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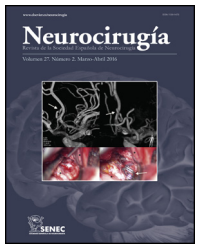

Clinical Research

Acute subdural hematoma from ruptured middle cerebral artery aneurysm: A rare and critical analysis of 25 cases

Cristina Romero-López[a,*], *Javier Ros de San Pedro*[a,b], *Francisco Arteaga-Romero*[a], *Beatriz Cuartero-Pérez*[b], *Ignacio Martín-Schrader*[a]

[a] *Department of Neurosurgery, Hospital Universitario Virgen del Rocío, Seville, Spain*
[b] *Regional Service of Neurosurgery, Hospital Clínico Universitario Virgen de la Arrixaca, Murcia, Spain*

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ABSTRACT

Background: An acute subdural hematoma (aSDH) is a rare presentation of a ruptured intracranial aneurysm with pathophysiology and prognosis poorly defined. According to literature, prognosis might be improved with prompt diagnosis, hematoma evacuation and aneurysm treatment. The objective is to specify pathophysiology, prognostic factors and management of this pathology.

Methods: We reported 23 cases of aSDH due to ruptured MCA aneurysm from literature revision and 2 cases from our center.

Results: Median age was 51 years and 48% (12/25) were females. At their arrival, 76% (19/25) presented decreased level of consciousness and 55.55% (10/18) neurological deficits. Aneurysmal location was left MCA in 57.14% (8/14) and MCA segments were M4 in 76.92% (10/13) and bifurcation in 23.07% (3/13), median aneurysmal size was 6 mm, median hematoma size was 10 mm, median midline shift was 9 mm, aneurysmal projection and MCA concavity were anterior in 100% (3/3), subarachnoid hemorrhage (SAH) was present in 52.17% (12/23). The treatment was surgery in 84% (21/25), endovascular in 12% (3/25) and in 20% (5/25) decompressive craniectomy (DC) was necessary. Glasgow Outcome Scale (GOS) was >3/favorable in 66.66% (16/24) and death in 16.66% (4/2).

Conclusions: Anterior MCA concavity and aneurysmal projection might be related with aSDH presentation in proximal MCA aneurysms. We should suspect aneurysm origin when there is no history or stigma of trauma, and CT shows disproportionately massive aSDH. Hematoma evacuation solves the compressive mechanism which is the main cause of neurological deterioration in pure aSDH cases, because of that, immediate hematoma evacuation could justify better outcome in these patients.

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Abbreviations: aSDH, acute subdural hematoma; MCA, middle cerebral artery; SAH, subarachnoid hemorrhage; CTA, CT angiography; GCS, Glasgow coma scale; HH, Hunt & Hess scale; GOS, Glasgow outcome scale; MS, midline shift; DC, decompressive craniotomy; IQR, interquartile range.

* *Corresponding author.*
E-mail address: cristina.romerolopez@gmail.com (C. Romero-López).

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Hematoma subdural agudo por ruptura de aneurisma de la arteria cerebral media: un análisis raro y crítico de 25 casos

Palabras clave:
Hematoma subdural agudo
Aneurisma roto
Arteria cerebral media

RESUMEN

Antecedentes: Un hematoma subdural agudo (HSDa) es una rara forma de presentación de un aneurisma intracraneal roto con una fisiopatología y un pronóstico pobremente definidos. De acuerdo con la literatura, el pronóstico podría mejorar con un diagnóstico, evacuación del hematoma y tratamiento del aneurisma de forma precoz. El objetivo del presente artículo es describir la fisiopatología, los factores pronósticos y el manejo de esta patología.

Métodos: Se reportan 23 casos de HSDa secundarios a aneurisma de arteria cerebral media (ACM) roto procedentes de la revisión de la literatura y 2 casos procedentes de nuestro centro.

Resultados: Mediana de edad de 51 años, 48% (12/25) fueron mujeres. A su llegada, el 76% (19/25) presentó deterioro del nivel de conciencia y el 55.55% (10/18) déficits neurológicos. La localización del aneurisma fue la ACM izquierda en el 57.14% (8/14), el segmento M4 en el 76.92% (10/13) y la bifurcación en el 23.07% (3/13), la mediana del tamaño del aneurisma fue 6 mm, la mediana del tamaño del hematoma 10 mm, la mediana de la desviación de línea media 9 mm, la proyección del aneurisma anterior y la concavidad de la ACM anterior en el 100% (3/3) y asociaban hemorragia subaracnoidea el 52.17% (12/23). El tratamiento fue quirúrgico en el 84% (21/25), endovascular en el 12% (3/25) y se realizó craniectomía descompresiva en el 20% (5/25). La Glasgow Outcome Scale fue >3/favorable en el 66.66% (16/24) y se produjo el fallecimiento en el 16.66% (4/2).

Conclusiones: La concavidad anterior de la ACM y la proyección anterior del aneurisma podrían estar relacionadas con la presentación en forma de HSDa de aneurismas de ACM proximal. Debemos sospechar el origen aneurismático ante ausencia de historia o estigma de traumatismo o un HSDa de tamaño desproporcionado en la tomografía. La evacuación del hematoma resuelve el mecanismo compresivo el cual es la principal causa de deterioro neurológico en HSDa puros, por ello, la evacuación inmediata del hematoma podría justificar un mejor pronóstico en estos pacientes.

Introduction

An acute subdural hematoma (aSDH), associated or not with subarachnoid hemorrhage (SAH), is a rare presentation of a ruptured intracranial aneurysm (0.5–10%).[1,2] Its pathophysiology and prognosis are poorly defined because of the paucity of cases. The most frequent location is posterior communicating artery, while middle cerebral artery (MCA) cases are less usual.[2] Although this type of presentation of ruptured aneurysm has been rarely studied, there are various hypothesis, for instance, previous adhesions to surrounding arachnoid membrane due to sentinel bleeds, a powerful jet of blood or specific aneurysm location and anatomy.[1–10] Despite these hypotheses, few studies have thoroughly examined cases of middle cerebral artery (MCA) aneurysms presenting with aSDH, which is the focus of this work.

On the other hand, publications have commonly suggested that the prognosis is ominous because of the poor clinical presentation and the presence of aSDH. However, according to recent literature, its prognosis might be improved with prompt diagnosis using CT angiography (CTA) +/− arteriography as well as hematoma evacuation and aneurysm treatment.[1–3,11]

This study aims to provide a more specific perspective on aSDH related to middle cerebral artery MCA aneurysms, as existing research generally addresses intracranial aneurysms without focusing on the particularities of the MCA. Verhey et al.,[3] in their review of subdural hematomas caused by cortical aneurysms, emphasize the need for careful vascular imaging to detect hidden aneurysms and prevent rebleeding. However, current studies have not thoroughly explored how the anterior concavity of the MCA and aneurysmal projection may be related to aSDH presentation, as proposed in our analysis.

In this context, our study not only expands the existing knowledge by reviewing a series of 23 published cases and 2 from our center, but also suggests new anatomical and pathophysiological relationships that may be crucial for diagnosis and treatment. Through a more systematic approach, this work contributes to the literature by providing relevant data on surgical management, aneurysmal anatomical factors and clinical prognosis, which could influence future therapeutic strategies for aSDH secondary to MCA aneurysms.

Fig. 1 – Search strategy.

Methods

Search strategy

We have completed the series with a literature revision. In February-2024 a Pubmed search was accomplished using the following item: “Acute subdural hematoma” AND aneurysm NOT "trauma*". We selected 6 articles from a total of 96, the other 90 articles were excluded because of their language, incomplete data or they did not treat on aSDH due to a ruptured MCA aneurysm. 9 articles selected from reference scanning. The search strategy is summarized in Fig. 1.

Patient selection

We conducted a review of 2 cases with diagnosis of acute subdural hematoma due to a ruptured middle cerebral artery aneurysm treated at our centers, in the period between January 2020 and December 2023.

Data collection

The following data were recorded: demographic characteristics, risk factors, clinical presentation, initial imaging tests, radiological characteristics of the hematoma and the aneurysm and type of treatment and functional outcome.

Regarding data collection, we considered decreased level of consciousness if Glasgow Coma Scale (GCS) < 15 or Hunt and Hess scale (HH) >2. Aneurysm location along the MCA was classified according to the Rhoton's[12] classification for the MCA segments, except for MCA bifurcation aneurysm. Aneurysm size was expressed in millimeters (mm) using its longest measurement. Aneurysm projection was deduced from the direction of its main axis in an axial plane. MCA concavity was considered as the inner surface of the curve of the MCA main trunk in an axial plane. aSDH size was determined by its thickness in mm, other units of measurement were dismissed. The presence of SAH was deduced from the available radiological images or its description in the body of the article. Glasgow Outcome Scale (GOS) was used for functional outcome, if the data were available; we considered GOS > 3 as favorable outcome.

Statistical analysis

Statistical characteristics were used to describe all variables. Frequency and percentage were used for categorical data whereas median and interquartile range for continuous data. The Pearson χ^2 test was used to test the relationship between categorical variables. Statistical significance was set at $p < 0.05$. Statistical analysis was performed using IBM SPSS Statistics®, version 22.0 (IBM Corp., Armonk, N.Y., USA).

We hypothesized that there is one mechanism of neurological deterioration when the radiological finding is a pure aSDH (hematoma compression), while there are two mechanisms if aSDH and SAH coexist (hematoma compression plus cerebral swelling). We analyzed the correlation between midline shift (MS)/SAH, decompressive craniotomy (DC)/SAH and GOS/SAH. In the first one, the MS groups were: MS superior to aSDH size (MS > aSDH) and MS equal or inferior to aSDH size (MS ≤ aSDH). In the last one, the GOS groups were GOS > 3 and GOS ≤ 3.

Case presentation

Case 1. His age was 51 years at presentation. He was a male with history of smoking and alcohol consumption, without alterations in haemostasis or evidence of traumatic

Table 1 – Description of the cases.

Author and publication year	Demographic data	Clinical presentation	Aneurysm location	Imaging tests	Aneurysmal size	Hematoma size and MS	SAH	Treatment	Functional outcome
Torné et al.[1] (2015)	45 years, female	GCS 3, anisocoria	MCA	Noncontrast CT, CT angiography or arteriography	NA	HS 10 mm MS 6 mm Fisher 3	Yes	Evacuation, clipping, DC	GOS 1
Torné et al.[1] (2015)	51 years, female	GCS 4, anisocoria	MCA	Noncontrast CT, CT angiography or arteriography	NA	HS 12 mm MS 15 mm Fisher 4	Yes	Evacuation, clipping, DC	GOS 1
Torné et al.[1] (2015)	55 years, female	GCS 7, anisocoria	MCA	Noncontrast CT, CT angiography or arteriography	NA	HS 15 mm MS 17 mm Fisher 4	Yes	Evacuation, clipping, DC	GOS 2
Torné et al.[1] (2015)	55 years, female	GCS 14	MCA	Noncontrast CT, CT angiography or arteriography	NA	HS 13 mm MS 15 mm Fisher 3	Yes	Evacuation, clipping	GOS 4
Schuss et al.[2] (2013)	42 years, female	HH 4	MCA	Noncontrast CT, CT angiography	5 mm	HS 6 mm, MS 6 mm	Yes	Coiling, evacuation	Favorable (at 6 months)
Schuss et al.[2] (2013)	49 years, male	HH 2	MCA	Noncontrast CT, CT angiography	6 mm	HS 5 mm, MS 5 mm	Yes	Coiling, evacuation	Favorable (at 6 months)
Schuss et al.[2] (2013)	55 years, female	HH 5	MCA	Noncontrast CT, CT angiography	13 mm	HS 1 mm, MS 1 mm	Yes	Evacuation, clipping	Favorable (at 6 months)
Schuss et al.[2] (2013)	69 years, male	HH 5	MCA	Noncontrast CT, CT angiography	13 mm	HS 12 mm, MS 8 mm	Yes	Coiling, evacuation	GOS 1
Schuss et al.[2] (2013)	57 years, male	HH 5	MCA	Noncontrast CT, CT angiography	14 mm	HS 16 mm, MS 14 mm	Yes	Evacuation, clipping	Unfavorable
Schuss et al.[2] (2013)	49 years, female	HH 5	MCA	Noncontrast CT, CT angiography	11 mm	HS 3 mm, MS 14 mm	Yes	Evacuation, clipping, DC	Unfavorable
Verhey et al.[3] (2018)	69 years, male	H/A	Right M4	Noncontrast CT, CT angiography	NA	NA	No	Evacuation, clipping	GOS 5
Shinmura et al.[4] (1989)	53 years, female	HH 5, anisocoria	MCA	Noncontrast CT, arteriography	NA	HS 90 g	No	Evacuation, clipping DC	Disability

– Table 1 (*Continued*)

Author and publication year	Demographic data	Clinical presentation	Aneurysm location	Imaging tests	Aneurysmal size	Hematoma size and MS	SAH	Treatment	Functional outcome
Gao et al.[5] (2019)	71 years, female	H/A, V	Left MCA bifurcation	Noncontrast CT and MRI, CT angiography	NA *Anterior aneurysm projection and anterior MCA concavity	NA	No	Evacuation, clipping	GOS 5 (at discharge)
King et al.[6] (1960)	23 years, female	H/A, V, left-sided 3rd nerve palsy, aphasic, right hemiparesis, decreased level of consciousness	Left M4	Arteriography, ventriculography	NA	NA	No	Evacuation, resection	GOS 5
Boop et al.[7] (1961)	37 years, male	Decreased level of consciousness, right hemiparesis), anisocoria	Right M4	Arteriography	6 mm	HS 200 cc	No	Evacuation, aneurysm resection	GOS 5
Rengachary et al.[8] (1982)	49 years, male	Decreased level of consciousness, neurological deficit (dysphasia)	Left M4	Noncontrast CT, arteriography	4 mm	HS 30–40 ml	NA	Evacuation, aneurysm resection	GOS 5
Singla et al.[9] (2014)	25 years, male	GCS 10, neurological deficit (hemiparesis)	Left M4	Noncontrast CT and MRI, arteriography	NA	HS 8 mm	No	Evacuation, clipping	GOS 5
O'Leary et al.[10] (1986)	28 years, female	Decreased level of consciousness	Left MCA	NA	NA	HS 30 ml	No	No	GOS 1
Gong et al.[13] (2014)	43 years, male	H/A, S	Left M4	Noncontrast CT and MRI, arteriography	NA	NA	No	Evacuation, clipping	GOS 5
Awaji et al.[14] (2016)	43 years, male	H/A, S, V	Left M4	Noncontrast CT and MRI, CT angiography, indocyanine	NA	NA	NA	Evacuation, clipping	GOS 5
Hori et al.[15] (2005)	57 years, male	Decreased level of consciousness, neurological deficit (right oculomotor paralysis)	Right M4	Noncontrast CT, arteriography	1,5 mm	NA	No	Evacuation, clipping	GOS 5

– Table 1 (*Continued*)

Author and publication year	Demographic data	Clinical presentation	Aneurysm location	Imaging tests	Aneurysmal size	Hematoma size and MS	SAH	Treatment	Functional outcome
Kurabe et al.[16] (2010)	75 years, male	H/A, V	Left M4	Noncontrast CT and MRI, arteriography	NA	NA	No	Evacuation, resection	NA
Freire et al.[17] (2018)	53 years, female	GCS 5, anisocoria	Right MCA bifurcation	Noncontrast CT, CT angiography	10 mm *Anterior aneurysm projection and anterior MCA concavity	MS 9 mm	No	Evacuation, clipping	Favorable
Present case 1	51 years, male	GCS 7, HH 4	Right MCA bifurcation	Noncontrast CT, CT angiography	4,3 mm *Anterior aneurysm projection and anterior MCA concavity	HS 7,56 mm MS 8,70 mm Fisher 2	Yes	Evacuation, clipping	GOS 5 (at 6 months)
Present case 2	53 years, male	GCS 5, HH 4	Right M4	Noncontrast CT, CT angiography, arteriography	4 mm	HS 28 mm MS 12 mm Fisher 3	Yes	Evacuation, clipping	GOS 5 (at 6 months)

GCS: Glasgow Coma Scale, HH: Hunt and Hess scale, H/A: headache, V: vomits, S: sickness, MCA: middle cerebral artery, CT: computed tomography, CTA: CT angiography, MRI: magnetic resonance imaging, HS: hematoma size, MS: midline shift, SAH: subarachnoid hemorrhage, DC: decompressive craniectomy, GOS: Glasgow Outcome Score. NA: not available. *Aneurysm projection and MCA concavity.

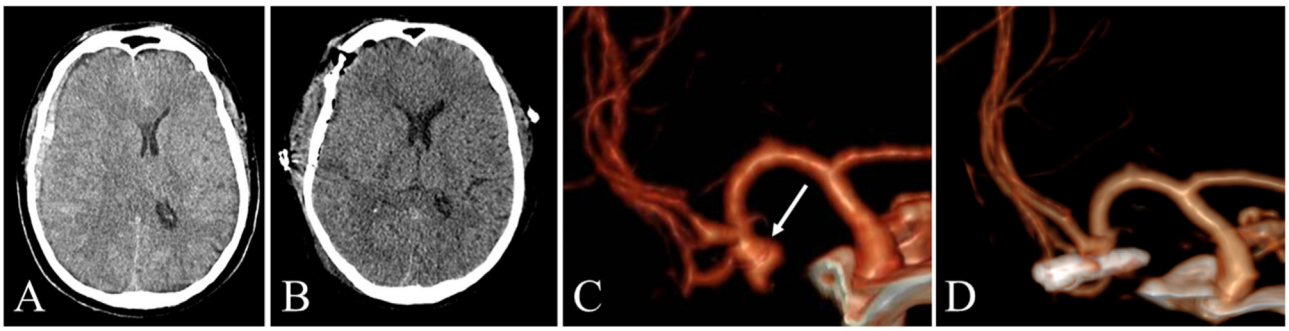

Fig. 2 – *Patient* 1. Image A: preop noncontrast CT, it shows a disproportionate mass effect to the hematoma size. Image B: postop noncontrast CT (24 h). Image C: preop CT angiography (CTA), it shows an anterior and lateral projection in a 3D reconstruction. The white arrow points the MCA aneurysm (M1). It is demonstrated the MCA anterior concavity and the aneurysm anterior projection. Image D: postop CTA, it shows an anterior and lateral projection in a 3D reconstruction. It is demonstrated the adequate aneurysm clipping.

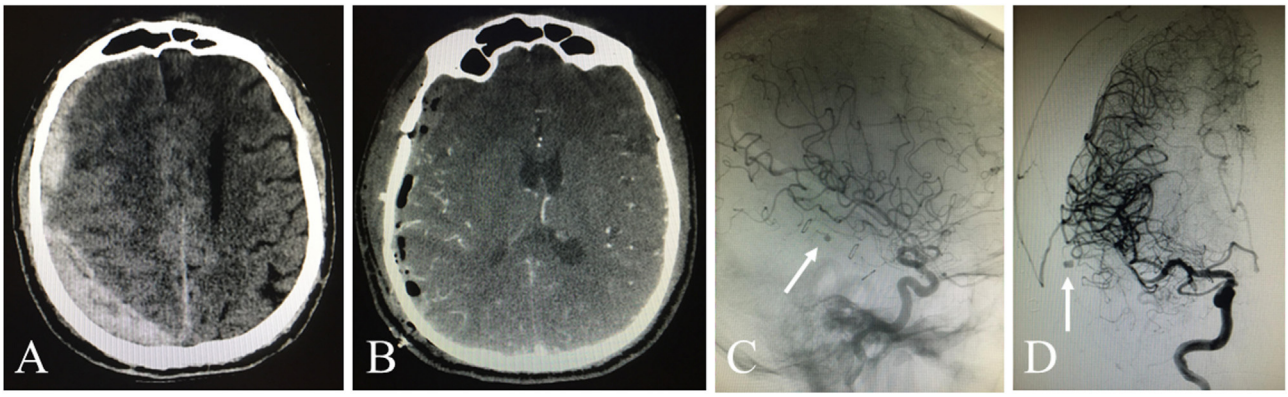

Fig. 3 – *Patient* 2. Image A: preop noncontrast CT. Image B: postop CT with contrast. Images C and D: lateral and AP arteriography projections of right internal carotid artery, the white arrows point the M4 aneurysm; its cortical location may facilitate the aSDH formation.

antecedents. At his arrival in the emergency room, the GCS was 7/15 and the HH 4. The noncontrast computed tomography (CT) demonstrated right aSDH with SAH Fisher 2. CTAs showed a right MCA bifurcation aneurysm. The aSDH size was 7.56 mm and the MS was 8.70 mm. The aneurysm size was 4.3 mm and presented anterior aneurysm projection and MCA concavity in axial plane. The surgical treatment was urgent hematoma evacuation and aneurysm clipping at the same surgery; DC was not necessary. Functional outcome at discharge and at sixth months was GOS 5. The main data are summarized in Table 1 and Fig. 2.

Case 2. His age was 53 years at presentation. He was a male with history of smoking and alcohol consumption, without alterations in haemostasis or evidence of traumatic antecedents. At his arrival in the emergency room, the GCS were 5/15 and the HH 4. The noncontrast CT demonstrated right aSDH with SAH Fisher 3. The CTAs showed a right temporal M4 aneurysm, an arteriography was made. The aSDH size was 28 mm and the MS was 12 mm. The aneurysm dome diameter was 4 mm. The surgical treatment was urgent hematoma evacuation in one surgery and aneurysm clipping in other surgery; DC was not necessary. Functional outcome at discharge and at sixth months was GOS 5. The main data are summarized in Table 1 and Fig. 3.

Results

The present series on aSDH due to a ruptured MCA aneurysm comprises 25 cases (23 from the literature plus 2 from our center). All patient data are summarized in Table 1.

Epidemiology and clinics

The median age was 51 years (interquartile range (IQR): 13) and 48% (12/25) were females. At their arrival, 76% (19/25) presented decreased level of consciousness and 55.55% (10/18) neurological deficits.

Radiological findings

The aneurysmal location was left MCA in 57.14% (8/14) and the MCA segments were M4 in 76.92% (10/13) and MCA bifurcation in 23.07% (3/13); the aneurysmal size was described in 12 cases, the median size was 6 mm (IQR: 7.85); the hematoma size was described in 13 cases, the median size was 10 mm

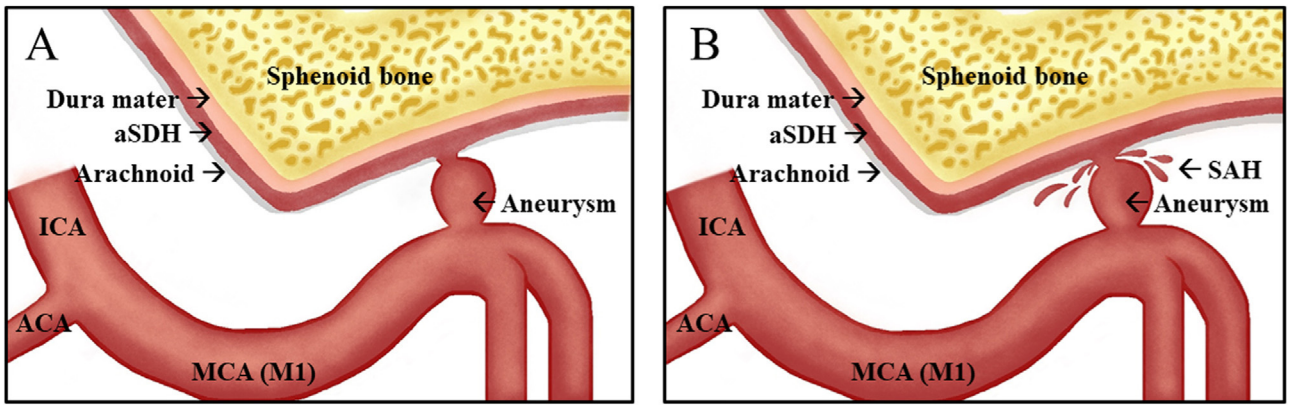

Fig. 4 – Pathophysiology. Axial view from above. The anterior MCA concavity and the anterior aneurysm projection are shown in both images; the image A is a representation of pure aSDH; the image B is a representation of aSDH and SAH. ICA: internal carotid artery, ACA: anterior cerebral artery, SAH: subarachnoid hemorrhage.

(IQR: 8.5); the MS was described in 13 cases, the median MS was 9 mm (IQR: 8.5); the aneurysmal projection and the MCA concavity were specified in 3 cases (MCA bifurcation aneurysms), the aneurysmal projection and the MCA concavity were anterior in 100% (3/3); SAH was present in 52.17% (12/23). The MS/SAH analysis was not possible due to the sample size.

Treatment

The treatment was surgery in 84% (21/25), in 4 cases the aneurysmal treatment was resection instead of clipping and in 20% (5/25) decompressive craniectomy was necessary. The treatment was endovascular in 12% (3/25), in these cases the hematoma evacuation was required. The DC/SAH analysis was not statistically significant ($p = 0.15$) but there was a positive trend between DC requirement and SAH ($\chi 2 = 1.98$).

Outcome

Finally, the outcome was GOS > 3/favorable in 66.66% (16/24), GOS 2–3/unfavorable in 16.66% (4/24) and death in 16.66% (4/2). The GOS/SAH analysis was not statistically significant ($p = 0.14$) but there was a positive trend between worse GOS and SAH ($\chi^2 = 2.12$).

Discussion

Pathophysiology

aSDH is a rare presentation of a ruptured intracranial aneurysm as cited above. Its pathophysiology is poorly defined, though there are various mechanisms described in the literature[1–10]: (1) previous adhesions between the arachnoid membrane and pia mater due to sentinel bleeds, (2) a powerful jet of blood tears the arachnoid membrane or lacerates the parenchyma projecting the blood to the subdural space, (3) giant or distal aneurysms that contact to the subdural space, (4) aneurysms protruding into the basal cisterns, for example, posterior communicating artery, might produce the rupture of the arachnoid membrane, (5) aneurysm adherence to the falx cerebri or dura mater.

We present two cases which illustrate two different mechanisms of aSDH presentation in MCA aneurysms due to aneurysm proximity to dura mater: (1) the morphology of the MCA main trunk and the aneurysm projection in bifurcation lesions of the MCA, and (2) the cortical location of the aneurysm. Case 1 presented an anterior aneurysm projection and an anterior MCA concavity in axial plane (Figs. 2 and 4), while the aneurysm location in Case 2 was temporal M4. Our hypothesis is that the anterior concavity of the MCA and the anterior projection of the aneurysm in an axial plane might be related with aSDH presentation in aneurysm located in proximal MCA segments; this pathophysiological mechanism is not described previously in the literature and it is schematically showed in Fig. 4.

On the other hand, the hematoma thickness is large, the median size was 10 mm, this fact could be explained because of the direct blood against dura mater. In addition, our hypothesis is that there is one mechanism of neurological deterioration if the patient presents a pure aSDH (hematoma compression), but there are two mechanisms if aSDH and SAH coexist (hematoma compression plus cerebral swelling). We could not analyze the MS/SAH correlation as described above.

Diagnostic process

Verhey et al.[3] stated that ruptured cerebral aneurysm should be suspected in spontaneous aSDH. Additionally, urgent CTA +/- arteriography should be considered in absent of trauma or other risk factors for subdural hemorrhage as coagulopathy.[3–5]

According to Singla et al.[9] 3D CT angiography is recommended in patients with aSDH and (1) no history of head trauma, (2) history of probable sentinel bleeding, (3) rapidly progressing symptoms and signs that suggest arterial bleeding or (4) mild head trauma whose CT shows disproportionately massive aSDH with or without SAH.

In this revision, the median hematoma size (10 mm) and the median MS (9 mm) were considerable. These findings support that we should suspect aneurysm origin when there is no history of head trauma or soft tissue traumatic stigmata,

and the CT shows disproportionately massive aSDH with or without SAH.

Prognostic factors

Other authors have reported a poor neurological status at presentation,[1,2,11] bigger aneurysmal size and older age[11] as prognostic factors of ominous outcome, although these publications were small single center series and the aneurysm location was not only MCA. Furthermore, according to Torné et al.[1] and Kulwin et al.,[11] brain shift and mass effect probably cause the initially neurological deterioration and aSDH evacuation may result in better functional outcome; in those series a good functional outcome was observed in 62.5%[1] and 40%[11] of the initial survivors who received early treatment.

In our literature revision, at their arrival at emergency room, 55.55% presented decreased level of consciousness and the outcome was GOS > 3/favorable in 66.66% at discharge. The treatment was aSDH evacuation in all cases and aneurysm treatment was surgical in 84% and endovascular in 12%. This also suggests that immediate hematoma evacuation and aneurysmal treatment might improve the functional outcome despite the initial neurological deterioration.

Moreover, the hematoma evacuation solves the compressive mechanism which is the main cause of neurological deterioration in pure aSDH cases, because of that, an immediate hematoma evacuation could justify a better outcome in these patients. In our analysis there was a positive trend between worse GOS and SAH, though the result was not statistically significant.

Future directions

In the cases reported, we observe a relationship between the anterior concavity of the MCA and the anterior projection of the aneurysm, a pathophysiological mechanism not previously described in the literature. These findings could guide future research on the development of aSDH in other types of intracranial aneurysms.

Furthermore, the clinical findings suggest that early evacuation of the subdural hematoma, combined with surgical or endovascular treatment of the aneurysm, can significantly improve patients' functional outcomes. This study highlights the importance of prompt surgical intervention, as the compressive mechanism of the hematoma is the primary cause of neurological deterioration in these patients. Future research could focus on validating these observations in larger cohorts and investigating the role of anatomical and morphological variations of aneurysms in predicting the risk of aSDH.

Study limitations

The main limitation of this study is related to the small number of patients and its retrospective approach. However, the data obtained provide further knowledge about this rare entity.

Conclusion

Anterior concavity of the MCA and anterior projection of the aneurysm might be related with aSDH presentation in proximal MCA aneurysms. We should suspect aneurysm origin when there is no history of head trauma or soft tissue traumatic stigmata, and the CT shows disproportionately massive aSDH with or without SAH. Moreover, the hematoma evacuation solves the compressive mechanism which is the main cause of neurological deterioration in pure aSDH cases, because of that, an immediate hematoma evacuation could justify a better outcome in these patients.

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None.

Declaration of competing interest

None.

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