5273

The Fetal Heart Rate in the Monkey (Macacus Rhesus).

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(Introduced by E. M. K. Geiling.)

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In the early summer of 1929 the writers, in connection with a joint study of parturition and the behavior of the new-born monkey at the Carnegie rhesus colony, recorded the pulse of 11 pregnant females and in 6 subjects were able to record the fetal pulse. To these we add some observations of Dr. R. R. Squier, who auscultated 2 pregnant females in 1930 (Nos. 39 and 51).

The procedure was as follows: The animal was caught with a net and held by pinning her elbows behind her back. It is important to note that a vigorous animal may do considerable running before she is caught. The captured animal was laid on her side on a table and after she had become quiet the experimenters took turns with the stethoscope, checking each other. The maternal pulse was first taken and then the stethoscope was placed over the animal's abdomen and the spot found where the fetal pulse was discernible. This varied greatly and seems to be, in the monkey, unpredictable. Certainly, if the optimum point depends on the position of the fetus its situation might be expected to vary greatly. The characteristic double click of the fetal heart beat was heard well; likewise occasionally the placental bruit.

As will be seen by the accompanying table, the maternal pulse ranged from 160 to 240, the fetal from 100 to 180, at periods from 3 to 32 days prior to parturition and at a copulation age of 129 to 163 days. The exceptional cases will be discussed separately. For the human being, cow and dog, Clark[1] quotes the following figures:

	Fetus	Adult
Human	135 (5-9 mos.)	70
Cow	161	50
Dog	120-170	100

Williams gives 120 to 140 as the fetal heart rate in man in his *Obstetrics.*

These figures are sufficient to bear out the common opinion that the fetal is consistently faster than the maternal heart rate. Our figures are for the most part contrary to these, but the discrepancy

[1] Clark, *Comp. Physiol. of Heart,* 1927.

TABLE I. *Fetal and Maternal Heart Rates.*

Female No.	Days before delivery	Fetal Copl'n Age	Pulse Mother	Pulse Fetus	Days before delivery	Fetal Copl'n Age	Pulse Mother	Pulse Fetus	Days before delivery	Fetal Copl'n Age	Pulse Mother	Pulse Fetus	Days before delivery	Fetal Copl'n Age	Pulse Mother	Pulse Fetus
12	30	150	200 220	104 156	20	160	198 212 212	104 108 140								
34	3	152	160 200 240 230	139 140 146 118												
39	31	129	220 222	164 160 166 172 172	21	139	168 180	144 160	12	148	186 200	100 144 148 160	9	151	204 228	128 122 126 128
40	32	138	214 212 216	172	22	148	220	110 112 140	10	160	228 200 200 224	116 130 176 180				
43	22	148	204		12	158	212 212	172 176								
69	6	147	208	114												
39	1	169	190	—	14 hours	170	140 144	184 188	10 hours	170	148	180				
51	5	163	188	144	12-16 hours	168	168 160 160	180 184 192 200 200								

is readily explained—the rapid pulse of the pregnant monkey is due to her excitement and vigorous exercise attending capture and subsequent struggles to escape. This is partly borne out by the pulse rate of a very tame pregnant female, *Macacus cynomolgus (Pithecus irus)* of the Yale Primate Laboratory. This animal after voluntarily climbing up on the experimenter's lap and while sitting there without restraint shows a pulse rate of 136. After strenuous romping with her cage mate the rate is increased to 188. On one occasion, in a large male with erect penis, the phallic pulse was 90.

The measurement of temperature offers a parallel case. We have made many readings of the rectal temperature which varies from 101° to 105.5° F. The younger females run about 104° on the average, the older ones 102.5°. This is certainly far above the normal temperature of the animal at rest. What this is we do not know.

It is clear that, in general, our results on the monkey are not transferable to other orders of mammals. It is seen that, whereas the fetal heart beat in other mammals is about double that of the mother, in the monkey the mother's pulse is double the heart rate of the fetus. The discrepancy is, therefore, fourfold.

An interesting aspect of the results is the increase of rate with successive readings made at the same sitting. This holds especially for the fetus. Partial asphyxia probably accounts for the accelerated heart.

We come now to consider the reversal in the relative heart rate of mother and fetus just before parturition. This consists principally of an acceleration of the fetal rate, though the maternal rate on the occasion of the auscultations involved was considerably slower than before.

As seen from the last items of the table, female No. 39 was auscultated on the 169th day of gestation (Oct. 30) but the fetal heart rate was missed. The next day the fetal heart rate was found to be 184 and 188, the maternal 140 and 144. Since it was first thought that there might be a mistake, the observation was repeated with 180 for the fetal, 148 for the maternal rate. Ten hours later the baby was born after one hour's labor. Immediately after birth the baby's heart rate was 200.

With these observations as a cue, female No. 51 was examined at 2:00 p. m. November 4, early in the 169th day of gestation. The table shows the result of counts by 2 of us; the relative heart rate was now the reverse of what it had been several days before, the fetal being much higher than that of the mother. On the basis of

the behavior of No. 39, birth of the second baby was sanguinely expected to occur promptly. At 9:00 a. m. the following morning (Nov. 5) the baby was found, still attached to the afterbirth, which the mother was handling and nibbling at but not eating. (It may be stated parenthetically that this same female failed to eat the placenta after giving birth the year previous.) The baby was dry, the placenta somewhat dry on the edge. Birth had therefore taken place some hours before, or 12 to 16 hours after the fetal heart rate had been taken. The baby's heart rate at 10:00 o'clock was 192.

The obstetrical question arises: does acceleration of the fetal heart rate presage impending labor? The answer must be left for further observation, easily carried out in the human. At present we know of no figures on the changes (or absence of changes) in the fetal heart rate taken for a week, let us say, before parturition.

5274

The Survival Period and Blood Pressures of Adrenalectomized Decerebrate Cats.

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In 1919 Bazett[1] described experiments on adrenalectomized cats showing that the time of survival after adrenal removal averaged 6 hours for decerebrate and 10 hours for lightly urethaned animals. Theoretically possible explanations, such as extra shock, hemorrhage, or pituitary injury in the case of the decerebrates, were advanced to explain this difference. It was emphasized that there was no immediate (within one hour) blood pressure fall even in animals surviving a few hours only. The present investigation to obtain experimental data to enable discrimination between the possible mechanisms for the more rapid death of the decerebrates, although so far unsuccessful in its aim, has disclosed facts pertinent to discussions in current literature.

Vincent and Thompson[2, 3] reported that adrenalectomy in decerebrate cats permitted survival for only ½ to 1 hour although control decerebrates lived "for several hours". Death in adrenalectomized

[1] Bazett, *J. Physiol.*, 1919, **53**, 320.

[2] Vincent and Thompson, *J. Physiol.*, 1928, **67**, proceedings.

[3] Vincent and Thompson, *Nature*, 1928, **122**, 998.