
In canine Purkinje fiber-papillary muscle preparations it was shown directly that electrotonic spread can take place across the junctions between Purkinje fibers and ordinary muscle fibers (P-M junctions). The P-M delay recorded during orthodromic propagation varied considerably within any given preparation. Moderate increases in the external concentration of K\(^+\) (up to 6 mM) consistently decreased the P-M delay; when the concentration of external K\(^+\) was increased to 8 mM the P-M delay increased. With larger concentrations of K\(^+\) (10 to 11 mM), total conduction block from the terminal Purkinje fibers to the muscle occurred; under the same conditions antidromic propagation from


Propagated vasodilation has been observed in the peripheral vasculature and may be significant in integrating the behavior of terminal arterioles and larger vessels. We have studied the characteristics of propagated vasodilation induced by acetylcholine in the microcirculation of the cheek pouch of the golden hamster. The technique of microionophoresis was used as a means of achieving relatively precise temporal and spatial application of drugs to single arterioles. Application of acetylcholine to an arteriole usually resulted in vasodilation which spread rapidly upstream and downstream from the point of application at a rate much greater than could be accounted for by diffusion or by other


Helically cut thoracic aortic strips (from rats, rabbits, and guinea pigs) in a state of low to moderate tone and under the influence of alpha-receptor blockade relaxed in response to isoproterenol. Propranolol blocked these relaxations. Helically cut thoracic aortic strips from cats and abdominal aortic strips from rats, rabbits, and cats were not relaxed by isoproterenol. In addition, aortic beta-receptor activity of rats and rabbits decreased with increasing age. The ability of thoracic aortas to be relaxed by isoproterenol was lost when rats were 90 days old and when rabbits were 2 years old. Significant loss of beta-receptor activity was not evident in rat trachea and stomach.


In anesthetized dogs, the vasoconstrictor nerves to the vessels of the hind limb left the spinal cord in the anterior spinal nerve roots from T-10 through L-4 levels. Maximal vasoconstrictor responses occurred on stimulation of the T-12, T-13, and L-1 roots; none occurred on stimulation of roots caudal to L-4. The nerves first entered the lumbar paravertebral chain at or above L-1; the last point of entry was at the L-4, L-5 level. No fibers left the lumbar chain at L-1, L-2, and L-3 levels. The first point of exit was at L-4, and nerves continued to leave as far distal as S-1, the most caudal point examined. The
Sodium nitrite completely relaxed thoracic and abdominal aortas from all species including thoracic aortas from old rats and rabbits. We conclude: (1) there are species differences in the response of thoracic aortic strips to beta-receptor stimulation; (2) a gradient in beta-receptor activity exists in the aorta with greater activity in the thoracic aorta and a relatively small amount of activity in the abdominal aorta; and (3) aortic beta-receptor activity decreases with increasing age.

**ADDITIONAL KEY WORDS** isoproterenol trachea stomach thoracic aorta abdominal aorta cat guinea pig rat rabbit

muscle to Purkinje fiber was still possible. The results can be explained satisfactorily by assuming that propagation across the P-M junction is electrical and that the geometry of the functional syncytium changes progressively from a cable-like system at the level of the terminal Purkinje fibers to a two- or three-dimensional irregular syncytium at the bulk of the myocardial mass.

**ADDITIONAL KEY WORDS** electrotonus in heart cardiac action potentials conduction in heart

maximal response to stimulation of the lumbar chain was at the L-4, L-5 level. With a single exception, the responses to electric stimulation of the anterior spinal nerve roots, lumbar chain, or sympathetic ganglia were confined to the vessels of the ipsilateral limb. In 22 dogs with unilateral sympathectomy (L-2 through L-7), changes in hind-limb vascular resistance were induced reflexly or by electric stimulation of the anterior spinal roots. The results indicated that sympathetic control of the resistance vessels of the hind limb was still absent 77 days after sympathectomy.

**ADDITIONAL KEY WORDS** canine limb perfusion limb blood flow sympathetic outflow reflex vasoconstriction vasomotor nerves anterior spinal nerve roots lumbar paravertebral chain peripheral resistance sympathectomy

means of movement of the agent. Longitudinal propagation velocities for a series of arterioles 20 to 40μ in diameter averaged 0.02 cm/sec. The propagated response was relatively specific, being induced by acetylcholine but not by histamine, K⁺, H⁺, or eledoisin. The response was graded in both extent and magnitude, was propagated bidirectionally from the point of origin, was observed in vessels as small as 15μ o.d., and could be blocked by lidocaine.

**ADDITIONAL KEY WORDS** microionophoresis arterioles acetylcholine ascending vasodilation vascular control

The possibility of sympathetic vasoconstrictor control of blood flow to active muscles was studied in dogs during graded exercise by comparing the blood flow in the normal with that in the sympathectomized hind limb. Blood flow was measured by electromagnetic flow transducers around each external iliac artery, or inferred from the oxygen saturation of blood samples from the common iliac veins. The dogs either ran for successive periods of 3 minutes at 5.5 km/hr and grades of 0, 7, 14, 21, and 28% or ran each level of exercise separately. Unilateral lumbar sympathectomy (L-2 through L-7) was performed when the flow transducers were implanted or later by a snare.

TOUBES, D. B., AND BRODY, M. J. Inhibition of reflex vasoconstriction after experimental coronary embolization in the dog. Circ Res 26: 211-224, 1970. (Department of Pharmacology, College of Medicine, University of Iowa, Iowa City, Iowa 52240.)

The possibility that failure of vascular resistance to increase contributes to hypotension after myocardial infarction was examined in the hindlimbs of dogs following embolization of the coronary arteries. Vascular resistance did not change significantly during sustained severe hypotension after embolization in either the intact hindlimb or in simultaneously autoperfused innervated and denervated hindlimbs using constant flow. In nonembolized animals, an immediate large increase in hindlimb vascular resistance occurred when equivalent hypotension was produced by stimulation of the distal end of the sectioned vagus nerve. Lack of such response during hypotension after embolization sug-

SANO, T., AND SAWANOBORI, T. Mechanism initiating ventricular fibrillation demonstrated in cultured ventricular muscle tissue. Circ Res 26: 201-210, 1970. (Institute for Cardiovascular Diseases, Tokyo Medical and Dental University, Tokyo, Japan.)

Ventricular muscle strips of the rat embryo heart were used for tissue culture preparations without adding trypsin. Fibrillation-like arrhythmia was induced by adding aconitine or strophanthin, and the potentials were recorded with one or two microelectrodes. The tracing by one microelectrode was no different than tracings from fibrillating adult mammalian hearts. The size and shape of the action potential varied beat by beat, and its time of appearance was quite irregular and rapid. But, when tracings obtained simultaneously by two microelectrodes were compared, most of the action potentials were roughly synchronous and thus unlike adult cardiac fibrillation. This ruled out the

MAYER, S. E., NAMM, D. H., AND RICE, L. Effect of glucagon on cyclic-3',5'-AMP, phosphorylase activity and contractility of heart muscle of the rat. Circ Res 26: 225-233, 1970. (Department of Pharmacology, Division of Basic Health Sciences, Emory University, Atlanta, Georgia 30322.)

The purpose of this investigation was to contrast the effect of glucagon and that of epinephrine on the concentration of cyclic adenosine 3',5'-monophosphate (cyclic AMP), the activity of phosphorylase a and the contractile amplitude of isolated perfused rat hearts. The two drugs were about equally effective except that the maximal augmentation of contractility by epinephrine ($5 \times 10^{-9}$ moles) was twice that produced by an equivalent dose of glucagon with a fourfold greater increase in cyclic AMP concentration. Combination of large doses of the two drugs caused increases in the cyclic nucleotide considerably greater than those required for maximal phosphorylase activation.
possibility of multiple reentry or multifocal origin in this preparation.

Because of the small size of the cultured tissue, reentry of the excitation wave probably could not occur, and the conclusion that fibrillation originated from a single focus is thus supported. Three varieties of the onset of fibrillation, i.e., gradual increase of tachycardia with progressively steeper slow diastolic depolarization, a prominent positive afterpotential followed by a negative afterpotential, and abortive action potentials superimposed on the repolarization of the preceding action potentials or on the negative afterpotential, supported the unifocal onset.

ADDITIONAL KEY WORDS single ectopic focus theory reentry theory Maximow’s hanging drop method aconitine strophanthin microelectrode positive and negative afterpotential minimal fibrillatory mass

technique. The latter allowed observations during exercise as early as 4 hours after sympathectomy. The magnitude of limb blood flow during exercise and the decline of exercise hyperemia were similar in the normal and the sympathectomized limb, as were the changes in the oxygen saturation of limb venous blood. However, electric stimulation of the lumbar sympathetic chain at the L-5 level in the conscious dog by a chronically implanted electrode reduced limb blood flow at all levels of exercise, the maximal flow of 1,000 ml/min was almost halved.

ADDITIONAL KEY WORDS peripheral resistance vasomotor nerves peripheral circulation

or associated with a maximal inotropic response. The effects of glucagon also developed more slowly than those of epinephrine. An increase in cyclic AMP was not detectable until after phosphorylase $a$ and contractile amplitude had increased.

The beta-receptor-blocking agents dichloroisoproterenol and pronethalol did not block the biochemical responses to glucagon in doses which abolished the epinephrine-induced increases in cyclic AMP and phosphorylase $a$. These results, along with those obtained by other investigators, indicate that glucagon can elicit the same biochemical responses in intact heart as have been obtained with epinephrine, but by action at a different receptor site.

ADDITIONAL KEY WORDS beta-receptor-blocking agents epinephrine catecholamines hormones metabolic control in heart rat heart metabolism pronethalol

ggested that inhibition of reflex vasoconstriction had occurred. Bilateral cervical vagotomy allowed normal reflex vasoconstriction to proceed during hypotension after infarction. These data indicate that (1) since vascular resistance is unchanged in both innervated and denervated hindlimbs, normal neurogenic vascular tone is sustained during hypotension after myocardial infarction and (2) the baroreceptor reflex, which normally promotes vasoconstriction during hypotension, is inhibited reflexly following myocardial infarction, probably by activation of cardiac vagal afferents.

ADDITIONAL KEY WORDS hypotension vasoconstriction acacia cardiogenic shock myocardial infarction coronary embolization hindlimb autoperfusion sympathetic stimulation cervical vagotomy reflex inhibition

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Anatomical and electrophysiological techniques were employed to investigate the aortic bodies in anesthetized puppies and dogs. The microscopic appearance, location, innervation, and vasculature of the aortic bodies were investigated by microdissection and histological examination of gelatine-injected preparations. Thoracic chemoreceptor impulses were recorded from the cervical vagus nerves, the nervous pathways in the thorax identified by cold blockade, and the blood supply to the receptors investigated by injection of drugs. Large, circumscribed aortic bodies were few, the majority of glomus cells being scattered in small groups along the vagal branches coursing on the

INGRAM, R. H., JR., SZIDON, J. P., AND FISHMAN, A. P. Response of the main pulmonary artery of dogs to neuronally released versus blood-borne norepinephrine. Circ Res 26: 249-262, 1970. (Department of Medicine, Emory University School of Medicine, Atlanta, Georgia 30303.)

The effects of sympathetic nerve stimulation and of norepinephrine infusions on the dynamic elastic properties of the main pulmonary artery were studied in 20 anesthetized, open-chest dogs. Pulmonary arterial pressure and diameter were linearly related between 5 to 45 mm Hg and at heart rates of 40 to 200 beats/min. Sympathetic nerve stimulation changed the stiffness (pressure-diameter slope) of the pulmonary artery by +35%; infusion of norepinephrine (0.25 μg/kg/min) by only +14%. Diameter intercepts, determined by extrapolation of the linear pressure-diameter line, were unchanged during stimulation, but decreased significantly during the infusion of norepinephrine.
Local application of norepinephrine to the wall duplicated the changes produced by sympathetic nerve stimulation.

Histologically, the arrangement of smooth muscle in the outer layers of the media of the artery suggested linkage of smooth muscle with continuous elastic fibers, whereas smooth-muscle cells of the deeper layers of the media appeared to connect with each other, and elastic fibers were discontinuous. The topical application of elastase to the outer wall effected a loss of elastic fibers in the outer layers of the media. After elastase, neither stimulation nor norepinephrine infusions increased stiffness; diameter intercepts decreased with both.

The observations are consistent with the idea that stiffening of this artery during nerve stimulation is produced by contraction of smooth muscle attached to elastic fibers and that the anatomical arrangement for stiffening is located in the outer layer of the media, where the sympathetic nerve endings are located. In contrast, blood-borne norepinephrine stimulates predominantly the inner layers.

ADDITIONAL KEY WORDS

- phenoxymenzamine
- vasoconstriction
- dynamic arterial elasticity
- walls of the pulmonary artery and aorta. Very few bodies were found in groups 1 and 2 at the right and left subclavian angles. The majority were in group 3, ventral to the aortic arch and pulmonary bifurcation and supplied by the ventromedial cervical cardiac branch of the left vagus, and in group 4, between the aorta and pulmonary artery, supplied by the recurrent cardiac branch of the right vagus. The arterial supply to the aortic chemoreceptors stemmed from the aorta and the brachiocephalic and left coronary arteries. In neither puppies nor adult dogs was there evidence of a supply from the pulmonary artery.

ADDITIONAL KEY WORDS

- afferent vagal impulses
- glomus cells
- hypoxia
- cold block of vagi
- nicotine
- α-lopheline
- cyanide
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