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Thermal Changes in Denervated and Sympathectomized Limbs With and Without Arterial Ligation.

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The skin temperature obtained by inserting the bulb of a thermometer between the toes of dogs was found to vary with the room temperature. Since the response to changes of room temperature was greatly delayed in long haired animals, those having short hair were used. It was found necessary to keep the animal 15-30 minutes in a new environmental temperature before the skin temperature became stabilized.

Mosser and Taylor[1] reported that alcoholic injection or crushing of the sciatic nerve in dogs resulted in a constant hyperthermia. In repeating their experiments that year we found that this hyperthermia was only relative, being entirely dependent on the room temperature. Apparently from their protocols the skin temperatures were taken in a cold room.

When normal short haired dogs were kept in a warm room (23-30°C.) the temperature between the toes was from 36-39°C. In a cool room (17-22°C.) the skin temperature fell 1-6°C., falling lower the cooler the room. In a cold room (13-17°C.) the skin temperature was 6-14°C. lower than that obtained in a warm room. In a freezing room (3-6°C.) the skin temperature fell to 8-18°C. and occasionally the rectal temperature fell about one degree.

These results showed that the dog had a thermal vasodilation level of 36-39°C. when kept in a warm room, and a vasoconstriction level of 22-26°C. when kept in a cold room. When the room temperature approached freezing the further decrease of skin temperature was apparently due to a direct effect on the blood vessels.

Section or Crushing of the Sciatic Nerve. (14 experiments.) The interruption of the peripheral nerves to an extremity by cutting or crushing the sciatic nerve produced very little difference in the temperature (0-2°C. higher on the operated side) when the dog was kept in a warm room. In a cool room the operated side showed a relative hyperthermia of 3-6°C., the rectal temperature remaining constant. When the animal was placed in a cold room a marked relative hyperthermia (4-10.5°C.) existed on the denervated side.

[1] Mosser, W. B., and Taylor, K. P. A., *Arch. Surg.*, 1926, **12**, 760.

That is, when the dog was taken from a warm room to a cool room, the skin temperature of the denervated limb remained about the same, but the temperature of the normal limb fell 3-6°C. In a cold room the temperature of the normal limb fell 4-10°C. When the dog was kept in a freezing room of 5°C. for one-half to one hour, the rectal temperature remained unchanged but both the limb temperatures fell to a level of 10-16°C., the thermal change being slower on the operated side. On returning to the warm room recovery to the original temperature was more rapid on the denervated side.

The denervated limb maintained its skin temperature at or near the vasodilation level in all environmental temperatures to a point as low as 13°C. As this effect was apparently due to the interruption of the vasomotor fibers in the sciatic nerve (Potts[2]) the lower lumbar sympathetic ganglia on one side were removed in other animals.

Unilateral Lumbar Sympathetic Ganglionectomy. (9 experiments.) Thermal changes similar to those obtained following section of the sciatic nerve were obtained when the second, third and fourth lumbar ganglia were removed on one side (method of Adson[3]). In a warm room the skin temperatures of both limbs were the same or the sympathectomized side showed a relative hyperthermia of 0.5-1°C. In a cold room no change or a slight fall (0-2°C.) occurred on the operated side, while on the normal side a fall of 5-13°C. was recorded. In the freezing room (5°C.) for one hour the temperature of both limbs fell to 10-16°C. (Fig. 1.) When

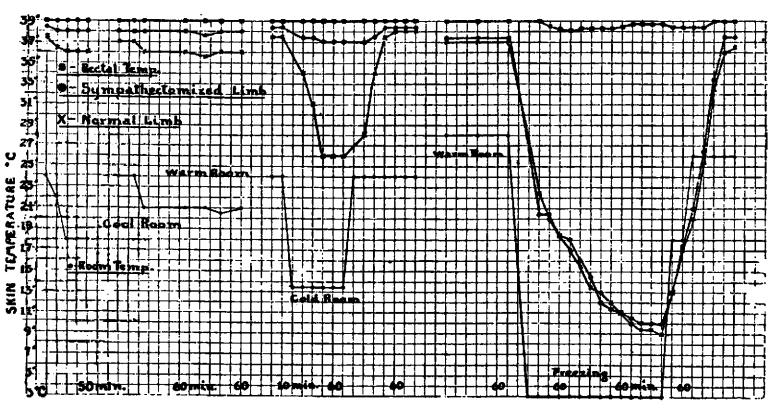

FIG. 1.
Effect of environmental temperatures on the skin temperatures of normal and sympathectomized limbs.

[2] Potts, L. W., *Anat. Anz.*, 1914, 138.

[3] Brown, G. E., and Adson, A. W., *Am. J. Med. Sc.*, 1925, **170**, 232.

the hind feet up to the ankles were placed in ice water (8°C.) for 3 minutes (Lewis[4]) with the animal in a warm room, the temperature of the hind limbs fell to the levels obtained in the freezing room. Within 10 minutes after immersion the temperature on the sympathectomized side had returned to the original level while on the normal side it was 9°C. lower than its original level.

Periarterial Sympathectomy. (3 experiments.) When periarterial sympathectomy was performed on the femoral artery of a dog practically no thermal difference was noted. In a warm room the skin temperature was the same in both limbs. In a cold room the limb temperatures fell symmetrically about 10°C., the rectal temperature remaining the same.

Division of Femoral Artery Distal to Profunda Branch. (2 experiments.) When the femoral artery was ligated and divided distal to the profunda branch, observations during the first 4 post-operative days showed no thermal difference when kept in a warm room. Placed in a cold room the temperature of both limbs fell, that on the ligated side being slightly lower (0.5-1°C.). In the freezing room the fall in temperature was uniform.

Division of Femoral Artery Proximal to the Profunda Branch. (4 experiments.) In a warm room the temperature of the ligated side was 2-5°C. lower than the control, while in a cold room the ligated limb was 5-9°C. lower. Placed in the freezing room the temperature of the operated limb quickly fell 4-7°C. lower than the normal side and the recovery was much slower when returned to a warm room. After the seventh post-operative day only a slight thermal variation (0-2°C.) existed between the limbs.

Division of Femoral Artery Proximal to the Profunda Branch and Lumbar Sympathetic Ganglionectomy. (2 experiments.) Ligation of the artery and a lumbar sympathectomy on the same side produced thermal readings 2-4°C. lower than the normal side when the dog was in a warm room. In a cold room the temperature of both limbs fell, that on the operated side being 1.5-2.5°C. lower. In the freezing room both temperatures fell symmetrically with the operated side 2-4°C. lower. Recovery was at the same rate in both limbs.

Division of Femoral Artery Distal to Profunda Branch and Section of the Sciatic Nerve. (3 experiments.) After section of the main artery and nerve to a limb a relative hyperthermia (2-6°C.) existed on the operated side when the dog was kept in a warm room. In

[4] Lewis, T., *Heart*, 1929, **15**, 8.

a cold room the thermal readings in both limbs fell, that on the operated side being 3-6°C. lower. In the freezing room both temperatures fell, but slower and to a lesser degree on the operated side. Recovery was slightly more rapid in the operated limb. After the eighth post-operative day the thermal responses were similar to those following section of the sciatic nerve alone.

Division of Both Femoral Arteries Proximal to the Profunda and Unilateral Lumbar Sympathetic Ganglionectomy. (2 experiments.) When the femoral artery to each hind limb was ligated and a unilateral lumbar sympathectomy performed the temperature of the toes on the sympathectomized side was 2-3°C. higher in a warm room. During the first half hour in a cold room the temperature fell in both limbs, that of the sympathectomized side being 2-8°C. higher. During the second half hour both limbs reached a new lower thermal level with the sympathectomized side 2°C. higher. When both hind feet were placed in ice water (8°C.) for 3 minutes, there was no thermal change in the rectum or fore limbs. The hind limbs showed a marked hyperthermia compared with the thermal readings of the foreleg; on the sympathectomized side the fall was 19.5°C. and on the other side 17°C. Recovery was slow and parallel in both limbs, about one hour elapsed before the temperatures returned to the original level.

Summary. Skin temperatures taken between the toes of dogs varied with the temperature of the room. The thermal vasodilation level of the normal limb of a short haired dog in a warm room was 36-39°C. The thermal vasoconstriction level was apparently 22-26°C. Section of the sciatic nerve or lumbar sympathectomy caused a relative hyperthermia in the limb of the operated side in dogs kept in a cold room. Following division of the femoral artery thermal responses paralleled those of the normal limb but were consistently slightly lower. Division of the femoral artery and ipsolateral lumbar sympathectomy or section of the sciatic nerve led to thermal responses to heat and cold similar to those obtained after division of the femoral artery alone. After division of the femoral arteries and unilateral lumbar sympathectomy the thermal responses were similar to, but more moderate than those after sympathectomy alone.