181 (2704)

A physiological study of the development of the collateral circulation in the leg of the dog.

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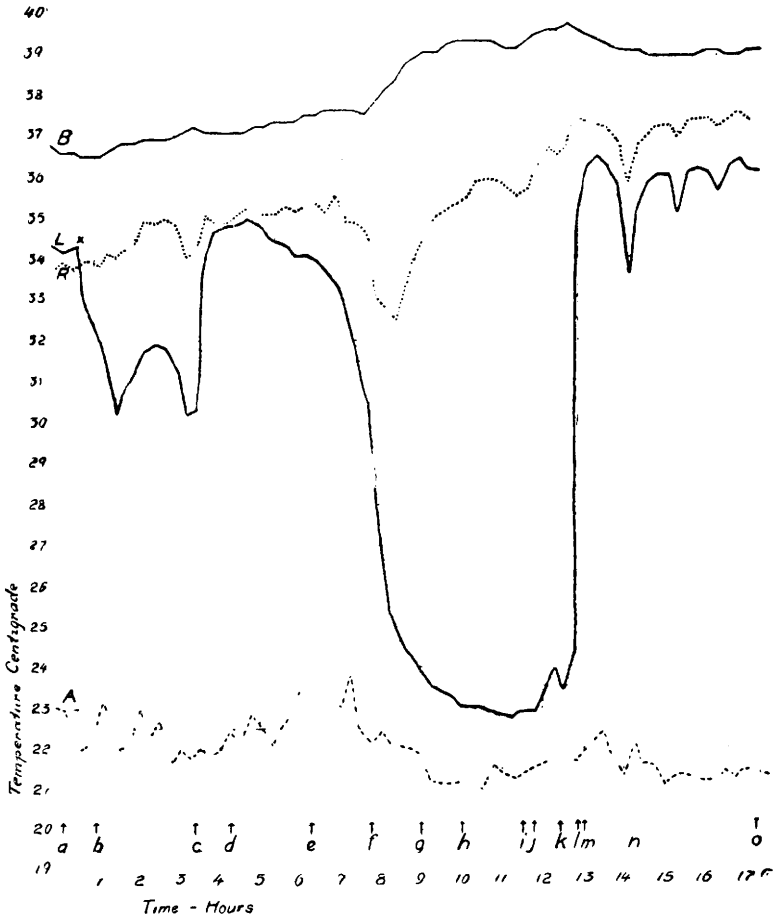
It has been known for many years that on ligating the main vessel in the leg of an animal, the temperature in that limb will fall, and that at some later time it may return to normal with the development of a collateral circulation. In reviewing the literature, however, we have been unable to discover any work which would show just how soon such a response takes place, and in just what manner. Consequently, we undertook the following experiments.

As a means of determining the flow of the blood in the limb, and the efficiency of the circulation, continuous record was kept of the temperature of the foot after tying off the superficial femoral artery on the one side, using the opposite limb as a control. This was done by means of two thermo-couple junctions soldered within needles and pushed into the foot pads of the two hind legs, according to the method of Barney Brooks.[1] For these junctions, German silver and copper wires were used. The copper wire from each junction was connected with one pole of a two-way switch. The German silver wire from each needle was joined to another piece of copper wire to form the "cold" junction, and the two were passed through a glass tube in the cork of a thermos bottle. From this cold junction in each case connection was made by the copper wire to the corresponding pole of the switch. By throwing the switch to the right or left, the thermo-electric current from one or the other needle could be sent into a galvanometer whose deflections were first calibrated according to known variations of temperature in order to transform the results into temperature readings. As an anesthetic we used amytal (iso-amyl ethyl barbituric acid), given in solu-

[1] Brookes, Barney, and Jostes, Fred A., A Clinical Study of Diseases of the Circulation of the Extremities: A Description of a New Method of Examination. *Arch. of Surgery*, Nov., 1924, pg. 485.

tion intraperitoneally, 0.055 grams per kilo of body weight of the dog.

The course of the experiment in dog No. 6 will be given as an example of the results in the series: The animal, a male, weight 20.5 kilograms, was given the calculated dose of 0.055 gm. of amytal per kilo, but it was necessary to repeat this one hour and ten minutes later to secure sufficient anesthesia. As soon as the



Dog VI. Male. Weight: 20.5 Kg.

A. Room temperature.
B. Rectal temperature of dog.
R. Temperature of right hind leg.
L. Temperature of left hind leg.
X. Artery ligated.

dog became unconscious, his body was wrapped in bagging, and an incision made in the left leg down to the femoral vessels. Two ligatures were placed around the artery in the upper part of Hunter's Canal but not tied. These ligatures were just distal to the saphenous artery which in the dog is a fair sized vessel running down the antero-medial aspect of the leg. The needles containing the junctions were sterilized in alcohol and inserted a distance of about one half inch, one into the central foot pad of each of the hind feet. A mercury thermometer was placed in the rectum, and a second to register room temperature was hung by. Readings were now taken of the temperature in both hind legs, the rectal and the room temperatures. When the temperature of the limbs seemed fairly constant, the left femoral artery was doubly tied. Temperature readings were then made every fifteen minutes. A few minutes after the ligatures were tied, the skin wound was closed with a few silk sutures. The details and remainder of the experiment are best understood by consulting the accompanying graph and notes.

As may be seen the temperature of the left leg after tying the artery fell rather abruptly not quite four degrees, then rose about one and a half degrees, fell again, then rose suddenly to above the normal level. This warmth was not maintained, however, and the foot gradually cooled down until eleven hours after ligation, at which time it had fallen about twelve degrees. The temperature then rose gradually for about one and one fourth hours, when suddenly there was a rapid change, and a rise of ten and a half degrees took place in fifteen minutes. The temperature then rose less abruptly two degrees more. The rise was accompanied by a simultaneous but less rapid increase of temperature in the normal leg. Subsequent slight simultaneous fluctuations in temperature were observed in both legs for a period of four hours more, when the experiment was terminated.

At this time the left foot was quite warm to the touch, except for the toes. Ten and one half hours later the dog was found to be awake but still very drowsy, with much staggering on attempting to walk. The left foot was superficially still slightly cold to the touch. Five days later both the legs seemed of the same temperature. Twenty days after ligation, the dog was sacrificed, and the left femoral artery found fibrosed between the two ligatures, but patent above and below.

Of a total of five dogs, on whom similar observations have been made, four have shown similar sudden rise of temperature, while the fifth apparently had a very efficient collateral circulation already in existence, so that there was only a small drop in temperature after tying the vessel.

From the rapidity of the rise in temperature it must be concluded that the first step in the establishment of a collateral circulation is a surprisingly abrupt vasomoter reaction. Further work is being carried out in an effort to analyze and determine the exact mechanism of this reaction.

182 (2705)

The effect of immersing and tearing Amoebae in salt solutions.

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In a previous publication[1] the effect of the injection of salts into Amœbæ was described by us. The results of those experiments afford criteria for judging the action of the substances directly on the protoplasm within the cell. From those studies a fuller conception may be obtained of the permeability to the salts when Amœbæ are immersed in solutions, and also some idea of surface reformation when the Amœbæ are torn in the same salt solutions.

Immersion of Amœbæ in different salt solutions shows that in order of increasing toxicity the salts range as follows: $MgCl_2$, $CaCl_2$, NaCl, KCl. Thus Amœbæ will live for 24 hours in M/6.5 $MgCl_2$; for about 5 hours in M/6.5 $CaCl_2$; for less than 1 hour in M/6.5 NaCl; and for less than 1 hour in as dilute a solution of KCl as M/104. Amœbæ will live for three days or more in M/13 $MgCl_2$, M/26 $CaCl_2$, M/52 NaCl and M/832 KCl. The Amœbæ which die in NaCl and KCl show a sinking and clumping of the

[1] Chambers, R., and Reznikoff, P., PROC. SOC. EXP. BIOL. AND MED., 1925, xxii, 320.