COMPARATIVE PHARMACOLOGY OF MYOGENIC AND NEUROGENIC HEARTS

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The hearts of adult vertebrates and molluscs are known to be inhibited by acetylcholine. These hearts are myogenic in that their pacemakers are muscular in nature, although the hearts may contain secondary regulating neurones. It is suggested that myogenic hearts in general may be inhibited by acetylcholine.

The hearts of decapod Crustacea, of Limulus and of the grasshopper, Melanoplus, have been shown to be accelerated by acetylcholine. Limulus, the decapod Crustacea, and probably Melanoplus have ganglionic pacemakers, i.e., are neurogenic. It is suggested that neurogenic hearts may be accelerated by acetylcholine.

Embryonic hearts (Fundulus) were shown by Armstrong (1935) to be unaffected by acetylcholine prior to vagal innervation. Apparently innervation sensitizes the heart so that it is inhibited by the drug. We have investigated the effect of acetylcholine on the heart of Limulus throughout early development. From the 21st to 32nd days when the heart is not innervated (Carlson and Meek 1908) acetylcholine is without effect. Later it is accelerated. It is suggested, therefore, that non-innervated hearts are not affected by acetylcholine.

Kymographic records were obtained of the heart beat of the annelid, Arenicola, and the hearts and dorsal vessel of Lumbricus were counted. Both these animals showed acetylcholine acceleration. Histological evidence supports the suggestion that their hearts are neurogenic.

The heart of the freshwater isopod Caecidotea is accelerated by acetylcholine. Multipolar ganglion cells have been described in the heart of the isopod, Ligia (Alexandrowicz, 1932). The hearts of two amphipods, Talorchestia and Bactrurus, and of a copepod, Diaptomus, are likewise accelerated. It is likely that they are neurogenic.

Baylor (1941) has found the heart of Daphnia to be inhibited by acetylcholine. Ingle (personal communication) has been unable to find ganglion cells in this heart.

Acetylcholine is without effect, even in high concentrations (10^{-3}) with or without eserine, on the hearts of Artemia or Eubranchippus. Pure adrenaline is also ineffective on the Atemia heart although adrenalin solution (Parke Davis) inhibits due to the reducing agent, sodium bisulphite. A variety of control experiments shows that lack of effect of acetlycholine is not due to lack of penetration into the animals. It is suggested on the basis of the Fundulus and Limulus embryo experiments that the hearts of Artemia and Eubranchippus are not innervated.

In general, potassium acts much the same as acetylcholine. Calcium antagonizes potassium by slowing the higher Crustacean and Limulus hearts but its effects on myogenic hearts are complex.

It is likely that the action of acetylcholine provides a pharmacological method for distinguishing between neurogenic, innervated myogenic, and non-innervated hearts.

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