Intracranial Aneurysm in Late Pregnancy
Report of a Successful Operation Utilizing Hypothermia

LYCURGUS M. DAVEY, M.D., JOSEPH A. FIORITO, M.D.*, AND FREDERICK W. HEBBE, M.D.
Division of Neurosurgery, Department of Obstetrics and Gynecology, and Division of Anesthesiology, Grace-New Haven Community Hospital and Yale University School of Medicine, New Haven, Connecticut

Rupture, or impending rupture, of an intracranial aneurysm is potentially one of the most lethal situations that occurs in young adults. When this happens during normal pregnancy, two lives are in jeopardy. Unruptured aneurysms are rarely symptomatic. The incidence and time of rupture parallel the hemodynamic changes of pregnancy, and are apparently greatest in the third trimester when the changes in maternal cardiac output and blood volume are at their peak.17 The obstetrical management of pregnant patients with diagnosed aneurysms of the circle of Willis has been marked by severe differences of opinion.

We are reporting the case of a symptomatic, but apparently unruptured, anterior communicating artery aneurysm in a woman who had definitive and successful aneurysmal surgery in the 8th month of pregnancy, which 3 weeks later ended with the normal delivery of a normal child.

Case Report

This 27-year-old pregnant housewife was admitted to the Grace-New Haven Community Hospital on May 28, 1963, with a chief complaint of sudden severe headaches.

First Admission. On April 18, 1963, she suffered an abrupt, intense, right-sided headache which required hospitalization elsewhere and which subsided in 3 days. Lumbar puncture 1 week later revealed a cerebrospinal fluid protein of 19 mg. per cent and 55 red blood cells per cubic millimeter, none of which were ependymal. On May 24, 1963, the patient experienced a period of light-headedness, and a sensation of pressure and tingling in the back of the neck and on the right side of the head. Numbness in the left leg, with paresis of the left foot and toes followed. These sensations subsided within minutes but were associated with a severe and persistent headache. She was admitted to Grace-New Haven Community Hospital for evaluation.

Past History. Her past history was non-contributory. Her first pregnancy had been uneventful and had terminated with the spontaneous delivery of an 8 lb, 15 oz. male, who, however, was thought to be a month postmature.

Physical Examination. Temperature, 98.6°F.; blood pressure, 115/70 mm. Hg; pulse, 88; weight, 185 lbs. The physical and neurological examinations were considered to be within normal limits. There was no uclial rigidity. The pregnancy appeared normal.

Laboratory Data. Hemoglobin, 10.5 gm.; hematoctrit, 38 per cent; white blood cells, 15,400 per cu. mm.; urinalysis, normal; serological tests for syphilis, non-reactive; blood glucose, 84 mg. per cent; blood urea nitrogen, 6 mg. per cent; total protein, 6.5 gm. per cent; albumin, 3.5 gm. per cent; globulin, 3.0 gm. per cent. X-rays of the skull were normal. An electroencephalogram, May 28, 1963, was suggestive, but not diagnostic, of an underlying seizure pattern and seizure potentiality in the right temporal area. On May 31, 1963, a right carotid arteriogram demonstrated an aneurysm at the junction of the internal carotid with the anterior cerebral artery, arising on the right and situated in the midline. Left-sided arteriography on June 3, 1963, showed a normal vascular pattern, except that the aneurysm was again demonstrated by the use of contralateral carotid compression. Lumbar puncture, June 4, 1963, revealed an initial pressure of 150 mm. Hg. There was no xanthochromia. Cerebrospinal fluid protein: 16 mg. per cent; cell count showed 5 red blood cells, and 9 white blood cells per cu. mm. The patient suffered no complications from the diagnostic procedures and was discharged, at her request, on June 8, 1963.

Second Admission. She was readmitted on June 17, 1963. History and physical examination were as on discharge and there had been no further episodes in the interim. Obstetrical consultation at this time indicated that her last menstrual period was on September 18, 1962, and the expected date of confinement June 25, 1963. Estimated fetal size was 6½-7 lbs. Pelvic examination showed that the fetal head was very high and the cervix long and tightly closed. The consultant felt that labor was not imminent and that the condition of the cervix was not favorable for the induction of labor.

Anesthesiology consultation indicated that the proposed craniotomy should be under general anesthesia supplemented by hypothermia. Osmotic diuretics were contraindicated because of the dehydrating effect on the pregnancy.24 Induced hypotensive anesthesia was contraindicated because of the adverse effects on the fetus.12-18 If the mother went into labor in the postoperative period, the continuous use of lumbar peridural anesthesia was anticipated.4

Anesthesia and Hypothermia. On June 20, 1963, the patient was brought to the operating room after premedication with meperidine 0.050 gm., promethazine 0.025 gm., and scopolamine 0.0005 gm., the effect of which was described as good. Cesarean section instruments, heated bassinet and infant resuscitation equipment were ready in the operating room. An indwelling Foley catheter was placed. A continuously recording fetal electrocardiogram was attached to the maternal abdomen; the fetal complexes were normal in rate and amplitude. Anesthesia was induced with intravenous thiopental 0.350 gm. in divided doses. After the injection of succinylcholine 0.060 gm. intravenously, the trachea was intubated with a 296 Murphy endotracheal tube,

Received for publication December 21, 1964.

* Deceased.
and, nitrous oxide, oxygen and halothane were adminis-
tered for maintenance anesthesia. The patient was
curarized and artificially respired with a Jefferson
ventilator. An arterial needle was placed in the right
brachial artery. Hypothermia was induced using a
blanket, supplemented with ice bags in the axillae and
groins. Fetal electrocardiogram was constantly recorded
and monitored. After 7 hours, the temperature was
88°F., and surgery was begun. The lowest recorded
temperature was 85°F. During this period, the systolic
blood pressure was stable at 80 mm. Hg and the fetal
heart gradually slowed as the cooling progressed, but
was regular at 80-82 beats per minute at the lowest
temperature. Rewarming was started at 7:50 p.m.,
11 hours after the induction of anesthesia, as closure
of the skull was begun. Spontaneous respirations were
adequate at 12:28 a.m., June 21, 1963, 16 hours after
induction of anesthesia. The fetal heart rate rose
steadily during rewarming, and at 93.5°F. it was
recorded as 118-122 beats per minute, when the patient
was transferred to the Intensive Care Unit. (See chart).
There was moderate fetal activity. No abnormal uterine
tone had been observed. Total urinary output was
700 ce. Arterial blood samples during the procedure
showed:

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<thead>
<tr>
<th></th>
<th>pH</th>
<th>Total CO₂</th>
<th>PO₂</th>
<th>O₂ Sat. per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early</td>
<td>7.315</td>
<td>43</td>
<td>117</td>
<td>97.8</td>
</tr>
<tr>
<td>Late</td>
<td>7.34</td>
<td>35.5</td>
<td>195</td>
<td>99.2</td>
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**Operation.** The skull was entered through a right
frontal osteoplastic craniotomy. The brain became
sicker when hyperventilation was increased. Yellowish
discoloration of the brain around the base of the aneu-
rysms suggested that there had been previous minimal
bleeding. There were 2 smaller aneurysms, all on the
right anterior cerebral artery. Aneurysmorraphy was
performed separately on the smaller aneurysms. In
spite of special efforts to avoid this very complication,
the base of the large aneurysm was caught in the loop
and when the loop was tightened, the large aneurysm
was amputated near its base. After a short period of
brisk bleeding, it was possible to place a clip across the
base of this aneurysm. The patient did not show signs of
shock. All aneurysms appeared completely controlled.

**Postoperative Course.** The patient was alert and
oriented the following morning. Her postoperative
course was benign except for extensive edema of the
face and eyes, and a minimal staphylococci auresus in-
fecition of one corner of the scalp wound which re-
pended to penicillin and topical bacitracin. Arteriogra-
phy, July 10, 1963, showed no filling of the aneurysm
but visualized both anterior cerebral arteries. A silver
clip was present where the base of the aneurysm had
been demonstrated earlier.

On July 13, 1963, 25 days after craniotomy, regular
uterine contractions began. Four hours later continuous
lumbar peridural anesthesia was induced and continued
through the labor. The patient was delivered by low for-
ceps of a male infant, weighing 6 lbs., whose Apgar
scores were 7 at 1 minute and 10 at 5 minutes. The
labor, anesthesia and delivery were considered normal.
The patient had a normal puerperium and was dis-
charged on the 7th postpartum day, 30 days after the
surgical treatment of the aneurysm.

Subsequent follow up of mother and child has been
normal in all respects.

**Discussion**

The question was which of the patient's 2 problems should take precedence:

1. When should the aneurysm be attacked
   intracranially?

2. When and how should the pregnancy be
terminated?

The aneurysm was proven, symptomatic, and in
danger of spontaneous rupture. The pregnancy
was within a month of term and the baby viable.
However, the estimated date of confinement was
doubtful, and the cervix was not ready for labor
or induction. Of the several possible solutions, all
carried calculated risk to one or both patients:

1. Allow spontaneous labor and attack the
   aneurysm in the postpartum period. This would
   have exposed both mother and child to the maxi-
mum danger from rupture of the aneurysm, and
   introduced the hazard of handling labor in a
   woman whose general condition might be critical
or even terminal.

2. Induce labor and attack the aneurysm in
   the postpartum period. This would have shortened
the time, but increased the stress on the aneurysm
and produced a premature infant.

3. Deliver the baby by elective cesarean section
   and attack the aneurysm immediately or in the
   postpartum period. This would have afforded
maximum protection to the baby, except for prem-
maturity, but would have exposed the mother
to the stress of a major operation plus problems
in the postoperative and postpartum periods.
Several authors have felt that abdominal de-
ivery per se offers no specific advantages.

Pool's opinion was that the aneurysm should be
treated in the same manner as if the patient
were not pregnant. Personal opinions were sub-
sequently solicited from others experienced in
the fields of hypothermia and/or neurosurgery.
Rosomoff and Virtue stated that they would
not hesitate to use hypothermia in this circum-
stance. Little informed us of a woman seven
months pregnant whose aneurysm was success-
fully clipped under hypothermia and who was
delivered by cesarean section prior to term. Uhlein
informed us of another case operated upon
successfully under similar circumstances,
but felt that hypothermia of the profound type
with circulatory arrest would not be well tolerated
by the fetus.

Despite the voluminous literature on induced
hypothermia, reports of its use and effects during
pregnancy are sparse. There have been reports of
the successful use of hypothermia during
pregnancy, as well as those that have