Anterior Communicating Artery Aneurysms. Analysis of Series Case

Aneurismas de Artéria Comunicante Anterior. Análise de uma Série de Casos

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ABSTRACT

Introduction: Anterior communicating artery complex (ACoA) is the most frequent intracranial aneurysms (30%) and the most complex of the anterior circulation, due to variation of architecture, flow and many branches involved. This paper aims to establish anatomical study and clinical manifestations, analyzing a series of cases of AcoA aneurysms. **Methods:** Articles in PubMed, Scientific Direct were reviewed using as key words, anatomy variations. In addition, AcoA features were analyzed based on our series cases. **Results:** Most common anatomical variations found in the literature were: plexiform (30%), curling (33%), fenestration (21%), duplication (18%). **Clinical features:** Fasciobraquial hemiparesis, headache, personality changes, intellectual deficit, anxiety, fear, emotional disturbances, dizziness, agitation, hypokinesia, decreased level of consciousness. Total of 5-year series of 234 cerebral aneurysms (32 deaths -13.6%). Analyzing the series, 41 ACoA (18%), with 32 ruptured (78%); 19 deaths (46%); 16 prior hypertension arterial (39%); and a ratio between women and men of 2.25 were found. **Conclusion:** In our series, we concluded that the ACoA aneurysms are more common in women, the diagnosis is often after rupture and high incidence of death. Probably the anatomical variations, location between bifurcation arteries, A1 characteristics and different direction of the domus, contribute for different outcomes and uncertain clinics. Therefore, to predict the topography of the aneurysm by analyzing only the clinic is difficult.

Key words: Aneurysm complication; Anterior Communicating Artery Aneurysms; Brain Aneurysm Cerebral Aneurysm.

RESUMO

Introdução: O complexo da artéria comunicante anterior (ACoA) é a localização mais frequente de aneurismas intracranianos (30%) e o mais complexo da circulação anterior, devido à variação de sua arquitetura e fluxo, podendo envolver alguns de seus ramos. Este trabalho objetiva estabelecer um estudo anatômico, suas manifestações clínicas e uma análise de uma série de casos de aneurismas de AcoA. Métodos: Revisão analisando trabalhos do PubMed, Scientific Direct, através de palavras-chaves, sobre variações anatômicas. Analisado também as características do aneurisma de AcoA com base em nossa série de casos. Resultados: As variações anatômicas mais comuns encontradas na literatura foram plexiforme (30%), ondulada(33%), fenestrada (21%) e duplicada (18%). As manifestações clínicas predominantes foram hemiparesia fasciobraquial, cefaleia, alterações de personalidade, déficit intelectual, ansiedade, medo, distúrbios emocionais, tonturas, agitação, hipocinesia e diminuição do nível de consciência. Em nossa série de 5 anos foram encontrados 234 aneurismas cerebrais (32 óbitos -13,6%). Analisando a série foram encontrados 41 ACoA (18%); 32 rotos (78%); 19 óbitos (46%); 29 mulheres (69%); 16 portavam hipertensão arterial prévia (39%); com razão entre mulheres e homens de 2,25. Conclusão: Em nossa série, concluímos que os aneurismas da ACoA são mais comuns no sexo feminino, com seu diagnóstico em muitos casos após a rotura e alta mortalidade. Provavelmente, as variações anatômicas, a localização entre as artérias de bifurcação, as características do segmento A1 e direções do domus, contribuíram para diferentes resultados e quadro clínico diversos.

Palavras-chave: Complicações aneurismáticas; Aneurismas da artéria comunicante anterior; Aneurisma cerebral.

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INTRODUCTION

Anterior communicating artery complex is the most frequent location of intracranial aneurysms in most reported series (~30%). Anterior communicating artery (ACoA) aneurysm is the most complex of the anterior circulation due to its unique angioarchitecture. It is frequent anatomical variations, deep interhemispheric location, and danger of severing the perforators with possibility ensuing neurologic deficits. When an intracranial aneurism (IA) ruptures, it causes subarachnoid hemorrhage (SAH)¹. Typical symptoms include sudden onset of severe headache, nausea, vomiting and loss of consciousness. Risk factors for SAH include: smoking, excessive alcohol consumption, hypertension and familial history. SAH is a devastating event associated with cumulative mortality up to 50% at six months. SAH represents only about 5-10% of all strokes. This disease strikes at a young age (≈ 50 years) and is often fatal. The loss of life productive years happens in similar way as cerebral infarction and intracerebral hemorrhage. The most important goal to treat subarachnoid hemorrhage (SAH) patients is to prevent rebleeding from the ruptured aneurysm. At present, this is achieved by occluding the aneurysm either with microneurosurgical or with endovascular. This paper aims to establish anatomical study of the ACoA complex and its clinical manifestations, analyzing a series of cases².

Methods

Review article was performed through papers analysis from PubMed, Scientific Direct databases using the keywords: Aneurism ruptured, Anterior Communicating Artery Aneurysms, Intracranial aneurism, Series of cases and Intracranial vascular anatomy. Forty-five articles were selected from 1997 to 2017. Analysis of clinical manifestation of AcoA aneurysms based on literature. Anatomic-clinical review and analysis of a series of cases were conducted. The variables tested could not be obtained from all patients. One should consider losses of some patient data and loss of some variables due to data storage problems.

Anatomical Considerations of ACoA

Aneurysms of the anterior cerebral artery (ACA) can be classified into 5 groups: A1 or proximal ACA aneurysms; anterior communicating artery (ACoA) or aneurysms of the anterior communicating artery, aneurysms of the A2 segment (A2), aneuryms of the A3 segment (A3) or classic pericallosal aneurysms; and aneurysms of the A4 and A5 segments or distal ACA aneurysms³. In many series, the ACoA complex is the most frequent site of intracranial aneurysms⁴⁻⁸. In Finland, the Middle cerebral artery (MCA) bifurcation is more frequent⁹⁻¹².

There is often asymmetry morphology of the A1 segments, and other anatomical variations are frequent in the ACoA region. The anterior communicating artery aneurysm (ACoA) usually originate from the junction of the dominant A1 and the ACoA. The dome of ACoA aneurysm is often close proximity with both A1 or A2¹³.

The Heubner recurrent artery (HRA) and perforators arising from the ACoA complex may become occluded during surgery with serious consequences¹⁴⁻¹⁷. This branch, more commonly, leaves the proximal part of A2. Large series of ACoA aneurysms report relatively high management morbidity and mortality¹⁸. Cognitive dysfunction and electrolyte imbalances are the major complications associated with the rupture of ACoA aneurysms¹⁹⁻²³. Anterior communicating artery aneurysms present frequently with subarachnoid hemorrhage (SAH) at small size²⁴⁻²⁵.

There is in unruptured aneurisms ACoA, an increased risk of rupture regardless of size, also as an associated aneurysm. In a Japanese study was analyzed in specimens the AcoA variations and founded: plexiform (33%), dimple (33%), fenestration (21%), duplication (18%), string (18%), fusion (12%), median artery of the corpus callosum (6%) and azygous anterior cerebral artery (3%)²⁶⁻²⁷. The perforating branches were also observed in all cadaver brains. The main branches and probably clinical manifestation are shown in Table 1²⁸.

The ACA is one of two terminal branches of the internal carotid artery (ICA) on the human brain. It has been proposed that hemodynamic alterations caused by vascular anomalies or anatomy and the Willis polygon flow variations lead to aneurysm formation²⁹⁻³¹. Classically, ACoA is supposed to be a short bridging vessel between ACA of equal diameter. The ACA usually courses anterior and medially to the interhemispheric fissure and passing over the optic chiasm and nerves, it joins at the midline the opposite one through the ACoA³².

There are two topographical parts of the ACA: precommunicating (A1) and postcommunicating (A2) segments regarding the point of ACA–ACoA junction³³. The communicating and choroid subparts of the cerebral part of internal carotid artery (ICA) with A1 segments and ACoA represent vascular components of an anterior segment of the cerebral arterial circle³⁴. The left and right A1 segments varied

in diameter from 0.9 to 4.0 mm in USA population or from 2.5 to 3.5 mm in Indian population, and in length from 7.2 to 18.0 mm, or from 10 to 19 mm, sending two to 15 perforating arterioles. These (posteroinferior and posterosuperior) arterioles usually supply the anterior cerebral commissure and globus pallidus, the optic chiasm, the anterior perforated substance, the genu of the internal capsule, the anterior hypothalamus and part of the thalamus. Unpaired ACoA was commonly between 0.2–3.4 mm in caliber in USA population, or between 1.0 to 4.0 mm in Indian population, whereas it was between 0.3–7.0 mm in length. Their branches (up to four) supply the optic nerves and chiasm, suprachiasmatic area, anterior perforated substance, lamina terminalis and frontal lobe. Many anomalies such as aplasia, hypoplasia, duplication or fenestration of ACA segments and ACoA have been described^{30,35}.

Authors used various methods such as digital subtraction angiography, computed tomography angiography or intraoperative observations to study the anterior cerebral circulation. However, those studies have a number of limitations. First of all, they are focused on patients with intracranial aneurysms, and not healthy subjects. Secondly, the authors made their conclusions on a relatively small study group, rarely exceeding 100 patients. Thirdly, their observations are often limited to the anomalies of the A1 segment (most commonly associated with ACoA aneurysms) regardless of ACoA and A2 segment anomalies³⁶⁻³⁸.

Comparatively few studies describe the anatomy of the ACoA complex in subjects without intracranial aneurysms. These are mainly cadaveric studies and thus it is hard to extrapolate to alive patients³⁹⁻⁴⁰. However, they still need further explore the anatomy of the anterior cerebral circulation. The results of such studies would be useful when planning surgical approaches, and would allow to avoid any unexpected anatomical variations during ACoA aneurysms' treatment. Such anatomical problems may include double fenestrations of the A2 segment mimicking an aneurysm neck or mistaking a duplicated A1 segment for an ACoA aneurysm⁴¹⁻⁴³.

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Branchs	Vascular territories	Clinical manifestations
Subcallosal branchs	Subcallosal área, including the rostrum and genu of the corpus callosum, anterior cingulate gyrus, parolfactory gyrus, paraterminal gyrus, septum pellucidum and column of the fornix, some belonging to the limbic system and Papez's circuit	Disturbance memory similar to Korsakoff's Syndrome, personality changes and decreased spontaneous activity
Hypothalamic branch	Hypothalamic area consisting of the anterior hypothalamus and lamina terminalis (LT)	Imbalance mineral, which may be fatal
Chiasmatic branch	Chiasmatic area compused of the optic chiasm and the superior part of the optic nerves	Visual alterations
Heubner recurrent artery	Lower surface of the frontal lobe of the caudate nucleo -1/3 previous of putamem of the external segment of the pale globe antero- inferior portion of the internal capsule arm uncinated fruit -hipothalamus (predominantly A1) - caudate nucleus and inner capsule	Hemiparesis with predominance in the face and in the upper limb. Compromised irrigation of the anterior arm of the internal capsule and aphasia when it surrounds the dominant hemisphere
Medial lenticulostriate arteries	Septum pellucidum, medial part of the anterior commissure and pallidum, pillars of the fornix, para- olfactory area, anterior limb of the internal capsule, anterior-inferior part of the striatum, and anterior hypothalamus	Behavioral change and memory, hemiparesis
Perforating branches of ACoA	Infundibulum of pituitary, optic chiasm, superior part of the optic nerve, anterior hypothalamus and lamina terminalis, anterior perforating substance, rostrum and genu of the corpus callosum, anterior cingulate gyrus, para- olfactory gyrus, paraterminal gyrus, septum pellucidum and column of fornix, and some parts of the limbic system. Anastomoses between perforators are frequent, particularly between hypothalamic branches	Memory deficits, changes of personality, and electrolyte imbalance
Basal branches ofA2 arise	Anterior hypothalamus, septum pellucidum, medial portion of the anterior commissure, fornix pillar and the antero-inferior portion of the striatum	Behavioral change and memory
Branches of A1 terminals	Anterior perforating substance, dorsal surface of the chiasm - suprachiasmatic portion of the hypothalamus optical treatment - dorsal surface of the optic nerve and lateral sulcus between the cerebral hemispheres and the inferior surface of the frontal lobe	Face and upper limb hemiparesis, visual disorders
Segment A1 excluding recurring and A2	- chiasma - anterior portion of the 3rd ventricle and hypothalamus - Caudate nucleus and pale globe	Emotional disturbances, personality disorder, intellectual deficit, anxiety, fear, mental disorders, dizziness, restlessness, vision impairment, hypokinesia, no motor deficit or level of consciousness

 Table 1. Perforating branches and their respective areas of irrigation and clinical manifestations.



Microsurgical Strategy with ACoA Aneurysms

The microsurgical surgery aims a total aneurysm occlusion, preserving the flow in all branches and perforating arteries. Before surgery, it is important to review the 3D angioarchitecture and abnormalities of the patient's ACoA complex with its ACoA aneurysms and to plan accordingly during the microsurgical dissection. There should be a clear view of the bone and vascular landmarks⁴⁴.

The surgical trajectory should provide optimal visualization of the ACoA complex without massive brain retraction, and both sides of the ACoA complex should be more or less accessible. Temporary occlusion of the A1 facilitates dissection and final clipping. Retrograde flow from the A2 compromises temporary occlusion. Retractors, dissection, temporary occlusion, or final clipping may injure the ACoA perforators. Microneurosurgical clipping of AcoA aneurysms requires experienced hands³².

Precise dissection in the 3D anatomy of the ACoA complex and perforators requires not only experience and skill but patience to manipulate the dome and the base under repeated protection of temporary clips. This is particularly important in cases of complex, large, and giant aneurysms. General rationale for occlusion of perforators with ensuing memory deficits are inadequate knowledge of the microsurgical anatomy of the ACoA complex, inadequate preoperative imaging and appreciation of the 3D angioarchitecture, inadequate microsurgical dissection technique as to the complexity of the ACoA region, clipping fastly performed with inadequate exposure, and reluctance to check the both sides of the aneurysm and change the position of the clip accordingly¹⁶.

Exposure in ACoA aneurysms surgery depends on multiple factors: rupture status, size and projection of the aneurysm dome direction (downward, upward, forward, backward); length, course, and dominance of the A1 trunks; orientation of the A2 fork; height of the ACoA complex from the skull base; neurovascular variations; presence of associated aneurysms; presence and extent of atherosclerosis in adjacent arteries and in the aneurysm base, detected by preoperative imaging if possible; presence of associated intracranial hemorrhage (ICH) and/or intraventricular hematoma (IVH); preexisting neurologic deficits; and previous surgeries¹⁷.

Casuistic

During 2009 to 2015, 234 cases of cerebral aneurysms were



Graph 1. Occurrence of AcoA Aneurysms.



Graph 2. Occurrence of Ruptured AcoA Aneurysms at the time of diagnosis.



Graph 3. Mortality Rate of the cases of AcoA Aneurysms.



Graph 4. Differentiation by gender of cases of AcoA aneurysms.

Original

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attended at the Neurosurgery Department of Santa Casa of Ribeirão Preto - São Paulo - Brazil. Of the total (234 cases), there were 32 deaths (13.6%). The occurrence of AcoA aneurysms was 41 cases (18%). Of these, 38 (78%) were ruptured at the time of diagnosis, 19 (46%) died, 13 (31%) were males and 29 (69%) were females. Of the 41 patients with AcoA aneurysm, 16 (39%) had previous hypertension.

CONCLUSION

As a conclusion, our data is similar to the literature. The aneurysms of ACoA is more common in women, diagnosis is often after rupture and high incidence of death. Probably the anatomical structure, variations and its location between bifurcation arteries, contributes for outcome. A variety of clinical findings with anatomy study was observed. This series stands out: Drawdown of consciousness, headache, hemiparesis and behavioral changes, as main symptoms. Therefore, make it difficult to predict the topography of the aneurysm by analyzing only the clinic. We suggest further studies to evaluate AcoA localization of aneurisms at emergency clinic and larger sample cases.

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