LEAKING intradural aneurysms usually produce extensive subarachnoid hemorrhage. In rare instances the bleeding may occur into the subdural space and the clinical manifestations may be those of an acute subdural hematoma.

Five such cases of subdural hematoma associated with bleeding intracranial aneurysm have been encountered within our experience with these lesions. They present additional problems in diagnosis and treatment not common to the usual aneurysm with subarachnoid hemorrhage.

CASE REPORTS

Case 1. N.P. was a 38-year-old, left-handed female who slipped on the linoleum on Mar. 17, 1942, striking her right cheek and elbow on the floor. She was confused and drowsy for 24 hours. X-rays of the skull showed no abnormality. A month later right frontal headache and vomiting developed and she became semicomatose, at which time she was referred to University Hospital.

Upon admission B.P. was 140/94; pulse rate 80, and respirations 15. She was drowsy, uncooperative and tended to perseverate. There was early bilateral papilledema. The right pupil was larger than the left. There was a mild right central facial palsy and a right hemiparesis. An extensor plantar response was present on the right.

Under local anesthesia a small bone flap was turned in the left parietal-parasagittal region. Bloody fluid and clot under increased pressure were evacuated from the subdural space. The bone flap was re-elevated 48 hours later when the patient again became comatose and totally hemiplegic. More bone was removed and a needle was inserted into the left superior temporal gyrus. Bloody fluid under increased pressure was encountered.

Angiography performed after the patient had improved showed a small aneurysm on the most proximal portion of the middle cerebral artery and elevation of the Sylvian vessels (Fig. 1).

No further treatment was instituted; she gradually improved. She has had no further difficulty for 9 years except for four grand mal seizures and occasional headache centered behind the left eye. Optic atrophy O.S. and astereognosis of the right hand persist.

Case 2. F.M. was a 45-year-old male under psychiatric treatment for chronic alcoholism and psychosis. On Aug. 23, 1945, he was struck on the occiput by a disturbed patient. He fell to the floor, arose and a few minutes later fainted and once

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Fig. 1. Case 1. Aneurysm of middle cerebral artery (lateral view).

Fig. 2. Case 2. Aneurysm of middle cerebral artery (frontal view) with subdural clot.
again he struck his head in falling. Later that day he complained of dizziness. Two days later there developed Jacksonian fits involving the right half of his body.

The patient had an expressive aphasia. The pupils were round and equal and reacted to light. A right central facial palsy and right hemiparesis were present.

Lumbar puncture revealed a pressure of 130 mm. of water. The fluid was grossly bloody.

Angiography demonstrated a small aneurysm on a peripheral branch of the left middle cerebral artery. A subdural clot over the left hemisphere was suggested by displacement of the entire arterial system toward the right producing a 1½ cm. space between cerebral cortical vessels and dura (Fig. 2).

**Fig. 3. Case 3. Aneurysm of right internal carotid artery (lateral view).**

Left parietal osteoplastic craniotomy revealed a chronic subdural hematoma depressing the cortex 1½ cm. A pea-sized aneurysm, actively bleeding, was found in the supramarginal gyrus. From this area upward toward the midline there was a triangular infarct within cortex. Inner and outer membranes of the hematoma were removed and the aneurysm was ligated and removed.

The following day the patient lapsed into deep coma. The subdural space was again explored and recurrent clot discovered and removed. The subdural space was obliterated by re-expansion of the brain by spinal infusion of Ringer's solution.

The patient made an uneventful recovery and 6 years later was adjusting well in the community. He has had convulsions which are well controlled by medication.

**Case 3.** H.S. was a 43-year-old, right-handed female found in a semicomatose state in the restroom of a restaurant 3 weeks before admission. She complained of pain in the right side of her head and had weakness of her left leg. Thirty minutes later she became unconscious and had a grand mal fit. Lumbar puncture revealed
grossly bloody CSF. She gradually improved, but later became more irrational and hyperactive and was referred to University Hospital on Jan. 6, 1951.

Examination revealed B.P. of 110/70, pulse rate of 76, and respirations of 20. She was disoriented and had periods of hallucination. An extensor plantar response was present on the right. There were no other localizing signs.

Fig. 4. Case 3. Photograph of subdural hematoma over frontal lobe as seen during intracranial trapping of aneurysm.

Angiography demonstrated a supraclinoid aneurysm projecting posteriorly from the internal carotid artery several mm. proximal to the bifurcation. There was elevation of both anterior cerebral arteries, more on the left, suggesting the possibility of intracerebral hemorrhage in the region of the corpus callosum (Fig. 3).

The internal carotid artery was ligated in the neck. Six days later this vessel was ligated intracranially (trapping the aneurysm) distal to the aneurysm but below the circle of Willis. A subdural hematoma, with an inner and outer membrane, was found over the right frontal lobe anterior to the intra-aural plane, depressing the cortex 1 cm. from the dura (Fig. 4). At this second operation, the aneurysm was seen to present posteriorly and the sac was thrombosed electrosurgically.

The patient recovered from the operation with a left hemiparesis and 3rd nerve palsy. One year later her physician reported that she was doing well and had only minimal residuals of her original neurologic deficit.

Case 4. H. I. was a 39-year-old, right-handed male who was struck on the head by a steel beam while at work. He had headache and stiff neck for 3 to 4 days. Five months later he had an episode of "flu" following which he had daily headache for 1 month. Twenty-four hours before admission to the hospital, he had sudden onset of weakness and dizziness while fixing a door. He became comatose, Cheyne-
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Stokes respirations developed, and blood pressure rose to 240/140. He gradually regained consciousness during the next 24 hours before being referred to University Hospital on May 3, 1951.

Examination revealed B.P. of 110/70, pulse rate of 60, and respirations of 20. Nuchal rigidity was present. The patient was drowsy and confused. Central facial palsy and hemiparesis were present on the left. Extensor plantar response was present bilaterally.

Lumbar puncture revealed a pressure of 170 mm. of water and grossly bloody fluid.

Angiography was performed after the acute clinical symptoms had subsided. A large aneurysm was demonstrated arising from the right anterior cerebral artery, approximately 2 cm. distal to the bifurcation of the internal carotid artery. There was displacement of the anterior cerebral artery to the left, suggesting an intracortical clot (Fig. 5).

Two days later the anterior cerebral artery was ligated intracranially proximal and distal to the aneurysm. Upon opening the dura, a large acute subdural hematoma of old and bright red blood was found over the right frontal lobe. While this was being evacuated the aneurysm began bleeding and a large subcortical clot

Fig. 5. Case 4. Aneurysm of anterior cerebral artery (frontal view).
extruded from the frontal lobe under increased pressure. A large clot was also found between the hemispheres and in the left frontal pole.

The patient tolerated the trapping procedure very well and except for a left hemiparesis which gradually disappeared in 1 month, he has no residuals 1 year later.

Case 5. H.W. was a 52-year-old, right-handed male admitted with a 2-week history of right-sided headache. The day before admission a sharp pain developed in the right side of his face and he fell from his tractor. He was seen by his doctor who found him to be conscious and presenting no external injuries except for abrasions about the face and neck. He was later referred to University Hospital on Oct. 6, 1951, when he became irrational.

Upon admission there were periods of bradycardia and Cheyne-Stokes respirations. Slight nuchal rigidity was present. He was restless and confused. Pupils were round and equal and reacted sluggishly to light. Superficial and deep pain sensation was decreased over the left half of the body. The left upper extremity showed weakness and forced grasping. The deep tendon reflexes were more active on the left. There was a bilateral extensor plantar response.

X-rays of the skull showed no abnormality.

Under general anesthesia a flap was turned in the right frontal parietal region. A soft fresh blood clot was found in the subdural space. This hematoma depressed the nonpulsating brain 2 cm. from the dura. Subarachnoid hemorrhage was seen beneath this clot. After total removal of the clot the brain pulsed normally.

Fig. 6. Case 5. Aneurysm of internal carotid artery (lateral view).
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Ten days later, a small aneurysm of the intradural portion of the right carotid artery was shown by angiography. This lesion was seen to present lateral to the carotid siphon. There was no displacement of the anterior or middle cerebral arteries (Fig. 6).

The internal carotid artery was then completely occluded in the neck with a Selverstone clamp over a 5-day period without ill effects. Two months later a minimal left hemiparesis remained.

DISCUSSION

Subdural hematoma with bleeding aneurysm has been reported by several authors in the study of autopsy material[2,3,6,7,10,11,12,14] but little attention has been directed toward the surgical significance of this condition.4,5,8,9 Although occurring infrequently in material seen at University Hospital during the period 1941–51 (5 subdural hematomas in 63 cases of surgically treated aneurysm1), these lesions presented additional diagnostic and therapeutic problems not common to the usual intracranial aneurysm.

Subdural hematoma in our material was found with aneurysms in various portions of the circle of Willis: 3 intradural carotid aneurysms (1 autopsy case), 2 middle cerebral aneurysms, 1 anterior cerebral aneurysm, and 1 vertebral aneurysm (autopsy case). A lesion of this same type was seen by Hassin6 in autopsy material associated with an aneurysm of the posterior communicating artery. Autopsy study has disclosed that clot accumulates in the subdural space through tears in the arachnoid.13

This group of cases of subdural hemorrhage associated with aneurysmal rupture presented two distinct syndromes. Three cases clinically simulated classical subdural hematoma, and the other 2 cases presented the characteristic story and findings of leaking aneurysm associated with subarachnoid bleeding. A history of significant trauma led to suspicion of subdural hematoma in 3 cases. The studies of Vance10 on fatal subdural hemorrhage from ruptured arteries suggest that trauma may be an important etiological factor in cases of this type, although the congenital nature may be suggested by an antecedent history of neurological symptoms; such a history may be the initial clue to the surgeon that he is dealing with a more complex lesion than an acute subdural hematoma.

Those cases presenting as bleeding aneurysm were readily diagnosed by angiography; however, the presence of subdural hematoma was not recognized until the skull was opened for attack upon the aneurysm. The presence of subdural hemorrhage was overshadowed by the roentgen signs of intracortical clot.

The diagnosis of aneurysm in those cases presenting as subdural hematoma is difficult. However, certain findings at the time of trephination suggest such a lesion. Following evacuation of the clot, the brain continues under marked tension leading one to suspect the possibility of leaking aneurysm as the source of the bleeding, particularly in the presence of subarachnoid hemorrhage. The presence of xanthochromic or bloody ventricular fluid under pressure or of subcortical clot is further evidence for the presence of
bleeding aneurysm. Aneurysms that manifest themselves clinically as subdural hematoma may be overlooked if the above signs and symptoms are not recognized by the surgeon at the time of evacuation of the clot. When the source of bleeding cannot be visualized through the intracranial opening used in evacuating the subdural clot, aneurysm should be sought for angiographically. Appropriate therapy can then be instituted when the lesion is demonstrated.1

SUMMARY

The presence of subdural hematoma with bleeding intracranial aneurysm was found to present additional diagnostic and therapeutic problems not commonly encountered. These subdural hematomas presented two distinct clinical lesions. The clinical findings in one group of cases simulated those of the usual subdural clot. In the other cases the subdural hematoma was discovered incident to treatment for recognized bleeding aneurysm. Upon exposure and evacuation of subdural clot a bleeding aneurysm should be suspected in the presence of subarachnoid hemorrhage, brain under tension, xanthochromic or bloody ventricular fluid, or intracortical clot. When any of these signs are found in association with subdural hematoma diagnostic angiography is indicated.

REFERENCES