A METHOD FOR THE STUDY OF ARTERIAL ANASTOMOSES

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Physiological aspects of anastomotic channels are not elucidated by ordinary injection methods. These merely reveal pathways which given streams of blood may or may not follow during life. We have studied in rabbits the complicated anastomosis of the circle of Willis, using a modification of the rapid coagulation technique devised by Franklin & Amoroso (1948).

This method was designed to demonstrate the distribution of blood throughout the body (or in a given organ) under any special conditions. A powerful blood coagulant mixed with a dye was introduced so that the 'active' part of the circulation would be clotted and could be seen after death. For instance, if the animal had previously received an adequate dose of adrenaline the post-mortem appearance of the dye, concentrated especially in the heart and lungs, and its relative lack in skin, muscles and viscera reflected the redistribution of blood which had occurred.

METHODS

The original method

Purified Russell's viper venom ('Stypven') was used in a solution of 1 mg./ml. distilled water solvent. This was injected intravenously, the dose being 1 mg./kg. body weight. With this had been mixed an equal volume of a solution of dye; 5 % Evans blue (the isomer of Trypan blue, T 1824) was preferred because it remains in the vessels. An anaesthetized rabbit thus injected usually died within 3 min.

The modification for arterial injection

For the rapid arterial blood stream, purified thrombin (Upjohn) and crude Russell's viper venom were found to be better coagulants.

A rabbit, weighing about 2 kg., was anaesthetized with intravenous nembutal (30 mg./kg.) and inhaled ether. Thrombin 150 units, or crude venom 20 mg., in 1·0 ml. normal saline was mixed with an equal volume of 5 or 10 % Evans blue. The injection was made slowly (0·5–0·75 ml./min.) by an indirect route (so that there was little interference with the normal blood flow) into either the internal carotid or vertebral system.

To inject the internal carotid artery, we inserted into the external carotid a fine cannula pointing towards the heart. The injected fluid then passed against the external carotid blood stream into the common carotid, and thence was carried up the internal carotid by the action of the heart. By keeping the column of dye in the common carotid constant the rate of injection could be matched against the velocity of the blood flow up the internal carotid.

The vertebral artery was similarly injected through a centrally pointing cannula in the axillary artery. To balance the pressures, the artery on the opposite side

which corresponded to that holding the cannula was also ligated, i.e. the external carotid or the axillary artery.

The carotid injections did not usually kill the animal, and death was then produced by clamping the ascending aorta. Unilateral vertebral injection, however, caused death rapidly (McDonald & Potter, 1948).

The head was severed and a small hole made in the skull to admit fixative. The cisterna magna also was opened and the head placed in 10 % formol saline. The brain was carefully removed when fixed. The vessels in the neck were also carefully dissected to exclude any important anomaly.

RESULTS

Coagulation was not always satisfactory and never complete throughout the arteries injected, but two of our findings (McDonald & Potter, 1949*a*) give some indication of the value of the method. First, a clear demarcation was seen in the posterior communicating artery between dyed, coagulated blood from the injected system, and undyed, fluid blood. This demarcation was also seen on the surface of the hemisphere between the territories of the middle cerebral and posterior cerebral arteries. This is indirect evidence that it is here that carotid blood meets and opposes the vertebral blood stream.

Second, when a vertebral artery was injected, a distinct thread of dyed, coagulated blood was seen passing from the injected artery into the same side of the basilar artery. Dye and clot were seen in the branches of the basilar artery on that side alone. This was evidence that streamline flow of the arterial blood from the vertebral arteries occurs in the basilar artery. We have since confirmed this by direct observation in the living rabbit (McDonald & Potter, 1949*b*).

SUMMARY

The use of an intravascular coagulant with a dye for studying the behaviour of the blood flow in arterial anastomoses during life is described.

Two features of the arterial supply to the rabbit's brain are noted. One of these, the streamline flow of vertebral blood in the basilar artery, could not have been demonstrated by conventional injection methods.

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