The Journal of the American Medical Association

Published under the Auspices of the Board of Trustees.

VOL. XLVIII.

CHICAGO, ILLINOIS, APRIL 27, 1907.

No. 17.

Original Articles

THE DIGESTION OF THE PROTEIDS OF COW'S MILK IN INFANCY.

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The proteids in cow's milk give rise to no digestive or nutritive disturbances in the feeding of young infants. If the foregoing statement be a fact, and I am convinced that it is, then the theories and practices that now hold the American profession with regard to the artificial feeding of infants must be radically altered. For years the idea of proteid indigestibility has existed, based principally on some crude test-tube experiments and the misappreciation of certain appearances of the baby's stools, and this error has lived because none challenged the hypothesis, but everybody accepted the casein indigestion as an easy explanation of the difficult digestion of cow's milk during infancy. However, such a mass of incontrovertible evidence has been presented by Escherich, Heubner and Rubner, Budan, Finkelstein and more especially by Czerny and Keller, that one must now admit that such a thing as the proteid indigestion of cow's milk is untenable.

INDIGESTIBILITY OF PROTEIDS NOT TENABLE.

The theories of the difficult digestion of cow's proteid were based on the following hypotheses, as stated by Czerny:

Conclusions drawn from the firm coagulum that forms in a test-tube when rennet is added to cow's milk, and the greater amount of proteid in cow's milk than in human milk; the presence of curds in the stools; mechanical irritation by hard clots, causing colic, etc.; the "foreign" albumin of cow's milk, a toxic irritant, and the putrefaction of proteid remnants.

When rennet is added to cow's milk in a test-tube a firm clot forms only when the test-tube is allowed to stand without agitation. If the tube be sealed and slowly inverted so as to imitate, even though crudely, the churning movements of the stomach, a fine flocculent precipitate is formed, and if one removes cow's milk from a child's stomach with a stomach tube a similar flocculent precipitate is obtained. If any conclusion can be drawn from the behavior of cow's milk with rennet, it is such as would not speak for its indigestibility. The so-called curds in the bowel movement of infants, by which are meant the common whitish, yellowish-white, or yellowish lumps, are not proteid material, but are fats or fatty soaps; rarely are they inspissated mucus or clumps of bacteria. Chemical examination of these masses will reveal their nature, and clinically they can be lessened or caused to disappear from the stools without altering the proteid contents by diminishing or removing the fat from the milk food. In hundreds of experiments in which I have given an undiluted fat-free

milk to babies, at times giving more than a quart in 24 hours, never, after careful examination, have I seen curds in the stools.

For such experiments, distinction must be made between skimmed milk and fat-free milk. Fat-free milk, which can be obtained by the centrifugal separation of milk, contains less than 0.5 per cent. of fat, and such a small amount of fat can be disregarded. When milk is skimmed by allowing it to stand in a suitable vessel until the cream rises and is skimmed away, or even siphoning the lower milk, the amount of fat in such milk is often more than 1 per cent., and such skimmed milk may occasion small, whitish, pin-point masses to appear in the stool when administered to a susceptible infant.

If curds or clots are not formed by the proteids, then no mechanical injury can be produced by the proteids, and the symptom of colic has been absent from the babies fed on proteid-rich, fat-free milk.

Biedert's hypothesis of "injurious food remnants," by which he taught that the casein masses precipitated in the stomach were retained in the gastrointestinal tract where they underwent putrefactive decomposition, and irritated the alimentary mucosa and might precipitate an attack of gastroenterocolitis; Biedert's hypothesis can be refuted by experiments with fat-free milk. It is found on experiment that the proteid content of milk resists bacterial decomposition for a long time. In the stools of many infants fed on proteid-rich, fat-free milk I have never been able to discover the least putridity. In three cases of ulcerative iliocolitis I have fed sterilized, undiluted, fat-free milk and have seen the bowel movements quickly change from lumpy, mucopurulent, bloody, putrid evacuations to smooth, salve-like, yellowish-brown movements devoid of offensive odor.

The hypothesis of Hamberger concerning *art-eigenes* and *art-fremdes* albumin has only a theoretic interest. The harmlessness of the proteid can be demonstrated clinically by its administration to any infant. I have given fat-free, proteid-rich milk to a large number of babies, over 200 in hospital and in private practice; to the premature new-born, to the infants in three cases of ulcerative iliocolitis, and in three cases of hereditary lues, to many atrophic babies, etc., and the result in each case was the same, so that one can state with the assurance of a mathematical demonstration what must follow every time the experiment is made.

In such an experiment as the following give a baby weighing, let us say, seven pounds, from three to four ounces of sterilized, fat-free, undiluted cow's milk every four hours, or five feedings in the 24 hours. The child will present no symptoms of distress, no meteorism, no vomiting of clots, no belching of gas, and its bowel movements will be smooth, soft, salve-like, brownish-yellow, homogenous and without offensive odor. The color of the movement may vary from a very light yellow to brownish-yellow, but with this single variation of color every other condition will be as I have briefly

described. I have made such experiments innumerable times, always with like results. The following cases are reported in more or less detail, illustrating the ease of proteid digestion.

CASE REPORTS.

CASE 1. Patient.—Baby A. was admitted to Wesley Hospital when three days old with its mother, who had a severe puerperal infection. The infant had a temperature of 100 F. On admission it weighed 5 pounds 12 ounces. Physical examination was negative.

Treatment.—The infant was given one-half grain of calomel in divided doses and weak barley water for two days. The temperature was then normal and it was given a small amount of milk, which was slowly increased to three ounces in 24 hours. There were free green curdy bowel movements and the milk was discontinued on the ninth day and one ounce of cream given with whey and barley. The food was continued for three days. The stools were increased in number, the curds became more numerous and the weight diminished. The food was changed, and through an error 20 ounces of whole milk was given for one day, when eight very curdy green bowel movements followed. The following day fat-free milk was given and the character of the stools changed immediately. They were soft and yellowish, with no curds. Two days later a number of fine curds were noted in the stool and it was learned that a siphoned milk, which was not fat free, had been used that day. The babe continued to thrive on the diet as shown in the chart. On September 15 one ounce of whole milk was added to the mixture and on the appearance of small curds it was withdrawn. A week later four ounces of whole milk were added to the food. Next the stools became hard and marble-like and whole milk was again withdrawn. Six days after this one ounce of cream was added; after this the bowel movement again became dry and firm and the tongue was coated; then the cream was removed. On the forty-sixth day the child was taken home by the mother in very evident good health, good color, active, eager for its food, no colic, gaining in weight and with clear, salve-like yellowish-brown stools.

Weight is indicated in pounds in ordinary figures, ounces in superior figures.

	September			2	5	6	8	9	10	October			12	15	17	24	26	29	30	November		
	24	26	29																	3	6	14
Cream				1	3														1			
Milk						20								1		4						
Fat-free milk							10	8	10	12			17	21	13	21	21	19	21	21		
Whey						8																
Barley water	18	9	8	5																		
Water		10	9	6			10	8	6	4	6	6				4			1		3	
Milk sugar	½																					
Cane sugar		1	1	1	½	½	½	½	½	½	½	½	½	½	½	½	½	1	1	¾	1	
No. of feedings	12	10	10	10	10	10	8	8	8	8	8	8	7	7	7	7	7	7	7	6		
Amount in ounces	1½	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	4		
Fats	0.	0.2	0.6	0.8	4.	0.	0.	0.	0.	0.	0.1	0.	.8	0.	0.	.8	0.	.8	0.	0.		
Proteids	0.	0.2	0.6	0.6	4.	2.	2.	2.5	3.	3.	3.	4.	3.	4.	4.	4.	4.	4.	4.	3.5		
Carbohydrates	3.7	5.6	6.0	7.5	6.	4.7	5.	5.	6.	5.2	6.5	8.	7.3	8.	9.	9.	8.	8.				
Total calories	114	148	187	239	485	145	133	151	169	231	288	300	312	300	330	364	300	320				
Energy quotient	25	67	65	85	179	51	47	53	60	82	99	100	100	99	103	120	96	103				
No. of B. movements	2	4	2	4	6	8	3	2	5	1	1	2	1	2	2	4	3	1	2			
Weight in pounds*	5.12	5.14	6.4	6.0	5.15	6.			6.1	6	6.4	6.6		6.11		6.14	6.15	7	7.9

Chart 1.—Weight.

Chart 2.—Food in calories.

with vomiting, high fever and diarrhea. The fever and diarrhea had continued up to the time of admission. The bowel movements were very frequent, from 10 to 20 a day; were very offensive, liquid and contained blood, mucus and pus.

Examination.—The child was in a condition of extreme emaciation and prostration when admitted to the hospital. He weighed 20 pounds. Lying on his back in great apathy, and with deeply sunken eyes, he looked more like a corpse than a living child. He was very dull and exhibited resistance only when disturbed for examination, feeding or changing his diapers. The cervical axillary and inguinal lymph glands were slightly enlarged. The skin was dry and pale, and the tongue

was very red and dry, the teeth were covered with dry secretion and the angle of the mouth was fissured. The heart beat was rapid and the muscle tone muffled; there were no other abnormal findings in the chest. The abdomen was sunken, but without muscular rigidity or tenderness. The liver could be felt an inch below the costal arch; the spleen was not palpable. Blood examination revealed 25,000 leucocytes. There was no Widal reaction. The bowel movements were thin, numerous, greenish and slimy; very small in amount, consisting of curds and debris and masses of pus, and were blood streaked. The odor was very offensive.

Charts 1 and 2 tabulate the food and progress in this case.

CASE 2. Patient.—H., male, aged 3 years, was admitted to Wesley Hospital.

History.—There are four children in the family, all well; the father and mother are in good health. The child was breast-fed and had no serious illness until three weeks before admission to hospital, when the present sickness began suddenly

Treatment.—Details are shown in Chart 2. The child was placed on stimulation, and fat-free milk and arrowroot were ordered every four hours. He took his nourishment only in small amounts and that after persuasion. The following day the stools were examined and found to contain many colon bacilli and cocci, pus, and starch granules. The child vomited several times and rejected his food. On the third day he was fed through a nasal catheter; four ounces of sterilized fat-free milk were given six times in the 24 hours. From this time on there was no vomiting and the character of the bowel movements changed. There were never any curds in the stools while he was taking the fat-free milk even, as seen in the chart, when he was having more than a quart a day. The soft yellow salve-like stools soon replaced the early stools and putridity was absent. On the fifth day in the hospital his temperature became 102+ F. The following morning the explanation of the rise in temperature was found in a red, swollen and tender condition of the right parotid gland; with this exception the improvement was uninterrupted. The additions that were made to the diet are shown in Chart 3 and illustrate the value of determining the energy quotient, in order properly to nourish the child.

SUMMARY.

A child entering the hospital in a very grave state with a severe ulcerating enterocolitis was fed on a fat-free, proteid-rich diet, without sign of distress or indigestion of this food. This food seemed to have a decidedly beneficial and therapeutic effect in allaying the inflamed bowel and lessening the putridity of the bowel content.

A 10-months-old child, three weeks ago, was taken suddenly ill with ileocolitis. For two weeks the conditions were much like those described in the preceding case. The child was put on fat-free, proteid-rich milk, and is now taking 8 ounces five times a day, or 40 ounces in the 24 hours. The movement was soft, absolutely free from any sign of curd, yellowish in color, salve-like in consistency and inoffensive in odor. The therapeutic result is similar to that in the other cases of ulcerative ileocolitis.

An atrophic child, now in Wesley Hospital, aged 5 months and weighing a half-pound less than he did at birth; that is, 7 pounds; he is taking as food 30 ounces of fat-free, sterilized milk a day. He was admitted to the hospital because his mother was worn out in her efforts to find a food for the child. The baby cried all the time, said the mother. On a fat-free milk, given every four hours, he has gained seven ounces in ten days; has no symptoms of colic and is much more contented. There are never any curds in the stools.

PERCENTAGE SCHEDULES FAULTY.

The former ideas of the nutritive and digestive disturbance that arose in the artificial feeding of infants

on cow's milk were based on the hypothesis that the proteid content of cow's milk was difficult to digest and, without demonstrating this, every means were taken to overcome the assumed difficulty. The milk was diluted until the proteids were reduced almost to the vanishing point. The proteids were split by the addition of rennet, and whey containing the "soluble" albumin with cream additions came into popular use. Alkalies, such as bicarbonate of soda or of potash or lime water, were used to diminish the curd coagulum. Cereal decoctions were said to have a similar action. The predigestion of the casein by pepsin or pancreatin was likewise prescribed, and of late we are told that citrate of soda makes proteid digestion easier.

Ludwig F. Meyer says that the difference in the behavior of human and of cow's milk should no longer be sought in the different caseins and their lighter or harder digestibility. The principal difference in the two milks, he says, consists much more in the whey, especially

Enterocolitis.

		October															November												
Date		15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	10	12	16	30		
Whole milk	Ozs.																5	5	5	5	5	5	5	5	5	10	10		
Fat-free milk	Ozs.	4	4	20	30	30	30	30	30	30	30	30	30	30	30	30	30	35	35	35	35	35	35	35	35	40	40		
Arrowroot water	Ozs.	8	8																										
Cane sugar	Ozs.																												
Wheat flour	Ozs.														2	2	2	2	2	2	2	2	2	2	2	1	1		
Quantity	Ozs.				6	6	6	6	6	6	6	6	6	6	6	6	8	8	8	8	8	8	8	8	8	10	10		
No. of Feedings					5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5		
No. of B. movements		?	?	?	?	8	8	8	5	7	4	9	7	2	4	7	5	5	2	5	4	2	2	2	2	3	2		
Blood	B	B	B	B	B	B	B																						
Pus	P	P	P	P	P	P	P	P	P		P																		
Mucus	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M												
Vomiting	V	V	V																										
Total calories		64														540	655									790	790		
Energy quotient		7														60	72									81	68		
Weight	Lbs.	20	20		19.15	—							19.15		19.15					20.4		20.10		21.2	21.5	22

too much fat and too little proteid. If, as the champions of the percentage method of feeding tell us, "the modification of the proteid is the most important change necessary in cow's milk, for it is the proteid which gives most of the trouble to the infant's digestion," then it must follow, after the demonstration of the innocuousness of cow's proteid, that the percentage method is built on an erroneous idea. Moreover, since the published schedules on the percentage basis exhibit a high degree of overfeeding and do not accurately tell the amount of food that a child is having, there is little, if any, reason at present for the existence of the method.

THE VALUE OF WHOLE MILK MIXTURES.

It may be asked what can be offered in its place, and I should answer the feeding of normal infants on whole milk mixtures, beginning with dilution not to exceed one part of milk to two parts of water and lessening the dilution until whole milk is reached, sometimes from six months to a year; and such whole milk should contain not to exceed from 2 to 3 per cent. of fat rather than 4 per cent., as is present in certified milk.

The baby from the first week should not be fed oftener than every four hours during the day and twice at night, and the amount at each feeding should be enough to satisfy its appetite. Few babies, if fed only every four hours, will take too much food. A check against overfeeding should be applied, however, in every child by estimating the caloric value of the food taken during the 24 hours. The caloric value of the infant's food is a matter of easy calculation.

For a further discussion of the caloric check against overfeeding I refer to the paper by Dr. Brenneman on that subject. It is understood, of course, that the food of the infant should be properly balanced and contain fat, carbohydrates and proteid in due proportion. The food elements, fat, proteid and carbohydrates, are not isodynamic in the sense that metabolism can be properly and continuously provided for on a diet made up entirely of any one or two of these elements. But what this due proportion should be is a matter for study in the individual case and not a part of this paper, except in so far as it points out the harmlessness of cow's milk proteid, and leaves for consideration the importance of a proteid rich diet.

CONCLUSIONS.

1. There is no evidence that the proteid of cow's milk causes any digestive disturbance in the infant.
2. All experiments prove that cow's proteid is easy to digest and resists putrefaction.
3. The methods mentioned above as aids in the digestion of the proteids are without reason.
4. In sterile, fat-free milk we possess an unequaled therapeutic agent in the treatment of the nutritive disorders of infancy.

Ten Laparotomies for Adhesive Peritonitis with Final Cure.—Greiffenhagen relates in the *St. Petersb. med. Wochenschr.* for October 13 the details of a case of chronic peritonitis with recurring lesions in a housemaid of 35, a primipara, finally cured after nephropexy had been done four times and laparotomy ten. The woman had had varioloid and scarlet fever as a child, but otherwise nothing could be discovered to account for the adhesive peritonitis. The appendix, adnexa and other organs were sound. The numerous operations were undertaken principally to relieve the intense recurring pains, without much hope of a permanent cure, but the patient has been in good health for eight years since the last operation. The first symptoms to attract attention were those from wandering kidney.

GLEANINGS FROM FOUR YEARS' EXPERIENCE IN THE CORRELATION OF CLINICAL AND RADIO-DIAGNOSTIC FINDINGS.

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During the past four years I have consistently employed as a diagnostic aid the x-ray in the field of internal medicine, and this in hospital, private and consultation work. The method followed was routinized, thus: A thorough clinical examination was first made and a tentative diagnosis formed, then a radiogram was taken and, if necessary, the fluoroscope used; if the clinical and radiographic evidences did not tally, the patients were re-examined, special attention being directed to the discrepancy. Thus the clinical and radiographic pictures were finally correlated and the previous errors noted. It frequently happened that many clinicians had the opportunity of seeing the same patient and of forming tentative opinions: internes, those seeking postgraduate instruction, general practitioners and hospital physicians. In such event the varied errors were recorded.

The first year's work served to develop sufficient skill in the use of the x-ray to make it of service and incidentally to demonstrate the high educational value of the method outlined since.

1. Diagnostic errors could be frequently corrected while the patient was under clinical observation.

2. Those who had arrived at wrong clinical conclusions could not readily cavil at the correct one when the latter was based on such correlated and partly visible work.

It seems to me that, notwithstanding the loss of the plates and detailed records in the late San Francisco fire, short reports of group cases showing the diagnostic value of such correlated work and the recording of the lessons learned, and of some of the common mistakes made by internes and those seeking postgraduate instruction, might be of service.

DIAPHRAGMATIC AFFECTIONS.

CASE 1.—Middle-aged man, whom previous examination had shown to be free from organic disease.

History.—An oculist had been testing his eye refraction and had used hyoscin as a pupil dilator. This had upset him, had made him nervous, and that morning he found he could not empty his chest during expiration.

Examination.—When he was stripped I was surprised to see that during the expiratory phase two cup-shaped hollows became evident, one at the outer border of each rectus muscle at the lower margin of the thoracic cage. These hollows almost disappeared during the latter part of inspiration, to become again marked during expiration, and the more strenuous the gentleman's expiratory endeavors became, the greater became the capacity of these retractions. The patient was neither dyspneic, nor in pain, but was mentally annoyed. The complaint of inability to expire completely, plus the hollows in the line of the diaphragm insertion, naturally suggested some abnormality in the action of that muscle.

X-ray Examination.—The fluoroscopic picture was interesting. The diaphragm moved up and down piston-like during respiration, but instead of each half being dome-shaped, it was as though the summit of each dome had been cut off, each half presenting a striking resemblance to a table mountain. This appearance was maintained during the whole respiratory phase and was evidently caused by a localized, bilateral spasm of the diaphragmatic fibers.

Since during inspiration the insertion and origin of these