Studies on Blood and Plasma Catalase

The 3rd Report

The Blood and Plasma Catalase Content in Blood Diseases

By

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From our former experiments¹⁾, it is concluded that the blood catalase content changes for itself in spite of the close connection with erythrocytes and hemoglobin. But the function of the plasma catalase is still unknown.

Therefore, it is important to clarify the clinical significance of the blood and plasma catalase content in patients of diseases of the blood.

EXPERIMENTAL

Results

1. Anemia caused by cancers

The results obtained from 6 cases of anemia caused by cancers show that the blood and plasma catalase content, catalase index and hemoglobin-catalase index decrease more than in healthy persons and tend to be notable when the process of cancer degenerates (Table I). On the contrary, the plasma-blood catalase ratio increases more than in healthy persons and it seems to decrease when cancers are in advanced stage.

Therefore, it is presumed that the decrease of the blood catalase in anemia patients caused by cancers is not only more pronounced than that of the plasma catalase, but also the catalase content in each red corpuscle decreases remarkably.

2. Anemia caused by ulcers

Data presented in Table I show that the blood catalase content decreases noticeably in anemia patients caused by ulcers, while the plasma catalase content, catalase index, hemoglobin-catalase index lie within a normal value. On the contrary, the plasma-blood catalase ratio increases more markedly than that of healthy persons and seems to decrease when ulcer is cured.

Thus it is concluded that the decrease of the blood catalase is accompanied by the decrease of erythrocytes and hemoglobin.

TABLE I
Anemias Caused by Cancers and Ulcers

Name	Diagnosis	Date	Erythrocytes	Hb.	Hb-index	Blood catalase	Plasma catalase	Catalase index	Hb-catalase index	Plasma-blood catalase ratio	Remarks
Y.R.	Gastric cancer	18/VII 1/VIII	207 200	28 25	0.68 0.62	2.99 2.92	12.58 12.24	1.44 1.46	0.62 0.68	4.21 4.18	2/VIII op.
M.U.	ditto, Peritonitis	12/V 5/VI	139 250	18 32	0.65 0.64	3.13 3.77	12.58 10.88	2.25 1.51	1.01 0.68	4.02 2.89	17/VI +
S.M.	ditto, Hepatic cancer	14/V 20/VI 23/VII	243 235 244	25 28 27	0.52 0.60 0.55	4.32 3.43 2.21	11.22 9.86 9.18	1.77 1.46 0.91	1.00 0.71 0.48	2.60 2.87 4.16	9/VIII +
O.Y.	Gastric cancer	17/I 6/II	153 181	39 42	1.27 1.16	4.42 5.51	12.24 10.20	2.28 3.04	0.66 0.76	2.77 1.83	
I.C.	ditto	30/IV 14/V	241 226	39 38	0.81 0.84	4.44 4.28	10.20 9.52	1.86 1.89	0.67 0.65	2.27 2.22	24/V +
K.S.	Cancer of pancreas	14/V 6/VI	193 171	45 45	1.16 1.32	5.07 4.76	10.54 9.52	2.63 2.78	0.65 0.62	2.08 2.00	12/VII +
S.T.	Gastric ulcer	16/III 5/IV	203 324	42 56	1.04 0.87	2.93 7.51	15.98 16.66	1.44 2.32	0.41 0.78	5.45 2.21	transfusion 3 times
O.G.	ditto	16/VIII 15/IX	214 330	50 62	1.17 0.94	3.81 7.48	14.96 13.94	1.78 2.26	0.44 0.70	3.92 1.87	
K.O.	ditto	17/I 7/II	175 271	35 65	1.00 1.20	5.71 8.50	13.94 14.28	3.26 3.13	0.95 0.76	2.44 1.68	ditto 7 times
Y.J.	ditto	8/IV 5/V	230 397	38 70	0.83 0.88	7.68 8.30	15.30 14.28	3.34 2.09	1.18 0.69	1.89 1.72	ditto 4 times

3. Pernicious anemia

As to pernicious anemia patient we found that the blood catalase content decreased and the catalase index and plasma-blood catalase ratio increased in marked degree, while the plasma catalase content and hemoglobin-catalase index were almost normal (Table II). When patient was recovered with increased erythrocytes, the blood catalase increased and the catalase index and plasma-blood catalase ratio decreased to a normal value.

Therefore, it appears in the case of pernicious anemia that the catalase content in each red corpuscle increases in company with hemoglobin, while the whole quantity of the blood catalase decreases pronouncedly.

4. Aplastic anemia and other anemias

The results obtained from a case of aplastic anemia show that the blood and plasma catalase content decrease remarkably, but the catalase index and hemoglobin-catalase index to a slight degree, while the plasma-

TABLE II
Various Anemias

Name	Diagnosis	Date	Erythrocytes	Hb.	Hb-index	Blood catalase	Plasma catalase	Catalase index	Hb-catalase index	Plasma-blood catalase ratio	Remarks
W.T.	Pernicious anemia	11/VI	69	27	1.96	4.49	12.92	6.50	0.97	2.87	A slight recovery by transfusion.
		19/VI	68	25	1.84	4.49	19.04	6.60	1.04	4.24	
		3/VII	134	37	1.38	4.45	14.28	3.32	0.70	3.21	
		13/VII	122	35	1.43	3.43	13.94	2.81	0.57	4.07	
		23/VII	135	46	1.70	6.60	10.88	4.88	0.83	1.65	
		10/VIII	154	51	1.65	6.09	8.16	3.95	0.69	1.34	
		30/VIII	239	55	1.14	6.80	13.94	2.84	0.72	2.05	
I.M.	Aplastic anemia	29/V	80	16	1.00	1.73	6.80	2.17	0.64	3.92	Transfusions were of no effect.
		18/VI	112	20	0.89	2.48	6.80	2.22	0.72	2.73	
		2/VII	152	28	0.92	2.41	5.78	1.58	0.50	2.39	
		23/VII	140	29	1.03	2.82	6.46	2.01	0.57	2.29	
T.N.	Thrombocytopenic purpura	23/IV	141	20	0.71	3.14	7.48	2.25	0.91	2.39	Thrombocytes 23/IV 7000 4/V 0
		4/V	103	20	0.95	3.26	4.74	3.17	0.95	1.45	
S.M.	ditto	5/VIII	85	20	1.17	2.18	6.80	2.55	0.63	3.13	ditto 5/VIII 5000
		12/VIII	53	12	1.13	1.40	6.12	2.64	0.68	4.37	

blood catalase ratio tends to increase (Table II).

Therefore, the decrease of the blood catalase in the case of aplastic anemia is more remarkable than that of the plasma catalase and the catalase content in each red corpuscle decreases also in a slight degree.

As to thrombocytopenic purpura, whose anemia resembles closely to aplastic anemia, the results are generally the same as in aplastic anemia.

By the by, the fact that the plasma catalase was found from the blood sample of T.N. who had almost no thrombocytes, suggests that a part of the plasma catalase does not originate in thrombocytes.

Table III shows that the blood catalase of a paroxysmal hemoglobinuria patient makes a marked decrease, but the plasma catalase, catalase index, hemoglobin-catalase index lie within a normal value, while the plasma-blood catalase ratio increases and returns to a normal value when the process takes a favourable turn. In the case of an artificial hemolysis in a living body by Rosenbach's cooling test, the plasma catalase and plasma-blood catalase ratio show a remarkable increase in spite of the diminution of erythrocytes, hemoglobin and blood catalase without any change of the catalase index and hemoglobin-catalase index.

Therefore, such hemolysis in a living body seems to be significant as to the origin of the plasma catalase.

5. Leukemia

Our results obtained from chronic myelogenous leukemia show, as

TABLE III
Rosenbach's Cooling Test of Paroxysmal Hemoglobinuria

Date	Time	Erythrocytes	Hb.	Hb-index	Blood catalase	Plasma catalase	Catalase index	Hb-catalase index	Plasma-blood catalase ratio	Urine		
										Colour	Al- bumin	Occult blood
15/II	Before test	290	75	1.29	6.97	14.28	2.40	0.54	2.25	red-brown	+	—
	15 min. after	304	72	1.18	8.36	28.56	2.75	0.67	3.41	ditto	+	—
	30 min. "	332	75	1.13	7.07	19.04	2.13	0.54	2.69	black-brown	++	+
	1 hour "	271	65	1.20	6.77	54.40	2.49	0.60	8.03	ditto	++	++
	2 hours "	274	63	1.14	6.97	88.40	2.54	0.64	12.68	ditto	++	++
	3 hours "	307	61	0.93	7.28	40.80	2.36	0.69	5.61	ditto	++	++
	4 hours "	305	65	1.06	7.38	21.76	2.42	0.66	2.79	ditto	++	++
	5 hours "	311	66	1.06	7.92	45.56	2.55	0.70	5.75	ditto	+	±
20/V	Before test	440	81	0.92	8.50	10.88	1.93	0.61	1.28	yellow	—	—
	15 min. after	437	73	0.84	9.04	27.20	2.06	0.72	3.01	ditto	—	—
	30 min. "	388	79	1.03	8.23	14.28	2.12	0.61	1.74	ditto	+	±
	1 hour "	436	80	0.92	8.23	25.84	1.89	0.60	3.14	black-brown	++	++
	2 hours "	381	78	1.02	7.79	42.84	2.04	0.58	5.50	red-brown	++	+
	3 hours "	418	75	0.90	7.92	34.00	1.90	0.61	4.30	ditto	+	±
	4 hours "	364	65	0.89	8.84	44.20	2.43	0.79	5.00	ditto	+	—

presented in Table IV, that the blood catalase content, catalase index, hemoglobin-catalase index decrease more or less in an early stage, but return to a normal value, as the condition of this disease is recovered by radiological treatment. When 0.7 cc. adrenalin chloride is subcutaneously injected in order to raise the number of leucocytes in the peripheric blood, we found a slight increase of the plasma catalase content and plasma-blood catalase ratio, while the blood catalase content, catalase index, hemoglobin-catalase index are almost unchangeable.

Therefore, the contraction of the spleen after injecting adrenalin has influence on the increase of the plasma catalase.

Contrary to chronic myelogenous leukemia, data obtained from acute myelogenous leukemia show, as presented in Table IV, that the blood catalase content decreases, being accompanied with marked anemia, but the plasma catalase content and plasma-blood catalase ratio increase remarkably.

6. Agranulocytosis

In a case of agranulocytosis caused by injecting salvarsan for the treatment of hereditary syphilis, we found the increase of the plasma catalase content and plasma-blood catalase ratio, while the blood catalase content, catalase index and hemoglobin-catalase index lie within a normal value (Table V).

Therefore, it is presumed that there is no close connection between the blood catalase content and the number of leucocytes, and the plasma catalase content is influenced also by another factor in addition to the

TABLE IV
Adrenalin Test of Leukemia

Name	Diagnosis	Date	Time	Erythrocytes	Leucocytes	Hb.	Hb-index	Blood catalase	Plasma catalase	Catalase index	Hb-catalase index	Plasma-blood catalase ratio
K.R.	Chronic myelogenous leukemia	12/II	Before test	426	76500	78	0.92	7.99		1.88	0.86	
			15 min. after	457	193200	80	0.88	7.75		1.69	0.56	
			30 min. "	414	199300	78	0.94	8.13		1.96	0.61	
			45 min. "	456	271400	80	0.88	8.40		1.86	0.61	
			1 hour "	460	255900	78	0.85	8.13		1.77	0.61	
			1.5 hours "	400	204400	79	0.99	7.72		1.93	0.57	
			2 hours "	390	176000	72	0.92	7.79		1.99	0.63	
		18/IV	Before test	531	30400	100	0.94	11.70	17.00	2.20	0.68	1.45
			15 min. after	520	22400	102	0.97	11.70	26.18	2.24	0.67	2.23
			30 min. "	587	37000	117	0.98	11.73	23.12	2.03	0.59	1.96
			45 min. "	552	47400	118	1.07	11.53	23.12	2.09	0.58	2.00
			1 hour "	584	43200	100	0.86	11.63	12.92	1.99	0.68	1.11
			1.5 hours "	536	38400	102	0.95	11.46	16.66	2.14	0.66	1.45
			2 hours "	558	36800	95	0.85	11.73	20.74	2.10	0.72	1.76
		10/IX 28/IX		300	16900	51	0.85	5.98	16.66	1.99	0.68	2.78
				247	6400	45	0.91	5.10	15.64	2.06	0.66	3.07
I.T.	Acute myelogenous leukemia	14/VII	Before test	133	33200	41	1.54	3.50	23.80	2.63	0.49	6.78
			15 min. after	143	38200	40	1.41	3.98	17.00	2.78	0.58	4.28
			30 min. "	151	43800	40	1.33	4.08	23.80	2.70	0.59	5.83
			45 min. "	147	37600	39	1.33	3.40	9.52	2.31	0.51	2.80
			1 hour "	137	34200	37	1.35	3.60	10.20	2.62	0.56	2.83
			1.5 hours "	143	28600	37	1.29	3.33	8.84	2.33	0.52	2.66
			2 hours "	140	28000	41	1.41	3.43	6.80	2.45	0.48	1.98

TABLE V
Agranulocytosis

Date	Erythrocytes	Leucocytes	Hb.	Hb-index	Blood catalase	Plasma catalase	Catalase index	Hb-catalase index	Plasma-blood catalase ratio
25/V	539	1150	104	0.97	11.55	40.80	2.05	0.62	3.69
27/V	540	800	104	0.96	10.08	37.40	2.02	0.61	3.43
29/V	566	1150	106	0.94	10.85	36.04	1.92	0.60	3.32
8/VI	510	5600	100	0.98	11.39	32.64	2.22	0.66	2.86
18/VI	499	2800	88	0.98	11.97	25.16	2.39	0.85	2.29
3/VII	435	4200	98	1.13	10.09	19.72	2.32	0.60	1.95
14/VII	510	6500	105	1.03	11.12	21.42	2.18	0.61	1.93

hemolysis and the function of the spleen.

DISCUSSION

Many workers accept the decrease of the blood catalase content in pernicious anemia patient, and v. Thienen²⁾ reports also the decreased content of blood catalase in the cases of aplastic anemia, but Nakanishi³⁾

asserts that the blood catalase content of paroxysmal hemoglobinuria is unchangeable. According to our former experiments¹⁾, it is clear that the blood catalase content changes for itself in spite of the close connection with erythrocytes and hemoglobin, and then decreases to a certain degree in the cases of cancers and ulcers. The results obtained from these experiments show that the blood catalase content decreases in various anemia patients, especially in the cases of aplastic anemia, thrombocytopenic purpura and acute myelogenous leukemia.

As for the catalase index many investigators differ in opinion in the cases of pernicious anemia. v. Thienen²⁾, Strauss and Rammelt¹⁾, Nissen⁵⁾, Zerner⁶⁾ and Nakanishi³⁾ recognize the increase of the catalase index, but Krumbhaar and Musser⁷⁾, Segall and Händel⁸⁾ deny such increase of the catalase index. Moreover, the catalase index of aplastic anemia is reported as normal by v. Thienen²⁾. Many workers such as v. Thienen²⁾, Neumann⁹⁾, Strauss and Rammelt¹⁾, Segall and Händel⁸⁾ report that the catalase index of chronic myelogenous leukemia falls in general within a normal value, while Zerner⁶⁾ and Nakanishi³⁾ recognize its increase. Data presented in these experiments show that the catalase index remains within a normal value in the cases of aplastic anemia, thrombocytopenic purpura, acute myelogenous leukemia, but that in anemia caused by ulcers and chronic myelogenous leukemia shows a slight decrease in early stage and returns to a normal value when the condition of these patients is recovered.

Contrary to anemia caused by cancers whose catalase index decreases markedly, the catalase index of pernicious anemia shows a remarkable increase in the worst stage, but returns rapidly to a normal value in the convalescence.

Because the hemoglobin-catalase index lies generally within a normal value except various anemias and acute myelogenous leukemia, the blood catalase content changes in the close connection with hemoglobin.

As for the plasma catalase content, Takisawa¹⁰⁾ reports that it decreases in cancer patients, but remains within a normal extent in ulcer sufferers. The results obtained from our experiments show that the plasma catalase content of anemia caused by ulcers, pernicious anemia and chronic myelogenous leukemia lies within a normal degree, but it decreases in the cases of anemia caused by cancers, aplastic anemia and thrombocytopenic purpura, while that of acute myelogenous leukemia and agranulocytosis increases. Especially in the latter case, the plasma catalase content shows an evident elevation in early stage and returns to a normal value when the condition of the patient is recovered. Moreover, we found the increased content of plasma catalase when the hemolysis in a living body was induced by Rosenbach's cooling test in a case of

paroxysmal hemoglobinuria, or the spleen was contracted by adrenalin injection in a case of chronic myelogenous leukemia.

Therefore, it is presumed that the plasma catalase content is influenced to a great extent not only by the hemopoietic function, but also by the hemolysis in a living body and the function of the spleen.

SUMMARY

From these experiments it can be concluded as follows: the blood catalase content changes in the close connection with erythrocytes and hemoglobin, but the plasma catalase content is influenced to a great extent not only by the hemopoietic function, but also by the hemolysis in a living body and the function of the spleen.

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