

Causes of the Low Oxygen Consumption in 1 to 7-day Old Prematures

By

F. VARGA, B. MESS and M. FEKETE

Department of Paediatrics and Institute of Anatomy,
University Medical School, Pécs

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Comparative data regarding O_2 consumption of premature infants [1—11] reveal notable differences between the mean values of so-called minimum O_2 consumption as also between the figures reported by the same authors, a phenomenon indicative of the probability that O_2 consumption considerably fluctuates even among prematures kept and examined under identical conditions. We, too, have observed strikingly low values in some cases, and the present investigations had the object to shed light on the causes of the low O_2 consumption.

MATERIAL AND METHOD

O_2 consumption has been studied in "normal" prematures weighing less than 2000 g. Babies in whom no serious neural, respiratory, etc. disorders had been noted up to the time of the investigation were regarded as "normal". The examinations were carried out under normal hospital conditions, at 22° to 24°C room temperature and 60 to 70 per cent relative humidity. The babies were so covered that only the region of the nose and mouth remained free. Temperature between cover and skin was between 29° and 31°C. Rectal temperature was kept between 35.5° and 37.2°C and remained practically constant during the investigations. O_2 consumption

was measured by means of a Noyons-type diapherometer, usually in the forenoon, without applying sedatives. Data collected during sleep or at complete rest were only evaluated.

The nomogram of DuBois and DuBois was used for the measurement of body surface. Determination of thyrotropin (TSH) was made with radioiodine according to the method of MESS [12].

RESULTS AND DISCUSSION

O_2 consumption of prematures shows the widest fluctuations during the first week of extrauterine life. Subsequently, fluctuations become less marked, and the volume of consumed O_2 increases from week to week [6]. In order to make comparisons possible, only babies aged 1 to 7 days were examined; their number totalled 55.

The study did not include babies younger than 24 hrs, as O_2 consumption is affected by the process of birth, and also because it was not always possible to ensure identical environmental conditions during the first day.

Under the said conditions, O_2 consumption varied between 2.1 and 6.7 ml/kg/minute; it was exceptionally

TABLE I

n = 55	Body weight kg	Body length cm	Body surface sq. m	O ₂ -consumption		Temperature °C
				per kg body weight ml	per 1.73 sq. m, ml	
Mean values	1.60 ±0.33	42.5 ±2.5	0.132 ±0.02	4.0 ±1.18	85 ±25.9	36.2 ±0.43
Extreme values	1.10—2.50	35—48	0.090—0.171	2.10—6.2 (1.05)	39.0—130 (23)	35.5—37.2

low (1.05 ml) in a single case (this value is bracketed in Table 1). The maximum value was, thus, at least three times higher than the lowest even if the single exceptional case is disregarded.

Although the infants had apparently been healthy at the time of the examinations, 11 babies suddenly died 1 to 5 days later. Autopsy revealed cerebral haemorrhage as the cause of death. O₂ consumption varied between 2.1 and 3.2 ml/kg/min in all fatal cases.

The baby with the aforementioned exceptionally low O₂ consumption died one hour after the examination, and autopsy revealed aspiration and extensive cerebral haemorrhage. Analysis of the 11 fatal cases justifies the conclusion that cerebral haemorrhage must have been involved in the development and maintenance of the low O₂ consumption.

It was shown in previous investigations [13] that the pituitary gland of infants who had died of severe malnutrition contained no TSH, and a

TABLE II

Energy metabolism of premature infants with cerebral haemorrhage

No.	Age days	Weight kg	Length cm	Surface sq. m	O ₂ -consumption			Temperature C°
					absolute ml	per kg body weight ml	per 1.73 sq. m, ml	
1	1	1.45	42	0.128	4.6	3.2	63	36
2	1	1.62	44	0.130	4.2	2.6	56	35.8
3	1	1.10	35	0.090	2.5	2.27	48	36
4	1	1.62	45	0.140	4.2	2.6	51	36.4
5	3	1.42	42	0.126	4.05	2.85	68	36.5
6	3	1.12	35	0.099	1.18	1.05	23	35.9
7	3	1.45	42	0.122	3.7	2.3	48	36.0
8	6	1.68	42.5	0.135	3.6	2.13	45.5	36.6
9	7	1.67	42.5	0.136	3.85	2.3	49	36.5
10	1	1.99	48	0.160	4.4	2.25	48	36.2
11	6	1.78	48	0.151	3.75	2.1	40.5	35.9
Mean values		1.53 ±0.22	42 ±4.22	0.129 ±0.02		2.3 ±0.56	49 ±10.7	

correlation was suggested to exist between the lack of TSH and the low O₂ consumption invariably encountered in such cases. It was, thus, only logical to assume a TSH deficiency in some babies displaying a low O₂ consump-

infection in the second week after the examination. Autopsy revealed cerebral haemorrhage also in these cases, but they have not been included in the cerebral-haemorrhage group because their low O₂ consumption

TABLE III
Energy metabolism and serum TSH level in premature infants

No.	Age days	Weight kg	Length cm	Surface sq. m	O ₂ -consumption			Temp. °C	TSH μU
					absol. ml	per kg body weight ml	per 1.73 sq. m. ml		
1	1	2.03	46	0.158	6.1	3.0	67.0	36.1	0.3
2	1	1.48	42	0.126	3.6	2.2	39.0	35.8	0.1
3	3	1.55	45	0.138	3.8	2.45	46.0	36	0.4
4	3	1.10	35	0.090	2.3	2.1	44.0	35.9	0.1
5	5	1.35	40	0.119	3.9	2.9	57.0	36.3	0.0
6	7	1.67	40	0.130	4.2	2.5	56.0	36.1	0.0
Mean value		1.53 ±0.29	41 ±4	0.126 ±0.02		2.5 ±0.12	53 ±9.6		
7	1	1.95	43	0.146	9.4	4.8	112	36.2	0.5
8	1	1.20	41	0.113	6.1	5.0	73.5	36.0	0.8
Mean value		1.57 ±0.53	42 ±1.0	0.129 ±0.02		4.9 ±0.1	96 ±10		

tion. TSH synthesis usually starts *in utero*, but might be retarded in certain cases. The recently elaborated method of MESS has made it possible to study the behaviour of TSH *in vivo*, by demonstrating its presence in 3 to 4 ml of serum.

The serum TSH level was examined in 6 babies displaying a low O₂ consumption; the level was subnormal in 4 cases, while there was no demonstrable TSH in the blood of 2 infants.

In 2 control babies with approximately normal O₂ consumption, the serum TSH level was normal.

Data regarding the rest of cases are assembled in Table IV. Three babies with low O₂ consumption are marked with a cross; they died of enteral

might have partly been due to the infection. Several more infants with a low O₂ consumption included in Table IV may have had cerebral haemorrhage or a low serum TSH level; these displayed no clinical symptoms, have not been examined in this respect and have, therefore, been left in this group. It can be seen that mean O₂ consumption amounted to 4.5 ml/kg/min, a value somewhat below the minimum reported in the literature.

O₂ consumption as referred to body surface was very low in all groups; it is well-known that Rubner's surface law does not apply to prematures, a subject we do not intend to discuss here.

TABLE IV

Energy metabolism of premature infants between one and seven days of age

No.	Age days	Weight kg	Length cm	Surface sq. m	O ₂ -consumption			Temperature °C
					absolute ml	per kg body weight ml	per 1.73 sq. m. ml	
1	1	1.90	46	0.151	7.4	3.9	85	36.6
2	1	1.75	43	0.140	7.5	4.3	92.5	36.2
3	1	1.05	35.5	0.095	5.0	5.0	97	36
4	1	1.8	45	0.147	7.1	3.9	83.5	37.2
5	1	2.03	46	0.158	11.7	5.8	128	36.6
6	1	1.20	37	0.104	3.45	2.8	57	36.5
+7	1	1.95	44	0.150	6.5	3.3	75	36.7
8	2	1.43	41	0.124	7.92	4.5	94	36.2
9	2	1.45	41	0.125	7.55	5.2	105	36.8
10	2	2.06	46	0.158	13.0	6.5	130	36.3
11	3	1.72	43	0.139	7.03	4.1	87.5	36.3
12	3	1.65	42.5	0.135	5.75	3.4	74.0	36.3
+13	3	1.13	35	0.094	3.95	3.5	64	36
14	3	1.4	43	0.127	8.1	5.8	110	35.8
15	3	1.56	43	0.131	7.0	4.5	93	36.8
16	3	2.23	42	0.150	6.5	2.8	75	37
17	4	1.45	41.5	0.126	5.9	4.1	84	36.5
18	4	1.56	45	0.137	6.9	4.4	87	36
19	4	1.44	41	0.124	8.3	5.7	120.0	36.5
20	4	1.47	42	0.127	6.2	4.3	87.0	36.2
+21	4	1.54	40	0.125	5.05	3.3	70.0	37.0
22	4	1.38	45	0.130	5.2	3.8	70	36.2
23	4	1.10	40	0.111	7.28	6.7	115	35.8
24	4	1.58	42	0.130	6.7	4.2	89	35.5
25	4	1.42	42	0.122	4.35	3.0	59	35.5
26	4	1.52	42	0.130	5.23	3.3	70	35.5
27	5	1.40	45	0.131	5.56	4.0	75	36.2
28	5	1.72	43	0.139	6.6	3.8	82	37.2
29	5	2.26	42	0.150	8.5	3.7	98	37
30	5	2.07	46	0.160	6.6	3.2	72	36
31	6	1.68	42.5	0.135	7.2	4.3	92	36.6
32	6	2.5	47	0.171	11	4.4	111	35.9
33	6	1.64	43	0.135	8.4	5.1	108	37
34	7	1.72	43	0.139	8.1	4.7	102	36
35	7	2.08	44	0.152	11.3	5.5	130	36.4
36	7	1.61	42	0.130	8.6	5.4	115	36.6
37	7	1.55	42	0.129	5.4	3.4	74	35.8
38	7	1.55	44	0.139	6.05	3.9	78	37.1
Mean value		1.65	42.5	0.134		4.5	100	
		±0.10	± 2.37	±0.02		±0.49	±18.3	

+ = Died

SUMMARY

Fifty-five prematures varying in age from 24 hrs to 7 days have been examined.

a) Mean O₂ consumption amounted to 4 ml/kg/min. There was a wide difference between the extreme values, and exceptionally low values were registered in some cases.

Eleven of the babies died of cerebral haemorrhage within a few days following the examination. Their mean O₂ consumption amounted to 2.3 ml/kg/min.

In 6 cases the serum contained no or a subnormal amount of TSH. O₂-consumption in these babies was likewise low, amounting to 2.5 ml/kg/min on the average.

In two control babies serum TSH and O₂ consumption were normal.

It is suggested that cerebral haemorrhage and a low serum TSH level are, among others, responsible for the low rate of O₂ consumption.

b) Mean O₂ consumption in the remaining 38 prematures amounted to 4.5 ml/kg/min.

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Dr. F. VARGA
Gyermekklinika
Pécs, Hungary