WATER RETENTION IN PNEUMONIA *

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It has been the custom at the Children's Memorial Hospital to keep daily weight records of all children under 2 years of age, if not suffering with a contagious disease. Dr. Amberg called our attention to the fact that children who keep up their weight or gaining weight during a febrile disease, may begin to lose weight with the disappearance of the fever. In some cases, this happened abruptly, in others gradually. A closer survey of the cases showed that the loss was more likely to occur in cases of lobar pneumonia. From the years 1914 to 1919 we were able to collect fifty-two cases of pneumonia suitable for our study. In all but one of the twenty-eight cases ending with a crisis, there was some loss of weight coincident with the crisis. This loss was frequently quite marked. The cases are recorded in Table 1. They represent uncomplicated cases. The table gives the age of the children, the duration of the disease before their entrance into the hospital, and the duration of the fever at the hospital. The loss of weight is recorded and the time during which it occurred. Figures 1 and 2 illustrate these conditions very well. In Figure 1 is recorded a loss of one pound; in Figure 2 is recorded a loss of 1 pound and 2 ounces within two days. The average loss of weight of the uncomplicated cases occurring within twenty-four hours, was $9\frac{3}{8}$ ounces. The maximum loss in one day occurred in Case 41— $11\frac{1}{4}$ pounds; the minimum, with the exception of Case 51 which was without loss, occurred in Case 2—6 ounces in two days.

We were unable to find any relationship between the degree and the rapidity of the loss to either the height of the temperature, as registered during the stay in the hospital, or to the duration of the fever. Neither was there a relationship between the range of the drop in temperature and the loss of weight. Unfortunately, in many instances, the data about the extent of the lung involvement are not sufficiently explicit; so we cannot say anything about a possible relationship between the amount of exudate and loss of weight. Figure 3 is of special interest. The child was brought in the day it was taken sick. On the third day

* From the Otho S. A. Sprague Memorial Institute Laboratory of the Children's Memorial Hospital.

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of the disease an increase in weight began, lasting to the crisis on the seventh day. At this time, the weight dropped a little (about 4 ounces) and remained stationary. With an abrupt increase in weight, an edema of the eyelids and feet became manifest. This disappeared as rapidly as it appeared. At the same time, the weight fell markedly.

Figure 1

Figure 2

In Table 2 are recorded twenty-two cases of pneumonia which did not end in crisis. Twenty-one of the patients had some complication. In five, there was no loss of weight with the gradual defervescence, and when there was a loss of weight it never was abrupt, but extended over a considerable number of days.

Case 52 is the only uncomplicated case of lobar pneumonia with lysis. It presented a weight curve (Fig. 4) perhaps more in keeping

TABLE 1.—ANALYSIS OF TWENTY-NINE CASES OF PNEUMONIA

Case Number	Age, Months	Duration of Disease before Entrance, Days	Duration of Temperature in Hospital, Days	Definite Crisis	Complication	Loss of Weight	Time of Loss of Weight, Days
2	10	?	2	Yes	None	Ounces 6	2
4	7	1	1	Yes	None	12	3
9	7	7	8	Yes	None	Pounds 1½	3
11	4	4	4	Yes	None	1	3
15	18	4	12	Yes	None	2½	4
16	19	12	4	Yes	None	1	2
17	12	3	4	Yes	None	1½	3
19	14	1	3	Yes	None	1½	3
20	14	8	3	Yes	None	3½	4
21	16	2	4	Yes	None	¾	2
26	16	8	1	Yes	None	1	1
27	8	5	2	Yes	None	2½	3
28	12	14	3	Yes	None	2	3
29	13	3	3	Yes	None	1	3
32	6	3	3	Yes	None	¾	1
33	14	4	4	Yes	None	1½	2
37	14	4	6	Yes	None	1½	2
38	8	2	6	Yes	None	1	1
40	3	3	3	Yes	None	¾	1
41	11	?	1	Yes	None	1½	1
42	12	3	5	Yes	None	1½	2
43	19	3	5	Yes	None	3	2
45	9	6	5	Yes	None	1	1
46	14	3	5	Yes	None	1	1
47	5	3	6	Yes	None	1	1
48	11	4	3	Yes	None	1	1
50	10	3	3	Yes	None	1	1
51	11	4	3	Yes	None	1	2
52	11	8	8	None	None	Increase 1¼	12

TABLE 2

Case Number	Age, Months	Duration of Disease before Entrance	Duration of Temperature in Hospital	Definite Crisis	Complication	Loss of Weight, Pounds	Time of Loss of Weight
1	7	5 days	3 days	No	Otitis media	None	
3	10	4 days	7 days	No	Otitis media	None	
5	12	10 days	13 days	No	Enteritis	3½	Gradual
6	3	7 days	9 days	No	Otitis media	1½	Gradual
7	11	6 days	3 days	No	None	1	Gradual
8	10	6 days	3 days	No	Otitis media	3	Gradual
10	16	?	5 days	No	Otitis media	None	
12	6	3 weeks	8 days	No	Otitis media	None	
13	12	4 days	3 days	No	Otitis media	None	
14	23	3 days	7 days	No	Meningitis	3	Gradual
18	9	3 days	6 days	No	Otitis media	1½	Gradual
22	19	2 days	8 days	No	Otitis media	¼	Gradual
23	8	3 days	6 days	No	Otitis media	1	Gradual
24	11	1 day	7 days	No	Otitis media	1	Gradual
25	13	8 days	9 days	No	Otitis media	¾	Gradual
30	13	6 days	3 days	No	Otitis media	1	Gradual
31	10	3 days	6 days	No	Otitis media	1½	Gradual
34	2	4 days	4 days	No	Otitis media	½	Gradual
36	14	4 days	4 days	No	Otitis media	1	Gradual
39	12	6 days	6 days	No	Otitis media	1½	Gradual
44	10	3 days	8 days	No	Empyema	2½	Gradual
49	18	7 days	4 days	No	Otitis media	2	Gradual

with what one would expect in a febrile disease associated with an increased metabolism. Here the drop in weight begins at the height of the fever before defervescence begins and proceeds rather uniformly.

Since the most frequent complication in our cases of pneumonia was otitis media, we were anxious to compare these cases with uncomplicated cases of otitis media. We were able to collect the data of eleven such cases, the ages of the patients varying from 4 to 13

Figure 3

Figure 4

months. In nine of these cases (only one without paracentesis), the fall of the temperature was as abrupt or nearly as abrupt as in the case charted in Figure 5. In three of these cases there was a more or less marked drop of weight associated with the drop in temperature. In one instance, the weight dropped from 17 to 16 pounds and 2 ounces (a loss of 14 ounces); in another from 16 pounds and 9 ounces to 16 pounds and 1 ounce (a loss of 8 ounces) within twenty-four hours, and in a third case 8 ounces were lost from 13 pounds within two days. In

one case there was no loss of weight; in five cases the loss of weight, incidental to the drop of temperature, did not amount to more than 3 ounces. In two of these cases the temperature dropped very considerably, once from 104 to 98 F., and another time from 104 to 99 F. In two cases the temperature dropped more gradually, and in each case there was some loss of weight extending over several days, the loss, however, not being very marked.

The number of our observations is rather small; however, they indicate that cases of lobar pneumonia with crisis are more likely to be accompanied by a marked loss of weight coincident with or rather shortly preceding defervescence. In complicated cases, the weight curve dropped from the beginning of the observation with or without an acceleration of the drop during defervescence. Uncomplicated cases

Figure 5

of otitis media may show a rather abrupt loss of weight with defervescence, but this seems to be more the exception than the rule.

Several factors may enter in this abrupt loss of weight in cases of pneumonia. It must be taken into consideration that a considerable amount of inflammatory exudate exists with this disease. Its rapid resolution has been shown to be associated with an increase in the amount of urine as well as in the amounts of the excreted chlorids and nitrogen, as shown by Cook.¹ The absorption and excretion of the inflammatory exudate or of its products may take part in this loss of weight. But this may not tell the whole story. Indeed, the occurrence of such abrupt losses of weight in some cases of otitis media shows that the resorption of the exudate cannot be the only factor concerned. Part, or even most, of this loss of weight may be due to an elimination

1. Cook, H. W.: Nitrogen Excretion in Pneumonia and Its Relation to Resolution, *Bull. Johns Hopkins Hosp.* **13**:307, 1902.

of previously retained water. Koeppe,² who observed an increase of weight of infants free from nutritional disorders during various febrile attacks, attributed this increase to retention of water.

That there is a marked change in the water economy of the body in pneumonia, as in other fevers, has been accepted by various authors. For instance, Fischer³ states: "Edema is not an uncommon accompaniment of fever. In some fevers it constitutes a symptom so marked that it is looked for clinically; in others, the increased amount of water held by the patient is clearly indicated by his increase in weight and his failure to excrete an amount of water through kidneys, lungs, skin and bowel, the equivalent of that ingested. With remission or discontinuance of the fever there has been noticed by the most careful observers an increase in the output of water by all the water excreting organs above the amount ingested." Woodyatt⁴ and his co-workers put it thus: "Everyone is familiar with the remarkable emptying out of water via the kidneys and skin which may follow the crisis in a case of pneumonia. Liters of water may thus be liberated in a few hours, giving visible proof of the water retention of the febrile stage."

In the case of pneumonia in children we may recall the fact that Maver and Schwartz⁵ were able to demonstrate by means of the Schade elastometer, the presence of edema of the skin which could not be detected by simple palpation. Indeed, changes in the water distribution have been made responsible for the fever occurring under various conditions. The pediatrician is familiar with that conception, particularly through the contributions of Heim and John,⁶ and of Peteri.⁷ Woodyatt and his co-workers have presented this view in a recent paper, lending it new support by their experimental evidence. The sum and substance of this conception of the mechanism of fever is, that water, which is usually at the disposal of the organism for purposes of heat regulation, becomes not available for this purpose. This may occur by removing a certain amount of water from the organism, or by binding it within the organism in such a way that it cannot exercise its heat-dissipating function by evaporation from the body surfaces

2. Koeppe, H.: Studien zum Mineralstoffwechsel. (1) Wasserretention nach Ernährungsstörungen, *Jahr. f. Kinderheilk.* **73**:9, 1911.

3. Fischer, M.: Edema and Nephritis, 1915, p. 196.

4. Balcar, Sansum and Woodyatt: Fever and the Water Reserve of the Body, *Arch. Int. Med.* **24**:116 (July) 1919.

5. Maver and Schwartz: Studies in Edema in Pneumonia, *Arch. Int. Med.* **17**:459 (April) 1916.

6. Heim and John: Das alimentäre Fieber, *Ztschr. f. Kinderheilk.* **1**:398, 1911; Die Thermoregulation des gesunden und ernährungsgestörten Säuglings, *Jahrb. f. Kinderheilk.* **73**:266, 1911.

7. Peteri, I.: Beiträge zum pathologischen Wesen und zur Therapie des transitorischen Fiebers bei Neugeborenen, *Jahr. f. Kinderheilk.* **80**:612, 1914.

and lungs. In such instances it would be possible to have a water retention and still not enough for proper heat regulation. This may occur in a disease like pneumonia. With restoration of the water-binding power of the tissues to the normal, which may occur more or less abruptly, water would be liberated for heat regulatory purposes and elimination in urine. In this way, the loss of weight coincident or shortly preceding the abrupt fall of temperature, could be explained.

It must be kept in mind that our data are only such as have been obtained in the course of the hospital routine and do not justify us to do further than call attention to this very interesting subject.