

Acute Subdural Hematomas Caused by Ruptured Aneurysms: Experience from a Single Turkish Center

Anevrizma Ruptürüne Bağlı Akut Subdural Hematomalar: Tek Merkez Deneyimi

ABSTRACT

AIM: Although an aneurysmal rupture typically presents on computed tomography (CT) imaging as only a subarachnoid hemorrhage (SAH), it may be associated with spontaneous (nontraumatic) subdural hemorrhage (sSDH). The purpose of this paper is to discuss the clinical and radiological characteristics, as well as a potentially dangerous situation in the diagnosis and the management of this life-threatening condition.

MATERIAL and METHODS: The Department of Neurosurgery at Inonu University (Turgut Özal Medical Center) (TOMC) maintains a prospective database of all patients treated for intracranial aneurysms since 1999. Using this database, we obtained patients with ruptured aneurysms who presented with sSDH on CT imaging.

RESULTS: 687 patients with radiographically documented ruptured aneurysms were admitted from January 2000 through January 2009. Of these, eleven patients presented with sSDH. The incidence of aneurysmal rupture with sSDH is 1.6 % in our series.

CONCLUSION: Acute sSDH on cranial CT should be considered for an urgent workup of a ruptured aneurysm, even in the absence or presence of SAH finding. CT angiography has advantages over cerebral digital subtraction angiography (DSA) and may be a reasonable alternative to latter modality in the diagnosis, triage, and treatment planning in patients with sSDH.

KEYWORDS: Acute subdural hematoma, Intracranial aneurysm rupture, Subarachnoid hemorrhage

ÖZ

AMAÇ: Bir anevrizma ruptürü tipik olarak tomografide subaraknoid kanama ile ortaya çıkmasına rağmen kendiliğinden (travmasız) subdural kanama ile beraber görülebilir. Bu makalenin amacı, bu hayatı tehdit eden durumun klinik ve radyolojik özellikleriyle birlikte tanı ve tedavisindeki potansiyel tehlikeleri tartışmaktır.

YÖNTEM ve GEREÇ: İnönü Üniversitesi Nöroşirürji Anabilimdalı (Turgut Özal Tıp Merkezi) 1999'dan bu yana intrakraniyal anevrizma tanısı ile tedavi edilen hastaların kayıtlarını prospektif olarak tutmaktadır. Bu veri tabanını kullanarak, tomografisinde akut subdural kanama ile gelen ruptüre anevrizma hastalarını tespit ettik.

BULGULAR: Ocak 2000-Ocak 2009 tarihleri arasında radyolojik olarak dökümanite edilmiş 687 hasta başvurdu. Bunların 11 (on bir) tanesinde akut travmatik olmayan subdural kanama mevcuttu. Akut subdural kanama-anevrizma rüptürü birlikteliği serimizde % 1,6 idi.

SONUÇ: Subaraknoid kanamanın varlığı veya yokluğunda bile, tomografide görülen akut travmatik olmayan subdural kanama anevrizma ruptürü ile ilgili acil çalışmalarını düşündürmelidir. CT anjiyografinin DSA'ya göre avantajları vardır ve akut olan bir travmatik olmayan subdural kanama olgularının tedavi planlaması, triyajı ve tanısında makul bir alternatif modalitedir.

ANAHTAR SÖZCÜKLER: Subdural kanama, Anevrizma ruptürü, Subaraknoid kanama

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INTRODUCTION

Subarachnoid hemorrhage (SAH) associated with acute subdural hematoma (SDH) originating from ruptured intracranial aneurysm is rare and carries a poor prognosis (9,12,13,19). Acute subdural hematomas (SDH) most commonly result from tearing of bridging and/or cortical veins. Much less frequently, subdural bleeding may be secondary to rupture of an intracranial aneurysm (4). Aneurysm rupture causing sSDH, though recognized, is distinctly unusual. We report our experience with eleven cases, and discuss some of the problems in the diagnosis and management of this extraordinary and fatal condition.

PATIENTS and METHODS

We searched retrospectively for cases of sSDH due to ruptured cerebral aneurysms whose presence had been confirmed by cerebral angiography (DSA) or those whose computed tomography (CT) scan showed coexisting sSAH. We reviewed the medical records, surgical charts, and brain CT scans of 687 sSAH patients treated in our department between January, 2000 and January 2009. The clinical characteristics of the patients, including gender, age, consciousness level in the emergency room evaluated on the Glasgow Coma Scale (GCS) (17), SAH grade on admission evaluated on the World Federation Neurological Surgeons (WFNS) scale (6), treatment received, and outcome 6 months after discharge evaluated on the Glasgow Outcome Scale (GOS) (10) were assessed.

RESULTS

Between January 2000 and January 2009, 687 consecutive patients at Turgut Özal Medical Center (TOMC) underwent standard surgery or endovascular intervention for intracranial aneurysms. Eleven patients were determined as having had an acute sSDH resulting from aneurysmal rupture, and these patients comprised 1.6% (11/687 patients) of our SAH series. Presences of the aneurysms were verified by DSA in all patients. CT angiography has been added our armamentarium in January 2007. The clinical characteristics and radiological findings of these 11 patients are summarized in (Table I). There were three men and eight women, and their average age at presentation was 64.0 and 54.5 years, respectively. The SAH grade on admission was grade I in two patients, grade II in two patients, grade III in two

patients, grade IV in three patients, and grade V in two patients. Two of the three patients with grade IV SAH (Case 6 and 7) underwent cerebral angiography and subsequent evacuation of the SDH and intracerebral hematoma (ICH) combined with clipping of the ruptured middle cerebral artery (MCA) aneurysm, within 6 h of admission but they died in the postoperative period. One of the patients with grade III SAH (Case 3) and one of the patients with grade V SAH (Case 8) underwent craniotomy and evacuation of the SDH. After improvement of their neurological status, cerebral DSA and subsequently clipping of the ruptured aneurysms were performed. Cerebral DSA of the other grade V SAH patient showed right internal carotid artery (R-ICA) bifurcation aneurysm but unfortunately she died before the surgery (Figure 1A,B). The other six patients (Case 2,4,5,9,10 and11) underwent cerebral DSA and subsequent evacuation of the SDH combined with clipping of the ruptured aneurysm (Figure 2A,B,C,D).The outcome of these patients were good recovery in five, severe disability in three, and death in three patients.

Aneurysm localizations were as follows; five in the internal carotid-posterior communicating artery (IC-PC), three in the MCA, two in the anterior communicating artery (ACoA), and one at the IC artery bifurcation.

DISCUSSION

Rupture of a cerebral aneurysm into the subdural space is a rare but well-known occurrence. Acute sSDH resulting from rupture of an aneurysm was first reported by Hasse (8) in 1855, and over 200 cases have been described since then (2,3,4,7,9,11,12,13,14,

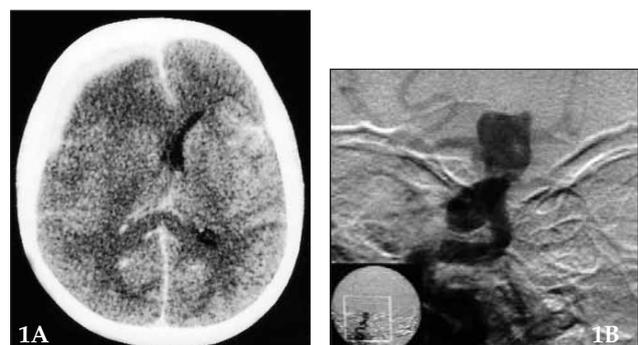


Figure 1: A) Cranial CT scan of Case 1 shows subarachnoid hemorrhage in cortical subarachnoid sulci, subdural blood collection on the surface of right frontal lobe, right hemispheric edema and subfalcine herniation, B) The angiogram reveals a large distal carotid artery aneurysm with irregular contour.

Table I: Clinical and radiological characteristics of 11 patients with acute SDH resulting from aneurysm rupture.

Case	Age/sex	GCS on admission	WFNS	Presence of SAH	Presence of ICH	Midline shift	Treatment	Location of aneurysm	Long term outcome (GOS)
1	68/F	6	V	(+)	(-)	(-)	DSA (No operation)	R-ICA Bifur.	Dead
2	53/M	14	II	(+)	(-)	(-)	DSA + Craniotomy + Clipping	L-PCoM A	Good
3	48/F	10	III	(+)	(-)	(+)	1) Craniotomy + Evacuation of SDH 2) DSA+ Craniotomy + Clipping	R-PCoM A	Disability
4	63/F	15	I	(+)	(-)	(-)	DSA + Craniotomy + Clipping	L-MCA	Good
5	51/F	14	II	(+)	(-)	(-)	DSA + Craniotomy + Clipping	ACoM A	Good
6	72/M	8	IV	(+)	(+)	(+)	DSA + Craniotomy + Evacuation of SDH and ICH + Clipping	R-MCA	Dead
7	56/F	7	IV	(+)	(+)	(+)	DSA + Craniotomy + Evacuation of SDH and ICH + Clipping	R-MCA	Dead
8	67/M	5	V	(+)	(-)	(+)	1) Craniotomy + Evacuation of SDH 2) DSA+ Craniotomy + Clipping	R-PCoM A	Disability
9	47/F	15	I	(-)	(-)	(-)	CTA + DSA + Craniotomy + Clipping	ACoM A	Good
10	57/F	13	III	(+)	(-)	(-)	CTA + DSA + Craniotomy + Clipping	L-PCoM A	Good
11	46/F	12	IV	(+)	(-)	(-)	CTA + DSA + Craniotomy + Clipping	R- PCoM A	Disability

CTA, CT angiography; ICA Bifur., Internal Carotid Artery Bifurcation; ICH, Intracerebral Hemorrhage; GCS, Glasgow Coma Scale; MCA, Middle Cerebral Artery; PCoM A, Posterior Cerebral Artery; SAH, Subarachnoid hemorrhage; SDH, Subdural Hematoma

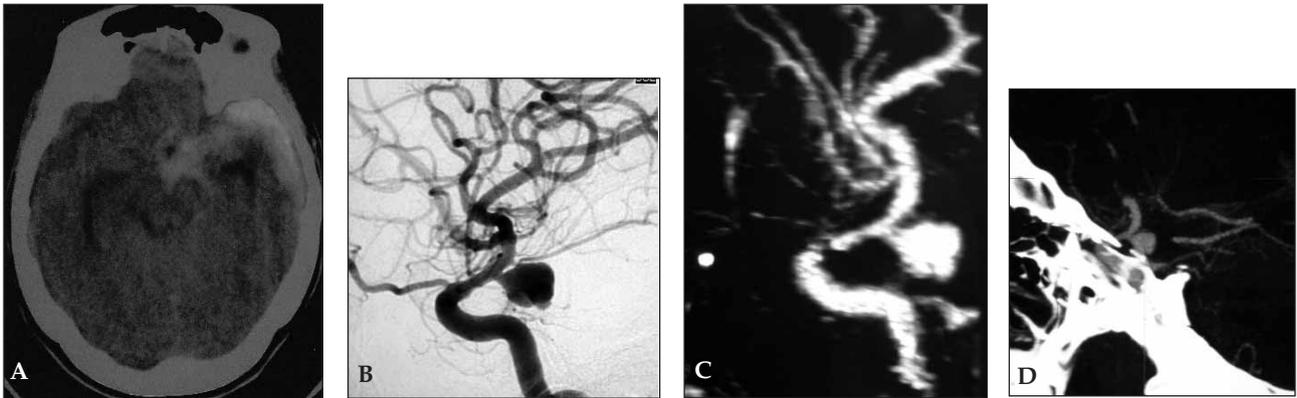


Figure 2: A) Cranial CT scan of Case 10 shows subarachnoid hemorrhage in suprasellar, interpeduncular and Sylvian cistern and subdural blood collection on the surface of the left temporal lobe, B) The angiogram reveals a large mid-carotid artery aneurysm with a narrow neck, C) and D) CT angiograms of the same patient show a large left IC-PC aneurysm with similar characteristics.

15,16,19). Prior to the era of CT, acute sSDH secondary to rupture of an intracranial aneurysm was diagnosed both at angiography or autopsy. Since the condition is frequently rapidly fatal, the reported incidence in autopsy studies (7,15) (10-22%) is higher than in clinical studies (3,9,13,14,16) (0.5-7.9%). Our experiences tend toward the middle of these two figures at about 1.6%. Acute sSDH in our series were found with aneurysms in various portions of circle of Willis: 5 IC-PC, 3 MCA, 2 AComA, and 1 ICA bifurcation. Four mechanisms for the development of acute sSDH due to ruptured aneurysms have been proposed (2,4,11,16,18). First, successive small bleeding episodes cause adhesion of the aneurysm to the adjacent arachnoid membrane, and the final rupture occurs into the subdural space. Second, a hemorrhage under high pressure may lead to pia-arachnoid rupture. Third, the arachnoid membrane is ruptured by rapid accumulation of blood under pressure from the leaking aneurysm. Fourth, erosion of the cavernous sinus wall by acute enlargement of the intracavernous aneurysm after thrombosis

Clarke and Walton (4) classified their patients into the three groups based on the amount of subdural clot and the clinical course: (Group I) cases with a massive and rapidly fatal intracranial hemorrhage, (Group II) cases with only an insignificant quantity of subdural blood, and (Group III) cases with a clinically significant subdural hematoma which is not rapidly fatal. In Group III patients, where the level of consciousness is not depressed (WFNS Grade 1-2), management may proceed in a standard manner with angiography and

surgery at the discretion of the neurosurgeon. Case 2, 5 and 10 were managed in this way with a good outcome. The management of patients in coma or whose level of consciousness is getting worse is problematical. There are two alternative approaches in Group I patients. First; emergency craniotomy is performed and evacuation of hematoma without angiography. Rapid cerebral decompression is therefore provided prior to definitive aneurysm surgery. The disadvantages of this approach include the threat of massive intra-operative hemorrhage from unidentified source and risk from early aneurysmal rebleeding. Two of our patients (Case 3 and 8) were managed in this fashion. They had an uncomplicated recovery from the first craniotomy and underwent diagnostic cerebral DSA and successful definitive surgery on the sixth and eighth day, respectively, without evidence of rebleeding. Second; diagnostic cerebral DSA is carried out before craniotomy and evacuation of hematoma. The preoperative identification of the responsible aneurysm and planning for its successful clipping may facilitate control of premature rupture if occurs. Four of our patients (Case 1,6,7 and 11) were managed in this fashion. One of these patients (Case 1) died before craniotomy.

Ruptured aneurysm should be ruled out in the differential diagnosis of acute sSDH, especially in the absence of head trauma. Appropriate therapy can be instituted when the lesion is demonstrated. Cranial CT only shows SDH and the accompanying findings, but does not reveal the cause of these pathologies. Although it is an invasive technique, cerebral DSA is still the gold standard and is indicated in acute sSDH

patients with no history of trauma. CT angiography or MR angiography instead of DSA may be used. In our series, CT angiography was used in last three patients (Case 9, 10 and 11). CT angiography has become a high-performance diagnostic tool. Compared with DSA, CT angiography has the advantage of noninvasiveness, with less morbidity, and is easier to perform on fragile unstable patients (1,5,20). Additionally, it is fast, less painful, does not necessitate sedation, and is especially useful in the case of a hematoma needing urgent surgical decompression. CT angiography also has an acceptable sensitivity, especially for the diagnosis of the aneurysm responsible for sSDH. CT angiography may have become the first-choice examination in the case of sSDH but the negative predictive value remains low and DSA remains mandatory after a negative CT angiography.

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