Simplified Thrombosis of a Large, Hypertrophic Hemangioma of the Scalp*

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The natural history of the small hypertrophic hemangiomas of infancy is well known.\textsuperscript{2,3} They increase in size up to about 4 months or until the end of the first year and then decrease with mottling of the mass and a gradual disappearance of color. By the fifth year most of them have disappeared or have become insignificant. The natural history of the large hypertrophic hemangiomas is now also well known, and their prognosis is quite a different matter.\textsuperscript{4,6-12} The size at birth is not the best criterion for differentiation between the two types. Some of the large tumors have not been observed at birth,\textsuperscript{7} or have been no more than a bluish discoloration at birth.\textsuperscript{10} Others have been as large as a tennis ball.\textsuperscript{4} In most there has been no tendency to bleeding at birth and several infants have been circumcised without incident.\textsuperscript{8,12} Thereafter two things may happen: the tumor increases rapidly in size and thrombocytopenia purpura develops. It is presumed that platelets are consumed by the rapidly growing tumor and thrombi of platelets have been found in them.\textsuperscript{7} In some instances a tendency to bleeding has been present very early. The patient of Southard et al.\textsuperscript{11} had bloody diarrhea on the second day, and enlargement of the mass which had been 4 cm. in diameter was not noted until the tenth day. It is more usual to note an enlargement before bleeding commences\textsuperscript{8} and in some enlargement and purpura appear simultaneously.\textsuperscript{4} In most instances these difficulties have arisen within the first few months of life, but here again there is some variation and in the case of Scherz et al.\textsuperscript{9} they were not present until the patient was 1 year old.

Growth of the tumor may be very rapid and very extensive and may easily simulate a malignant neoplasm. In the case of Silver et al.,\textsuperscript{10} which commenced with a small elevated vascular area behind one ear (and which ended fatally), the tumor spread over the neck, chest, back and arms. In the second case of Good et al.,\textsuperscript{7} which commenced with a small, red "birthmark" on the medial aspect of the knee, it spread to involve the entire leg. Illustrations in that paper show the really remarkable extent to which such lesions may progress and explain why amputation of the leg was seriously considered in that instance. The skin may ulcerate and rapid external exsanguination may occur. The patient of Meeks et al.,\textsuperscript{8} a 6-week-old child, required a replacement of 810 cc. of whole blood. Massive hemorrhage also may occur into the tumor, into the soft tissues, or into the alimentary or genitourinary tracts. In the fatal case of Silver et al.\textsuperscript{10} the patient had a hemothorax and in Franklin and Williamson's\textsuperscript{8} fatal case, the patient died of respiratory obstruction following a hemorrhage into the neck.

Perhaps the milder large tumors will regress as will the small tumors, if the child does not expire from his thrombocytopenic purpura. Weissman and Tagnon\textsuperscript{12} had the impression that in both of their cases there was spontaneous resolution as their first patient did not show any response to splenectomy and their second had only a token dose of radiotherapy. In both instances recovery was slow. Most authors were convinced that an active treatment must be instituted in view of the well-defined mortality and of the exhausting hospitalizations and seemingly endless blood transfusions that are necessary to carry the child through severe purpura. Prednisone has been advised.\textsuperscript{9} Roentgen-ray treatment has been given to the spleen without avail and Weissman and Tagnon\textsuperscript{12} and Good et al.,\textsuperscript{7} have not been impressed with the results of splenectomy, though Meeks et al.\textsuperscript{8} considered it to be of value. Good et al.,\textsuperscript{7} in fact, pointed out that it may be harmful. One of their infants died later of an overwhelming infection, indicating that the spleen is indeed a useful organ in an individual's early contact with infection.

Most authors agree that when recovery occurs, from whatsoever cause, diminution of the mass and elevation of the count of platelets have occurred at the same time. Most active therapeutic effort has therefore been directed towards arrest of the growth of the tumor by radiotherapy. If radiotherapy is not given early, or not given in sufficient quantity, more than one dose may be necessary. In 1 instance death occurred in spite of repeated therapy. Roentgen rays in these young infants are not without danger. Cataracts follow if the eye is included in the field of adequate dosage. Carcinoma has been known to develop in the thyroid of individuals subjected to radiotherapy for a variety of reasons.\textsuperscript{1,2} The possibility of induc-
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ing sarcoma of the long bones may not be dis-
counted. In spite of these disadvantages, surgery
has offered no serious challenge. Surgical removal
before purpura develops may be difficult, and,
once it is established, surgery (except for biopsy)
is virtually impossible. In the second case of Good
et al., surgery in three stages was not entirely
satisfactory in removing a previously irradiated
tumor and slight flexion deformity of the knee
resulted.

Recently we were confronted with an infant
with a large hemangioma of the left forehead (Fig.
1) whom our colleagues in radiotherapy had de-
clined to treat because of the danger of irradiation
to the lens of the eye and because it was believed
that external exsanguination or thrombocyto-
penia could develop before radiotherapy had
become effective.

Case Report

The child, born on Feb. 3, 1963, was seen by us on
the 2nd day of life.

Examination. Count of red blood cells was 6,600,000
per c.mm. Hemoglobin was 21.9 gm. per cent. Count
of white blood cells was 15,400 per c.mm. Count of
platelets was 302,000 per c.mm.

The central raised area of the hemangioma was
obliquely quadrilateral. Its long axis lay on the left
forehead along the junction of the internal carotid
(frontal) and external carotid (superficial temporal)
circulations. This central area was 6 cm. long, 4 cm.
broad and was raised 4 cm. above its surrounding base.
In addition to this central raised area there was a very
wide base elevated about 1 cm. above normal tissue.
This base extended well to the right of the midline
down into the nose and upper eyelid and down slightly
toward the zygoma. The base and the central portion all
pulsated vigorously. The central mass overhung the
left eye so that this eye could not be examined.

Course. The skin over the central area had dried and
by the 5th day it had become necrotic in the middle
and it was obvious that it would soon ulcerate. It was
also felt that the base was enlarging.

Treatment. Experiments done here in the past year
showed that a thrombus (Fig. 2) is formed in the
femoral artery of a dog when the electrical polarity
between the normally electronegative intima and the
normally electropositive adventitia is reversed. This
reversal is accomplished by passing a small current be-
tween these structures by means of platinum electro-

trodes, one adjacent to the segment of lumen to be
thrombosed, carrying a positive charge, and, the other,
at some distance, carrying a negative charge. The ap-

paratus used consisted of a system of dry batteries in
which the current was controlled by a tapped poten-
tiometer and a series resistance of a value exceeding the
average resistance of tissue by at least several hundred-
fold, resulting in an essentially constant source of cur-
rent. The flow of current was monitored by a shunted
microammeter having an accuracy of 2 per cent of full
scale. Variations in resistance of tissue and delivered
voltage were not monitored. We estimate the average
potential difference at the electrodes to be in the range
of a D.C. current of 0.25 V.-1.0 V.

FIG. 1. (Left) Hemangioma before treatment. Note
that the skin has become necrotic. The base extends
across the midline and down into the nose. The eye
cannot be seen. (Right) After treatment. Scars from
needle would have been smaller had the electrodes been
insulated at the site of entry. The eye may now be
opened and is perfectly normal.

Generalizing from our experience with isolated ves-
sels it was predicted that by passing a large number
of electropositive electrodes with relatively large area of
surface through the richly vascular tumor, there would
be sufficient random occlusion of vessels throughout the
mass to result in its eventual destruction without the
risk of external bleeding.

Puncture of the mass of tumor by a needle produced
such a vigorous jet of blood when the needle was with-
drawn that we first ligatured the external carotid artery
and the superficial temporal artery as a preliminary
stage under local anesthesia. The external carotid was
of the diameter of the operator’s little finger. These pro-
dcedures did not lessen the vigor of the hemorrhage that
resulted from puncture by the needle, but firm pressure
controlled the hemorrhage both before and after fig-
ture so that clotting was quite satisfactory. A grid of
8 electropositive platinum electrodes was inserted
deep to the central raised area close to the periosteum,
and, superficial to them, four electronegative electrodes
were placed as in Fig. 3. A current of 2 mA. was passed
for 3 days (72 hours). When the electropositive elec-

trodes were removed, no bleeding took place, but when
the negative electrodes were removed, moderate bleed-
ing occurred. This was easily stopped by pressure. The
mass was obviously less pulsative. Where the uninsu-
lated positive electrodes came in contact with the skin,
an area of necrosis of the skin, 3 mm. in diameter, oc-
curred.

Three days later the electrodes again were inserted
into the more pulsatile periphery of the tumor. To avoid
further necrosis of the skin their proximal one-sixth had
been insulated and they were anchored by sutures.
Three days later they were removed and it was now ap-
parent that the whole central mass of the tumor had
thrombosed (144 hours). Three days later, 5 positive
electrodes were replaced and kept for 8 further days
(216 hours). The necrotic center was then debrided,