A NOTE ON THE EFFECT OF HAMYCIN ON ELECTROLYTES IN THE FROG HEART

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Treatment of frog heart with hamycin, an antifungal antibiotic, effected an increase in the potassium content of perfusion fluid. Changes in sodium content were not observed.

ARORA (1962) first reported the presence of cardiotonic activity in hamycin, a new antifungal antibiotic. An investigation was thereafter undertaken to study the effects of hamycin on the sodium and potassium in frog heart.

EXPERIMENTAL AND RESULTS

Hamycin solution was prepared by adding 0·1 g. of the powder to 10 ml. of propylene glycol at 85°. A 0·6 per cent solution (w/v) was obtained, the rest remaining insoluble. The soluble fraction was dissolved in amphibian Ringer-Lock solution to give a concentration of 10^{-6} g./ml.

Rana temporaria of either sex were used to prepare Straub hearts. One ml. of Ringer-Locke solution containing the same amount of propylene glycol as in the hamycin solution, was put into the cannula and left for 5 min. The fluid was then removed and kept as control for electrolyte estimation. One ml. of hamycin solution was then put into the cannula and left until systolic arrest was complete. This fluid was also collected and retained for electrolyte estimation. Similar experiments were made with tincture of digitalis, 25 ml./litre. In 3 control experiments, Ringer-Locke solution containing only propylene glycol was left in contact for 15 min.

After the systolic arrest was complete, the ventricle was removed, blotted on filter paper and quickly weighed on a torsion balance. It was then dried overnight at 115° and the dry weight recorded.

Sodium and potassium estimations were made on a Perkin Elmer flame photometer.

A concentration of 10^{-6} g./ml. of hamycin or 25 ml./litre of tincture digitalis induced systolic arrest in the Straub-Feuhner preparation in 5 to 10 min. Control preparations beat normally over this period.

Hamycin treatment resulted in an increase in the potassium content of the perfusion fluid (Table I). The change, when expressed in terms of tissue water amounted to 9·2 m-equiv./litre $\pm$1·38 s.e. A similar increase was noted with tincture of digitalis (Table I). There was no change in the electrolyte content of perfusion fluid in control experiments.

No definite change in the sodium content was observable, either with tincture of digitalis or hamycin (Table I) and no alteration in the tissue water content could be detected as a result of treatment with either drug.

Discussion

Hajdu and Leonard (1959) in their review of the mechanism of action of cardiotonic drugs suggested that the cardiotonic action of digitalis might be due to a loss of tissue potassium, a slight gain in tissue sodium and some loss of tissue water but without any alteration in the total concentration of intracellular monovalent cations. Such effects would theoretically result in an increase in potassium and a decrease in sodium content of the perfusion fluid. Hamycin treatment of the frog heart resulted in a definite increase in the potassium content of the perfusion

TABLE I

THE EFFECTS OF HAMYCIN AND DIGITALIS ON THE ELECTROLYTE CONTENT OF PERFUSION FLUID IN THE STRAUB-HEART PREPARATION

Drug concentration	Heart weight mg.		Tissue water mg.	Water per cent	Mean water ±s.e. per cent	Change in electrolyte content of fluid (m. equiv./litre)		Change in potassium m-equiv./litre of tissue water	Mean change in potassium ±s.e.
	Wet	Dry				Potassium	Sodium		
Hamycin 10^{-6} g./ml.	159	24·75	134·25	84·4		+1·275	nil	9·5	
Hamycin ,,	200	31·15	168·85	84·5		+0·675	nil	4·0	
Hamycin ,,	131	20·53	110·47	84·3	84·2	+1·05	nil	9·5	9·2
Hamycin ,,	80	12·2	67·8	84·7	±0·23	+0·825	nil	12·2	±1·38
Hamycin ,,	102	17·1	84·9	83·3		+0·900	−2·41	10·6	
Tr. digitalis 25 ml./l.	102	17·66	84·34	82·7		+0·900	nil	10·6	
Tr. digitalis ,,	146	28·18	119·82	82·1	82·9	+0·600	nil	5·0	7·0
Tr. digitalis ,,	83	13·32	69·68	83·9	±0·53	+0·375	nil	5·4	±1·86
Control	103	18·99	84·01	81·5		nil	nil	nil	
Control	100	15·35	84·65	84·65	82·65	nil	nil	nil	
Control	85	15·5	69·50	81·8	±1·00	nil	nil	nil	

fluid, an effect known for digitalis and also confirmed in the present study. The change was particularly marked when calculated in terms of tissue water. Although the results do not represent quantitative exchanges between intracellular and extracellular fluids, there can be little doubt that the extra potassium in the perfusion fluid must have been derived from the cells. The inability to show any changes in sodium content of the perfusion fluid was due to the fact that changes in tissue sodium content are known to be slight (Hadju and Leonard, 1959) and are therefore not likely to be detected in the perfusion fluid which itself has a high sodium content.

The effect of hamycin on potassium thus further confirms its digitalis like activity.

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