

The high lipid content of malignant tumors is notable. The high phospholipid content in malignant tumors as compared with benign tumors seems to be of particular interest. The water content of tumors is generally high as has been reported, little difference was found in the content of residual or unknown unsaponifiable substance. The experiments are being continued.

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Obliteration of Vasoconstrictor Gradient in the Extremities Under Nitrous Oxide-Oxygen, Ether, and Tribromethyl Alcohol Anesthesias.

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Recent studies of peripheral vascular diseases have brought out the importance of differentiating the element of spasm from that of organic occlusion. Vasoconstriction can be demonstrated in the extremities of most individuals with normal blood vessels by measuring the surface temperatures. This action is present in varying amounts depending on the interplay of environmental conditions and the nervous mechanism. It possesses a definite gradient¹ so that it usually begins about the knee and progressively increases distally. Consequently the toes are normally the coldest parts of the lower extremity. These surface temperature differences can under certain conditions be made to disappear. In a series of 22 individuals with normal vessels it was found that this took place when the lumbar sympathetic fibres were paralyzed by spinal anesthesia. All surface temperatures of the extremities came to approximately the same level, with a variation of $\pm 1.7^{\circ}\text{C}$. from the mean. This evidently represents a condition of physiological vasodilatation in the vessels of the extremities and we have called it "the normal vasodilatation level." Its importance consists in that it permits an accurate estimate of the degree of spasm in any given case of vascular disease. The failure to react to the normal level in the latter signifies the presence of organic occlusion, the degree of which is measured by subtracting the maximum temperature achieved from the

¹ Morton, J. J., and Scott, W. J. Merle, "The Measurement of Sympathetic Vasoconstrictor Activity in the Lower Extremities," *J. Clin. Invest.*, in press.

normal vasodilatation level. Having established the response to known regional sympathetic paralysis, we now report the effect of certain general anesthetics upon the vasoconstrictor gradient in order to simplify if possible the methods for gaining this information.

We have found that nitrous oxide-oxygen, ether, and tribromomethyl alcohol individually in anesthetic doses will completely obliterate the vasoconstrictor gradient. Thus Chart 1 records the surface temperatures in the toes and soles of a patient, otherwise normal, undergoing an operation for herniotomy under nitrous oxide-oxygen anesthesia. The toes show a rise of $9^{\circ}\text{C}.$, and the soles of $7^{\circ}\text{C}.$, both reaching the same level, $34^{\circ}\text{C}.$ In Chart 2, the temperatures of the left great toe, left sole and left hand are recorded before and after nitrous oxide-oxygen anesthesia in a boy with right dactylitis. The initial temperature of the toe was $22^{\circ}\text{C}.$, that of the sole, $25.5^{\circ}\text{C}.$, and that of the hand $30.5^{\circ}\text{C}.$ Ten minutes after beginning nitrous oxide-oxygen anesthesia these surface temperatures, originally showing various degrees of vasoconstriction, had begun to increase and 20 minutes after the beginning of the anesthetic they had reached the normal vasodilatation level and were all within $1^{\circ}\text{C}.$ of each other. Similar results were obtained with ether and tribromomethyl alcohol.

If the anesthesia does not reach the proper depth, which we

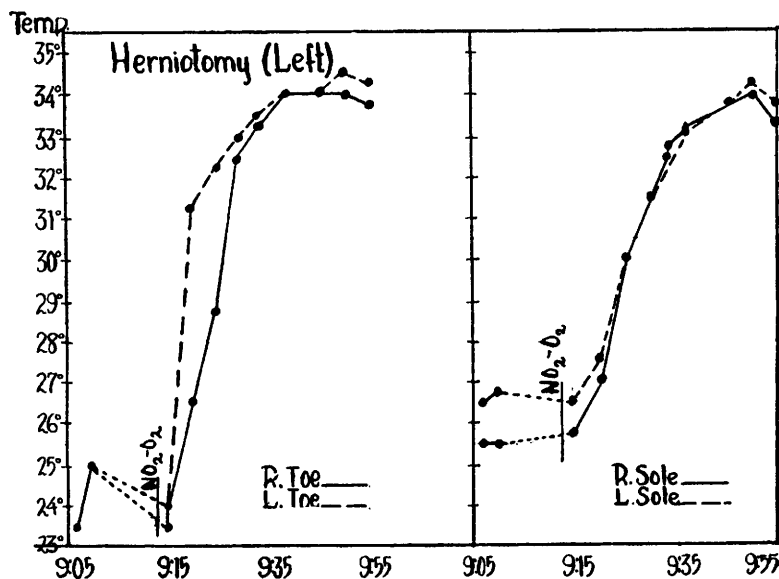


CHART 1.

Normal blood vessels. Vasoconstriction overcome by nitrous oxide-oxygen anesthesia.

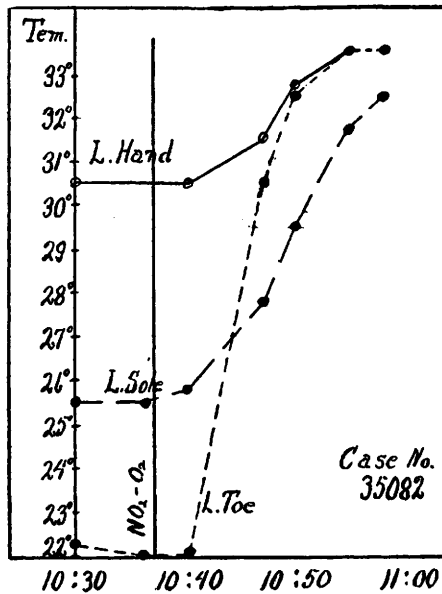


CHART 2.

Normal blood vessels. Obliteration of vasoconstrictor gradient in extremities by nitrous oxide-oxygen anesthesia.

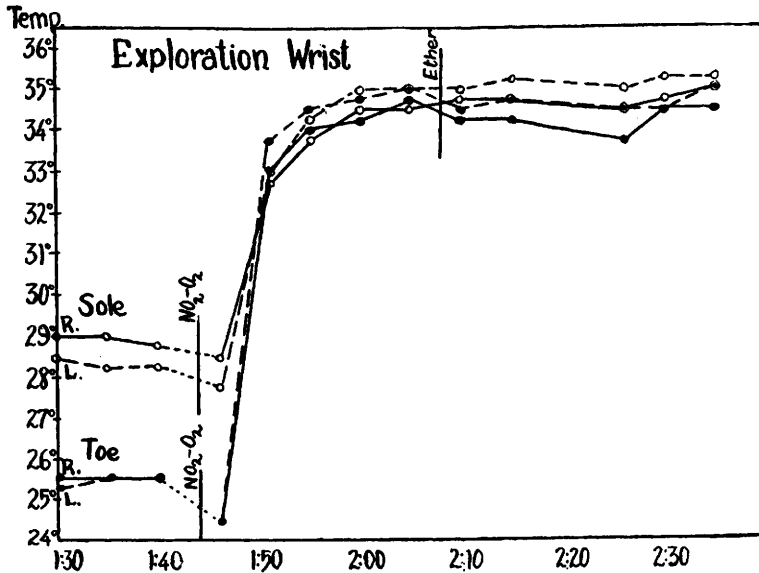


CHART 3.

Normal blood vessels. Normal vasodilatation level produced by nitrous oxide-oxygen anesthesia. Addition of another general anesthetic agent causes no further change in level.

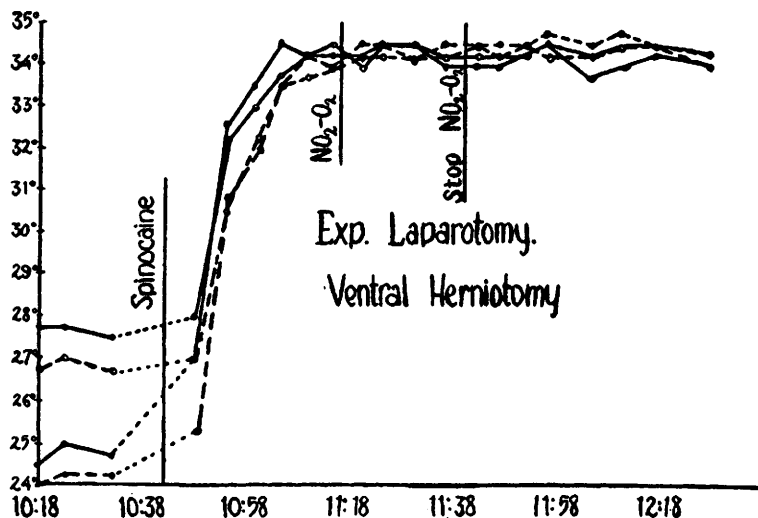


CHART 4.

Normal blood vessels. Normal vasodilatation level produced by spinal anesthesia. Addition of a general anesthetic causes no further change in level.

have associated with loss of consciousness and moderate muscular relaxation, complete vasodilatation does not occur. In fact, with struggling a temporary increase in vasoconstriction may be observed. Usually within 20 minutes of the induction of a satisfactory anesthetic, the gradient is completely abolished. Nitrous oxide-oxygen is satisfactory alone in many cases. In some, it is convenient to add a little ether in order to facilitate complete anesthesia. This in no way vitiates the test.

When the normal vasodilatation level is reached with one of these anesthetic agents, the addition of a second one has no effect on the surface temperature readings. (Chart 3.) Also, after obtaining the maximum effect on the surface temperatures from spinal anesthesia, the administration of an inhalation anesthetic causes no augmentation. (Chart 4.) These phenomena were to be expected on the basis of our hypothesis that the vessels when freed from sympathetic vasoconstriction dilate to their physiological maximum.

An application of these studies to vascular diseases is shown in Charts 5 and 6. The general anesthesia produced by nitrous oxide-oxygen reinforced for relaxation with ether causes fully as complete vasodilatation to the normal level as that which followed spinal anesthesia. At least under certain conditions it is simpler to induce a short inhalation anesthesia than it is to carry out spinal anesthesia

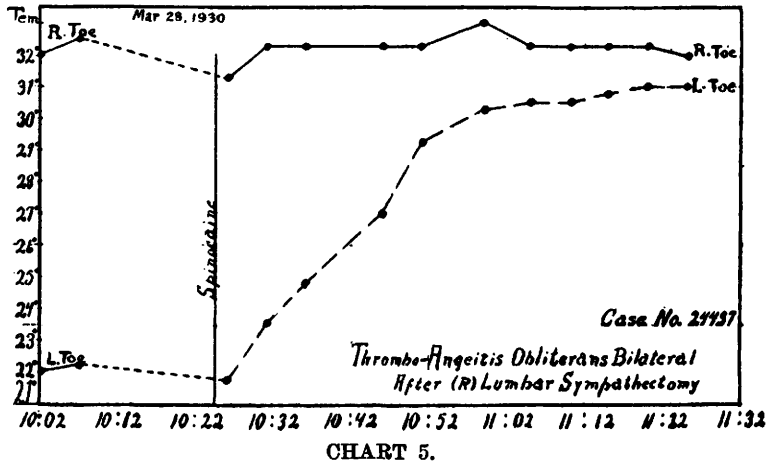


CHART 5.

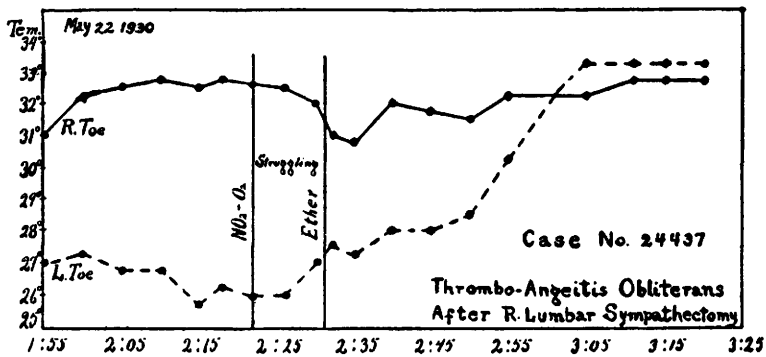


CHART 6.

Thrombo-angiitis obliterans several months after right lumbar sympathectomy. Right extremity at normal vasodilatation level and shows no significant change from either spinal or general anesthesia. Left extremity (non-operated)—

(5) Spinal anesthesia overcomes vasoconstriction.

(6) General anesthesia—Nitrous oxide-oxygen alone; unsatisfactory anesthesia and little effect on vasoconstriction. Nitrous oxide-oxygen reinforced with ether; satisfactory anesthesia and complete obliteration of vasoconstriction.

or paravertebral block.^{1, 2, 3} Although the latter are more selective in their action, the estimation of vasospasm in vascular disease seems to be as satisfactory by means of these general anesthetics.

² White, James C., *J. Am. Med. Assn.*, 1930, xciv, 1382.

³ Brill, S., and Lawrence, L. B., *Proc. Soc. Exp. Biol. and Med.*, 1930, xxvii, 728.