OCCLUSION OF THE MIDDLE CEREBRAL ARTERY
UNDER NORMOTENSION, AND ANEMICALLY INDUCED AND
CHEMICALLY INDUCED HYPOTENSION*

BRUCE RALSTON, M.D.,† THEODORE RASMUSSEN, M.D.,‡
AND THELMA KENNEDY, M.S.

Division of Neurological Surgery, University of Chicago, Chicago, Illinois
(Received for publication September 21, 1954)

During the past four years, there has been a growing interest in the use of induced hypotension for surgical procedures. Whereas this was previously accomplished by arteriotomy and retransfusion,† most recent work deals with the reduction of blood pressure by means of “neurogenic” or “ganglioplegic” mechanisms such as are available in total spinal anesthesia‡ and by chemical ganglionic blocking agents.

During hypotension induced by ganglionic blocking agents, the blood pressure falls as a result of arteriolar dilatation, 13 the pulse generally remains stable, capillary refill time is unaltered, the skin is pink and respiration is slow. In hypotension produced by bleeding there is associated arteriolar constriction leading to capillary stasis, anoxia and the increased danger of irreversible tissue damage.

The clinical use of ganglionic blocking agents (mostly of the methonium group) has now become extensive, both in the United States and abroad. A number of complications have been reported. Among these are cerebral artery occlusion, decerebration, and blindness. 2,6,7 Other workers, however, have been impressed with the increased safety with which certain major surgical procedures can be carried out with the help of this method. 12,13,18

Perhaps the most important area for the application of this new method has been in neurological surgery. Its use has markedly reduced the hazard of operating on large vascular meningiomas and some of the major vascular anomalies of the brain. Neurosurgical reports of experiences with blocking agents have been almost uniformly favorable. They indicate that fatalities have been low and that those that have occurred are not generally traceable to the hypotension. 1,12,13,17,18

Despite the use of methonium compounds in several thousand cases, little has been done experimentally to check on the clinical impressions or to study the altered vascular dynamics or to search for pathological changes in the vascular tree. Morris et al. 11 found in unanesthetized humans, in the supine position, a significant decrease in cerebral blood flow following

---

* This study was supported by research grant B-532 from the National Institute of Neurological Diseases and Blindness, of the National Institutes of Health, Public Health Service.
† Now at the National Institute of Neurological Diseases and Blindness, Bethesda, Maryland.
‡ Now at the Montreal Neurological Institute, Montreal, Canada.
marked depression of the blood pressure. This occurred in the presence of
diminished cerebral vascular resistance. Cerebral oxygen consumption was
only slightly reduced because of a more complete extraction of oxygen from
the blood. They concluded that there is apparently little danger of cerebral
anoxia in the supine patient with a mean blood pressure of 55 mm. Hg when
employing hexamethonium induced hypotension. Finnerty et al.\(^6\) obtained
similar results for blood flow and found a critical rate of flow at which symp-
toms appeared. Flow studies by Stone,\(^6\) however, following administration of
hexamethonium to young adults, showed no change despite reduction of
mean arterial pressure of 40–50 per cent.

The objectives of this study have been to compare and to contrast, in the
monkey, the degree of pathological and electrical disturbance of the brain
produced by a controlled vascular lesion (permanent occlusion of the middle
cerebral artery), under normotensive, anemically induced, and chemically
induced hypotensive conditions.

MATERIALS AND METHODS

The middle cerebral artery of the monkey (Macaca mulatta) was permanently
occluded and divided at its origin in a manner that has been well standardized and
described elsewhere.\(^8\) There was some modification of the technique. Instead of an
osteoplastic craniotomy, the procedure was carried out through a large subtemporal
craniectomy. Although the artery can be satisfactorily exposed and divided through
a small bony opening, a bony decompression of at least 8 cm. diameter was found
necessary to prevent death of the animal from cerebral edema associated with the
infarction.

All manipulations of the skin and temporalis muscle were done with the electro-
surgical unit to reduce bleeding to a minimum. For EEG recording, a Type A, 8
channel Offner machine was used. Recording was carried out from both sides of the
head during the operation. This was done through phonograph needle electrodes
driven into the skull above the bony opening on the operated side, and from sub-
galeal needle electrodes contralaterally. The disposition of these electrodes was as
has been described previously.\(^8\) Records were made at intervals in the postoperative
period, employing the subgaleal needle electrodes.

Blood pressure was measured every few minutes through a plastic cannula in-
serted into the femoral or common iliac artery and connected to a mercury manom-
eter. Patency was constantly maintained by using a slow continuous high pressure
drip of normal saline through the system. This was provided by a modified pressure
cooker with a needle valve at the outlet. There was no need for anticoagulants.
Blood was removed or infused through this cannula when necessary. An additional
cannula was placed in a leg vein for the introduction of drugs. The circle of Willis
was approached by an overhanging head technique, thus eliminating the need for
intravenous sucrose to facilitate exposure.\(^8\) The middle cerebral artery was dissected
free from its covering of arachnoid and cut between clips placed as close to its origin
as possible.

Three groups of animals were studied:

1) **Normotensive** (5 animals). In this, the control group, the blood pressure was
not permitted to fall, blood transfusion or dextran being given, as necessary.

2) **Anemic Hypotensive** (6 animals). In this group, the blood pressure was lowered