it is performed, the number of complications becomes greater. These complications should be well known in order to search consciously their prevention.

Complications could be categorized as: complications of the intracranial arteries, complications of the extracranial arteries, complications during the catheter insertion and complications on the puncture site. Most common complications during cerebral artery coiling are the rupture of aneurysm and vascular thrombosis.

Rupture during Coiling

The risk of this complication is described 1-5% in the literature (2, 3). It is not very common but the mortality rate is high: 40-50% (2, 3). The clinical manifestation is from light leakage of the contrast into the subarachnoid space to massive bleeding and intracranial hypertension.

The mechanism of this complication is associated with an incident during coil positioning, micro catheter or guide wire insertion. The percentage associated with good clinical issue is accordingly: 90%, 57%, 100% in the broad spectrum analyses (7).

In some cases, the risk of rupture is connected to the insertion of the coil with bigger size then needed (8). The risk of rupture is greater with the smaller aneurysms due to difficult movement of the micro catheter and bigger stress inside the aneurysm sac (9, 10).

Sometimes the risk of aneurismal rupture is greater when the size of the coil is bigger than needed. (8). With the smaller aneurysms the rupture risk is bigger as well a cause to difficult microcatheter movement and greater stress inside the aneurismal sac. (9, 10)

The rupture of anterior communicant artery is more common because of the acute angle between the internal carotid artery and anterior cerebral artery.

Coil embolization could be done under local or general anesthesia. In a retrospective study with 186 patients (15) with SAH the risk of rupture is much more significant for local anesthesia compared to general anesthesia. The possible explanation is that the patient's movements under local anesthesia can displace the micro instruments and spoil the procedure.

Recognition and Treatment

Mortality rate and long-lasting neurological complications could be reduced when the appropriate measures are taken as soon as possible (5). First radiological sign of eventual perforation is a breach of the micro instruments out of the aneurismal sac. The perforation is followed by rise of the arterial pressure and pulse rate. Some of these signs can appear when the cerebral artery endothelium is irritated from the catheter or during superficial anesthesia.

After eventual perforation the role of the anesthesiologists is important to keep the arterial pressure within the normal range until the hemorrhage is under control. When there is a contrast leakage from the aneurysm the anticoagulant treatment should be stopped. Protamine sulfate in a dose of 5-10 mg for every 100 UI heparin should be applied. It is important to have in mind that protamine sulfate is not without side effects. More common of them are cardiovascular – hypotension, also anaphylaxis, pulmonary hypertension. Good alternative of protamine sulfate are antiplatelet drugs like aspirin and clopidogrel according to some studies (16, 17).

The role of immediate external ventricular drainage or craniotomy could be essential in emergency SAH treatment (19).

Overall, the thromboembolic events are more common and lead to increased mortality the artificial rupture of the vessel is more stressful (20). Не се разбира смисълът.

Thromboembolic Complications during Coiling

Thromboembolic events are recognized as full or partial occlusion of the artery that can appear at the place of the aneurism, in a distal or every other part of the vessel undergoing endovascular treatment. Thromboembolic events lead to greater mortality compared to artificial perforation of the vessel. On the other part the recognition of these complication is not easy and only angiography or magnetic resonance could show some microemboli.

The frequency of thromboembolic events within 24h after coiling is reported 2-15% in the literature. (21).

Mechanism

Thromboembolic complications appear as a result of thrombus formation within the catheter. That could happen after coil positioning, vasospasm or coil malpositioning. Prolapsed coil loops serve as a site for platelet aggregation, leading to local thrombosis or distal thromboembolism (26).

Regardless of the applied technique, the ruptured aneurisms are riskier for thrombus formation compared to unruptured aneurysms (24). Larger aneurysms often have residual flow within the coil mass so the clot volume in larger aneurysms could lead to increased risk of propagation and distal embolization (26).

In the literature (30, 31) is described that coiling with previous stenting is more risky for thrombosis. The treatment with anticoagulants and antiaggregants can significantly reduce the risk of thrombosis.

Hypercoagulability and vasospasms are predisposing factors for thrombus formation (33).

Heparin-induced thrombocytopenia (HIT) and antiphospholipid-antibody syndrome (APS) are risky for thromboembolic events (35, 36). HIT could be indicated during the procedure when there is lack of answer after heparin application or when unexpected thromboembolic events appear together with reduced thrombin time. APS leads to repeated venous and arterial thromboembolic complications. In these cases, most valuable is the patient's history and conscious searching of these pathologies.

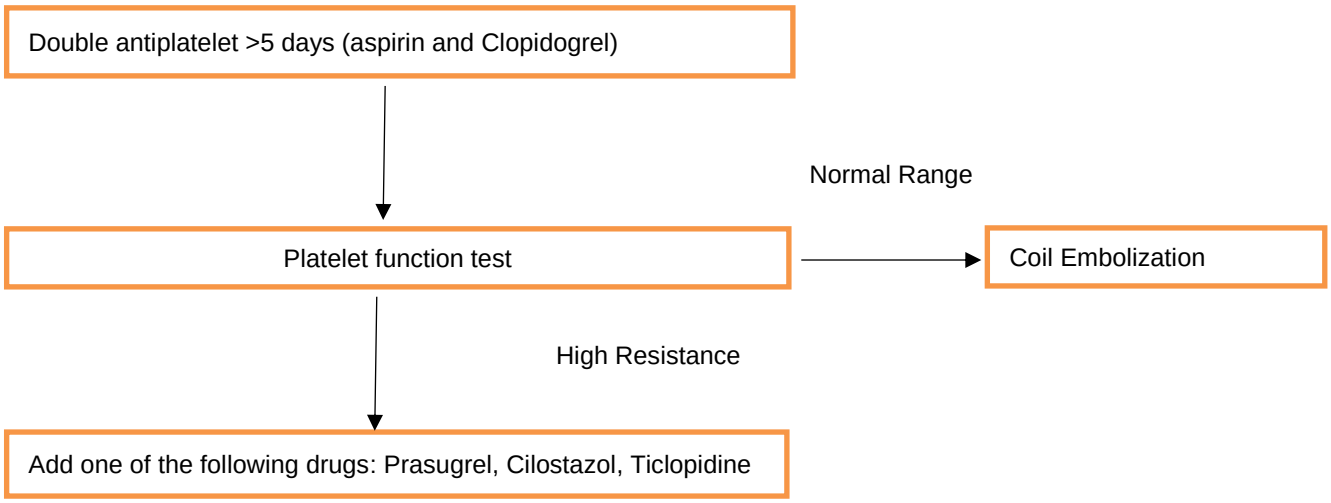

Figure 3: Modified preventive antiplatelet preparation for coiling of unruptured aneurysm according to platelet functional test.

Recognition and Treatment

The first angiographic sign of thrombus formation is the abnormal blood flow near the coil or embolus in the distal part. Thrombus formation is a dynamic process and the thrombus can be with varying in size and shape in the early stage. When thrombus is suspected the radiographic images are helpful. Neurophysiological monitoring of the cerebral function like electroencephalography, auditory and somatosensory evoked potentials is recommended in this case. This monitoring gives helpful information about regional blood perfusion and eventual thrombus formation during general anesthesia (16).

Recommended treatment of thrombosis in the literature (35, 36) is the maintenance of hypervolemia and hemodilution together with intravenous heparin in higher doses, peri- and postoperative antiplatelet treatment, intra-arterial thrombolysis with urokinase or tissue plasminogen activator or intravenous application of glycoprotein IIb/IIIa.

The study of Edwards et al (50) recommends 100-300 mg/daily aspirin and 75 mg Clopidogrel 5-7 days before coil positioning. An alternative is 300-500 mg aspirin and 300 mg Clopidogrel before the procedure.

Oral antiplatelet therapy before coiling of unruptured aneurysm as a prevention is very common. Edwards et al. describe that preventive antiplatelet therapy in patients with ruptured aneurysm and high risk for thromboembolic events could be helpful without significant side effects like intracranial or systemic hemorrhage.

Many functional tests for platelet reactivity are available and could be done for patients under antiplatelet treatment. Such tests can effectively guide antiplatelet therapy.

Recognition of the variability of platelet aggregation and the ability to measure it are very important factors in the reduction of thromboembolism during endovascular aneurismal treatment.

CONCLUSION

Endovascular coiling becomes more and more common in clinical practice. Physicians are more experienced but complications could always appear.

The treatment of rupture includes: identification of the hemorrhage, heparin neutralization, fast and thorough occlusion of the aneurysm, control of arterial pressure, intracranial pressure and ventricular drainage.

The p of thrombus formation is the best way to avoid thromboembolic complications. Once appeared a clot should be treated immediately to avoid secondary complications that could be life-threatening.

Complications of endovascular coiling could appear even with the most experienced medical team and cutting edge technology and devices. So every physician should be familiar with the worst scenarios and the ways of prevention and treatment.

Our clinical case tries to focus attention on the possible complications of endovascular coiling of cerebral aneurysms. It aims on reminding so simple yet so important things like thorough examination and taking history of the patient about comorbidities, medications, previous anesthesia and interventions. When the procedure is not urgent preoperative preparation should not be underestimated. Close monitoring of the patient is obligatory. We must be familiar with the complications in order to treat the patients as effectively and successfully as possible.

"...the truth is too simple: one must always get there by a complicated route…" George Sand correspondence 1867a.

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