HYPOTHERMIA ANESTHESIA IN THE
SITTING POSITION

REPORT OF TWO CASES OF ACOUSTIC NEURINOMA*

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In an editorial appearing in the March 1950 issue of Surgery, Gynecology
and Obstetrics, Horrax3 remarked that "the removal of an acoustic
tumor is, by and large, the most serious and potentially hazardous
operation of all those undertaken for intracranial new growths." He went
on to say that "the five year mortality for the intracapsular procedure is
between 50 and 60 per cent, and the chance of useful survival is not over
40 per cent, probably less. For complete removal the five year mortality
varies from 12 to 25 per cent, and the useful survival figure is at least 65
per cent. From these data, it would appear that primary, complete extirpa-
tion of acoustic tumors is the surgical procedure of choice."

In 1949, Atkinson1 clearly demonstrated that the postmortem finding
of malacia pontis following removal of acoustic neurinoma is caused by
occlusion of the anterior inferior cerebellar artery or one of its branches.
Thus, the problem of total removal of acoustic neurinoma is twofold: first,
the actual size of the lesion and second, preservation of the blood supply
to the brain stem. Atkinson pointed out that there is a decrease in the num-
ber of functioning anastomotic branches between the anterior inferior and
posterior inferior cerebellar arteries following cerebellar resection and com-
pression of this structure, which is a necessary step for removal of a large
acoustic neurinoma. In addition, he noted that there may be associated
spasm of the arterial branches of the anterior inferior cerebellar artery when
the main branch is occluded; this also holds true for their collateral anas-
tomoses with adjacent arteries. Therefore, these vascular changes may
contribute to infarction of the brain stem. Atkinson reached the conclusion
that there is grave danger to the patient if the anterior inferior cerebellar
artery is occluded during operation on an acoustic tumor because of the
possible damage to the autonomic pathways in the lateral portions of the
tegmentum of the brain stem.

On the other hand, in 1955 McKenzie,5 in discussing operative treat-
ment, observed that in order to carry out a total removal of acoustic neurin-
omas the anterior inferior cerebellar artery is invariably clipped and di-

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vided. He concluded that: "In all probability surgeons will have an irreducible mortality in the neighborhood of 10 per cent because of the importance of this artery."

Recent studies, such as those carried out by Rosomoff\(^6\) in 1956, have demonstrated that following experimental surgical interruption of the major cerebral arteries during hypothermia anesthesia no infarction developed, or if small lesions were found they were restricted to relatively silent areas. The temperatures were reduced in experiments on dogs to 22–24\(^\circ\)C. In this study Rosomoff pointed out that there is a reduction of blood flow that facilitates hemostasis and a decrease in the brain volume that enhances surgical exposure and diminishes intracranial pressure.

With few exceptions, acoustic neurinomas are now being approached surgically with the patient in a sitting position. This poses the problem of postural hypotension and air embolism. Gardner\(^2\) has recently dealt with hypotension by using an inflatable cuff over the lower extremities. McKenzie\(^4\) stated that the risks of air embolism and hypotension are outweighed by the advantage of properly visualizing the line of cleavage between the tumor and the brain stem in a relatively bloodless field.

TECHNIQUE OF HYPOTHERMIA IN THE SITTING POSITION

Hypothermia anesthesia was performed in the sitting position on 2 young female patients with huge acoustic neurinomas in an effort to avoid the possible complication of malacia pontis after clipping and dividing the anterior inferior cerebellar arteries during the total removal of the tumors. Anesthesia was induced with intravenous Surital and tracheal intubation with the aid of succinylcholine for relaxation. Anesthesia was maintained with nitrous oxide and small fractional doses of Surital. Chlorpromazine was not employed because of its hypotensive effect as a result of autonomic blockage. Three standard electrocardiographic limb leads were applied to monitor the electrocardiographic actions on an oscilloscope. The patients' lower extremities were wrapped in elastic bandages or encased in elastic stockings from the toes to the groins. The patients were then placed in the supine position between the large precooled Therm-O-Rite blankets. They were then raised gradually to a sitting position, using the American Sterilizer table and the Craig headrest (Fig. 1). In each instance, the temperature was lowered to 30\(^\circ\)C. The electroencephalographic leads placed over the frontal, parietal, and temporal regions made continuous recordings. While hypothermia was being induced, the right brachial artery was cannulated under direct vision to permit constant intra-arterial pressure readings. The radial arteries were not used because of insufficiency of the ulnar artery. A venous cutdown in the same arm was employed for intravenous infusions. One bottle of intravenous solution containing a vasopressor agent was on hand to offset a possible fall of the systolic blood pressure below 100 mm. of mercury. The patients were draped in such a fashion as to allow for immediate thoracotomy and cardiac massage in the event of cardiac arrest.
Instruments for thoracotomy and cardiac stimulants were available in the operating room.

The temperature of 30°C. was reached in each instance prior to occlusion and division of the anterior inferior cerebellar artery. In the first patient a delay in reaching 30°C. occurred because only one blanket was used. The sitting position of the patient resulted in kinking the tubes within the single blanket and stopping the circulation of the coolant. When a second blanket was added the temperature promptly dropped to the desired level. This complication did not occur in the second patient when two blankets were used (Fig. 1). The temperature of 30°C. was maintained until removal of the tumor was accomplished and closure was commenced. At no time was there any sign of cardiac disturbance in either patient, and at no time did the systolic blood pressure drop below 90 mm. of mercury. As a matter of fact, the anesthetic chart of Case 1 showed a marked hypotension until the 30°C. level was reached, at which time pressures fell only to mild hypertensive levels. The blood pressure in Case 2 was essentially in the low, normotensive range with one episode of severe hypotension. At no time were alarming hypotensive levels approached.

The patients were allowed to warm and regain full control of their medullary centers. Tracheotomy was performed immediately after the operation in both instances to facilitate postoperative care. In Case 2 an
immediate tarsorrhaphy was performed; in Case 1 this procedure was done on the 4th postoperative day to treat an early neuroparalytic keratitis.

The patients made remarkably uneventful recoveries without any significant disturbance of fluid or electrolyte balance. Each patient maintained a low-grade elevation of temperature for a week or 10 days after operation, apparently because of the blood in the subarachnoid space and contusion of the resected cerebellar lobe. Postoperatively, no neurologic sign suggestive of infarction of the brain stem occurred. In fact, improvement of preoperative neurological deficits was noticeable in 7 to 14 days.

**CASE REPORTS**

**Case 1.** M.F., a 42-year-old widowed, former professional pianist and organist, in 1951 noted the onset of a roaring sound of the left ear and loss of certain high tones within a musical chord. Two years later the hearing had decreased markedly in the left ear. Concomitantly, incoordination developed in her gait, as well as in the left upper extremity and she also noted a numbness on the left side of the face that involved the upper lip, cheek, forehead, and side of the tongue. By 1955, it was evident that her speech was slurred and that she had difficulty in swallowing, with a tendency to regurgitate fluids through her nose.

**Examination** on admission in September 1956 revealed early bilateral papilledema. Marked nystagmus on right and left lateral gaze and a rotary type of nystagmus on upward gaze were present. The corneal reflex on the left was completely absent. Hypesthesia and hypalgesia existed on the left side of the face, together with suggestive weakness of the left temporalis and masseter muscles. A partial peripheral type of left facial weakness was observed. The left labyrinth was completely unresponsive with almost total deafness on that side. The pharyngeal reflex was absent on the left and the patient’s speech was markedly slurred. The tongue tended to deviate to the left. Marked ataxia in the left upper and lower extremities with other signs of dyssynergia were found; motor strength was unimpaired. She walked on a broad base and staggered to the left. The deep tendon reflexes on the left side were hypeactive as compared to the right.

Roentgenograms of the skull revealed a wide funnel-shaped porus acusticus on the left consistent with acoustic neurinoma.

Routine laboratory studies were within normal limits. The opening cerebrospinal fluid pressure was 230 mm. of water; the closing pressure was 180 mm. The fluid was xanthochromic and contained 263.5 mg. of protein.

**Diagnosis.** Left acoustic neurinoma.

**Operation.** On Oct. 22, 1956, a huge, partly degenerated, acoustic neurinoma which extended from the foramen magnum through the incisura, markedly compressing the brain stem, was uncovered by Dr. Paul H. Crandall. After the lateral half of the cerebellar hemisphere was resected, the tumor was totally removed according to the technique described by McKenzie.6 No noticeable damage to the brain stem occurred during this dissection. The wound was closed in the usual fashion. The patient tolerated the hypothermia anesthesia in the sitting position quite well, but maintained a moderate to marked degree of hypertension throughout the procedure.

**Course.** The patient had an immediate low-grade febrile course which gradually subsided. At no time did she show significant electrolyte or fluid imbalance. She
was fed for the first week by nasal gastric tube following the discontinuation of intra-
venous feedings 48 hours after surgery. Tracheotomy performed immediately after
surgery provided a satisfactory airway and seemed to play a major role in the post-
operative course. Tarsorrhaphy was done 4 days after surgery because of an early
neuroparalytic keratitis. On Nov. 8, 1956, a left hypoglossal-facial anastomosis was
carried out under general anesthesia. The patient had an uneventful recovery and
was discharged.

Case 2. L.A.S., a 25-year-old housewife, awoke one morning in mid-March 1956,
with numbness and tingling of the left side of her body and head, weakness of the
left extremities, and deafness and tinnitus in the left ear. These symptoms progressed
slowly in intensity and soon became associated with left facial weakness, unstead-
iness of gait, slurring of speech, and decreased visual acuity. On direct questioning
she described the frequent occurrence of severe suboccipital headaches and occa-
sional dizzy spells with facial flushing over the past 4 years.

Examination. On admission on Oct. 2, 1956, early papilledema was found. The
visual acuity O.U. was 20/20 with normal peripheral and central fields except for
enlarged blind spots. Nystagmus of a marked degree was found on left and right
lateral gaze with a rotatory type on upward gaze. The sensory portion of the left
trigeminal nerve was completely involved but only a partial motor loss was found.
Moderate weakness of the entire left side of the face with associated loss of taste on
that side was present. Loss of hearing in the left ear of nonconduction type was
severe to the point of clinical deafness. Moderate loss of conduction was also present
on the right. The gag reflex was absent bilaterally and the uvula rose to the right
side. The vestibular test on the right was normal; on the left there was no response.
The spinal accessory and hypoglossal nerves were intact.

Marked ataxia of the left extremities was present with staggering of gait and a
tendency to fall to the right. In addition, an almost athetoid movement of the left
upper extremity existed during finger-to-nose testing.

No definite involvement of pyramidal tract or medial lemniscus was found. The
superficial and deep tendon reflexes were essentially normal with plantar responses
being flexor.

At lumbar puncture the opening pressure was 230 mm. of water. The fluid was
very slightly xanthochromic containing a total protein of 314 mg. per cent and a
colloidal gold curve of 555432110. The Pandy was 3+. The electroencephalogram
and the electrocardiogram were normal. Roentgenograms of the skull showed ero-
sion and funnelling of the left porus acusticus. Planograms of the petrous bones con-
firmed these findings. Roentgenogram of the chest was normal.

Diagnosis. Left acoustic neurinoma.

Operation. Total removal of a very large acoustic neurinoma which extended
from the incisura to the foramen magnum was performed.

Course. The patient responded immediately after anesthesia and had an un-
eventful convalescence. As in the first case, nasal gastric-tube feeding was used until
she could swallow easily. A left hypoglossal-facial nerve anastomosis was performed
on Nov. 15, 1956. Recovery was uneventful.

DISCUSSION

Although the risk of hypothermia is added to hazards generally present
when an effort is made to do a total removal of an acoustic neurinoma, it is
felt that these 2 cases serve to illustrate that such a procedure is feasible and may be carried out with relative safety. And, in the future, lower hypothermic levels may be utilized to give added protection to the brain stem. Careful attention must be given to the preoperative cardiovascular status, position of the patient, and blood pressure during operation. The intraarterial pressure readings were about 20 mm. of mercury above those taken with the usual balloon sphygmomanometer.

It is apparent, of course, that in approximately 90 per cent of patients, according to McKenzie, total removal of an acoustic neurinoma may be accomplished without producing significant malacia pontis. Thus, these 2 patients may well have fallen into this major group. It is felt, however, that hypothermia significantly helped them survive during their operative procedure as well as during the postoperative period. It is believed that, in selected cases, hypothermia anesthesia in a sitting position will reduce the mortality of total removal of acoustic neurinomas below 10 per cent by avoiding infarction of the brain stem. This technique may also be of value in the neurosurgical approach to vascular tumors and anomalies in the posterior fossa. Recently, since these initial experiences, a third patient with a vascular lesion of the anterior portion of the circle of Willis was operated upon successfully by Dr. Theodore Kurze. The sitting position with a modified position of the head and hypothermia anesthesia of 29–30°C were employed. The visualization of the pathology was excellent. The patient tolerated this position and the hypothermia without significant hypotension or other changes in vital signs. Various anti-G suits for lower extremities and abdomen are now under study in an effort to determine their adaptability to hypothermia anesthesia in the sitting position for neurosurgical problems.

SUMMARY

A new technique employing hypothermia anesthesia in a sitting position has been presented. Its value for various types of neurosurgical procedures has been discussed.

ADDENDUM

Since submission of this paper for publication 3 additional patients have been operated upon by the various members of the staff, employing hypothermia anesthesia in the sitting position. The first patient, a 22-year-old female, was explored for a probable cerebellopontine-angle tumor. The temperature was lowered to 30°C. The second, a 52-year-old male, harbored an aneurysm of the anterior communicating artery. The temperature was decreased to 28°C. The aneurysm was successfully isolated between silver clips. The most recent problem was an arteriovenous malformation of the right occipital lobe in a 15-year-old boy. The temperature was lowered to 30°C. during the successful resection of the lesion. Normotensive blood pressure levels were maintained in all of these patients without the use of vasoconstrictor drugs. The patients tolerated hypothermia anesthesia in the sitting position without complications.
REFERENCES


