Blood Picture After Extirpation of Cerebral Hemispheres.

29th Hematological Paper.

By

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Introduction.

When cerebral hemispheres were removed, surviving rabbits present, as was shown in a preceding paper¹⁾ of mine, a very peculiar blood picture. All the myeloid leucocytes in a circulating blood showed a very strong peroxidase reaction (of Sato and Sekiya), while the oxidase reaction (of Winkler and Schultze) of them remained only normally strong. I obtained thus the counter blood picture of what Prof. Sato²⁾ obtained in a "peroxidase-punctured" rabbit.

In the present paper I desire to describe the change of blood picture in the rabbits in which the cerebral hemispheres have been removed,—the blood picture except the oxidase and the peroxidase reaction.

Method of Experiment.

1. Animal used.

Normal rabbits were put (three times) to Sato and Sakurada's³⁾ liver function test, and b-classed (or with low liver power for ammonia-detoxication) and f-classed (or with high liver power for ammonia-detoxication) rabbits, were used. After the operation, rabbits were in a fasting state, because they neither ate nor drank.

1) S. Kuribayashi, Tohoku J. Exp. Med., to be published.

2) A. Sato, Tohoku Igaku Zasshi, 1924, 8, 79.

3) A. Sato and H. Sakurada, Tohoku J. Exp. Med., 1927, 8, 347.

2. Blood examination.

Blood was taken from an ear vessel before operation, and 3 and 6 hours after it. And then blood was examined every 24 hours till the rabbits died.

3. Method of blood examination.

Red cells were counted by use of Hayem's solution and white cells by use of Türk's solution. For the differentiation of white cells, use of the Tohoku Pediatric Method,⁴⁾ with a slight modification was made. Solution B was applied for five minutes instead of 1 minute in the Tohoku Pediatric Method.

Hemosedimentation rate of erythrocytes was examined by Yoshida's⁵⁾ micro method. The readings in millimeters of microsedimeter took place at 15, 30, 45 and 60 minutes respectively after the blood taking.

4. Method of extirpation of cerebral hemispheres.

The operation was performed according to Kinukawa's⁶⁾ description.

The hair was cut and an incision was made through the skin in the middle line in a length of about 6 cm.. At first a hole was made on a disc of skull bone with a trephine, and then it was enlarged in diameter from 3 cm. to 4 cm. with bone-forceps through which an operation was performed. After the incision of dura mater with a small stunt edge spoon, cerebral hemispheres were carefully removed completely from the basal ganglions. Tampons of cotton were applied on the hole to prevent bleeding, and the skin was sutured.

5. Normal blood picture.

In each animal, blood was examined twice before beginning the experiment, and the mean of the two counts was regarded as the normal count of each normal.

Result of Experiment (Cf. Table 1).

1. Time of survival of the rabbits.

The rabbits survived two days in 6 cases (60%), 3 days in 1 case (10%), 4 days in 2 cases (20%), 5 days in 1 case (10%) after the operation.

4) A. Sato, T. Suzuki and Ry. Shibata, Tohoku J. Exp. Med., 1934, 24, 195.

5) M. Yoshida, Tohoku J. Exp. Med., 1936, 29, 400.

6) C. Kinukawa, Tohoku J. Exp. Med., 1933, 22, 184.

2. Red cell count.

Red cell count showed the minimum value in 3 cases (Nos. 3, 7 and 10 in Table 1) 3 hours, in 3 cases (Nos. 1, 2 and 5 in Table 1) 6 hours, in 1 case (No. 4 in Table 1) 1 day, in 2 cases (Nos. 8 and 9 in Table 1) 2 days, in 1 case (No. 6 in Table 1) 3 days after the operation. The difference between the mean value before the experiment and the minimum count of red cells after the operation was 1.08 millions.

3. Hemoglobin (Sahli's value).

Hemoglobin ran parallel to that of red cell count in all the cases.

The maximal difference between the mean value before the operation and the minimum value after the operation was 10 hemometer value.

4. Total white cell count.

Total white cell count was reduced in parallelism to the reduced count of pseudoeosinophile leucocytes in the majority of cases.

5. Pseudoeosinophile leucocytes.

The percentage of pseudoeosinophile leucocytosis was different 3-6 hours after the operation according to the cases, but on the first day of experiment, count returned to the initial before the operation in all instances. It did not show a remarkable variation on the 2nd day; it showed rather a tendency to decrease in a slight degree, except for only 1 case (No. 9 in Table 1). This case showed an increase which was, presumably, a result of threatening death. Three rabbits (Nos. 1, 6 and 7 in Table 1) survived over 2 days and showed a tendency to gradual increase toward the death, only one (No. 4 in Table 1) showing a decrease before death.

6. Lymphocytes.

Lymphopenia occurred in all the cases on the 1st day of experiment and reached the initial count on the 2nd day; then it showed neither an increase nor a decrease. The rabbits which survived two days showed a tendency to a slight decrease of lymphocytes until death.

7. Basophiles, monocytes and eosinophiles.

As to the change of these leucocytes, definite relation could not be found.

8. Nuclear shift in pseudoeosinophile leucocytes.

Except for only one case (No. 2 in Table 1), nuclear shift to the left was seen in the majority of cases 3-6 hours after the operation, 4 animals died under an increasing nuclear shift to the left 2 days after operation (Nos. 3, 4, 5 and 10 in Table 1). Nuclear shift to the right

TABLE
Blood picture of rabbits with

No. of rabbits Sex and Class of rabbits	Body weight (in kilos)	Day of exper- iment	Time of blood examination	Red cell count per cmm. (million)	Hemoglobin (Sahli's value)	Total white cell count per cmm.	Varieties			
							Basophiles		Eosino- philes	
							%	Absolute count per cmm.	%	Absolute count per cmm.
No. 1 ♀ RF	2.40	22. I	Before operation	5,60	80	13,000	3.2	420	1	130
		22. "	3 hours after operation	5,30	75	10,900	1	110	0	0
		22. "	6 hours after	4,95	72	8,300	1	80	0	0
	2.35	23. "	1 day after	5,37	78	8,600	4.2	360	0	0
	2.22	24. "	2 days after	5,05	72	6,800	3.7	250	0	0
	2.10	25. "	3 " "	5,07	72	6,800	0.9	60	0	0
		26. "	4 " "	5,03	73	12,000	4	480	0	0
	1.90									
No. 2 ♀ RF	2.46	1. II	Before operation	5,54	80	10,900	2.7	290	0.3	33
		1. "	3 hours after	5,26	78	10,500	1	110	0	0
		1. "	6 " "	4,71	75	13,000	2.8	360	0	0
	2.40	2. "	1 day after	5,04	73	12,500	1.8	230	0	0
	2.35	3. "	2 days "	4,80	78	13,400	2.8	380	0	0
No. 3 ♀ Rb	2.70	8. II	Before operation	6,45	85	13,000	3.8	570	0	0
		8. "	3 hours after	5,37	75	10,600	3.4	360	0	0
		8. "	6 " "	5,78	80	12,000	3	360	0	0
	2.55	9. "	1 day after	6,50	85	12,400	3.3	410	0	0
	2.50	10. "	2 days "	6,23	83	12,000	2.5	300	0	0
No. 4 ♀ Rf	2.40	25. II	Before operation	4,96	80	8,000	3.9	310	0.9	72
		25. "	3 hours after	4,12	72	10,500	1.4	150	0.6	63
		25. "	6 " "	4,82	80	9,000	2.3	210	0	0
	2.35	26. "	1 day after	4,06	75	9,000	2.2	200	0.4	36
	2.20	27. "	2 days "	4,28	78	6,600	4.8	320	1.6	106
	2.10	28. "	3 " "	4,75	78	2,100	3.9	80	2.5	52
No. 5 ♀ Rf	2.30	4. III	Before operation	5,34	73	8,000	2.7	220	0	0
		4. "	3 hours after	5,34	72	8,500	0.9	80	0	0
		4. "	6 " "	4,74	70	8,900	0.5	50	0	0
	2.15	5. "	1 day after	5,33	72	13,000	2	260	0	0
	2.10	6. "	2 days "	5,49	78	7,400	1	70	1	74
No. 6 ♂ Rb	2.70	10. III	Before operation	5,53	80	11,200	4.4	490	1.8	202
		10. "	3 hours after	5,12	78	11,700	1.4	160	0	0
		10. "	6 " "	4,96	78	6,300	4	250	1.2	76
	2.55	11. "	1 day after	5,12	76	8,300	3	250	0.4	33
	2.50	12. "	2 days "	4,95	75	13,000	3.4	440	0.9	117
	2.30	13. "	3 " "	4,57	74	12,000	2.4	290	0.5	60
	2.20	14. "	4 " "	6,15	80	15,000	2	300	0	0
	2.15	15. "	5 " "	6,10	75	16,000	2	320	0	0
No. 7 ♂ Rf	2.70	23. III	Before operation	6,27	75	11,000	2.7	300	0.3	33
		23. "	3 hours after	5,36	70	10,500	0.3	30	0	0
		23. "	6 " "	5,77	75	8,000	2.7	220	0	0
	2.65	24. "	1 day after	5,65	75	10,000	2.2	200	0.4	40

1.

cerebral hemispheres removed.

of leucocytes						Arne'th's* nuclearshift in pseudoeosinophiles								Sedimentation rate of erythro- cytes (Yoshida's micro method)			
Pseudo- eosino- philes		Monocytes		Lympho- cytes													
%	Absolute count per cmm.	%	Absolute count per cmm.	%	Absolute count per cmm.	I			II	III	IV	V	15'	30'	45'	60'	
						M	W	T									
30	3900	1	130	64.8	8400	0	0	6	42	41.5	10	0.5	0.5	0.8	1.5	1.8	
42.6	4600	1	110	55.4	6000	0	0	15	40	41	4	0	0.2	0.5	0.6	1	
44.2	3700	0.8	66	54	4500	0	0	18	40	39	3	0	0.5	0.8	1	1.5	
44.8	3900	1	86	50	4300	0	0	12	45	40	3	0	0.7	1	2	2.5	
42	2900	1.3	89	53	3600	0	0	12	43	40	5	0	1	2	6	15	
63	4300	0.7	46	35.4	2400	0	0	14	40	42	4	0	not clear				
70	8400	1	120	25	3000	0	0	8	39	40	12	1	1	2	2.5	3	
46	5000	2	220	49	5300	0	0	5	44.5	41	9	0.5	0.5	1	1.5	2	
70.5	7400	1	110	27.5	2900	0	0	7	49	39	5	0	0.5	0.7	1	1.5	
68	8800	0.7	91	28.5	3700	0	0	6	46.5	42	5	0.5	0.2	0.5	0.8	1	
53	6600	1.3	160	43.9	5500	0	0	8	51	36	5	0	0.5	2	5	7	
53.5	7200	1	130	42.7	5700	0	0	5	48	39	8	0	4	8	16	18	
44	6600	1	150	51.2	7680	0	0	7	43.5	38	11	0.5	0.2	0.5	1	1.5	
69	7300	0.6	64	27	2900	0	0	12	50	33	5	0	0.2	0.5	0.7	1	
63.8	7700	0.8	360	32.4	3900	0	0	12	46	34	8	0	1.5	1	1.5	2	
57	7100	0.6	75	39.1	4800	0	0	11	42	40	7	0	0.3	0.7	1.5	3	
56	6700	0.5	60	41	4900	0	0	11	43	30	8	0	0.5	3	7	10	
44.5	3600	2	160	48.7	3900	0	0	10	38	40	11	1	0.2	0.3	0.5	1	
64	6700	1.6	170	32.4	3400	0	0	29	41	43	4	0	0.1	0.2	0.4	0.6	
63.1	5700	1	90	33.6	3000	0	0	12	41	43	4	0	0.1	0.5	1	1.5	
47	4200	2	180	48.4	4400	0	0	15	43	33	9	0	0.1	0.3	0.5	1	
44.6	2900	1	66	48	3200	0	0	30	35	32	3	0	1	6	8	11	
49.5	1000	0	0	44.1	930	0	0	38	40	20	2	0	not clear				
45	3600	1.3	100	51	4100	0	0	5	47	35	11	2	0.5	1	1.5	2	
64.3	5500	1	85	33.8	2900	0	0	14	52	27	5	2	0.2	0.5	0.8	1	
55	4900	1.5	130	43	3800	0	0	7	51	35	5	2	0.2	0.5	1	1.5	
58	7500	2	260	38	4900	0	0	7	48	35	8	2	0.2	2	3	5	
56.9	4200	0.6	44	40.5	3000	0	0	8	54	35	3	0	2	4	8	10	
37.4	4200	0.4	45	56	6300	0	0	4	43	39	13	1	0.2	0.5	1	1.8	
65	7600	0.9	100	32.7	3800	0	0	8	50	32	10	0	0.3	0.5	1	1.5	
58.2	3700	1	63	35.6	2200	0	0	10	49	30	11	0	0.2	1	1.2	1.8	
62	5100	1.3	110	33.3	2800	0	0	9	40	42	9	0	1	3	6	8	
71	9200	0.4	52	71	9200	0	0	5	39	40	14	2	not clear				
72.3	8700	1	120	23.8	2900	0	0	4	40	41	14	1	22	28	30	30	
74.5	1200	1	150	22.5	3400	0	0	5	39	43	12	1	22	27	28	30	
74	11800	0	0	24	3800	0	0	4	39	44	11	2	10	25	27	28	
56	6200	2	220	39	4300	0	0	10	36	39	14	1	1	2	3	4	
68	7100	1.3	140	30.4	3200	0	0	17	43	29	11	0	1	2	4	6	
66.5	5300	1	80	29.8	2400	0	0	25	41	33	10	0	0.5	0.8	1.2	2	
57.7	5800	1	100	38.7	3900	0	0	21	43	25	11	0	2	5	10	12	

Table 1. Continued.

No. of rabbits Sex and Class of rabbits	Body weight (in kilos)	Day of experi- ment	Time of blood examination	Red cell count per cmm. (million)	Hemoglobin (Sahli's value)	Total white cell count per cmm.	Varieties			
							Basophiles		Eosino- philes	
							%	Absolute count per cmm.	%	Absolute count per cmm.
	2.60	25. III	2 days after	5,90	73	7,200	2.1	150	0.4	29
	2.50	26. "	3 " "	5,82	72	7,300	1.2	90	0	0
	2.42	27. "	4 " "	6,18	78	10,500	2.2	230	0	0
No. 8 ♂ Rb	2.90	31. III	Before operation	6,11	73	10,500	4.4	460	0	0
		31. "	3 hours after	6,43	74	14,000	1	140	0	0
		31. "	6 " "	6,35	73	8,600	5.1	440	0	0
	2.78	1. IV	1 day after	6,61	74	9,500	2.3	220	0	0
	2.70	2. "	2 days "	5,35	70	7,700	1	80	0	0
No. 9 ♂ Rb	2.15	8. IV	Before operation	6,17	73	9,200	3.3	300	0.3	28
		8. "	3 hours after	5,83	72	16,000	3.6	580	1	160
		8. "	6 " "	6,20	72	6,000	3.1	190	0	0
	2.10	9. "	1 day after	5,86	70	13,000	1.7	220	0	0
	2.05	10. "	2 days "	5,40	70	14,000	1.4	200	0	0
No. 10 ♂ Rb	2.60	14. IV	Before operation	6,10	82	12,000	6.3	760	0.7	84
		14. "	3 hours after	5,30	72	13,800	3	410	0.3	41
		14. "	6 " "	5,71	80	12,500	4.9	610	0	0
	2.35	15. "	1 day after	5,62	80	12,600	6	760	0	0
	2.20	16. "	2 days "	6,80	82	9,400	3.7	350	0.3	28

* M=myelocytes; W=metamyelocytes with slightly indented nuclei; T=meta-
two, three and from nuclear segments and V= polymorphonuclears with five or more

was present in 3 cases (Nos. 7, 8 and 9 in Table 1) out of the 5 cases surviving the operation 2 days. In the remaining 2 cases (Nos. 1 and 6 in Table 1) it was present even 3 days after the operation, presumably due to hunger.

9. Sedimentation of red blood corpuscles.

The sedimentation of red blood corpuscles showed a retardation in 6 cases (Nos. 1, 3, 4, 5, 6 and 9 in Table 1) 3 hours after the operation, in 4 cases (Nos. 2, 7, 8 and 10 in Table 1) 6 hours after it. In most cases hemosedimentation showed a remarkable acceleration until death, but 2 cases (Nos. 1 and 10 in Table 1) which at first showed an acceleration later retarded.

Comment.

In this experiment, red cell count showed a decreases after operation in all the cases, this probably being due to bleeding during the

of leucocytes						Arneeth's* nuclearshift in pseudoeosinophiles								Sedimentation rate of erythrocytes (Yoshida's micro method)			
Pseudo-eosino- philes		Monocytes		Lympho- cytes													
%	Absolute count per cmm.	%	Absolute count per cmm.	%	Absolute count per cmm.	I			II	III	IV	V		15'	30'	45'	60'
						M	W	T									
58.2	4200	1.6	120	37.7	2700	0	0	11	43	32	14	0		2	8	12	15
66.3	4800	0.5	36	32	2300	0	0	20	43	26	10	1	4	11	15	18	
70	7400	0.8	84	27	2800	0	0	16	39	31	12	2	8	15	23	24	
50.6	5300	2	210	43	4500	0	0	4	46	37	13	0	0.5	0.7	1	1.6	
74.8	10500	1.5	210	22.7	3200	0	0	17	44	31	7	1	0.2	0.8	1	1.2	
66	5700	1.2	100	27.7	2400	0	0	4	51	38	7	0	0.2	0.5	0.7	1	
57.6	5500	1	95	39.1	3700	0	0	4	44	40	12	0	1	2	3	4	
69.2	5300	1.3	100	28.5	2200	0	0	3	41	40	15	1	1	3	7	11	
44.2	4100	2.2	200	50	4600	0	0	9	43	39	8	1	0.3	0.6	1.2	1.8	
69	11000	1.4	220	25	4000	0	0	15	48	32	5	0	0.2	0.3	0.5	1	
68	4100	1.5	90	27.4	1600	0	0	20	47	30	3	0	0.4	1	1.2	1.3	
68.1	8900	1	130	29.2	3800	0	0	15	40	36	8	1	0.5	1.5	3	4	
63.7	8900	0.4	56	34.5	4800	0	0	11	45	33	9	2	3	4	6	8	
46	5500	0	0	47	5600	0	0	4	41	40	15	0	0.5	1	1.4	1.8	
70	9700	0	0	26.7	3700	0	0	8	47	32	13	0	0.7	1	2	3	
62.2	7800	0	0	32.9	4100	0	0	6	43	40	11	0	0.2	1.2	1	1.2	
59	7400	0	0	35	4400	0	0	6	44	36	14	0	0.5	2	4	6	
52	4900	0	0	44	4100	0	0	8	46	35	11	0	0.3	0.4	1	1.5	

myelocytes with deeply indented nuclei; II, III and IV = polymorphonuclears with nuclear segments.

operation. 3-6 hours after the operation, pseudoeosinophile leucocytosis occurred in all the cases, which was, I think, an effect of the operation, and 3 days after operation leucocytosis occurred again in all the cases, which was presumably a premortal symptom.

3-6 hours after operation, absolute relative lymphopenia occurred in all the cases, and 3 days after operation lymphopenia appeared again in all the cases, brought about presumably by hunger.

Nuclear shift to the left was seen in the majority of cases, resulting no doubt from an influence of the operation, and 3 days after operation, nuclear shift to the right was seen in the majority of cases, which was, I suppose, due to hunger.

Summary and Conclusions.

On the results of investigation of 10 rabbits with cerebral hemispheres removed, I have come to the following conclusions:—

1. Red cell count showed the minimum value 3-6 hours after operation and approached gradually the mean value before operation in the majority of cases.
 2. Hemoglobin value ran parallel to that of red cell count in all the cases.
 3. Total white cell count was reduced in parallel to the reduced count of pseudoeosinophiles in the majority of cases.
 4. Pseudoeosinophile leucocytosis was present in a different degree according to cases 3-6 hours after operation, but on the first day of experiment, the count returned to the initial value before the operation and did not show any remarkable variation on the 2nd day, rather showing a slight tendency to decrease, and 3 rabbits which survived longer than 2 days showed a gradual tendency to increase until death, excepting only one which showed a decrease before death.
 5. Lymphopenia occurred in the majority of cases.
 6. As to basophiles, monocytes and eosinophiles, a definite conclusion was not obtained.
 7. 3-6 hours after operation, nuclear shift to the left was seen in the majority of cases. Nuclear shift to the right was present in 3 out of the 5 cases surviving the operation 2 days, and in the remaining 2 cases 3 days after operation.
 8. The sedimentation of red blood cells showed a retardation in the majority of cases 3-6 hours after operation, and then a remarkable acceleration until death.
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