although no evidence is available as to its nature. That it is impossible to saturate the placental transport system even by elevating maternal blood glucose to unphysiological levels, often fatal, has been observed(5). Thus, a complete inhibition of sorbose transfer could not be obtained by raising the level of maternal glucose. It is possible, of course, that more than one mechanism may be involved. The elucidation of the character of the placental mechanism for transport of sugar remains to be accomplished.

Summary. Sorbose alone and with glucose have been infused intravenously into pregnant rabbits near term, and permeability coefficients for sorbose under these 2 conditions have been calculated. It has been shown that there is a significant depression of permeability coefficient for sorbose when the maternal blood is overloaded with glucose. The results have been interpreted as indicating a competitive inhibition by glucose of sorbose transfer across the placenta.

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Received February 17, 1958. P.S.E.B.M., 1958, v97.

Role of Common Ions in Production of Increased Oxygen Consumption by Ouabain.* (23904)

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Since Ringer published his classical papers (1) it has become increasingly apparent that the common ions potassium and calcium alter the heart beat. More recent work(2-5) indicates that the toxic effects of digitalis may be altered by potassium and calcium, and the reports of Holland, Greig, and Dunn(6) and of Vick and Kahn(7) show that digitalis may enhance loss of potassium from the heart. Because of the importance of these common ions to the heart beat and to some actions of digitalis, it was thought desirable to investigate their relation to another effect of digitalis, namely increased oxygen consumption.

Methods. Hearts from embryos of chicken eggs incubated 5 days were dissected into Locke solution of the following composition: NaCl 9.00 g; KCl 0.42 g; $CaCl_2 \cdot 2H_2O$ 0.32 g; $NaHCO_3$ 0.20 g; dextrose 1 g; the solution was adjusted to pH 7.2-7.4. The hearts were then placed in a cartesian diver and experiments were performed as previously described (8,9). After a 10-minute period the same solution (for control experiments) or ouabain was added and observations on beat and measurement of oxygen consumption continued for 30 minutes. Similar experiments were carried out using each of following solutions: Locke without potassium; Locke with 4 × potassium; Locke without calcium; Locke with 4 × calcium (sodium bicarbonate was omitted). The hearts were kept in these solutions for about 30 minutes before observations and measurements were started. The results of each experiment were graphed, and a master graph for each group of experiments was constructed by averaging and graphing oxygen consumption at each even-numbered minute. Control experiments(8), recently supplemented by others, indicate that oxygen consumption during the entire 40-minute period is linear; therefore a curve of control oxygen consumption of each experiment was obtained by extending the curve of oxygen consumption during the 10-minute control period by dotted

* This work was aided by grants from Am. Heart Assn., Chicago Heart Assn., and Life Insurance Medical Research Fund.

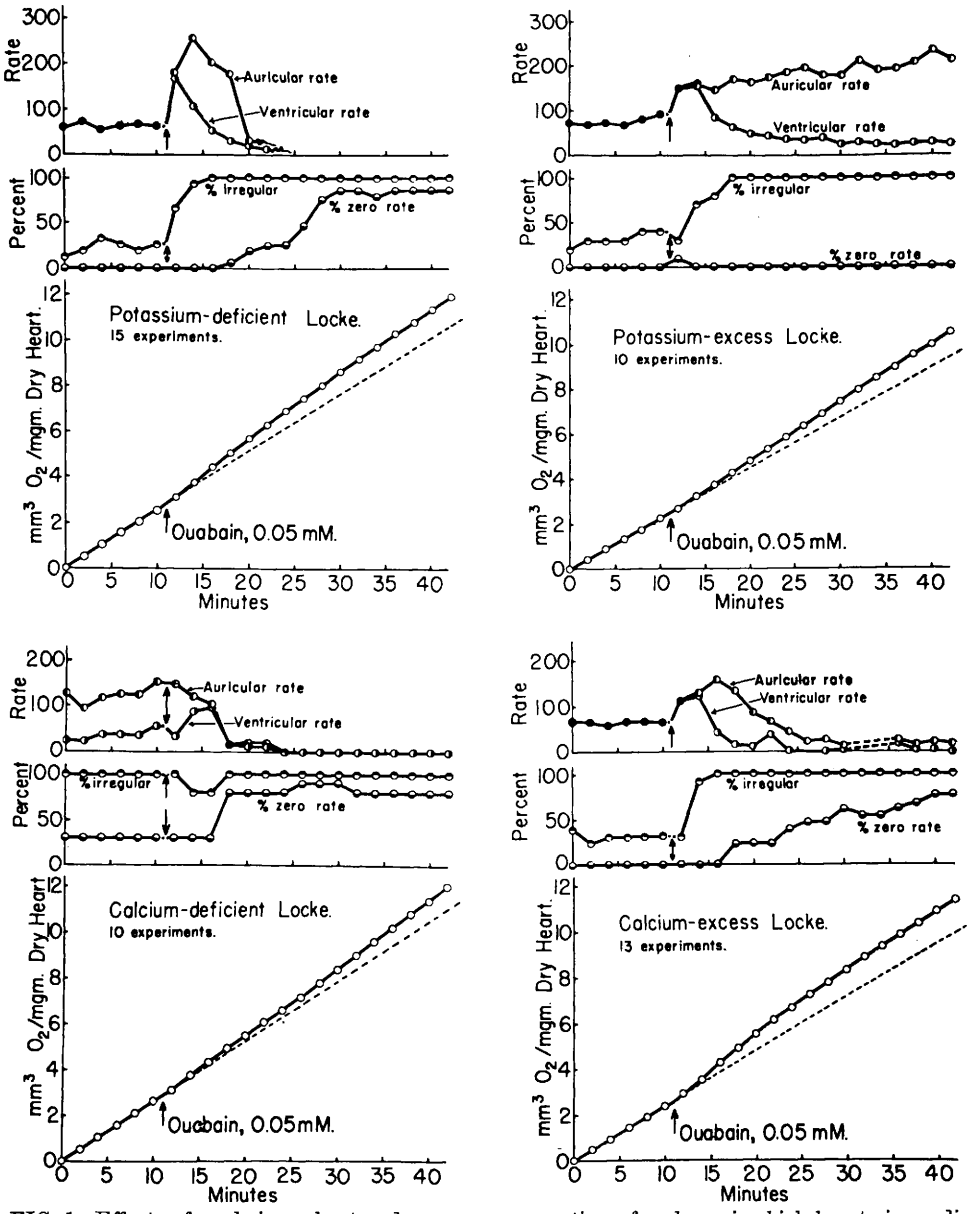

FIG. 1. Effects of ouabain on beat and oxygen consumption of embryonic chick hearts in modified Locke solutions.

line through the following 30-minute period; thus each experiment served as its own control. For statistical purposes, control oxygen consumption was expressed as mm^3 O_2/mg dry heart/hour, and % change in oxygen consumption was computed as experimental consumption/control consumption • 100. Mean and standard deviation were then calculated for each group of experiments. In comparing 2 means a probability of less than 0.01 ($p = < 0.01$) was regarded as indicating a significant difference.

Results. Results of these experiments and computations are shown in Table I and Fig. 1. Table I A indicates that the solutions did not alter oxygen consumption. Table I B indicates that ouabain caused a statistically significant increase in oxygen consumption in all

TABLE I.

A. Oxygen consumption in various solutions

Solution	No. of exps.	Oxygen consumption, mm^3 O_2/mg dry heart/hr
Locke	61	15.93 ± 3.704
K-deficient Locke	19	15.20 ± 4.518
K-excess "	15	13.32 ± 2.710
Ca-deficient "	23	16.67 ± 3.883
Ca-excess "	13	14.19 ± 4.867

B. Change in oxygen consumption

Solution	Drug added	No. of exps.	$\frac{\text{Exp., } mm^3 O_2\text{/mg dry heart/30 min.}}{\text{Cont., } mm^3 O_2\text{/mg dry heart/30 min.}} \cdot 100$
Locke	Locke (control)	49	100.32 ± 9.680 %
"	Ouabain, 0.05 mM	23	117.50 ± 19.750 %*
K-deficient Locke	*Idem*	15	116.43 ± 20.355 %*
K-excess "	"	10	115.57 ± 13.545 %*
Ca-deficient "	"	10	112.91 ± 14.951 %*
Ca-excess "	"	13	118.72 ± 30.819 %*

* $p = < 0.01$. ± refers to stand. dev. in all cases.

solutions. Fig. 1 shows that increased oxygen consumption produced by ouabain in each solution is similar to that previously described in Locke, Ringer, etc., solutions(8). Fig. 1 shows that in calcium-deficient Locke, the beat before and after ouabain is so distorted that effects of the drug are difficult to evaluate. However, the Fig. also shows that heart rate in other solutions is lower but the incidence of irregularities is the same as in Locke, Ringer, etc. solutions(8). Also the effects of ouabain on beat are basically the same in all solutions: initial increase in rate, then increase in irregularities, and eventually increase in incidence of standstill. And finally, these effects are intensified in potassium-deficient and calcium-excess Locke and reduced in potassium excess Locke solution.

Discussion. These observations on the beat verify results published previously that toxic effects of ouabain are intensified by potassium deficiency and calcium excess, and are reduced by potassium excess.

Despite differences in toxic effects on beat of hearts in solutions containing abnormal quantities of potassium and calcium, ouabain increases oxygen consumption identically in all solutions. Therefore it is probable, as postulated earlier(8), that the action of ouabain in increasing oxygen consumption is independent of its action on beat of heart.

Summary and conclusions. Ouabain causes increased oxygen consumption of embryonic chick hearts in Locke solution and in Locke solutions whose potassium or calcium contents had been radically decreased or increased. The effects of ouabain on the beat are exaggerated in potassium-deficient and calcium-excess solutions and reduced in potassium-excess solutions. Increased oxygen consumption produced by ouabain is not dependent on changes in beat of the heart.

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Received February 18, 1958. P.S.E.B.M., 1958, v97.