THE EFFECTS OF INTRACAROTID DIODRAST*

ELDON L. FOLTZ, M.D.,† L. B. THOMAS, M.D., AND
A. A. WARD, JR., M.D.
Division of Neurosurgery, University of Washington School of
Medicine, Seattle, Washington
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The increasing popularity of Diodrast angiography since 1938 has been
motivated by the obvious clinical value of this procedure, but it is surpris-
ing that no investigations of the action of Diodrast on cerebral
function have been undertaken until recently. The occurrence of complica-
tions following cerebral angiography has been poorly documented in the
past and, indeed, has often gone unrecognized. However, the recent wide-
spread enthusiasm for angiography has resulted in an increasing awareness
of the clinical sequelae of this procedure. Physiological investigation into
the causes of these sequelae has been almost totally lacking. For these rea-
sons, it seemed pertinent to study the effects of intracarotid Diodrast.

METHODS

Experiments were carried out in 12 monkeys (Macacus rhesus), 4 cats, and 10
humans. Of the 12 monkeys, 6 were anesthetized with Dial,‡ 1 with pentobarbital,
and in the remaining 5 the surgical exposure was carried out under pentothal anes-
thesia with the experimental recording being done under local anesthesia in the
neck. One of these monkeys was paralyzed with dihydro-beta-erythroidine hydro-
bromide.§ All of the cats were anesthetized with Dial.‡ In the humans the recording
was carried out under local anesthesia in 5 cases, with intravenous pentothal in 4,
and with vinethene-ether in 1 case.

With the exception of 5 human cases where the Diodrast was introduced by
percutaneous puncture of the carotid artery, all carotid injections in the remaining
humans and in all the experimental animals were accomplished by means of an
inlying polyethylene catheter. In the animals a PE 20 polyethylene catheter was
introduced into the surgically exposed common carotid artery and usually threaded
up the internal carotid artery to the base of the skull. In humans a PE 50 catheter
was used in the same manner.

The electroencephalograms were recorded on 8-channel Grass or Offner instru-
ments using small needle electrodes inserted into the scalp. Bipolar recording was
used throughout, and the electrode placements were the same in all cases. The
arm-to-arm electrocardiogram was likewise recorded on the EEG. Continuous rec-
ording of the cerebrospinal fluid pressure was carried out in animals by means of a

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nylon catheter ligated in the lower end of the dural sac after the tip of the catheter had been threaded up to the mid-thoracic level. This catheter was directly connected to a Statham strain gage whose output was recorded by a carrier-wave amplifier and ink writer.

Changes in the caliber of pial vessels were observed in certain animals after wide bilateral exposure of the cerebral hemispheres, by a modified Forbes window inserted into a small trephine hole, and by a lucite calvarium. In the latter instance the entire bony calvarium of a monkey was aseptically removed. An acrylic plate, molded to the removed calvarium, was inserted in position by multiple wires. In addition to visual inspection, high speed color motion pictures were taken of the pial circulation during Diodrast injection.

Thirty-five per cent and 70 per cent Diodrast solutions were both used in each case except in two humans where only 35 per cent solutions were used. The order and timing of the injections of the different strength solutions were so arranged that the effects observed were clearly a direct result of the immediately preceding injection. The temperature of the injected Diodrast was maintained by a controlled temperature water bath. Cool solutions were maintained at 70°F., and warm solutions at 99.8°F. The injection time was kept constant for each case. The volume of Diodrast per injection was 2½ cc. for cats, 4 cc. for monkeys, and 10 cc. for humans. Adequate precautions were taken to maintain sterility and to guard the Diodrast solutions against light. Stellate blocks, when performed, were carried out with 1 per cent monocaaine, using minimum volumes to obtain maximal homolateral pupillary constriction.

RESULTS

The effects of intracarotid Diodrast on the brain seem to be twofold. First, a direct vascular effect and, secondly, a neuronal or cellular effect. The vascular effect is a short, severe vascular spasm followed by a longer lasting vascular dilatation. The neuronal effect may be a result of direct toxic action of the drug on the brain, or possibly a combination of this and the vascular changes.

Vascular Effects. The cerebral vascular effects were studied by direct visualization of the cortex during the Diodrast injections and also by continuous measurements of the intracranial pressure during and following Diodrast injections. Direct cortex visualization showed, in all cases, a severe vasospasm of the pial arterioles starting at the midpoint of the injection. This began as a high speed, repetitive series of momentary arteriolar constrictions which gave a fluttering appearance lasting only a few seconds. This was replaced by cortical blanching in which the dark veins stood out in startling contrast. This second phase always began during the end of injection and lasted for 60 to 90 sec., definitely after the completion of injection. This was followed by the third phase consisting of a cortical blush lasting 1 to 2 min. Both 35 per cent and 70 per cent Diodrast caused these changes, though changes induced by the 70 per cent solutions were always more severe. Injection of similar volumes of saline under identical conditions showed none of these effects.

The results of continuous recording of intracranial pressure changes dur-